Athens, Greece
4-5, November 2022

Rehab

2nd INTERNATIONAL REHABILITATION CONFERENCE
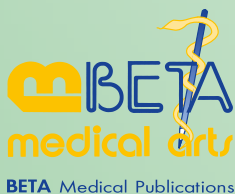Faculty of Health Sciences | Metropolitan College

Rehab 2022

Proceedings of the
2nd International Rehabilitation Conference
"From Disability to Person and Quality of life"

4-5 November 2022

Edited by Panagiotis Siaperas, Elena Siapati, Anthi Chaida

METROPOLITAN COLLEGE

BETA medical arts

BETA Medical Publications

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WHO hosted network

World Rehabilitation Alliance

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Foreword

On behalf of the Organising and Scientific committee, we are honoured to present the proceedings of the 2nd International Rehabilitation Conference "From Disability to Person and Quality of life" organised by the Faculty of Health and Rehabilitation Sciences of Metropolitan College in Greece, the first institution from Greece that is a member of the World Rehabilitation Alliance, a global network of the World Health Organisation (WHO).

The aftermath of the COVID pandemic and its consequences, alongside the modern way of life, obviate the need for a Rehabilitation framework of recovery or adaptation that will promote functionality, independence and prosperity for every citizen, irrespective of age, level of functioning, disability or social background. In light of this, the 2nd International Rehabilitation Conference embraces the initiative of the World Health Organisation "Rehabilitation 2030 Call for Action" and the relevant publication of "Rehabilitation Competency Framework". Through this action, WHO aims to support people locally and internationally to get back, keep, or improve physical, mental and cognitive abilities needed for daily life that might be lost, because of a disease or injury, as a side effect of a condition or treatment, or due to social barriers and deprivation. The Faculty of Health and Rehabilitation Sciences of Metropolitan College in Greece actively participates in this WHO initiative since 2020.

The 2nd International Rehabilitation Conference proceedings are a testament to the premier interdisciplinary work of researchers, practitioners and educators, discussing the most recent innovations, trends, clinical challenges encountered, and solutions adopted in the fields of Health, Sports, Health-Allied Sciences, Human and Life Sciences and Rehabilitation. The scientific programme included keynote presentations, a diverse range of symposia topics, interactive poster sessions, and workshops, run by leading practitioners, researchers, service users, caregivers and rehabilitation stakeholders, offering a fruitful scientific stand to all participants.

We would like to thank for their significant contributions all the conference participants and our keynote speakers: Prof. Cathy Bulley (Co-Director of the Centre for Health, Activity and Rehabilitation Research, Queen Margaret University, Edinburgh, Scotland), Dr. Johnny Collett (Lead for Clinical exercise and rehabilitation research, Centre for Movement, Occupational and Rehabilitation Sciences, OxINMAHR, Oxford Brookes University), Dr. Cathal Morgan (Technical Officer, WHO Regional Office for Europe, Rehabilitation, Disability Inclusion and Assistive Technology Heath Services), Dr. Maria Pyrgeli (Paediatric Rehabilitation Physiatrist, MSc, PhD, SFEBPRM), Dr. Agis D. Tsouros (MD, PhD, FFPH, International Adviser on Health Policy, Strategy and Diplomacy, Former Director, Policy and Governance for Health and Wellbeing at WHO Europe, Adjunct Professor, Global Health, University of Boston), Vaggelis Avgoulas (Lawyer, Member of the Board of Directors, Athens Bar Association, Chairman of the NPO "Me Alla Matia", Member of the Social Policy Committee of the Central Union of Municipalities).

We are grateful to the Organising, the Scientific and the Honourary Committees for their invaluable input to the conference. Many thanks to the numerous student volunteers of Metropolitan College for their tireless contribution. Special thanks to Evaggelia Arvaniti, Head of the Secretariat of the Organising Committee, and to Panagiotis Kolelis, Metropolitan College's Marketing and Communications Specialist.

On Behalf of the Scientific Committee,
Panagiotis Siaperas, Anthi Chaida, Elena Siapati

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Preface: Inclusion at Work

Evangelos Avgoulas

Lawyer, Chairman of NPO "Me Alla Matia"

The concept of inclusion is being discussed more and more lately in various work environments. However, it hasn´t been given the attention it should have until now. When referring to inclusion, we mean the equal participation of individuals from every social group in the work sector. In other words, not to exclude anyone from potential opportunities just because he/she/they belong to a social group that is considered subordinate or less competent. Despite one should not even have to argue why inclusion and diversity at work are essential and beneficiary for everyone, we shall take a closer look at those whys.

What does the research show us?

- Diverse and inclusive work environments are two times more likely to reach or even exceed their financial goals, six times more likely to be innovative, and six times more likely to predict change correctly.
- Inclusive and diverse teams are more innovative, participatory, and creative.
- Companies that invest in diversity have more loyal and happier customers.

Therefore, environments accessible to disabled —and not only— employees enhance company profitability. That seems only reasonable: on the one hand, the more diverse the perspectives of a team's members are, the more likely it is for that team to come up with original ideas and solutions to its problems; on the other hand, people from excluded social groups, such as the disabled, have to hone constantly their creativity to survive. And this is something inconceivable for the privileged part of our society.

Customer Loyalty & Representation

When it comes to customer loyalty, one can merely consider that when a company invests in the diversity of its employees, a broader range of customers can relate to them. This way, the company can expand its clientele, secure an economic advantage, and have an edge over its competitors. This advantage is strengthened further if these competitors do not emphasize inclusion as much but rather reproduce a uniform corporate status quo. Notably, more and more people choose to support companies that clearly show their human side, not only with CSR actions but also with the direct staffing of positions inside their companies with people who belong to vulnerable social groups. P&G is an excellent example of such a company, as they rank among the top companies for people with disability. Conversely, individuals who experience underrepresentation tend to reject companies that do not take them and their needs into account. A typical example is the United Kingdom, where businesses lose around £17 billion from the disabled public yearly due to the lack of accessibility.

Unemployment

Inclusion is particularly critical for a much more fundamental reason: as long as it is not secured, the monster called unemployment thrives.

The disabled, due to the stigma and insecurity of employers regarding their recruitment, are plagued by unemployment at overwhelmingly higher rates than the non-disabled. For example, in the United States in 2019, the percentage of disabled people working was 19.3% compared to 66.3% for non-disabled people. That means that 4 out of 5 people with disability are not working. The possible causes for that interweave. In a recently published paper, Pagano explains the vicious circle of sciolism and lack of knowledge regarding disability issues, the stigma that still accompanies them, and the existing fear of employers that people with disability are untrustworthy in the workplace (Pagano, 2021). Consequently, this is how a pool of willing talents remains unexploited due to stereotypes.

Any substantial changes?

Despite hiring people driven by diversity being mandatory, this legal commitment does not seem to have the desired results. If changes in legislation are not flanked by meaningful changes in social consciousness regarding the value of diversity, they will remain a "bogeyman" to which companies will only seemingly comply. In reality, discrimination is perpetuated within the work environment due to still prevailing misconceptions. This problem calls for the implementation of inclusion and diversity programs so that the work environments can evolve and smoothly assimilate previously excluded individuals. Through the professional conciliation of disabled and non-disabled people, it will become clear that disabled workers can be productive, as long as employers also understand the benefits of diversity and focus on people rather than their percentages and corporate profile. Only when hiring disabled people is perceived as an opportunity and not a legal obligation will it become possible to reap the benefits of such a choice and witness professional development for the people that need it the most.

Mental health of Greek university students during Covid-19 period in urban and non-urban areas

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Abstract

The sudden outbreak of Covid-19 has induced significant changes in mental health. A vulnerable social group affected was University students. According to the literature, University students worldwide experienced various cognitive, social, emotional and psychological difficulties due to the Covid-19 pandemic. This research study aimed to investigate the effect of age, gender and region, on the mental health of Greek University students. One hundred and fifty-six Metropolitan College students participated in the study. Subjects were selected using simple random sampling. Invitations of the study were sent via e-mail and the participation of the students was voluntary. Mental health was examined on three levels: anxiety, depression and stress. Students completed the DASS-21 questionnaire to assess mental health dimensions. Data were analysed using a 3-way MANOVA. Results showed that students' mental health, and specifically the dimension of anxiety, was only affected by region. Unexpectedly, students from non-urban areas had higher levels of anxiety than students from urban areas. Stress and depression, however, were not affected by region. Moreover, no statistical differences were found between age, gender and the three levels of mental health. Implications of the study are being discussed as well as future directions of research in terms of intervention and rehabilitation.

Keywords: Covid-19, students' mental health, region, age, intervention

1.   Introduction

The sudden outbreak of the Covid-19 pandemic has affected various societies worldwide and caused disruption in various aspects of human life. One of the most important areas affected was mental health. People from all over the world experienced symptoms of anxiety, depression and stress because of the changes brought about by the pandemic and subsequent isolation. The DSM-5 (2015) defines anxiety as an intense feeling of worry, fear, mental distress and discomfort. Depression is characterised by intense sadness, hopelessness and negative thoughts, while stress through Generalized Anxiety Disorder is described as a feeling of intense nervousness, anxiety and irritability (A. P. A, 2015). These symptoms appear to have occurred with variations in intensity, frequency and the factors that led to their onset. On the other hand, not all people seem to have developed mental health problems because of the pandemic. In the face of an unprecedented situation for our society, such as the pandemic, it is considered imperative to further investigate the circumstances of such symptoms taking into account different social, economic and other factors.

1.1 The effect of age on mental health in the Covid-19 period

Scientific research has shown that age affects mental health during the pandemic. In their research, Nwachukwu et al. (2020) studied the mental health of Canadian citizens using online questionnaires. They collected data from 8,267 people, focusing on 3 specific variables. In a similar study, Gregory et al. (2021) studied anxiety, depression and stress in relation to a

traumatic event. The sample consisted of 5,320 Canadian citizens aged from 17 to 70 plus. The above studies concluded that older people had better mental health than younger people. In contrast to previous studies, Banna et al. (2022) concluded that people older than 40 years old experienced higher levels of anxiety, while people younger than 23 years old had higher levels of depression.

1.2 The effect of gender on mental health during the Covid-19 period

Gender also appears to be a contributing factor of mental health during the Covid-19 pandemic. In their research Wathelet et al. (2020) aimed to study the mental health of French students during the pandemic. Participants consisted of men, women and non-binary sex individuals. Soltan et al. (2021) investigated the same issue in 282 medical students from Egypt. In addition, del Río-Casanova et al. (2021) studied the mental health of Spanish citizens in the early stages of the pandemic. All of the above studies concluded that the female population experienced more anxiety, depression and stress symptoms than men. Furthermore, some researchers have found that people from the LGBTQ community developed more mental health problems, such as anxiety and depression, than heterosexual people (Gonzales et al., 2020; Nowaskie & Roesler, 2022).

1.3 The effect of region on mental health during the Covid-19 period

Region also seems to play an important role in mental health. Islam et al. (2020) investigated the mental health of university students in Bangladesh. A similar study was conducted by Lew et al. (2020) in which 11,473 students from urban and non-urban centers in China participated. Husky et al. (2020) similarly studied the mental health of French students during the period of mandatory confinement for Covid-19. All of the above studies concluded that living in urban centers leads to increased levels of anxiety, depression and stress. In contrast, levels of depression and stress were less elevated in non-urban centers.

1.4 Current Study

Existing literature has demonstrated that the Covid-19 pandemic has brought about significant changes in the mental health of individuals. In fact, mental health appears to be significantly influenced by age, gender and factors related to people's area of permanent residence. The mental health and pandemic association is gaining more and more scientific ground and studies are still at an early stage in the international scientific community. Studies on the pandemic and mental health in Greece are even more limited, while few studies have focused on the mental health of Greek students and the impact of age, gender and place of residence. The present study attempted to further investigate the effect of age, gender and region on the mental health of Greek students during the Covid-19 pandemic.

Inferentially, we hypothesised that age would have a statistically significant effect on mental health, expecting increased levels of anxiety, depression and stress in younger students. Similar results were expected for gender. More specifically, we hypothesised that women would have higher levels of anxiety, depression and stress than men and the gender ''other''- although the literature on the last gender category is limited or nonexistent. Finally, we hypothesised that students living in large urban centers would have higher levels of anxiety, stress, and depression than students from non-urban centers.

2. Methodology

2.1 Participants

One hundred and fifty-six students from various campuses of Metropolitan College in Greece participated in the survey. Participants were selected by simple random sampling. Two age groups were created: 20-30 years old and 31-40 years old. The gender of the participants was divided into 3 categories: male, female and other. The gender "other" was created for people who did not want to declare a specific gender or belonged to the LGBTQ community. The permanent residence of participants in urban and non-urban centers was also considered to be an important factor. Half of the participants were residents of 2 large urban centers (Athens, Thessaloniki), while the other half were residents of 2 non-urban centers (Crete, Rhodes).

2.2 Design

A quantitative design was used for the specific research. Three independent variables were used: age, gender and region (urban and non-urban centers). Age was used as a quantitative proportional variable and consisted of two levels (20-30 and 31-40 years). Gender was treated as a quantitative nominal/categorical variable and included 3 levels (0=male, 1=female and 2=other). Lastly, the place of residence (urban and non-urban centers) was used as a quantitative nominal/categorical variable and had 4 levels (0= Rhodes, 1=Athens, 2=Thessaloniki and 3=Crete). The mental health of Greek students during this year's Covid-19 was used as the dependent variable. This quantitative tactical variable included 3 levels (0=Anxiety, 1=Depression, 2=Stress).

2.3 Materials -Apparatus

To explore the research questions and to measure mental health and its levels (anxiety, depression and stress), the Depression Anxiety Stress Scale-DASS-21 was used. This scientific instrument was created by Lovibond and Lovibond (1995) and has been translated into various languages, including Greek, by Lyrakos et al. (2011). It has a good reliability and validity in both English (depression scale a=0. 94, anxiety scale a=0. 87, stress scale a=0. 91) and Greek version (depression scale a=0. 85, anxiety scale a=0. 84, stress scale a=0. 84) (Antony et al, 1998, Pezirkianidis et al., 2018). The Scale is available and easily accessible in the Greek language and it has also been used in various scientific studies.

DASS-21 consists of 21 questions and the answers are graded on a 4-point Likert scale (from 0=never/does not apply to 3=applies a lot). Questions 2,4,7,9,15,19,20 measure anxiety levels (0-7=normal, 8-9=mild, 10-14=moderate, 15-19=severe, 20-42= extreme), questions 3,5,10,13,16,17,21 measure depression levels (0-9 =normal, 10-13= mild, 14-20=moderate, 21-27=severe, 28-42= extreme) and questions 1, 6, 8, 11, 12, 14, 18 measure stress levels (0-14=normal, 15-18=moderate, 19-25=moderate, 26-33=severe, 34-42= extreme).

2.4 Procedure

Firstly, the researchers sent, through the Academic Officer of the university, the Consent Form and the Questionnaire to the emails of all Metropolitan College students. In order to be eligible to participate in the survey, participants had to be 20-40 years old, permanent

residents of specific urban or non-urban centers (Athens, Thessaloniki, Rhodes, Crete) and active students at the time of completing the questionnaire. Students who expressed interest and met the above criteria read the Information Form, completed the Consent Form and then responded to the DASS-21 Questionnaire via Google forms. The participation of the students was entirely voluntary. The completion of the questionnaire lasted 10 minutes. After the data collection, no personal or other contact information was requested from any participant. The data collected for further processing and statistical analysis. Data analysis was performed using a 3-way MANOVA in IBM SPSS Statistics 26 software.

2.5 Ethical Considerations

This study was conducted in accordance with the principles and code of ethics of the BPS. All the forms provided were designed to fully inform and guide the participants regarding the topic of the research process. If anyone wished to withdraw, they could do so any time they wished with a personal code. In general, the research respected the full anonymity and voluntary nature of the participants as stipulated by the BPS Code of Ethics and Conduct (Oates et al., 2021).

3.   Results

3.1 Cronbach Alphas

A Cronbach's reliability coefficient was initially estimated in order to establish the reliability and internal consistency of the questionnaire used. In general, the DASS-21 showed high levels of reliability and internal validity corresponding to those of the English and translated questionnaire (stress_a=0. 90, anxiety_a=0. 88, depression_a=0. 90).

3.2 Descriptive Statistics

One hundred and fifty-six students participated in the survey of which 43.6% were male, 52.6% female and 3.8% belonged to the gender "other". The majority of the participants (71,8%) were 20-30 years old (Mean age =23 years, SD=3,1), while 28.2% were 31-40 years old (Mean age =35,9 years, SD=3). In terms of region, 56.4% lived in urban centers, while 43.6% lived in non-urban centers. More specifically, 28.2% of the population lived in Athens and 28.2% in Thessaloniki. In non-urban centers 26.9% of the population resided in Rhodes and 16.7% in Crete.

3.3 Mental health and age

No statistically significant differences were found between age and students' mental health in all three dimensions. However, when studying the relationship between age and stress levels, it was found that 20–30-year-old students had moderate levels of stress, while 31–40-year-olds had mild levels of stress. In terms of anxiety, younger students had moderate levels of anxiety, while older students experienced higher levels of anxiety. Finally, younger students experienced moderate levels of depression, in contrast to older students who experienced below-average levels of depression.

3.4 Mental health and gender

The effect of gender on the dependent variable and its dimensions was also not statistically significant. Although there were no statistically significant differences, it was found that the male population of the sample had mild levels of stress, the female population had moderate levels of stress and the "other" had mild levels of stress. The male students surveyed had medium levels of anxiety, the female students had severe levels of anxiety and the "other" had extreme levels of anxiety. Greek students belonging to the male and female population showed moderate levels of depression, while the "other" population showed high levels of depression.

3.5 Mental health and region

No statistically significant effect was found between region and the dimensions of mental health, stress and depression. However, the statistical analysis revealed that residents of urban centers had mild levels of stress, while residents of non-urban centers had medium levels of stress. In terms of depression levels, residents of Athens and Thessaloniki, as well as residents of Rhodes and Crete, showed moderate symptoms of depression (Table 1).

Table 1. Effect of Region on Mental Health

	Mental Health	df	Mean	Mean Square	F	Sig.
Area of Living	Total Stress	1	-	57.4	0.516	0.47
Urban	-	-	17.6	-	-	-
Non-urban	-	-	19.06	-	-	-
	Total Anxiety	1	-	591.9	5.501	0.02
Urban	-	-	11.7	-	-	-
Non-urban	-	-	16.8	-	-	-
	Total Depression	1	-	6.3	0.051	0.82
Urban	-	-	14.8	-	-	-
Non-urban	-	-	16.4	-	-	-

N= 156, Error= 145

3.5.1 Anxiety and region

A statistically significant relationship was found between region and the anxiety dimension of mental health (F= (1, 145) = 5.501, p= 0.02). More specifically and unexpectedly, residents of urban centers showed moderate levels of anxiety, while residents of non-urban centers showed severe levels of anxiety.

3.6 Mental health and independent variables

No statistically significant interactions were found between a) mental health with gender and age, b) mental health with gender and region, c) age and region, and d) the 3 independent variables.
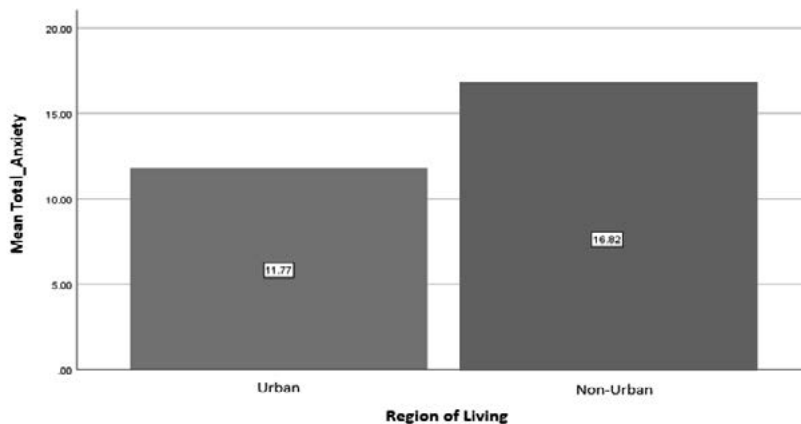
Figure 1. Statistical Significance in Effect of Region on Anxiety

4.   Discussion

The present study attempted to investigate the mental health of Greek students during the Covid-19 pandemic, taking into account factors such as gender, age and region (urban and non-urban centers).Following existing literature, we hypothesised that older students would experience lower levels of anxiety, stress and depression. The results of the survey, although not statistically significant, showed that the 31–40-year-old group had lower stress levels than younger students, higher anxiety levels than younger students and similar depression levels with younger students. These results could be explained by recent socio-economic and political factors. The war in Ukraine in 2022 brought serious changes in global economy and everyday life. As a result, it is possible that all people regardless of their age were affected psychologically. Younger and older people are trying to adapt to the new circumstances and especially to the changes war has brought to the cost of living. Moreover, Qiu et al. (2020) explain that older people are more likely to die from Covid-19 which could explain the increased levels of anxiety in the 31–40-year-old group.

   The second hypothesis about gender and its effect on mental health revealed no statistical significance. However, women appeared to experience more stress and anxiety than men, while depression remained at the same levels for both sexes. Interestingly, the gender 'Other' had severe levels of depression and anxiety compared to males or females. Previous studies have shown that stress, anxiety and depression are more prevalent in women than in men. According to the literature women present more internalising symptoms, whereas men present more externalising symptoms. Women across the world tend to have a variety of roles (e.g. mother, wife, caretaker, worker), increased everyday responsibilities and are by nature more vulnerable and sentimental than men. However, in our study women experienced only higher levels of anxiety and stress. Surprisingly, depression was the same for both men and women. It is likely that Covid-19 and the subsequent quarantine have equally affected male and female students' depression symptoms. As regard to the gender 'Other', the results of our study agree with the results of other studies (Alonzi et al., 2020) that this gender category is often associated with higher levels of depression and anxiety, probably because of their identity difficulties. However, the gender 'other' in our study included different identity

categories, so it is unclear whether the majority of the sample declared themselves as binary, non-binary or other.

The third hypothesis regarding the permanent area of residence was not supported by the results, as no statistically significant relationship was found between region and mental health. However, and while neither stress nor depression had a statistically significant effect on region, there was a statistically significant relationship between anxiety and region. Surprisingly, and in contrast to previous studies, people from non-urban areas had higher levels of anxiety compared to people from urban centers. Our results are in agreement with some studies: Chang et al. (2020) and Zhang et al. (2020) have found that non-urban residents had more anxiety than people who lived in big urban cities. This finding could be explained considering that the non-urban centers in our study are large islands and resemble urban centers. Another possible reason for these results is the medical facilities. In urban areas, the medical care provided is often better than in rural areas. Medical staff is usually more skillful and experienced in cities than in non-urban regions. Also, transportation from small to large cities with better medical centers could be more difficult and time-consuming. All of the above conditions could cause higher levels of anxiety in rural populations.

5. Limitations

Any deviations of our results from previous studies may be related to methodological differences. The use of different statistical criteria and research tools, the sample size and its characteristics, the inability to focus on a specific condition of Covid-19 (quarantine, mask use, vaccination) and others, are factors that could affect the results of the study. Also, in 2022 Covid-19 is not as much of a public concern as it was in 2019-2021 (focus on wars, economic crisis, fighting the virus with vaccines) which could also have affected the results. It is also worth mentioning that the participants of the study were not interviewed or screened for mental disorders prior to the pandemic. It is possible that several participants may have had a disorder beforehand, which could have affected the results of the investigation. In addition, the gender 'Other' accounted for a very small percentage of the participants. Given that this gender, although small in number, experienced severe symptoms of anxiety and depression, it is likely that larger sample sizes could have resulted in statistically significant transgender differences, due to the pandemic and other gender-related factors.

6. Future Research/Recommendations

Future research could use larger sample sizes with equal numbers of the 3 genders we have studied. The investigation of a variety of urban and non-urban areas, the mixed application of qualitative and quantitative design and different statistical criteria, as well as the detection of pre-existing psychopathology, could provide valuable information to the scientific community, regarding the investigation of the mental health of Greek students after a pandemic. The alteration of the variables used could also highlight a different topic for the specific scientific area. Research on this field will lead to life improvement and especially to the implementation of preventive measures and the protection of peoples' mental health. To conclude, the results of the present and of future studies can lead to the development of better techniques regarding the investigation, assessment, diagnosis and rehabilitation of individuals with mental health problems due to a pandemic or a crisis.

Acknowledgments

References

American Psychiatric Association. (2015). 'Diagnostic Criteria from DSM-5'. Translated from English by K. Gkotzamani, Medical Publications Litsas, Athens

Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). 'Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample'. Psychological assessment, 10(2), p. 176.

Alonzi, S., La Torre, A., & Silverstein, M. W. (2020). 'The psychological impact of preexisting mental and physical health conditions during the COVID-19 pandemic'. Psychological trauma: theory, research, practice, and policy, 12(S1), S236.

Banna, M. H. A., Sayeed, A., Kundu, S., Christopher, E., Hasan, M. T., Begum, M. R., ... & Khan, M. S. I. (2022). 'The impact of the COVID-19 pandemic on the mental health of the adult population in Bangladesh: a nationwide cross-sectional study'. International Journal of Environmental Health Research, 32(4), p. 850-861.

Chang, J., Yuan, Y., & Wang, D. (2020). 'Mental health status and its influencing factors among college students during the epidemic of COVID-19'. Journal of Southern Medical University, 40(2), p.171-176.

Del Río-Casanova, L., Sánchez-Martín, M., García-Dantas, A., González-Vázquez, A., & Justo, A. (2021). 'Psychological responses according to gender during the early stage of COVID-19 in Spain'. International Journal of Environmental Research and Public Health, 18(7), p.3731.

Gonzales, G., de Mola, E. L., Gavulic, K. A., McKay, T., & Purcell, C. (2020). 'Mental health needs among lesbian, gay, bisexual, and transgender college students during the COVID-19 pandemic'. Journal of Adolescent Health, 67(5), p.645-648.

Gregory, M. A., Legg, N. K., Senay, Z., Barden, J. L., Phiri, P., Rathod, S., ... & Paterson, T. S. (2021). 'Mental Health and Social Connectedness Across the Adult Lifespan in the Context of the COVID-19 Pandemic'. Canadian Journal on Aging/La Revue canadienne du vieillissement, 40(4), p.554-569.

Husky, M. M., Kovess-Masfety, V., & Swendsen, J. D. (2020). 'Stress and anxiety among university students in France during Covid-19 mandatory confinement'. Comprehensive Psychiatry, 102, 152191.

Islam, M. S., Sujan, M. S. H., Tasnim, R., Sikder, M. T., Potenza, M. N., & Van Os, J. (2020). 'Psychological responses during the COVID-19 outbreak among university students in Bangladesh'. PloS one, 15(12), e0245083.

Lew, B., Kõlves, K., Osman, A., Abu Talib, M., Ibrahim, N., Siau, C. S., & Chan, C. M. H. (2020). 'Suicidality among Chinese college students: A cross-sectional study across seven provinces'. PloS one, 15(8), e0237329.

Lovibond, & Lovibond, P. F. (1995). 'Manual for the depression anxiety stress scales' (Second edition.). Psychology Foundation of Australia. Available in: http://www2.psy.unsw.edu.au/groups/dass/

Lyrakos, G. N., Arvaniti, C., Smyrnioti, M., & Kostopanagiotou, G. (2011). 'Translation and validation study of the depression anxiety stress scale in the Greek general population and in a psychiatric patient's sample'. European Psychiatry, 26(S2), p.1731-1731. doi: 10.1016/S0924-9338(11)73435-6.

Nowaskie, D. Z., & Roesler, A. C. (2022). 'The impact of COVID-19 on the LGBTQ+ community: Comparisons between cisgender, heterosexual people, cisgender sexual minority people, and gender minority people'. Psychiatry research, 309, 114391.

Nwachukwu, I., Nkire, N., Shalaby, R., Hrabok, M., Vuong, W., Gusnowski, A., ... & Agyapong, V. I. (2020). 'COVID-19 pandemic: age-related differences in measures of stress, anxiety and depression in Canada'. International Journal of Environmental Research and Public Health, 17(17), 6366.

Oates, J., Carpenter, D., Fisher, M., Goodson, S., Hannah, B., Kwiatowski, R., ... & Wainwright, T. (2021). 'BPS Code of Human Research Ethics'. British Psychological Society. Available in: https://www.bps.org.uk/guideline/bps-code-human-research-ethics-0

Pezirkianidis, C., Karakasidou, E., Lakioti, A., Stalikas, A., & Galanakis, M. (2018). 'Psychometric properties of the depression, anxiety, stress scales-21 (DASS-21) in a Greek sample'. Psychology, 9(15), p.2933-2950

Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., & Xu, Y. (2020). 'A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations'. General psychiatry, 33(2).

Soltan, M. R., Soliman, S. S., & Dawoud, M. E. (2021). 'A study of anxiety, depression and stress symptoms among Fayoum medical students during COVID-19 lockdown, Egypt'. The Egyptian Journal of Neurology, Psychiatry and Neurosurgery, 57(1), p.1-6. Available in: https://ejnpn.springeropen.com/articles/10.1186/s41983-021-00377-2 [10 Sep 2021]

Wathelet, M., Duhem, S., Vaiva, G., Baubet, T., Habran, E., Veerapa, E., ... & D'Hondt, F. (2020). 'Factors associated with mental health disorders among university students in France confined during the COVID-19 pandemic'. JAMA network open, 3(10), e2025591-e2025591.

Zhang, W. R., Wang, K., Yin, L., Zhao, W. F., Xue, Q., Peng, M., ... & Wang, H. X. (2020). 'Mental health and psychosocial problems of medical health workers during the COVID-19 epidemic in China'. Psychotherapy and psychosomatics, 89(4), p.242-250.

The Type, and the Effect of Therapeutic Exercise on Quality of Life and Fatigue in Patients with Systemic Lupus Erythematosus in Greece: A cross-sectional study

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Abstract

Systemic Lupus Erythematosus (SLE) is an autoimmune disease with sever symptoms, such as fatigue and has a high impact on patient's quality of life. The aim of this study was to determine the rate, the type, and the effect of therapeutic exercise in patients with SLE on quality of life and fatigue in Greece. Three questionnaires were used to measure quality of life (SF36), fatigue (FSS), and physical activity (mIPAQ) and 101 patients with SLE answered about their personal choices. The (IBM) SPSS -25 Statistics was used for statistical analysis, and the Kolmogorov-Smirnov, ANOVA, and Pearson Correlations were used to test the variables of interest. The results showed that the sample's average (mean) for quality of life was lower than normal (48,3), for fatigue was high (41,7) and the total score of physical activity was slightly moderate (1603,79 METs). Furthermore, for Vigorous exercise the average was extremely low (555.79 MTEs) of gym training, 30 minutes per day, twice a week, for moderate exercise also low (824,65 METs), of housekeeping and cleaning, 1 hour per day, twice a week, and for low exercise (walking) extremely low (239,87 METs), for 30 minutes, three times per week. A high average (50,5) of the sample was presenting by patients who choose to remain seating during the day. The conclusions were that the patients with SLE in Greece do not undertake physical exercise on a regular basis. They choose moderate physical activity of house keeping and cleaning, while choosing a sedentary-lifestyle which brings further problems to their health, although exercise was found to have positive results.
Keywords: Systemic Lupus Erythematosus QoL; Fatigue; Physical Activity; Therapeutic Exercise

1. Introduction

Systemic Lupus Erythematosus (SLE) is an autoimmune disease that affects 1-3 people in 100,000, with most of the patients to be female in the reproductive afe between 20 and 40 years old (Fortuna & Brennan, 2013). This disease is also called "disease with many faces" because of the different symptoms in each patient (Rivas-Larrauri & Yamazaki-Nakashimada, 2016). According to Georgianaki et al. (2017), the frequency of the SLE in Greece has increased the recent years, with the underlying lesions having a serious impact on patients' health.

SLE triggers an autoimmune reaction of the immune system, with severe clinical manifestations such as rushes in the body and the face (butterfly rush), joints pain, low fever, Raynaud Phenomenon, cardiac, respiratory and kidney issues, photosensitivity, severe fatigue and more (Kiriakidou & Ching, 2020). Furthermore, the disease is characterized by exacerbations and recessions. The exacerbations can be file threatened and can decrease the levels of patients' mental and body health, and Quality of Life (Elera-Fitzacarrald et al., 2018; Schmeding & Schneider, 2013).

The main treatment of SLE is drugs (immunosuppressants, antimalarials, Biological Agents and steroids) (Aparicio-Soto, 2017; Davis & Reimold, 2017; Bruce, 2010). Other methods have been developed to decrease the symptoms of SLE, such us therapeutic exercise, diet, relaxation techniques, Pilates, acupuncture etc. (Frangtham et al., 2019). Especially, with respect t theraputix exercise, studies have shown that is safe, has significant benefits on patient's physical and mental ability, by decreasing the inflammation levels in blood, the pain and fatigue, increasing the joints' range of motion and cardiorespiratory function without the activation of the disease (Roeh et al., 2019; Ayan, de Pedro-Munez & Martinez-Lemos, 2018; Wu, YUM & Tsai, 2017; O'Dwyer, Durcan & Wilson, 2017; Sharif et al., 2017). The most common type of exercise for SLE patients is aerobic exercise. This type of exercise has proven to be effective on patients pain, fatigue, and quality of life, but it did not have higher effects than other types of exercise, like resistance exercise or yoga (Alexanderson & Bostrom, 2020; Gavilian-Carrera et al., 2020; Soriano-Maldonado et al., 2018; Bennati et al., 2018; Middleton et al., 2018 Perandini et al., 2016; Abrahao et al., 2016 Perandini et al., 2015).

In the Greek literature there are not many studies about SLE and exercise. Some researchers have studied the effects of exercise in Rheumatoid Arthritis, but not in SLE (Metsios et al., 2020; Metsios & Kitas, 2018; Metsios et al. 2015). The aim of this study was to determine whether the patients with SLE in Greece, perform exercise on daily basis, and if they do what is the type, the frequency, and the effect of exercise on fatigue and quality of life in these patients.

2. Methods

Three questionnaires were used in the form of electronic Microsoft Forms, for the measuring of fatigue, QoL, and Physical Activity. This form was sent to the associations and societies of Rheumatologists and Patients with Rheumatisms in Greece via e-mail. The form remained available for completion from 27/02/2021 till 27/04/21.

2.1 Sample

The sample of this study was 101 patients with SLE from all over the country. The inclusion criteria were patients with SLE, aged 20 to 45. The exclusion were patients with other type of rheumatism or type of Lupus.

2.2 Tools

The first tool was the Greek SF-36 Health Survey for QoL, which is a questionnaire of 36 questions and measures 8 aspects of patient's life, such as pain, social and family life, physical ability, self-image, etc. The higher score is 100 with the best QoL, and the lowest is 50 with the worst QoL. The validity of this questionnaire is >90% and the reliability is 0.79 to 0.95. It is translated in Greek for the general population, and it is also used for patients with SLE (Ware & Raczek, 1993; Pappa, et al., 2005).

The second tool was the Fatigue Severity Scale. This questionnaire was developed to measure the levels of severity of fatigue in Multiple Sclerosis and SLE (Krupp et al. 1989). It consists of 7 questions about the impact of fatigue in daily routine, social and physical activities, and mental health. The score ranges between 9 and 63, with the higher the score, the higher the level of fatigue.

The third tool was the International Physical Activity Questionnaire (IPAQ) with validity 0.35-0.45 and reliability 0.80-0.93. This questionnaire divides the physical activity into three categories, Vigorous (3000- 6000 METs), Moderate (1500-3000 METs) and Low/Walking (600-1500 METs). It is also counting the sitting time (Papathanasiou et al. 2010). In this questionnaire there was a modification by adding 2 more questions about the preference of exercise types in Vigorous and Moderate categories.

2.3 Statistical Analysis

Data analysis was conducted by the statistic program SPSS -25 (IBM Corp. Released 2017. IBM SPPS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.) and divided in two sections. In the first section the quality variables were described with multitudes (n) and the quantity variables with mean and Standard Deviation (Std). In the second section Pearson Correlations, and Linear Regressions were used to test the variables of interest.

3. Results

The demographic results were 93 female and 8 males, and the average age was 33.82 (±7.34) years (Table 1).

Table 1. Sample's Sex and Age.

	(N=101)			Men (N=8)		
	Mean	StD	Mean	StD	Mean	StD
Sex			92,1		7,9	
Age	33,82	7,34	33,52	7,44	37,38	5,52

3.1 Results of SF-36, QoL Questionnaire

The results of total score about QoL in patients with SLE were 48.3(±19.3). The results of the FSS were 41.73 (±7.22) (Figure 1.)
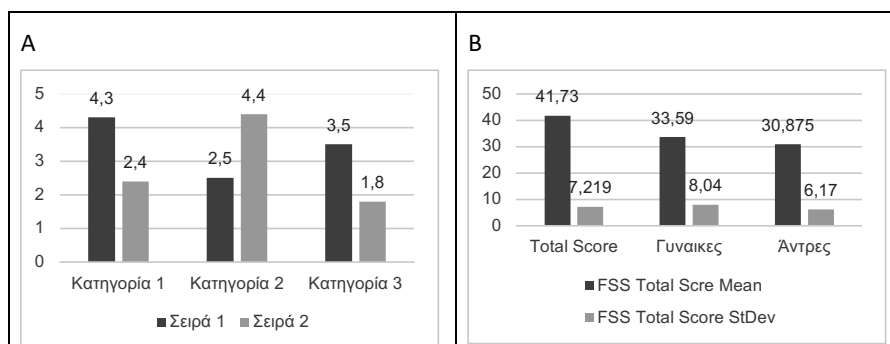
Figure 1. A. Results of SF-36 QoL. B. Results of Fatigue Severity Scale (FSS).

3.2 Results of IPAQ (Modified)

The results of the IPAQ were for the total score 1603.79 METS (±1695,80), for Vigorous exercise 557,65 (±987,62), for Moderate exercise 824,8 (±811,66), and for low/Waking 239,87 (±404,9) (Table 2.). The days of Vigorous exercise were twice a week (Figure A.) and more than the half of SLE patients (58.4%) did not perform Vigorous exercise. The hours of Vigorous exercise per day were 30 min for the 73,2% of the study participants (Figure B.), with the most desirable choice being gym exercise (Figure C.). The days of Moderate exercise were twice a week (Figure D.), for 1 hour a day (Figure E.), house cleaning (74.04%) (Figure F.). For Low exercise, the most common answer was "none" during the week (39.6%) (Figure G.), and for the rest of the sample was 30 min (Figure H). The sitting time was about 6 to 10 hours per day (50.5%) (Figure I.)

The conduction of the Pearson Correlations between exercise and Fatigue and Exercise and QoL have shown a positive correlation between the exercise and QoL (r=0.385), and a negative correlation between exercise and Fatigue (-0.384) (Table 3). In addition, linear regressions have shown that the P Value between the variables of interest and the exercise was under $p<0.001$ on each variable (Table 4).

Table 2. Results of the Total Score of IPAQ.

	(N=101)		Women (N=93)		Men (N=8)	
	Mean	StD	Mean	StD	Mean	StD
Total Score IPAQ	1603,79	1695,80	538,58	289,82	637,375	579,98
Vigorous	557,65	987,62	528	913,44	960	1451,38
Moderate	824,8	811,66	843,01	916,75	750	1068,99
Walking	239,87	404,90	244,74	413,12	202,125	311,79
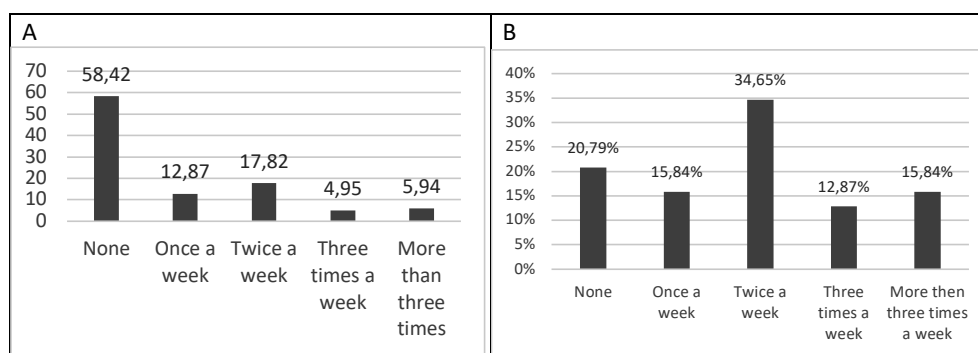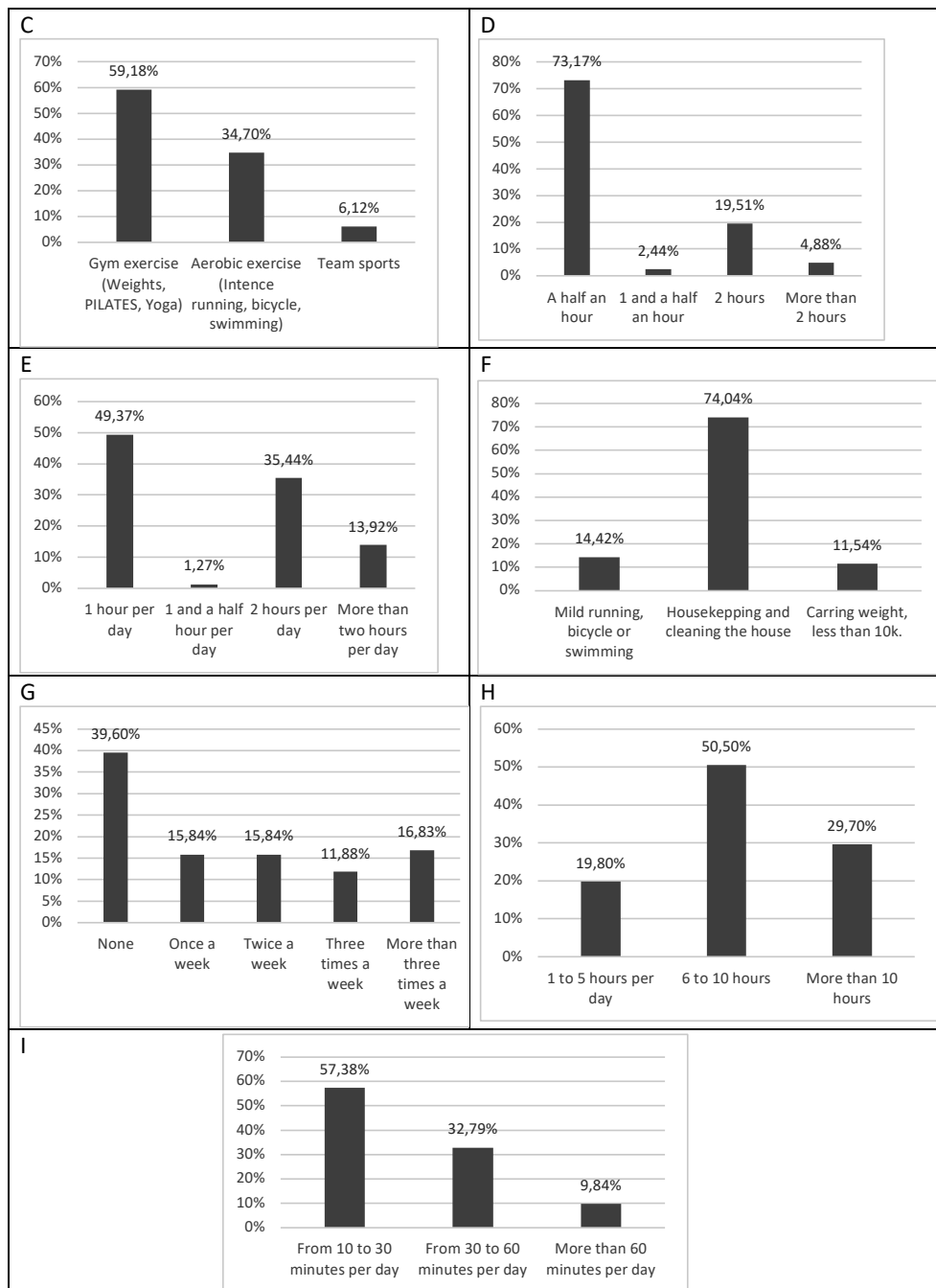
Figure 2. A. Number of days of Vigorous P.A., B. Hours per day of Vigorous P.A., C. Type of Vigorous P.A., D. Number of days of Moderate P.A., E. Hours per day of Moderate P.A, F. Type of Moderate P.A., G. Days of Walking, H. Hours per day of Walking and I. Sitting time per day.

Table 3. Pearson Correlation between exercise and QoL, and exercise and Fatigue.

	(n)	Pearson Correlation	P value
QoL	101	**0.385**	**0.000**
Fatigue	101	**-0.384**	**0.000**

Table 4. Linear Regressions between exercise and QoL, and exercise and Fatigue.

	(n)	Pearson Correlation	Sum Square	P value
QoL	101	0,385	5493,5	**0,000**
Fatigue	101	-0,384	769,017	**0,000**

4. Discussion

The aim of this study was to determine whether exercise is a rehabilitation option for patients with SLE in Greece. In addition, the precedence, the type, and the intensity were measured. According to Eriksson et al. (2012), patients with SLE have the tendency to sit more, and they achieve low scores on aerobic capacity compered to general population, the same results were found in this study.

The guidelines of ACSM (2018) for exercise in people with chronic diseases such as SLE patients, suggest moderate exercise for 150 to 300 min, and vigorous exercise for 75 to 150 min per week. Ayan and Martin (2007) suggested 30 min exercise programs in 70-80% of HR to decrease the symptoms in patients with SLE. This study found that the patients in Greece have extremely low levels of physical activity levels with total score of 1603,79 METS. The absence of exercise and physical activity reached more reached more than 50% of study participants for all types of exercise intercity, and for those who did it for a sort of period (30 min per week), which is the lowest level of exercise according to ACSM guidelines. The most common answer about the type of physical activity during a week was housekeeping and cleaning in a very high percentage, but that can be typical because women in Greece are responsible for housekeeping and cleaning (Eurostat, 2018).

Gavilan-Carrera et al. (2019) and Stojanovich et al. (2016) found that moderate and vigorous exercise can be very helpful on QoL in patients with SLE. The results of the current study about QoL were under the borderline of 50, which is very normal since the correlation of low exercise levels and QoL was positive.

Similar results with QoL were found about fatigue. The score of 41,73 was high, that means that the lack of exercise and physical activity had major impact on fatigue in these patients. Many studies have shown that aerobic exercise can reduce fatigue in patients with SLE (Avaux *et al.*, 2016); Tench et al, 2003), which is something that did not happen in this case.

5. Limitations

The study was conducted during the Sars Covid 19 pandemic, which led the country to many restrictions. Furthermore, there was a possibility, patients could answer wrong the questionnaires.

6. Conclusions

In conclusion, this study found that patients with SLE did not perform any type of exercise and physical activity on a daily basis. The main type of physical activity during a typical week was

housekeeping and cleaning for most of study participants. However, exercise was found to have a positive effect in patients with SLE who performed any type of exercise weekly by reducing fatigue and increasing QoL.

References

Abrahão, M., Gomiero, A., Peccin, M., Grande, A., & Trevisani, V. (2016). Cardiovascular training vs. resistance training for improving quality of life and physical function in patients with systemic lupus erythematosus: A randomized controlled trial. Scandinavian Journal of Rheumatology, 45(3), 197–201. https://doi.org/10.3109/03009742.2015.1094126

Aparicio-Soto, M., Sánchez-Hidalgo, M., & Alarcón-de-la-Lastra, C. (2017). An update on diet and nutritional factors in systemic lupus erythematosus management. Nutrition Research Reviews, 30(1), 118–137. https://doi.org/10.1017/S0954422417000026

Avaux, M., Hoellinger, P., Nieuwland-Husson, S., Fraselle, V., Depresseux, G., & Houssiau, F. A. (2016). Effects of two different exercise programs on chronic fatigue in lupus patients. Acta Clinica Belgica, 71(6), 403–406. https://doi.org/10.1080/17843286.2016.1200824

Ayán, C., de Pedro-Múñez, A., & Martínez-Lemos, I. (2018). Efectos del ejercicio físico en personas con lupus eritematoso sistémico: Revisión sistemática. Medicina de Familia. SEMERGEN, 44(3), 192–206. https://doi.org/10.1016/j.semerg.2017.12.002

Benatti, F. B., Miyake, C. N. H., Dantas, W. S., Zambelli, V. O., Shinjo, S. K., Pereira, R. M. R., Silva, M. E. R., Sá-Pinto, A. L., Borba, E., Bonfá, E., & Gualano, B. (2018). Exercise Increases Insulin Sensitivity and Skeletal Muscle AMPK Expression in Systemic Lupus Erythematosus: A Randomized Controlled Trial. Frontiers in Immunology, 9, 906. https://doi.org/10.3389/fimmu.2018.00906

Bruce, I. N. (2010). Re-evaluation of biologic therapies in systemic lupus erythematosus. Current Opinion in Rheumatology, 22(3), 273–277. https://doi.org/10.1097/BOR.0b013e3283374e78

Craig, C. L., Marshall, A. L., Sj??Str??M, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J. F., & Oja, P. (2003). International Physical Activity Questionnaire: 12-Country Reliability and Validity: Medicine & Science in Sports & Exercise, 35(8), 1381–1395. https://doi.org/10.1249/01.MSS.0000078924.61453.FB

Davis, L. S., & Reimold, A. M. (2017). Research and therapeutics—Traditional and emerging therapies in systemic lupus erythematosus. Rheumatology, 56(suppl_1), i100–i113. https://doi.org/10.1093/rheumatology/kew417

Eriksson, K., Svenungsson, E., Karreskog, H., Gunnarsson, I., Gustafsson, J., Möller, S., Pettersson, S., & Boström, C. (2012). Physical activity in patients with systemic lupus erythematosus and matched controls. Scandinavian Journal of Rheumatology, 41(4), 290–297. https://doi.org/10.3109/03009742.2011.624117

Fangtham, M., Kasturi, S., Bannuru, R. R., Nash, J. L., & Wang, C. (2019). Non-pharmacologic therapies for systemic lupus erythematosus. Lupus, 28(6), 703–712. https://doi.org/10.1177/0961203319841435

Gavilán-Carrera, B., Garcia da Silva, J., Vargas-Hitos, J. A., Sabio, J. M., Morillas-de-Laguno, P., Rios-Fernández, R., Delgado-Fernández, M., & Soriano-Maldonado, A. (2019). Association of physical fitness components and health-related quality of life in women with systemic lupus erythematosus with mild disease activity. PLOS ONE, 14(2), e0212436. https://doi.org/10.1371/journal.pone.0212436

Gavilán-Carrera, B., Vargas-Hitos, J. A., Morillas-de-Laguno, P., Rosales-Castillo, A., Sola-Rodríguez, S., Callejas-Rubio, J. L., Sabio, J. M., & Soriano-Maldonado, A. (2020). Effects of 12-week aerobic exercise on patient-reported outcomes in women with systemic lupus erythematosus. Disability and Rehabilitation, 1–9. https://doi.org/10.1080/09638288.2020.1808904

Gergianaki, I., Fanouriakis, A., Adamichou, C., Spyrou, G., Mihalopoulos, N., Kazadzis, S., Chatzi, L., Sidiropoulos, P., Boumpas, D. T., & Bertsias, G. (2019). Is systemic lupus erythematosus different in urban versus rural living environment? Data from the Cretan Lupus Epidemiology and Surveillance Registry. Lupus, 28(1), 104–113. https://doi.org/10.1177/0961203318816820

Jung, J.-Y., Kim, H.-A., & Suh, C.-H. (2016). THU0296 LOW BM, LOW HDL Cholesterol and Current Steroid Dose Might Contribute To Subclinical Atherosclerosis in SLE Patients with Low Disease Activity. Annals of the Rheumatic Diseases, 75(Suppl 2), 294.1-294. https://doi.org/10.1136/annrheumdis-2016-eular.4465

Kiriakidou, M., & Ching, C. L. (2020). Systemic Lupus Erythematosus. Annals of Internal Medicine, 172(11), ITC81–ITC96. https://doi.org/10.7326/AITC202006020

Krupp, L. B. (1989). The Fatigue Severity Scale: Application to Patients With Multiple Sclerosis and Systemic Lupus Erythematosus. Archives of Neurology, 46(10), 1121. https://doi.org/10.1001/archneur.1989.00520460115022

La, P., Ma, C., Fb, B., & Fr, L. (2016a). Effects of acute aerobic exercise on leukocyte inflammatory gene expression in systemic lupus erythematosus. 18.

La, P., Ma, C., Fb, B., & Fr, L. (2016b). Effects of acute aerobic exercise on leukocyte inflammatory gene expression in systemic lupus erythematosus. 18.

Metsios, G. S., & Kitas, G. D. (2018). Physical activity, exercise and rheumatoid arthritis: Effectiveness, mechanisms and implementation. Best Practice & Research Clinical Rheumatology, 32(5), 669–682. https://doi.org/10.1016/j.berh.2019.03.013

Metsios, G. S., Moe, R. H., & Kitas, G. D. (2020). Exercise and inflammation. Best Practice & Research Clinical Rheumatology, 34(2), 101504. https://doi.org/10.1016/j.berh.2020.101504

Metsios, G. S., Stavropoulos-Kalinoglou, A., & Kitas, G. D. (2015). The role of exercise in the management of rheumatoid arthritis. Expert Review of Clinical Immunology, 11(10), 1121–1130. https://doi.org/10.1586/1744666X.2015.1067606

Middleton, K. R., Haaz Moonaz, S., Hasni, S. A., Magaña López, M., Tataw-Ayuketah, G., Farmer, N., & Wallen, G. R. (2018). Yoga for systemic lupus erythematosus (SLE): Clinician experiences and qualitative perspectives from students and yoga instructors living with SLE. Complementary Therapies in Medicine, 41, 111–117. https://doi.org/10.1016/j.ctim.2018.09.001

O'Dwyer, T., Durcan, L., & Wilson, F. (2017). Exercise and physical activity in systemic lupus erythematosus: A systematic review with meta-analyses. Seminars in Arthritis and Rheumatism, 47(2), 204–215. https://doi.org/10.1016/j.semarthrit.2017.04.003

Papathanasiou, G., Georgoudis, G., Georgakopoulos, D., Katsouras, C., Kalfakakou, V., & Evangelou, A. (2010a). Criterion-related validity of the short International Physical Activity Questionnaire against exercise capacity in young adults. European Journal of Cardiovascular Prevention & Rehabilitation, 17(4), 380–386. https://doi.org/10.1097/HJR.0b013e328333ede6

Papathanasiou, G., Georgoudis, G., Georgakopoulos, D., Katsouras, C., Kalfakakou, V., & Evangelou, A. (2010b). Criterion-related validity of the short International Physical Activity Questionnaire against exercise capacity in young adults. European Journal of Cardiovascular Prevention & Rehabilitation, 17(4), 380–386. https://doi.org/10.1097/HJR.0b013e328333ede6

Pappa, E., Kontodimopoulos, N., & Niakas, D. (2005). Validating and norming of the Greek SF-36 Health Survey. Quality of Life Research, 14(5), 1433–1438. https://doi.org/10.1007/s11136-004-6014y

Rivas-Larrauri, F., & Yamazaki-Nakashimada, M. A. (2016). Lupus eritematoso sistémico: ¿es una sola enfermedad? Reumatología Clínica, 12(5), 274–281. https://doi.org/10.1016/j.reuma.2016.01.005

Sharif, K., Watad, A., Bragazzi, N. L., Lichtbroun, M., Amital, H., & Shoenfeld, Y. (2018). Physical activity and autoimmune diseases: Get moving and manage the disease. Autoimmunity Reviews, 17(1), 53–72. https://doi.org/10.1016/j.autrev.2017.11.010

Tench, C. M. (2003). Fatigue in systemic lupus erythematosus: A randomized controlled trial of exercise. Rheumatology, 42(9), 1050–1054. https://doi.org/10.1093/rheumatology/keg289

World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. (2013). JAMA, 310(20), 2191. https://doi.org/10.1001/jama.2013.281053

Wu, M.-L., Yu, K.-H., & Tsai, J.-C. (2017). The Effectiveness of Exercise in Adults With Systemic Lupus Erythematosus: A Systematic Review and Meta-Analysis to Guide Evidence-Based Practice: Meta-Analysis of Exercise in SLE. Worldviews on Evidence-Based Nursing, 14(4), 306–315. https://doi.org/10.1111/wvn.12221

Knowledge, attitude and practices of evidence-based health care among Greek health professionals

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Abstract

Introduction & Aim: The role of Evidence-Based Practice (EBP) in the health sector is important as it promotes the implementation of the best health care. Evidence-based practice is the process of incorporating the best available research evidence, professional experience, and client values into practice decisions. The research aimed to investigate the knowledge, attitude and actual practice of Greek health professionals (SLT, OT, PT) for EBP.

Methods: The survey involved 50 graduates and health professionals, who work or collaborate with Metropolitan College. Participants completed two questionnaires (EBPQ & FRESNO) that examine the knowledge, attitude and practical application of evidence-based practice. The data collection was carried out following the relevant protocol and the Code of Research Ethics of the Metropolitan College. The data were analyzed with SPSSv23.

Results: The analyses showed that the majority of participants have a positive attitude to EBP. However, their self-reported knowledge and skills to EBP seems to be minor and a small percentage applied it in their therapeutical regimen. Speech Therapists (STs) score higher on EBP questionnaires compared to Occupational Therapists (OTs) and Physical Therapists (PTs) (SLT>OT>PT). Postgraduate students score significantly higher compared to allied health professionals (p=.028).

Conclusions: The participants of the study seem to make an effort to use EBP. However, the lack of sufficient knowledge mainly regarding the component of the research methods and data interpretation has been highlighted. The findings are in line with the literature. The development of relevant training seminars could contribute to the acquisition of the required skills by health professionals.

Keywords: evidence-based practice, health care, health professionals

1. Introduction

1.1 Literature Review

Evidence-Based Practice (EBP) is defined as the integration of scientific research findings, the clinical experience of health professionals, and the needs and desires of each case into treatment decision-making (Ratner, 2006). The application of EBP principles has led to significant advances in improving the quality of health care provided as well as the outcome of treatment. Many professional bodies and accreditation boards expect all clinicians (i.e., health professionals and students of any discipline) to follow EBP as it leads to optimal care delivery (Melnyk and Fineout-Overhold, 2022).

Research from the past decade highlights that graduates and health professionals have a positive attitude towards EBP (Johnston et al., 2003; Iles and Davidson, 2006). However, they tended to rely mostly on experience gained through their clinical work or other colleagues and less on scientific evidence to develop treatment plans (Upton and Upton, 2006; Ross, 2010). Most common barriers were time, difficult access to valid research and journals as well as lack

of personal skills in searching for relevant research and evaluating research evidence (Iles and Davidson, 2006; Krueger et al., 2010). They also appear to rarely make consensual clinical decisions, as discussing patients' values and expectations and providing choices to patients or carers is a challenge for healthcare professionals (Johnston et al, 2003; Ratner, 2004). Scurlock-Evans et al (2014) and Upton et al. (2014) through their review of 32 studies conducted between 2000 and 2012, provided further support for the findings of the primary studies.

Allied Health professionals have a positive attitude towards EBP but do not apply it in practice. The main reasons include lack of time and a misconception of what EBP actually is. Over the past 10 years, EBP has been increasingly integrated as a core component in the curriculum of undergraduate, post-graduate and continuing health education programs worldwide (Frenk et al., 2010). However, it appears that although knowledge, skills and access to research articles have improved significantly, the application of EBP in clinical work remains limited. A relatively recent review of 11 systematic reviews based on a total of 3,947 articles (published from 2012–2017) conducted by Saunders et al. (2019) highlighted that health professionals tend to have moderate to high knowledge and skills, and a positive attitude towards EBP, but the majority do not apply it in their clinical work. The reviewers were unable to make any comparisons between health professional specialties as there was a wide variation in methodological approaches and data collection tools. Patelarou et al. (2014) seem to agree on this last point, adding that researchers use data collection tools that are of limited validity or reliability.

The number of studies investigating the views and practice of Greek health professionals in relation to EBP is limited. Even fewer are the indications coming from paramedical professions such as speech therapy, physical therapy and occupational therapy (Alexandri et al., 2021). The study of Alexandri et al. (2021), in 186 PTs, OTs, STs and Special Educators showed that most of the participants embodied the EBP principles but did not apply it in practice. The 98.4% of them responded that their clinical decisions are based solely on their clinical experience. Mavroidi's (2015) study on 40 STs (22 graduates and 18 students) using the Adapted Fresno Test, concluded that STs are accustomed in creating a clinical question, have a relative familiarity with the existence of available sources of information for finding information, and the type of research they should choose. Nevertheless, they are not accustomed to statistics and statistical significance and as a result they rely on the descriptive elements of the abstract.

1.2 Purpose of the study

The scarce research evidence concerning Greek health professionals highlighted the necessity of conducting the present study. The purpose of this survey was to examine the knowledge, attitude and behavior of graduates and health professionals, specifically STs, OTs and PTs regarding EBP. The study used two different valid and reliable tools in order to highlight both self-reported opinions, but also real knowledge and skills based on theoretical scenarios. The research questions developed are: 1) What is the participants' self-reported level of EBP knowledge and skills? 2) Are the self-reported level of knowledge and skills similar to the actual level? 3) What is the degree of application of EBP in clinical work? 4) What demographic characteristics may influence EBP knowledge, attitude and practice?

2. Methods

2.1 Study design

A cross-sectional survey design was employed. The survey was conducted among students and professional STs, PTs and OTs at a Greek college during 2020-21.

2.2 Participants

A total of fifty individuals participated in this study. Twenty-five allied health students and twenty-five allied health professionals of three different specialties: Speech and language therapy (SLT), occupational therapy (OT) and physiotherapy (PT). Participants should be studying or collaborate with Metropolitan College. The professional should be in actual practice of their profession. Demographic characteristics of participants are displayed in Table 1.

Table 1: Demographic characteristics of participants

Variable		N	(%)
Gender	Male	21	(42)
	Female	29	(58)
Age group	20-29	27	(54)
	30+	23	(46)
Specialty	SLT	16	(32)
	PT	17	(34)
	OT	17	(34)
Professional status	Postgraduate	25	(50)
	Professional	25	(50)

2.3 Ethical considerations

College ethics committee (CREC) approval was obtained prior to initiating the study. All participants prior to questionnaires completion had to give their informed consent.

2.4 Materials

Data collection was conducted with the use of two valid and reliable questionnaires: The EBP Questionnaire (EBPQ, Upton and Lewis, 1998; Upton et al., 2012; Upton et al., 2014) and the Adopted Fresno Test (AFT, Ramos et al., 2003; Bishop and McCluskey, 2003; Buchanan et al., 2015).

The EBP Questionnaire (EBPQ, Upton et al., 2014) is a 24-item self-report measure, consisting of three subscales: practice (use - 6 items), attitude (attitude toward EBP - 4 items), and knowledge (knowledge and skill in EBP - 14 items). Items are scored on a 7-point Likert scale (1=never, 7=frequently). Afterwards, the mean score is calculated for each subscale as well as the global score. The EBPQ has been found to be quick and easy to administer, to have a good level construct validity and a very good level of internal reliability as measured by

Cronbach's alpha; the α for the overall questionnaire is 0.87 and 0.85 for practice, 0.79 for attitude, and 0.91 for knowledge subscale (Upton & Upton, 2006). At the end of the questionnaire there are also six demographic questions regarding sex, age, profession, position, specialty, qualification. The particular questionnaire has been translated and used in many research studies widely examining the concept of EBP in health care (e.g., de Pedro et al., 2009; Gonzalez-Torrente et al., 2012 Tomotaki et al., 2018; Liao et al., 2021).

The Adopted Fresno Test (AFT) as modified by Buchanan et al. (2015) measures the actual knowledge and practice of the research component of EBP. In other words, the ability to develop an appropriately clinical question, and choose the best research design and scientific sources that could guide clinical decisions. It consists of three main questions that participants were asked to answer based on one of two different clinical scenarios presented. The first question is an open question that asks participants to write a focused question (PICO-Population, Intervention, Comparative Intervention, Outcome) which could help them to organize a search of the literature. The two others are false/true questions that ask participants to choose the appropriate study design and sources that could use in order to answer their clinical question. The first question is marked with 16 points, the second with 3 points and the third with 11 points. Thus, the score ranges from 0 to 30. The AFT has been found to have a satisfactory level of internal consistency as measured by Cronbach's alpha (all scales α≥0.70), and excellent level of test-retest reliability (ICCs ranged from 0.87 to 0.96) except the Q3 that was good (0.71, Buchanan et al., 2015). The AFT has been translated and used in many research studies (e.g., Al Shahrani, 2020; da Silva et al., 2021; Liao et al., 2021).

2.5 Procedure

Due to Covid-19 restrictions the data collection was held online. An informational email regarding study was sent to potential participants. Those who were interested in participating could follow a link where after giving their consent could complete anonymously the questionnaires. The mean duration of questionnaires completion was twenty minutes.

2.6 Analysis

Descriptive and inferential statistics were used to analyze the data. Quantitative variables are presented with measures of central tendency and dispersion while qualitative variables with absolute and relative frequencies. The normality of quantitative data was assessed by using Shapiro- Wilk test. For groups comparisons, One-way ANOVA or Independent Samples T-test was used when data met the assumptions of parametric tests. Otherwise, the non-parametric Kruskal-Wallis or Mann-Withney U test was employed. Participants with any missing values were excluded from the analysis. All statistical analyses were performed by using SPSS v23 (IBM, 2015). Significance level was set at 5% ($p \leq 0.05$).

3. Results

The response rate per specialty was 32% (n=16) for SLTs, 34% (n=17) for OTs and 34% (n=17) for PTs. The exact percentage of professional status (allied health professionals and postgraduate students) per specialty is presented in Figure 1.
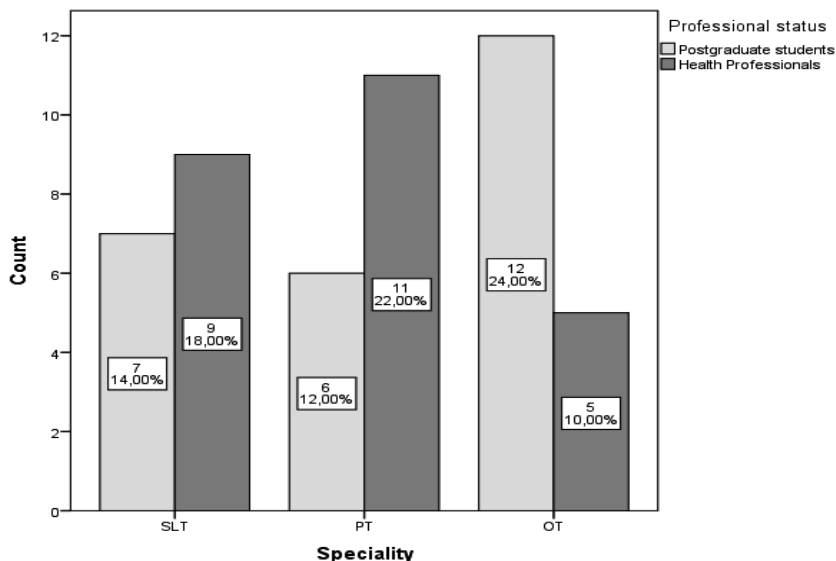
Figure 1. Bar graph illustrating the percentage of professional status per specialty.

The total scores of AFT and EBPQ per specialty and professional status are displayed in Table 2. The analysis demonstrated that participants score low to moderate on knowledge in developing a PICO clinical question and identify scientific sources to address their question as tested by AFT. Participants' scores based on self-reported EBPQ are high in attitude subscale suggesting a positive attitude, moderate in practice subscale suggesting a moderate level of the use evidence-based practice. Participants' scores on knowledge and skills subscale are rather low (below average). Regarding the effect of specialty in scores, a significant difference in Q1 and Q2 scores as well as in total AFT among the three specialities was indicated. In fact, SLTs score higher in those tasks compared to other groups (SLT>OT>PT). A series of Mann-Whitney test was conducted in order to detect which specialities differ significantly (Table 2). The results showed that SLTs' scores are higher than PTs' at significant level (p range .001-.002). No other significant difference was found. Moreover, the analysis showed a statistically significant difference in Practice (subscale of EBPQ) among the three groups. SLTs self-reported scores are higher compared to other groups (SLT>OT>PT). The Bonferroni post hoc analysis revealed that SLT's scores are higher than PTs' at significant level (p=.021). No other significant difference was found. Regarding the effect of professional status in scores only a significant difference in knowledge and skills of EBPQ subscale was observed. Between the two groups, postgraduate students score significantly higher compared to allied health professionals (p=.028). The effect of gender and age on scores of both groups was minor (p>.05)

Table 2. Comparison of ATF and EBPQ scores per specialty and professional status

		Specialty					Professional status			
		SLT	PT	OT	F/χ^2	p value	Postgrade students	Health Professionals	t/U	p value
Adopted Fresno Test										
Q1 score	Min	6,00	2.00	2.00	9.16	**0.010**	2.00	2.00	231.00	.113
	Max	13.00	14.00	13.00			14.00	12.00		
	Median	9.00	5.00	8.00			9.00	7.00		
	Mean	9.31	5.71	7.53			8.21	6.81		
	S.D.	1.92	3.70	3.71			3.98	2.93		
Q2 score	Min	2.00	1.00	1.00	16.96	**<0.001**	1.00	1.00	279.50	.503
	Max	3.00	3.00	3.00			3.00	3.00		
	Median	3.00	1.00	2.00			2.00	2.00		
	Mean	2.56	1.41	1.94			2.04	1.88		
	S.D.	.51	.71	.75			.86	.77		
Q3 score	Min	1.00	1.00	1.00	0.660	0.718	1.00	1.00	269.50	.392
	Max	5.00	5.00	5.00			5.00	4.00		
	Median	2.00	2.00	2.00			2.00	2.00		
	Mean	2.50	2.29	2.29			2.63	2.12		
	S.D.	1.10	1.31	1.40			1.53	.91		
AFT total	Min	9.00	4.00	5.00	11.22	**0.004**	4.00	4.00	223.50	.084
	Max	21.00	23.00	21.00			23.00	17.00		
	Median	15.00	8.00	13.00			13.50	11.00		
	Mean	14.37	9.41	12.41			13.37	10.77		
	S.D.	3.01	5.14	4.42			5.28	3.74		
Evidence Based Practice Questionnaire										
Practice	Min	2.00	1.66	1.83	3.93	**0.026**	2.00	1.66	1.33	.188
	Max	6.00	4.83	4.66			6.00	4.83		
	Median	3.67	2.50	3.33			3.67	2.83		
	Mean	3.77	2.82	3.27			3.48	3.09		
	S.D.	1.08	.89	.93			1.03	1.00		
Attitude	Min	2.33	2.00	2.66	1.93	0.153	3.00	2.00	1.55	.129
	Max	4.00	3.66	3.33			4.00	3.66		
	Median	2.71	2.71	2.33			3.33	2.71		
	Mean	2.89	2.78	2.46			3.29	2.82		
	S.D.	.89	1.22	1.05			1.15	.99		
Knowldge and skills	Min	3.21	3.42	3.21	4.54	0.103	3.21	3.21	205.50	**.038**
	Max	6.40	4.50	5.00			6.40	5.00		
	Median	4.20	3.85	4.00			4.28	3.96		
	Mean	4.49	3.88	4.04			4.36	3.92		
	S.D.	.93	.33	.51			.83	.39		

4. Discussion

The findings of the present research showed that graduates and health professionals, specifically STs, OTs and PTs, showed a positive attitude towards the use of EBP. Participants' knowledge concerning EBP seems to be lacking and despite their supportive attitude, only a small percentage applied it in their therapeutical approach. Low to moderate knowledge in developing a PICO clinical question and identification of scientific sources to address their question was shown in this study. Participants seem to hold a positive attitude toward EBP but implementation to practice is a bit limited. This is displayed by their remarkable low scores on knowledge and skills subscale (below average).

These findings are in line with the literature (e.g., Upton and Upton, 2006; Ross, 2010; Mavroidi, 2015; Patelarou et al., 2015; Alexandri et al., 2021; Saunders et al., 2021). Health professionals seem to have a positive attitude towards EBP but face several obstacles and only few actually translate attitude to practice. The findings of the present study are in contrast with those of Mavroidi's research (2015) suggesting that STs score lower to EBP compared to other health allied professions (e.g., PTs). Nonetheless, findings support that younger qualified professionals are more familiar with EBP in terms of knowledge and skills compared to more experienced ones.

4.1 Study limitations

Several limitations are present thus, the generalisation of these findings is limited. The research was conducted over a period of six months and the results are based on only 50 participants. The sampling is a convenient one, the participants were graduates or health professionals collaborating with the Metropolitan College. Therefore, the findings should be taken into account with caution.

4.2 Suggestions for practical application

It is important that frameworks offer clinicians free access to online databases to explore their knowledge and develop their EBP application skills. These measures act as supportive factors in the use of EBP not only because they save time on data searching but they can be less costly, since most articles are subscription-based and clinicians cannot access them unless they pay (Creswell and Hirose, 2019)

Graduates as well as health professionals also gain most of their knowledge in their undergraduate program, which highlights the importance of incorporating EBP into the curriculum. Training that includes EBP is also necessary for the ability to objectively assess therapeutic skills by clinicians, as high rates in self-assessment in most cases are not supported by deep knowledge, consistent application of EBP guiding principles. More specifically, attending funded or graded seminars and workshops, could be helpful in learning the use of EBP as well as conferences where health professionals could share their knowledge and present their clinical work to young therapists (Alexandri et al., 2021).

4.3 Suggestions for future research

Further robust quantitative research (e.g., with large representative sample) should be conducted to be able to draw clear conclusions. More parameters could be included (e.g., barriers) for complete conclusions. Yet, it would be useful to use mixed method design to

collect both quantitative and qualitative data helping in a better understanding and dealing with any difficulties (Creswell and Clark 2010).

References

Alexandri P., Mouratidis, G. and Kozyrakis L. (2021) 'Xtizontas Gefures', 14th Panhellenic Conference of Speech Therapy, pp. 279-280, Available at https://14thcongress.logopedists.gr/ f

Al Shahrani, A., S. (2020) 'Development and evaluation of an evidence-based medicine module in the undergraduate medical curriculum' BMC Medical Education, *20*(1), pp. 1-9.

Bishop B, McCluskey A. (2003) *'The reliability of the Adapted Fresno Test of Evidence-Based Practice: In OT-Australia'*, 22nd National Conference Proceedings: Melbourne.

Buchanan, H., Jelsma, J., & Siegfried, N. (2015) 'Measuring evidence-based practice knowledge and skills in occupational therapy—a brief instrument'. BMC medical education, 15(1), pp. 1-12.

de Pedro Gomez, J., Morales-Asencio, J. M., Abad, A. S., Veny, M. B., Roman, M. J., and Ronda, F. M. (2009) 'Validation of the Spanish version of the evidence based practice questionnaire in nurses' Revista espanola de salud publica, 83(4), pp. 577-586.

Gonzalez-Torrente S., Pericas-Beltran J, Bennasar-Veny M, et al. (2012)' Perception of evidence-based practice and the professional environment of primary health care nurses in the Spanish context: a cross-sectional study' BMC Health Serv Res, 12, 227. [PMC free article] [PubMed] [Google Scholar]

Tomotaki, A., Fukahori, H., Sakai, I., & Kurokohchi, K. (2018) 'The development and validation of the Evidence-Based Practice Questionnaire: Japanese version'. International journal of nursing practice, 24(2), e12617.

Da Silva, A. M., Valentim, D. P., Martins, A. L., & Padula, R. S. (2021) 'Instruments to assess Evidence-Based Practice among healthcare professionals: a systematic review', bioRxiv.

Liao, Y. H., Tang, K. S., Chen, C. J., Huang, Y. H., & Tiao, M. M. (2021) 'A study on how using an interactive multimedia e-book improves teachers' ability to teach evidence-based medicine depending on their seniority', BMC medical education*,* 21(1), pp. 1-9.

Creswell, J. W. and Hirose, M. (2019) 'Mixed methods and survey research in family medicine and community health', Family Medicine and Community Health, 7(2).

Frenk J, Chen L, Bhutta ZA, et al. (2010) 'Health professionals for a new century: transforming education to strengthen health systems in an interdependent world' Lancet, 376 (9756), pp. 1923-1958.

Melnyk, B. M., & Fineout-Overhold, E. (2022) 'Evidence-based practice in nursing & healthcare: A guide to best practice' Lippincott Williams & Wilkins.

Patelarou A.E, Evridiki P., Hero B. et al. (2013) 'Current evidence on the attitudes, knowledge and perceptions of nurses regarding evidence-based practice implementation in European community settings: a systematic review' J Community Health Nurs, 30, pp. 230–44.

Ramos KD, Schafer S, Tracz SM. (2003) 'Validation of the Fresno test of competence in evidence based medicine' BMJ, 326 (7384), pp. 319-321.

Ross, J. (2010) 'Information literacy for evidence-based practice in perianesthesia nurses: readiness for evidence-based practice' Journal of Perianesthesia Nursing, 25(2), pp. 64-70.

Upton, D., Stephens, D., Williams, B., and Scurlock-Evans, L. (2014) 'Occupational Therapists' attitudes, knowledge, and implementation of evidence-based practice: a systematic review of published research', British Journal of Occupational Therapy*,* 77(1), pp. 24-38.

Upton, D., & Upton, P. (2006) 'Knowledge and use of evidence-based practice of GPs and hospital doctors', Journal of evaluation in clinical practice, 12(3), pp. 376-384.

Upton, D. & Upton, P. (2006) 'Development of an evidence-based practice questionnaire for nurses' Journal of Advanced Nursing, 53(4), pp. 454–458.

Upton D, Lewis B, (1998) 'Clinical effectiveness and EBP: Design of a questionnaire' British Journal of Therapy and Rehabilitation, 5 (12), pp. 647-650.

Upton, P., Scurlock-Evans, L., Stephens, D. & Upton, D. (2012) 'The adoption and implementation of evidence-based practice (EBP) among allied health professions', International Journal of Therapy and Rehabilitation, 19(9), pp. 497–503.

Saunders, H., Gallagher-Ford, L., Kvist, T., and Vehviläinen-Julkunen, K. (2019) 'Practicing healthcare professionals', Evidence-based practice competencies: An overview of systematic reviews, Worldviews on Evidence-Based Nursing, 16(3), pp. 176-185.

IBM Corp. (2015) *'IBM SPSS Statistics for Windows',* Version 23.0. Armonk, NY: IBM

The impact of Adverse Childhood Experiences on occupational performance of children living in foster centers, according to their caregivers

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Abstract

Adverse Childhood Experiences (ACEs) affect the health and functioning of children and adolescents. The present research records the perception of the caregivers of children with a history of ACEs, who live temporarily in foster centers in Greece, with regard to the problems of occupational performance displayed by the children and the levels of satisfaction that the children derive from the performance and participation in daily occupations. A total of 6 social workers were interviewed for a sample of 15 children using the Canadian Occupational Performance Measure (COPM), during semi-structured telephone interviews. Data were analysed using Interpretative Descriptive Analysis. The results showed that indeed children with a history of ACEs demonstrated difficulties in occupational performance, while for a large percentage of the sample the difficulties were related to all three areas of life (Self-Care, Productivity and Leisure). However, one cannot say with certainty whether as the number of Adverse Childhood Experiences in each child's history increased, so proportionally did occupational performance problems. Despite this, a precarious conclusion that could be drawn was that as the number of ACEs increased, the level of performance and the degree of satisfaction children derived from performing occupations, which belonged to the problematic occupational areas, decreased. Also, older children showed more intense difficulties and a lower degree of satisfaction in the problematic areas of their occupations. The knowledge produced by this research is in agreement with the existing literature, informs the practice in the field of Occupational Therapy in Greece and is a trigger for future research in the field by occupational therapists.

Keywords: Adverse Childhood Experiences (ACEs), occupations, Occupational Therapy

1. Introduction

ACEs are frequent in childhood and constitute a massive stressor with long-lasting adverse effects on the brain, as well as on the mental and physical health (Herzog and Schmahl, 2018). Childhood stressors have such a high prevalence worldwide that they are considered to be a major public health problem (Agorastos *et al.,* 2019). The term "Adverse Childhood Experiences" is a broader term than childhood trauma and child abuse or neglect and is increasingly encountered in the recent literature. The term was first proposed in 1998 (Felitti *et al*., 1998) and groups ACEs into 7 categories; psychological, physical or sexual abuse, violence against family members, or living with household members who were substance abusers, mentally ill, suicidal or imprisoned. One of the main conclusions drawn by Felitti *et al.*'s was that as the number of ACEs in a person's history increases, so does the risk of developing hazardous to health behaviours and chronic diseases in later life (Felitti *et al*., 1998). There is an increasing number of studies studying the health problems allegedly

associated with ACEs (Petruccelli *et al.*, 2019), whereas Felitti et al.'s conclusion is confirmed by recent research (Hughes *et al.*, 2017).

Exposure to adverse experiences during critical developmental stages affects the neural networks of the brain (Agorastos *et al.*, 2019). Recently published research highlights the negative impact of childhood trauma on the developing brain and especially on the occupational performance of children and adolescents (Fraser, MacKenzie and Versnel, 2019). According to an informational aid on Trauma in Occupational Therapy (AOTA, 2015), children with a history of trauma may exhibit occupational performance difficulties in all occupational areas. As derived from a literature review, ACEs do not seem to have previously been linked exclusively to children's occupational performance, apart from the publication of Fraser, MacKenzie and Versnel (Fraser *et al.*, 2019), where the main aim of the research was to record the contemporary practice of occupational therapists in children and adolescents with complex trauma. For this reason, it was recognised as clinically interesting and innovative to further investigate the issue by conducting the present research. In Greece, this research aspires to be the first research that links ACEs with occupational performance.

2. Methodology

2.1. Objectives and assumptions

The focus of the research was the occupational performance of children with a history of ACEs. The main purpose was to investigate the perception of the caregivers of children with a history of ACEs, who work in foster centers, regarding the occupational performance problems that children experience and the levels of satisfaction that children gain from the performance and participation in daily occupations. The underlying hypothesis was that children with ACEs are likely to experience problems in all three areas of occupational performance, as evidenced by the existing literature. Furthermore, it was hypothesized that the more ACEs children have in their history, the more important will be the problems of occupational performance and, consequently, that the number of ACEs proportionally affects children's functioning. The hypothesis was based on the fact that the number of ACEs is in a dose-response relationship with the health problems that people experience in later life (Kinner and Borschmann, 2017). In addition, the aim of the research was to make a first record of the needs of the specific children at occupational level, from the point of view of Occupational Therapy. This would help to gain more knowledge regarding how an occupational therapy programme could help the specific population by providing them with occupational possibilities during the children's stay in foster centers.

2.2. Research design

A qualitative research approach was chosen, using Interpretive Descriptive Analysis for the analysis of the data. Interpretive Description is an inductive analytic approach, designed to generate ways of understanding clinical phenomena that are applicable to clinical practice (Thorne *et al.*, 2004). Interpretive Descriptive Analysis was used in recent qualitative applied research in the field of Occupational Therapy (Fraser *et al.*, 2019), where data was analysed regarding the performance of children with a history of complex trauma; and there the data were collected using semi-structured interviews with health professionals (occupational therapists).

2.3. Field and sample

The field in which the sample was sought was child foster centers that have branches in various regions of Greece, where children with a history of ACEs are provided with temporary accommodation and support services. The target population of the research was children with a history of ACEs. Their participation, however, took place through the researcher's contact with their caregivers, who work in the above structures and support children with a history of ACEs. The criterion for including a child in the sample was that he/she had completed at least one month of residency in the specific structure, so that his occupational profile could be detected. The number of participants was set at 15 children, which is the acceptable minimum threshold for qualitative research using interviews (Vasileiou *et al*., 2018).

The children's caregivers were the 'quasi-researchers', as they answered on behalf of the children during a semi-structured interview with the researcher. These health professionals were selected to collect the data in part because, as social workers, they have access to the children's files and therefore know information regarding the number and type of ACEs that children have had. Furthermore, because they are in direct, often daily contact with the children, they could provide sufficient information about the children's functioning in the areas of occupational performance. The criterion for the participation of a health professional in the research was to have at least one month of previous service in the specific position of the structure, in order to exclude new recruits who would not be sufficiently familiar with the children's occupational profile. Otherwise, no other exclusion criteria were set.

2.4. Survey procedure and data collection tool

A total of six individual interviews took place with six caregivers, all of whom were social workers with experience in the specific population (children with a history of ACEs). The interviews lasted 20-30 minutes per child for whom data was collected. The data collection tool used was the Canadian Occupational Performance Measure (COPM) (Law *et al*., 2014). The COPM measures performance in the areas of Self-Care, Productivity, and Leisure Time Management and is used to identify and quantify occupational performance problems, taking into account the satisfaction gained from occupational performance and providing a ranking of priorities. Its structure and the way COPM's applied for the needs of this research is consistent with the methodology followed in a recent study, where the symptoms caused by trauma were sought, with a sample of 151 children of toddler age (Fraser *et al*., 2019) and there a questionnaire was used with questions concerning -among others- in the areas of Play, Sleep, Social participation, and there, the questionnaire was completed using the method of individual interviews of children's caregivers by the researchers.

2.5. Measures to ensure ethics

In the documents exchanged between the researcher and the foster centers, emphasis was placed on the voluntary character of participation and the possibility of withdrawal at any stage of the research. Also, the anonymity of all (participants, structures and children) was ensured throughout the duration of the research and for the future, with respect to the management of the data and the presentation of the findings. For this purpose, a codename was used, excluding the possibility of detecting the real names. No personal data or information from which the children's identity could emerge was requested, and

confidentiality was further ensured by recording longhand the data and then converting it digitally with access only by the researcher. The project was approved by the Ethics Committee of the Metropolitan College and then a 'Letter of contact' followed with an 'Information Form for potential participants' and after receipt of a signed 'Advised Consent Form', interview dates were scheduled.

3. Results

3.1. Data regarding occupational performance

The COPM was administrated to the 6 social workers, which yielded narrative data for 15 children. The total sample collected was 54 occupational performance problems, as seen in the three Pie charts. Most difficulties were almost equally distributed in 2 of the 3 occupational areas. The largest segments in each problematic area were School, Personal Hygiene and Socialisation with the smallest segments being the handling of money, sexual behaviour and quiet recreation. Areas of difficulties varied in terms of results, but overall difficulties were primarily concentrated in specific problematic areas. Figure 1 schematically categorises occupational performance problems by occupational area (Self-Care, Productivity and Leisure Time Management) and shows the representation of each area in percentage of the total occupational performance problems recorded. In addition, the number of children who showed difficulties in each sub-category of the Occupational area is listed.
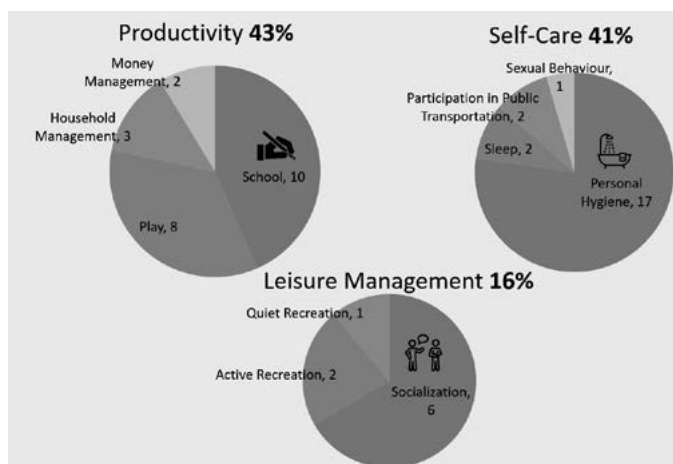
Figure 1. Distribution of occupational performance problems in the 3 occupational areas and number of cases falling into the sub-categories of each occupational area.

The distribution of the 54 occupational performance problems recorded in the 3 occupational areas as follows: 23 problems in the Productivity area (43%), 22 in the Self-Care area (41%) and 9 in Leisure Time Management (16%). Therefore, most difficulties are found almost equally distributed in 2 of the 3 occupational areas. In other words, most cases (*N*=7) have difficulties in 2 of the 3 occupational areas, while slightly fewer cases (*N*=6) have difficulties in all 3 occupational areas and only 2 cases show difficulties in only 1 occupational

area. The above diagram also represents how the occupational performance difficulties of each area are distributed in its individual sub-categories. The breakdown in absolute numbers is as follows:

1) The 23 performance problems concerning types of Productive activity are further distributed as follows: 10 concern school, 8 concern play, 3 concern participation in productive activities of the foster center (household management), and 2 concern money management. The area of Productivity is the most represented occupational area where the sample experienced difficulties.

2) The 22 occupational performance problems related to Self-Care are further distributed as follows: 17 relate to personal hygiene (7 personal hygiene, 6 feeding and 4 dressing/undressing/laces/fastenings), 2 refer to sleep, 2 refer to functional mobility and participation in public transportation and 1 concerns sexual behaviour.

3) The 9 occupational performance problems related to Leisure Time Management sub-categories are further distributed as follows: 6 have to do with socialization in general (starting and maintaining a relationship, demonstrating reciprocity etc.), 2 refer to active recreation (sports, participation in the playground) and 1 is about quiet recreation (participation in group activities in foster centers).

3.2. Data regarding ACEs

Perhaps the most critical factor of the sample, relevant to the purposes of this research, was the number of ACEs that each case had in his/her history. As shown in Figure 2, there were cases that listed from 1 single ACE to 6 ACEs, while no child had all 7 categories of ACEs recorded in their history. The majority ranges from 3 to 5 ACEs per child.
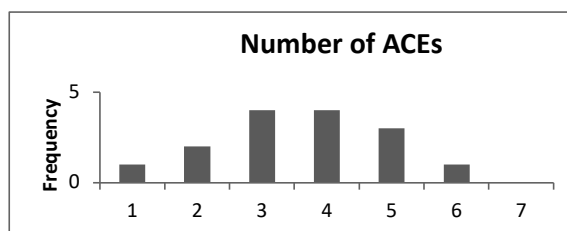
Figure 2. Distribution of the number of ACEs per child

4. Discussion

The results show that children with a history of ACEs demonstrated difficulties in performing occupations that they wanted or needed to do and/or occupations that were expected from their chronological age to be capable of performing. The results varied in terms of the occupational area in which the children experienced difficulties, although primarily the difficulties were concentrated in specific problematic areas. Also, the results vary in terms of the degree of difficulty shown by the children and in terms of the levels of satisfaction they gained from the way they performed the specific occupations at the time of the interviews, according again to the perceptions of their caregivers.

The initial correlation made was between the free variable of the number of ACEs and the number of occupational performance problems displayed by the sample. Results demonstrate that there is no direct correlation between the problems of occupational performance and the ACEs. This contradicts the dose-response relationship that has been supported in the literature between the number of ACEs and the health problems that people experience in later life (Kinner and Borschmann, 2017). However, this could be attributed to the small research sample. Furthermore, it is simplistic and risky to assume that each ACE by itself has the same importance factor and the same effect on all children. Still, it cannot be assumed that the children in the sample exhibited the same resilience or the same levels of self-regulation skills that, as have been shown in the literature, are protective against the effects of ACEs (Whitney, 2020).

Furthermore, the number of ACEs was compared with the mean level of performance and the mean degree of satisfaction that the children obtained from performing occupations. There appeared to be a trend showing that as the number of ACEs increased, the level of performance decreased. In other words, children with the most ACEs in their history displayed worst occupational performance. The same trend was seen with regard to the satisfaction factor. Other sample parameters, such as age, gender, country of origin, and length of stay in the foster center were then compared to see if they played a role in the number of occupational performance problems, intensity, or satisfaction reported in the sample. A weak correlation emerged only with regards to age, with older children showing more intense difficulties in the problematic areas of their occupations. Also, with increasing age, the index that measures the degree of satisfaction derived from the classified as performance problems occupations also seems to decrease. However, this is a weak correlation that does not lead to a safe conclusion. Other than that, no correlation was observed between the other examined parameters in the specific sample.

4.1. Methodological limitations and suggestions for future research

A key methodological limitation was the fact that children's occupational performance and satisfaction were measured based on data collected from their caregivers (rather than from the children themselves). Another limitation was the fact that foster centers were the physical and social environment of the children at the time of investigation of their occupational performance. A steadfast belief of occupational therapy, which is consistent with the ICF framework, is that "contexts (cultural, personal, temporal, virtual) and environment (physical, social) influence the individual's access to occupations, while influencing the quality of performance and their level of satisfaction" (Kouloumbi, 2017). Furthermore, it is expected that a large part of the results regarding children's occupational performance can be attributed to clinical symptomatology. However, it was not possible to exclude from the sample children who had a diagnosis of a disorder, as this would exclude a large part of the population. Another limitation may be the fact that all data were drawn exclusively from social workers, a specialty whose epistemological basis is the understanding of the social world, therefore, the results could have been influenced by this perspective. For this reason, it would be interesting for the present research to be a pilot study for future ethnographic research, in which the researcher-occupational therapist would monitor within the structures for a period of time the occupational profile of the specific population and they themselves would record the difficulties in occupational performance.

In addition, another methodological limitation was the fact that ACEs were captured using a Questionnaire based on a specific categorisation, based on the literature, and as a result, some categories may have been omitted. Also, only the ascertained ACEs were recorded, based on the children's history, while there may have been other adverse experiences that could not be pinpointed with certainty and were, therefore, omitted. In addition, there was no way to quantify the importance of each ACE and to make comparisons, so they were recorded only as a number and not graded according to their severity. Another important limitation lies in the fact that the existence of a history of ACEs is not necessarily in a linear relationship with the image presented by the children in the areas of occupational performance. It would be interesting to have a study with a larger sample of participants, which in its design would also include a control group - children of a similar age, but without a history of ACEs - in order to examine the possibility of a causal relationship. Likewise, it would also be interesting to conduct a large-scale research project to study the effect of ACEs on functioning, using the official Questionnaire drawn up by the WHO and entitled 'ACEs International Questionnaire' (ACE-IQ) (WHO, 2018).

5. Conclusions

From the results it emerged that children with a history of ACEs showed difficulties in occupational performance, with children of similar age lacking stressful events in their history having a lower risk of occurrence or no occupational performance problems to the same degree, intensity, and duration. The basic hypothesis was that children with ACEs show problems in all three areas of occupational performance (Self-Care, Productivity and Leisure, with ranking based on COPM, 2022). Indeed, almost the same percentage of children had difficulties in two of the three (N=7) or in all three occupational areas (N=6), while only 2 of the 15 children had difficulties in only one occupational area. Difficulties in occupational performance were chosen to be commented based on the occupational area where the difficulty occurred.

Furthermore, it was hypothesised that the more severe ACEs children have in their history, the more severe will be the occupational performance problems (at the level of importance, satisfaction, and ability to perform), a fact that is at least weakly confirmed, as it appeared that as the number of ACEs increased, both the level of performance and the degree of satisfaction in the way they performed the specific occupations decreased. Finally, the question of whether the number of ACEs proportionally affects the functionality of the children, seems to be answered positively, as the results showed that indeed children with a history of ACEs had difficulties in performing occupations, not showing a balance between the three occupational areas, which is a factor of functionality, in the light of occupational therapy (Law *et al.*, 2014).

In conclusion, the knowledge produced by the research agrees with the existing literature regarding the effect of ACEs on occupational performance and informs the practice of the Occupational Therapy (and by extension the other health and welfare disciplines that work with the specific population). In Greece, the clinical practice of occupational therapists in the specific field is not widespread and, therefore, there is no recorded knowledge about the needs of the specific population at occupational level. The present research recorded these needs, including children of different age groups, identifying the problematic areas of their occupation, and completing a first – though indicative, due to the limited size of the sample -

record of the field. It could, therefore, be a trigger for the creation of an individualised occupational therapy program (individual or in a group), which would help the specific population by providing occupational possibilities during the time of residency in the foster centers. The research question raised, therefore, seems to be of great importance for the applied practice of Occupational Therapy in Greece, as it is judged that the profile of children with ACEs who live in foster centers, as conveyed from the point of view of their caregivers, justifies the need for occupational therapy intervention.

References

Agorastos, A., Pervanidou, P., Chrousos, G. P., & Baker, D. G. (2019). 'Developmental trajectories of early life stress and trauma: A narrative review on neurobiological aspects beyond stress system dysregulation', Frontiers in Psychiatry, 10(MAR), 1–25. https://doi.org/10.3389/fpsyt.2019.00118

American Occupational Therapy Association. (2015). Occupational Therapy's Role in Mental Health Promotion, Prevention, & Intervention With Children & Youth: Childhood Trauma. Available at: https://www.aota.org/Practice/Children-Youth/Mental%20Health/School-Mental-Health.aspx

COPM (2022) The Canadian Occupational Performance Measure. Available at: https://www.thecopm.ca/ (Downloaded: 31 January 2022)

Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., Koss, M. P., & Marks, J. S. (1998). 'Household Dysfunction to Many of the Leading Causes of Death in Adults The Adverse Childhood Experiences (ACE) Study', American Journal of Preventive Medicine, 14(4), 245–258.

Fraser, K., MacKenzie, D., &Versnel, J. (2019). 'What is the Current State of Occupational Therapy Practice with Children and Adolescents with Complex Trauma?',Occupational Therapy in Mental Health, 35(4), 317–338. https://doi.org/10.1080/0164212X.2019.1652132

Herzog, J. I., &Schmahl, C. (2018). 'Adverse childhood experiences and the consequences on neurobiological, psychosocial, and somatic conditions across the lifespan', Frontiers in Psychiatry, 9(SEP), 1–8. https://doi.org/10.3389/fpsyt.2018.00420

Hughes, K., Bellis, M. A., Hardcastle, K. A., Sethi, D., Butchart, A., Mikton, C., Jones, L., & Dunne, M. P. (2017). 'The effect of multiple adverse childhood experiences on health: a systematic review and meta-analysis', The Lancet Public Health, 2(8), e356–e366. https://doi.org/10.1016/S2468-2667(17)30118-4 53

Kinner, S. A., &Borschmann, R. (2017). 'Inequality and intergenerational transmission of complex adversity', The Lancet Public Health, 2(8), e342–e343. https://doi.org/10.1016/S2468-2667(17)30139-1

Kouloumbi, M. (2017). Occupation and task. Athens: Konstantaras publications, pp 142-143, 155.

Law, M., Baptiste, S., Carswell, A., McColl, M.A., Polatajko, H., Pollock, N. Canadian Occupational Performance Measure (COPM) (2014). (Eds.) Καναδικό Μέτρο Εκτέλεσης Έργου (ΚΜΕΕ). Editing in Greek. Siaperas, P., Skaltsi, P. Athens (2018).

Magruder, K. M., McLaughlin, K. A., & Elmore Borbon, D. L. (2017). 'Trauma is a public health issue', European Journal of Psychotraumatology, 8(1), 1375338. https://doi.org/10.1080/20008198.2017.1375338

Petruccelli, K., Davis, J., & Berman, T. (2019). 'Child Abuse & Neglect Adverse childhood experiences and associated health outcomes: A systematic review and meta-analysis', Child Abuse & Neglect, 97(July), 104127. https://doi.org/10.1016/j.chiabu.2019.104127

Thorne, S., Kirkham, S. R., &O'Flynn-Magee, K. (2004). 'The Analytic Challenge in Interpretive Description, International Journal of Qualitative Methods, 3(1), 1–11. https://doi.org/10.1177/160940690400300101

Vasileiou, K, Barnett, J., Thorpe, S. & Young, T. (2018). 'Characterising and justifying sample size sufficiency in interview-based studies: systematic analysis of qualitative health research over a 15-year period', BMC Medical Research Methodology, 18(1), 1–18.

WFOT (2018) Definitions of Occupational Therapy from member organizations. Available at: https://wfot.org/resources/definitions-of-occupational-therapy-from-member-organisations(Downloaded: 26 January 2022)

Whitney, R. (2020). 'Self-Regulation as Key Factor in Protection Against the Harmful Effects of Adverse Childhood Experiences: Critical Role for Occupational Therapists', The Open Journal of Occupational Therapy, 8(1), 1–9. https://doi.org/10.15453/2168-6408.1622

World Health Organization (2018). Adverse Childhood Experiences International Questionnaire. In Adverse Childhood Experiences International Questionnaire (ACE-IQ). Geneva

The latest neuropsychological assessment and cognitive rehabilitation approaches in Cerebral Palsy

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Abstract

The aim of the present review is to highlight the latest neuropsychological approaches in assessment and rehabilitation in cerebral palsy patients. For this purpose, a systematic database research in PUBMED was conducted to emerge these approaches. In total 1.158 articles have been reviewed. For neuropsychological assessment, 516 articles have been reviewed in the first round and 12 found to be eligible. For rehabilitation, 642 articles have been reviewed and 5 found to be eligible. Eligible articles showed that assessment approaches consist of simple cognitive tasks, cognitive tests, and neuroimaging methods. With regards to rehabilitation, virtual reality (VR), neurotransmission cognitive theory intervention and neurostimulation techniques were prominent. Both assessment and rehabilitation approaches demonstrate high accuracy for their purpose.

Key words: neuropsychology, assessment, rehabilitation, cerebral palsy

1. Introduction

Cerebral palsy is the most common early-onset, non-progressive neuromotor disability observed in children (Rosenbaum et al., 2007; Novak et al., 2017), affecting approximately two to four individuals per 1000 births (Aisen *et al.*, 2011; Oskoui *et al.*, 2013). Since life expectancy in people with cerebral palsy is similar to that of the general population (Colver, 2012), rehabilitation and therapy for these children is essential, with broader implications for social, health and education services (Hutton et al., 1994)

1.1 Non-motor Deficits

Beside the motor-oriented classification, cerebral palsy's non-motor comorbidities account for a substantial part of the deficits and functional limitations experienced by the patients (Fluss and Lidzba, 2020). These deficits are significantly affecting the patient's quality of life and depend on the different types of cerebral palsy.

In more detail, cognitive impairments observed in spastic hemiplegia affect speech and language, visuospatial functions, working memory, executive functions, and attention deficits (Fluss and Lidzba, 2020). The intelligence of the children facing the aforementioned condition is often preserved, as the mean IQ level can reach up to 78,5 (Stadskleiv *et al.*, 2017). Spastic diplegia impairments are associated with visuospatial functions, working memory, executive functions, and attention difficulties (Fluss and Lidzba, 2020). Intelligence is also often preserved, as 67% to 78% of these children demonstrate an IQ level greater than 70 (Stadskleiv *et al.*, 2017). Although, children present normal language comprehension, they express difficulties in verbal intelligence (di Lieto *et al.*, 2017). While intelligence is often preserved in the above, in spastic quadriplegia it is often mildly to severely affected (Fluss and Lidzba, 2020). Other cognitive domains also heavily impaired, are language and speech, visuospatial

functions, while working memory, executive functions and attention are also observed to be declined.

In dyskinetic cerebral palsy, more severe cognitive deficits are observed. Intelligence is severely compromised as it is preserved in less than 50% of the cases (Fluss and Lidzba, 2020). Furthermore, visual, and verbal attention, visuospatial and visuoperceptual abilities, visual and verbal memory, verbal learning, and cognitive flexibility are also significantly affected (Ballester-Plané *et al.*, 2018).

Ataxic cerebral palsy has received much less attention due to its low prevalence (Fluss and Lidzba, 2020 & Cans *et al.*, 2002), so cognitive deficits associated with it, follow the same pattern. However, (Al-Mosawi, 2021) associated ataxic cerebral palsy with motor coordination loss, trembling, hypotonia, weakness or other cerebellar abnormalities.

1.2 Aim of the present study

With the survival rates ranking up to those of the general population, interventions must take place to ease the burden of these children, as well as their caregivers. Pharmaceutical interventions may be an option which include mostly oral administration of drugs such as antispastic, laxative, psychiatric, anxiolytic, neuroleptic, antiepileptic drugs and in some cases, drugs preventing heart-diseases and cardiovascular risk factors, urinary drugs and anti-osteoporosis drugs are delivered (Pons *et al.*, 2016). The use of the aforementioned medicines is increasing respectively as the Gross Motor Function Classification System (GFMCS) levels increases, which can lead to polypharmacy (Pons *et al.*, 2016). Therefore, beyond the pharmaceutical approach, there is a new trend gaining ground since 2011, focusing on the neuropsychological rehabilitation of cerebral palsy (Aisen *et al.*, 2011). Neuropsychological rehabilitation is gaining popularity for its non-invasive nature and its efficiency, and the aim of the present study is to unfold the latest neuropsychological approaches in assessment and rehabilitation of cerebral palsy patients.

2. Method

A systematic database research was conducted to identify the latest neuropsychological approaches in assessment and rehabilitation in cerebral palsy. The database used was PudMed. Following assessment, 516 articles were relevant in the first round, while 12 were eligible (Table 1). Regarding rehabilitation, 642 articles were relevant in the first round, while only 5 found to be eligible after reviewing (Table 2).

3. Results

Neuropsychological assessment in cerebral palsy is multidimensional and includes cognitive tasks, tests as well as neuroimaging methods. For instance, (Pereira *et al.*, 2019) used the D-KEFS to assess the executive functions of children. This test asks children to follow two rules: never place a big disk above a smaller one and never move more than one disk at the same time. The outcomes highlight planning competences. Cognitive tasks can also be used for assessing working memory, like the Corsi Cube test, where the participant must indicate the blocks touched by the examiner in a backward order (Souto *et al.*, 2020). Memory capacity is defined by the most extensive series recalled correctly. Attention may also be assessed the same way. Conner's Continuous Performance Test II is a computerised test where participants

are instructed to press a button on every letter, except letter X, in the 250 milliseconds duration of each stimulus (Mak *et al.*, 2020). It consists of 20 trials and measures the time to process information.
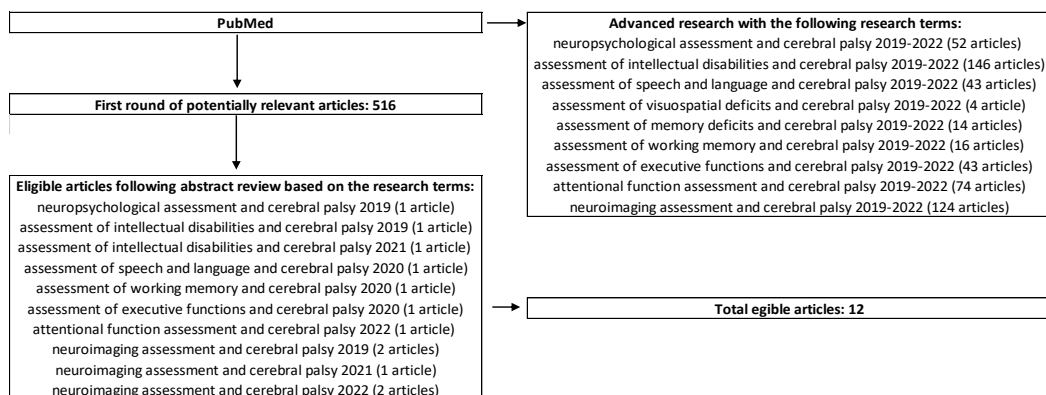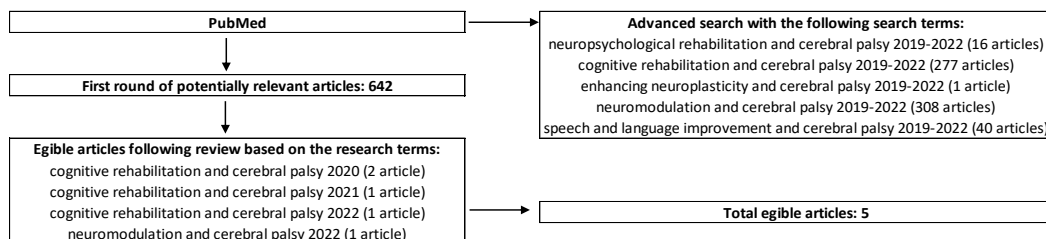
Table 1. Neuropsychological Assessment Articles

PubMed

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First round of potentially relevant articles: 516

Advanced research with the following research terms:
neuropsychological assessment and cerebral palsy 2019-2022 (52 articles)
assessment of intellectual disabilities and cerebral palsy 2019-2022 (146 articles)
assessment of speech and language and cerebral palsy 2019-2022 (43 articles)
assessment of visuospatial deficits and cerebral palsy 2019-2022 (4 article)
assessment of memory deficits and cerebral palsy 2019-2022 (14 articles)
assessment of working memory and cerebral palsy 2019-2022 (16 articles)
assessment of executive functions and cerebral palsy 2019-2022 (43 articles)
attentional function assessment and cerebral palsy 2019-2022 (74 articles)
neuroimaging assessment and cerebral palsy 2019-2022 (124 articles)

↓

Eligible articles following abstract review based on the research terms:
neuropsychological assessment and cerebral palsy 2019 (1 article)
assessment of intellectual disabilities and cerebral palsy 2019 (1 article)
assessment of intellectual disabilities and cerebral palsy 2021 (1 article)
assessment of speech and language and cerebral palsy 2020 (1 article)
assessment of working memory and cerebral palsy 2020 (1 article)
assessment of executive functions and cerebral palsy 2020 (1 article)
attentional function assessment and cerebral palsy 2022 (1 article)
neuroimaging assessment and cerebral palsy 2019 (2 articles)
neuroimaging assessment and cerebral palsy 2021 (1 article)
neuroimaging assessment and cerebral palsy 2022 (2 articles)

→ | Total egible articles: 12 |

Table 2. Neuropsychological Rehabilitation Articles

PubMed

↓

First round of potentially relevant articles: 642

Advanced search with the following search terms:
neuropsychological rehabilitation and cerebral palsy 2019-2022 (16 articles)
cognitive rehabilitation and cerebral palsy 2019-2022 (277 articles)
enhancing neuroplasticity and cerebral palsy 2019-2022 (1 article)
neuromodulation and cerebral palsy 2019-2022 (308 articles)
speech and language improvement and cerebral palsy 2019-2022 (40 articles)

↓

Egible articles following review based on the research terms:
cognitive rehabilitation and cerebral palsy 2020 (2 article)
cognitive rehabilitation and cerebral palsy 2021 (1 article)
cognitive rehabilitation and cerebral palsy 2022 (1 article)
neuromodulation and cerebral palsy 2022 (1 article)

→ | Total egible articles: 5 |

Tests are another way to assess aspects of cognitive deficits. (Bertoncelli *et al.*, 2019) used the Wechsler Intelligent Scale for Children (WISC-V) to assess intellectual disabilities in patients up to age of 16 years. WISC-V can assess Verbal Comprehension Index (VCI), Visual Spatial Index (VSI), Fluid Reasoning Index (FRI), Working Memory Index (WMI), and Processing Speed Index (PSI). VCI examines similarities (how two words are similar) and vocabulary (definition of a word). VSI measures visual spatial processing in a timed trial (Block Design) where children put together red and white blocks in a pattern according to a model. FRI measures inductive and quantitative reasoning via Matrix Reasoning (children must choose one missing square from a five-option array) and Figure Weights (a stimulus book pictures shapes on a scale and a selection must be made to keep the scale balanced). WMI measures working memory ability through a Digit Span process where a sequence of numbers must be repeated in reverse. PSI measures processing speed through Coding, where children under 8

years of age mark rows of shapes with different lines according to a code and children over 8 years of age transcribe a digit-symbol code using a key. WISC-V has also been used in a digital format, with the same reliability and validity as the pencil-to-paper version (Coceski *et al.*, 2021). However, if participants are older than 16 years, the Weschler Adult Intelligent Scale is recommended for intellectual assessment (Bertoncelli *et al.*, 2019).

Other tests that can be used to assess language particularly in cerebral palsy patients are the Communication Function Classification System (CFCS) and Functional Communication Classification System (FCCS) test (Pennington *et al.*, 2020). CFCS categorises each child's communication performance both as sender and receiver of messages (Hidecker et al., 2011). It has five levels: on the first level the child effectively sends and receives familiar and unfamiliar patterns; on the second level communication is effective but slower paced; on the third level there is effective communication with only familiar patterns; on the fourth level communication is inconsistent both as sender and receiver with familiar patterns and on the fifth level communication is seldom effective even with familiar patterns (Pennington *et al.*, 2020). FCCS rates a child's observable communication performance (Barty et al., 2016). FCCS also categorises performance in five levels; on the first level communication is effective on most occasions; on the second level communication is effective in most situations but help may be needed; on the third level communication is effective is some situations; on the fourth level assistance is required in most situations and on the fifth level communication is achieved only by using movements (Pennington *et al.*, 2020).

Neuroimaging constitutes a more sophisticated assessment method. MRI neuroimaging assessment has been reported to have a 92,27% accuracy in cerebral palsy diagnosis (Morgan *et al.*, 2019). (Gullion *et al.*, 2019) reported that an MRI scan can detect periventricular leukomalacia, with high position accuracy (right parietal white matter), offering diagnosis at a very early age (9 months old). MRI has also the potential to assess executive functions, by identifying focal lesions and particularly frontal lesions associated with lower attention control and cognitive flexibility (Crichton *et al.*, 2020). Furthermore, white matter lesions, the major cause of cerebral palsy, can be detected by MRI (King *et al.*, 2021). The MRI Classification System assesses pathogenic findings in MRI scans and assists in diagnosis (Påhlman et al., 2022). Such results led (Hu *et al.*, 2022) to report that diagnosis of cerebral palsy main relies on neuroimaging methods.

Rehabilitation has a broad range of interventions. (Aran *et al.*, 2020) mentioned virtual reality (VR) as an effective way to ameliorate a significant amount of deficits, presenting promising improvement in cognitive function, such as orientation, spatial perception, visuomotor construction and thinking operations after 10 weeks. Visuo-spatial perception impairments were also improved since early VR provides visual feedback which in turn improves perception skills. Furthermore, VR sought to improve visuomotor abilities through drawing, copying shapes and other construction tasks. Finally, VR also improved executive functions because of the requirements of the games (attention control, cognitive flexibility, goal setting and information processing), which challenged children's executive functions.

Another neuropsychological non-invasive rehabilitation intervention based on neurotransmission cognitive theory, proposes that using safe vibration frequency waves it is possible to achieve both cognitive and physical rehabilitation. This approach applies vibration frequency waves on any nerve point of the body, leading to rerouting of information and adjustment of malcognitive maps (Khan *et al.*, 2020).

Furthermore, neuromodulation techniques are also highly promising. In this aspect, (Ko *et al.*, 2021) used tDCS intervention by applying anode electrodes on the most affected side (right or left) of the dorsolateral prefrontal cortex and the cathode electrode was placed over the contralateral supraorbital region. Their study revealed that tDCS is feasible and associated with improvement in cognitive function, language, and cognitive impairments. (Chen et al., 2022) presented similar results, using a TMS-CACT treatment, with children showing cognitive improvement after 12 weeks. Non-invasive brain stimulation is widely used to modulate neuronal plasticity (Flöel, 2014). These neurostimulation techniques are suited for enhancing neuroplasticity in cerebral palsy patients. tDCS-induced plasticity is dependent on the subject's state during stimulation (Ko *et al.*, 2021), and high-frequency TMS can improve cerebral perfusion and local cerebral blood flow (Chen et al., 2022). Finally, (Lima *et al.*, 2022) applied anodal tDCS over the Broca's area and left dorsolateral prefrontal cortex, with great speech rehabilitation outcomes.

4. Conclusions

The aim of the present study was to unfold the latest neuropsychological approaches in assessment and rehabilitation of cerebral palsy known to have a wide spectrum of cognitive disabilities, significantly affecting the quality of life of afflicted individuals.

Neuropsychological assessment promises accurate diagnosis with a broad range of options, specifically for cerebral palsy patients, depending on which issue needs to be addressed. The different neuropsychological assessments can be used individually or in combination to assess multiple aspects of the associated impairments. Specifically neuroimaging methods can be used in combination with tests, to achieve a holistic assessment with respect to the mental state and the anatomy of the patient.

After assessment has taken place, rehabilitation interventions are implemented to ameliorate the diagnosed deficits. Again, there are various rehabilitation options offering precise, beneficial outcome in a non-invasive manner. Rehabilitation based on neurotransmission cognitive theory, can offer both cognitive and physical rehabilitation, without adverse events, and it should be considered as one the best options. Neurostimulation-induced neuroplasticity is also a thorough, feasible, option without adverse events. To address the multiple deficits of cerebral palsy, a multidisciplinary approach is required. Therefore, clinicians from different disciplines should take advantage of precise neuropsychological methods in assessment and rehabilitation to improve the quality of life of patients.

References

Aisen, M.L. *et al.* (2011) 'Cerebral palsy: Clinical care and neurological rehabilitation', *The Lancet Neurology*, 10(9), pp. 844–852. Available at: https://doi.org/10.1016/S1474-4422(11)70176-4.

Al-Mosawi, A. (2021) 'The Early Treatment of A Boy From Virginia With Ataxic Cerebral Palsy'. *Journal of Paediatrics and Child Health Issues*, 2(4), pp 1-5. Available at: https://doi.org/10.5281/ZENODO.4777413.

Aran, O.T. *et al.* (2020) 'Effectiveness of the virtual reality on cognitive function of children with hemiplegic cerebral palsy: A single-blind randomized controlled trial', *International Journal of Rehabilitation Research*, 43(1), pp. 12–19. Available at: https://doi.org/10.1097/MRR.0000000000000378.

Ballester-Plané, J. *et al.* (2018) 'Cognitive functioning in dyskinetic cerebral palsy: Its relation to motor function, communication and epilepsy', *European Journal of Paediatric Neurology*, 22(1), pp. 102–112. Available at: https://doi.org/10.1016/j.ejpn.2017.10.006.

Barty, E., Caynes, K. and Johnston, L.M. (2016) 'Development and reliability of the Functional Communication Classification System for children with cerebral palsy', *Developmental Medicine & Child Neurology*, 58(10), pp. 1036–1041. Available at: https://doi.org/10.1111/DMCN.13124.

Bertoncelli, C.M. *et al.* (2019) 'Identifying Factors Associated With Severe Intellectual Disabilities in Teenagers With Cerebral Palsy Using a Predictive Learning Model', *Journal of Child Neurology,* 34(4*)*, 34(4), pp. 221–229. Available at: https://doi.org/10.1177/0883073818822358.

Cans, C. *et al.* (2002) 'Prevalence and characteristics of children with cerebral palsy in Europe', *Developmental Medicine and Child Neurology*, 44(9), pp. 633–640. Available at: https://doi.org/10.1017/S0012162201002675.

Chen, J., Yu, X. and Luo, G. (2022) 'Effects of Transcranial Magnetic Stimulation Combined with Computer-Aided Cognitive Training on Cognitive Function of Children with Cerebral Palsy and Dysgnosia', *Computational and Mathematical Methods in Medicine*, 2022. Available at: https://doi.org/10.1155/2022/5316992.

Coceski, M. *et al.* (2021) 'Assessing IQ in adolescents with mild to moderate cerebral palsy using the WISC-V', *The Clinical Neuropsychologist,* 36(7), pp. 1-20*.* [Preprint]. Available at: https://doi.org/10.1080/13854046.2021.1928290.

Colver, A. (2012) 'Outcomes for people with cerebral palsy: Life expectancy and quality of life', *Paediatrics and Child Health (United Kingdom)*, 22(9), pp. 384–387. Available at: https://doi.org/10.1016/j.paed.2012.03.003.

Crichton, A. *et al.* (2020) 'Brain magnetic resonance imaging is a predictor of bimanual performance and executive function in children with unilateral cerebral palsy', *Developmental Medicine and Child Neurology*, 62(5), pp. 615–624. Available at: https://doi.org/10.1111/DMCN.14462/ABSTRACT.

Flöel, A. (2014) 'tDCS-enhanced motor and cognitive function in neurological diseases', *NeuroImage*, 85, pp. 934–947. Available at: https://doi.org/10.1016/J.NEUROIMAGE.2013.05.098.

Fluss, J. and Lidzba, K. (2020) 'Cognitive and academic profiles in children with cerebral palsy: A narrative review', *Annals of Physical and Rehabilitation Medicine*, 63(5), pp. 447–456. Available at: https://doi.org/10.1016/J.REHAB.2020.01.005.

Gullion, L. *et al.* (2019) 'The Impact of Early Neuroimaging and Developmental Assessment in a Preterm Infant Diagnosed with Cerebral Palsy', *Case Reports in Pediatrics*, 2019, pp. 1–7. Available at: https://doi.org/10.1155/2019/9612507.

Hu, Y. *et al.* (2022) 'Genome-wide analysis of circular RNAs and validation of hsa_circ_0086354 as a promising biomarker for early diagnosis of cerebral palsy', *BMC Medical Genomics*, 15(1), pp. 1–9. Available at: https://doi.org/10.1186/S12920-022-01163-6/FIGURES/3.

Hutton, J.L., Cooke, T. and Pharoah, P.O.D. (1994) 'Life expectancy in children with cerebral palsy', *BMJ*, 309(6952), pp. 431–435. Available at: https://doi.org/10.1136/BMJ.309.6952.431.

Khan, A.A. *et al.* (2020) 'Neurotransmission cognitive theory: A novel approach for non-invasive brain stimulation using mechanical vibrations for the rehabilitation of neurological patients', *Medical Hypotheses*, 143. Available at: https://doi.org/10.1016/J.MEHY.2020.110078.

King, A.R. *et al.* (2021) 'Early detection of cerebral palsy in high-risk infants: Translation of evidence into practice in an Australian hospital', *Journal of Paediatrics and Child Health*, 57(2), pp. 246–250. Available at: https://doi.org/10.1111/JPC.15191.

Ko, E.J. *et al.* (2021) 'Effect of Anodal Transcranial Direct Current Stimulation Combined With Cognitive Training for Improving Cognition and Language Among Children With Cerebral Palsy With Cognitive Impairment: A Pilot, Randomized, Controlled, Double-Blind, and Clinical Trial', *Frontiers in Pediatrics*, 9, p. 893. Available at: https://doi.org/10.3389/FPED.2021.713792/BIBTEX.

di Lieto, M.C. *et al.* (2017) 'Spastic diplegia in preterm-born children: Executive function impairment and neuroanatomical correlates', *Research in Developmental Disabilities*, 61, pp. 116–126. Available at: https://doi.org/10.1016/J.RIDD.2016.12.006.

Lima, V.L.C.C. *et al.* (2022) 'Neuromodulation: A combined-therapy protocol for speech rehabilitation in a child with cerebral palsy', *Journal of Bodywork and Movement Therapies*, 29, pp. 10–15. Available at: https://doi.org/10.1016/J.JBMT.2021.09.002.

Mak, C. *et al.* (2020) 'Six-month follow-up of a mindfulness yoga program, MiYoga, on attention, executive function, behaviour and physical outcomes in cerebral palsy', *Disability and Rehabilitation*, 44(6), pp. 966–972. Available at: https://doi.org/10.1080/09638288.2020.1783582.

Morgan, C. *et al.* (2019) 'The Pooled Diagnostic Accuracy of Neuroimaging, General Movements, and Neurological Examination for Diagnosing Cerebral Palsy Early in High-Risk Infants: A Case Control Study', *Journal of Clinical Medicine 2019,* 8(11), p. 1879. Available at: https://doi.org/10.3390/JCM8111879.

Novak, I. *et al.* (2017) 'Early, Accurate Diagnosis and Early Intervention in Cerebral Palsy: Advances in Diagnosis and Treatment', *JAMA Pediatrics*, 171(9), pp. 897–907. Available at: https://doi.org/10.1001/JAMAPEDIATRICS.2017.1689.

Oskoui, M. *et al.* (2013) 'An update on the prevalence of cerebral palsy: a systematic review and meta-analysis', *Developmental Medicine & Child Neurology*, 55(6), pp. 509–519. Available at: https://doi.org/10.1111/DMCN.12080.

PÅhlman, M., Gillberg, C. and Himmelmann, K. (2022) 'Neuroimaging findings in children with cerebral palsy with autism and/or attention-deficit/hyperactivity disorder: a population-based study', *Developmental Medicine & Child Neurology*, 64(1), pp. 63–69. Available at: https://doi.org/10.1111/DMCN.15011.

Pennington, L. *et al.* (2020) 'Communication disorders in young children with cerebral palsy', *Developmental Medicine and Child Neurology*, 62(10), pp. 1161–1169. Available at: https://doi.org/10.1111/DMCN.14635/ABSTRACT.

Pereira, A. *et al.* (2019) 'Promoting School Engagement in Children with Cerebral Palsy: A Narrative Based Program', *International Journal of Environmental Research and Public Health 2019,* 16(19), p. 3634. Available at: https://doi.org/10.3390/IJERPH16193634.

Pons, C. *et al.* (2016) 'Medication, rehabilitation and health care consumption in adults with cerebral palsy: a population based study', *Medical Rehabilitation*, 31(7), pp. 957–965. Available at: https://doi.org/10.1177/0269215516663286.

Rosenbaum, P. *et al.* (2007) 'A report: the definition and classification of cerebral palsy April 2006', *Developmental Medicine & Child Neurology*, 49, pp. 8–14. Available at: https://doi.org/10.1111/J.1469-8749.2007.TB12610.X.

Souto, D.O. *et al.* (2020) 'Motor imagery in children with unilateral cerebral palsy: a case–control study', *Developmental Medicine & Child Neurology*, 62(12), pp. 1396–1405. Available at: https://doi.org/10.1111/DMCN.14672.

Stadskleiv, K. *et al.* (2017) 'Neuropsychological profiles of children with cerebral palsy', *Developmental Neurorehabilitation*, 21(2), pp. 108–120. Available at: https://doi.org/10.1080/17518423.2017.1282054.

Breast Cancer and Quality of Life: A multidisciplinary approach

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Abstract

Despite the progress in modern medicine, breast cancer still causes millions of death worldwide. Classical chemotherapy is associated with severe side effects, while cancer patients suffer also from cancer disease relapse. To this end, CAR-T or Natural killers (NK)-based immunotherapy is an innovative therapy that would hopefully give impressive therapeutic results in breast cancer patients, as already does in leukemias and lymphomas. A holistic approach is thus introduced nowadays to support patient at multiple levels. In particular, manual lymph drainage is a physiotherapeutic technique that may serve both as palliative and preventive therapy of lymphedema, a side effect which 30% of breast cancer face. Occupational Therapy plays a vital role in the embracement of activities of daily life (ADL) for breast cancer patients, since it is effective in improving fatigue, depression and general independence leading to increased quality of life (QoL). In combination to occupational therapy, physical activity decreases fatigue, chemotherapy-induced peripheral neuropathy, cognitive impairment, arthralgia, lymphedema, recurrence, and mortality, and improve QoL. Cancer diagnosis and cancer-related treatments can result in both negative physical and psychological long-term side effects and may lead to deterioration of patients' QoL. Among psychological interventions, cognitive behavioural therapy (CBT) is a psychosocial intervention with promising results for improving QoL in breast cancer patients. Furthermore, nutritional support tailored to the needs of breast cancer patients is also an important parameter to be included.

Keywords: Breast cancer, CAR-NK Cognitive Behavioural Therapy, Activities of Daily Living, manual lymph drainage

1. Introduction

Neoplasia is the second leading cause of mortality and one of the most important causes of morbidity worldwide. Breast cancer the most common type of cancer, causes millions of deaths (Fahad Ullah, 2019). It is estimated that in 2020, there were 2.3 million women diagnosed with breast cancer and 685.000 deaths globally. According to WHO, 2.520 deaths were caused by breast cancer in Greece in 2020. However, when it is diagnosed at an early stage, prognosis is quite satisfactory, with survival rates of at least 5 years' expectancy. On the other hand, the five-year survival rate among women with Stage IV breast cancer is only 22% (Alvarado et al., 2012). As populations throughout the world are growing and aging, the number of new breast cancer diagnoses is rising. The number of new cases has increased significantly over the past decades, and it is expected to further rise in the coming ones (Arends et al., 2017, Bossi et al., 2021).

2. The therapy of breast cancer moves from classic chemotherapy to modern CAR-T immunotherapy: New avenues open in improving patients' life

Molecular signatures of breast cancer cells, such as the estrogen, progesterone and HER2 receptors' status, are exploited in modern therapeutic approaches (Nounou et al., 2015). As a first line treatment, surgery and radiation are applied to remove the largest part of tumour. The great challenge in these treatments is the persistence of cancer cells in the body, while the metastatic cells cannot be easily removed or irradiated. The classical chemotherapy (alkylating agents, antimetabolites, antibiotics, vinca alkaloids, taxanes, etc.) is associated with severe adverse-side effects, as myelosuppression, alopecia, nausea, neuropathy, etc.

Targeted therapy of breast cancer is the best scenario that modern medicine offers. Hormone-depletion therapy targets around 75% of the cases, as being responsive to estrogens and progesterone. An example of a drug belonging to this category is tamoxiphen that is given prophylactically after the surgery, to prevent tumour relapse. Main complications of this type of therapy are the severe abnormalities in menstrual cycle and osteoporosis.

Immunotherapy offers a promising alternative to conventional interventions as it benefits from the specificity of monoclonal antibodies (mAbs) that bind to tumour-specific antigens. mAbs (like Trastuzumab) have been used for the past 15 years, showing marked therapeutic results. The main disadvantage with immunotherapy is that there is still the need for chemotherapeutics, while cancer cells often become resistant to treatment.

Immunotherapy based on immune cells is the ultimate goal in the treatment of cancer. Chimeric antigen receptor (CAR)-T immunotherapy, a brand-new therapy, is based on educating patient's own T-lymphocytes to target and kill cancer cells (Brudno and Kochenderfer, 2019). CAR consists of the single chain fragment variant (scFv) of a specific antibody targeting tumour-specific antigens, irrespective of the presentation via the major histocompatibility complex. In this way, the ''armed'' T-cells are guided to recognize, become activated and destroy cancer cells (Ma et al., 2019).

The first CAR-T product (Kymriah) yields almost complete recovery rates for leukemia and lymphomas. The cost for therapy with Kymriah was 475.000 $, when approved in 2017. However, the efficacy of CAR-T cells in solid tumours such as breast cancer, has been limited. This is most likely due to the immunosuppressive tumour environment, and the low infiltration of immune cells in the tumour.

Although clinical trials in breast cancer employing CAR-T cells are ongoing, we need to rethink the selection of the immune cells. In particular, T-cells are associated with specific disadvantages, as the off-tumour effects, and the cytokine release syndrome (Toulouie et al., 2021). Natural killer (NK) cells constitute an attractive alternative with multiple benefits including the ease of isolation from patients without leukopheresis. Recent studies have shown that CAR-NK-92 cells, engineered via a novel approach for transduction of the *in vitro* transcribed-mRNAs for CAR, provoked significant cytotoxicity against MCF-7 (breast metastatic adenocarcinoma) human cells, in co-incubation assays (Georgiou-Siafis et al., 2022). In the future, CAR- immunotherapies are anticipated to be introduced in clinical practice.

3. The double role of Manual Lymph Drainage as evasive and palliative therapy for breast cancer patients

One out of three breast cancer patients develop secondary lymphedema, either immediately after surgery or at any following stage of their lives. Complete decongestive therapy is the leading means of treatment for lymphedema patients, either as preventive, evasive or palliative therapy.

Complete decongestive therapy (CDT) includes Manual lymph drainage (MLD), compression and compressive garments as a long term means of preservation.

MLD is a kind of gentle massage technique, applied for the treatment of the lymphatic system in order to reduce edema by increasing lymphangion mobility and lymph flow. It was originally introduced by Dr Emil Vodder in the early 1930 and has been used widely in the treatment of lymphedema all over the world (Pritschow, 2014).

Research suggests that when secondary lymphedema after breast cancer surgery is treated with compression therapy swelling goes down about 30% to 37%. When MLD was added to the intensive course of compression bandaging, the swelling went down another 7.11% (Ezzo et al., 2015). However, there are also cases, especially among last stage cancer patients where MLD serves as a means of palliative therapy (Todd, 2009). Although there are studies suggesting that effectiveness of MLD is not established due to study limitations in design and sample size (Beck et al., 2012), the general idea is that any means that can serve as a comfort for pain and dysphoria if widely used.

4. The role of occupational therapy in patients with breast cancer

Occupational therapists work with cancer patients helping them to perform their daily activities at work, home, or school. The primary role of the occupational therapist is to address obstacles in engagement and participation in self-care, productivity, and leisure (Hwang et al., 2020).

According to a recent paper, specific cancer-related impairments such as falls, cancer-related fatigue, upper extremity impairments, cognitive function impairments are in the focus of occupational therapy (OT) interventions (Pergolotti et al., 2016). Referrals to occupational therapy services occur most often for patients with breast cancer (Wallis et al., 2020). Breast cancer may significantly impair a woman's ability to participate in daily activities, including housework, return to work, and adequate performance to the main social roles (Petruseviciene et al., 2018).

The purpose of this article is to highlight the valuable role of the occupational therapy approach in the rehabilitation of patients diagnosed with breast cancer.

Based on existing bibliography, occupation-based problem-solving strategies (OB-PSS), engagement in meaningful activities via OT programs in the community, activities to promote return to work (RTW), have found to be effective in improving fatigue, depression and general independence leading to increased QoL (Petruseviciene et al., 2018, Şahin and Uyanık, 2019, Andrea Marcella Désiron, 2010). In addition, remote OT services via telemedicine in a breast cancer recovery program is feasible, effective, and acceptable to patients (Lai et al., 2021b).

OTs should consider on the intervention components and how they can be integrated into their own OT practice. Research is emerging in breast cancer treatment, but additional high quality and occupation-based studies are needed.

5. Exercise and Survival for Women with Breast Cancer

Research has indicated that demographic factors such as older age at diagnosis and marital status can predict longer survival times for breast cancer patients, in addition to medical factors like hormone receptor status and disease-free interval. Further studies are needed to identify non-medical, modifiable factors that can slow the progression of the disease and improve survival outcomes for advanced breast cancer patients (Holick et al., 2008).

Physical activity has been identified as a potential modifiable factor that can protect against breast cancer. Studies have shown that both pre- and post-diagnosis physical activity is associated with improved survival outcomes, with the greatest survival benefit observed for physical activity undertaken after a breast cancer diagnosis (Palesh et al., 2018).

Exercise interventions for breast cancer are an active area of research. Examining exercise therapies within the context of rehabilitation and aftercare is crucial. The aim of this article is to emphasise the benefits of physical activity or exercise therapy on reducing mortality, decreasing side effects of illnesses, and improving the overall treatment of the condition throughout rehabilitation.

Physical activity is an effective, safe and useful tool for achieving various goals in rehabilitation and aftercare. Studies have shown that physical activity can decrease fatigue, chemotherapy-induced peripheral neuropathy, cognitive impairment, arthralgia, lymphedema, recurrence, and mortality, and improve quality of life (Wirtz and Baumann, 2018). Encouraging breast cancer patients to participate in exercise interventions can not only improve their physical health, but also reduce fatigue, depression, and anxiety.

6. Psychological Interventions for Fostering Quality of Life in Breast Cancer Patients

Both cancer diagnosis and different types of treatments can have negative physical and psychological consequences and impact patients' life. Some of the most widely reported physical side effects from women under medical treatment for breast cancer are often pain, fatigue, nausea, vomiting, hot flashes, and sleeping disorders (Lavdaniti et al., 2019) (Schmidt et al., 2018). As far as psychological outcomes are concerned, some of the most common mental health issues which women with breast cancer deal with are anxiety and mood disorders, adjustment disorder, somatoform disorder, nicotine or alcohol abuse/dependence, eating disorders and mental disorders derived from medical conditions (Abrahams et al., 2018).

It is clear that breast cancer is a disease that significantly affects patients' and survivors' QoL. The nature of the disease or the negative side-effects of the medical treatment have a great impact on QoL of breast cancer patients. Breast cancer is a disease that can affect various and different aspects of patient's life such as physical and emotional state, occupation, social life, body image and sexuality, cognitive functioning, vitality levels and pain (Firkins et al., 2020). Thus, an abundance of research in the field of psycho-oncology has been devoted to developing and evaluating psychological interventions for improving cancer patients' and survivors' QoL, well-being, and disease management.

In research and clinical practice different types and protocols of psychological interventions have been studied and applied to enhance QoL. Among them, cognitive behavioral therapy (CBT) seems to be the most widely used evidence-based practice for improving mental health

(Getu et al., 2021). The basic principles of CBT are based on a combination of behavioral and cognitive psychology theories. In recent years, CBT has become the most popular and effective model of psychotherapy applied in clinical practice (Sun et al., 2019).

Clinical research findings support the efficacy of CBT with vast variety of populations and diseases. CBT can have a positive impact on improving mental health in breast cancer patients. A large number of studies conducted in order to investigate the effect of CBT on the psychological, physical, and QoL of breast cancer patients. The effectiveness of CBT has been proved in a large number of physical and mental health issues such anxiety and depression (Getu et al., 2021, Jelvehzadeh et al., 2022), insomnia (Lai et al., 2021a), fatigue (Getu et al., 2021), QoL (Getu et al., 2021, Jelvehzadeh et al., 2022) (Lai et al., 2021a), and general wellbeing (Lai et al., 2021a, Ardizzone et al., 2022). The impact of a large number of studies conducted on the effects of CBT interventions is not well known because studies have not been combined into a systematic review (Holtdirk et al., 2021). As a result, there is a need to review the applications of CBT interventions and their effectiveness to various aspects of disease, symptoms management and promotion of well-being and quality of life in breast cancer patients.

7. The Importance of Nutrition Care for Oncology Patients

Nutritional vulnerability and under-nutrition are very common in cancer patients; and can be caused by several factors including the surgical management of cancer, the side effects of anti-neoplastic drugs, the presence of a tumour that induces hypermetabolism and the tumour site (Islami et al., 2021). Importantly, malnutrition is a predictor of poor prognosis, independently of disease stage (Bossi et al., 2021). Older patients, patients at advanced disease stage and patients with gastrointestinal tract, head, neck, liver, and lung cancer are at higher risk of malnutrition (Arends et al., 2017).

The aim of the current article is to summarise the peer-reviewed evidence and the recommendations regarding the multi-disciplinary diagnosis, prevention, and management of malnutrition in cancer patients.

The detection of malnutrition, cachexia and sarcopenia at an early stage is of key importance and for this purpose regular assessment of dietary intake, unintentional changes of body weight, and assessment of body mass index are recommended (Muscaritoli et al., 2021). A baseline assessment should be carried out at cancer diagnosis and repeated upon significant changes of the clinical situation (Muscaritoli et al., 2021). When malnutrition, cachexia or sarcopenia are identified, nutritional treatment is deemed necessary (Pilleron et al., 2022). The accurate calculation of energy requirements and total energy expenditure through indirect calorimetry is important for this purpose. In the absence of such direct measurements a caloric target of 25-30 kcal per kg of body weight, per day with a protein intake target of 1.2-1.5 g per kg of body weight, per day can be used to support restore or maintenance of lean body mass (Arends et al., 2017). It is notable that in severely malnourished patients feeding support should be initiated slowly to reduce the risk of refeeding syndrome (Stanga et al., 2008).

Cancer nutritional care includes the following strategies: nutrition counselling, food fortification, oral nutrition support with enteral feeds high in energy and protein and palliative nutrition to alleviate nutrition or drug-induced symptoms (Arends et al., 2017). Successful nutritional interventions are composed of individualised plans that aim to increase

functionality and physical activity, increase dietary intake, and decrease hypermetabolic stress (Arends et al., 2017).

Lastly, in patients with advanced or terminal cancer the implementation of dietary interventions should be considered against the potential burden associated with them. In palliative situations the provision of nutrition support should be based on comfort, as there is very limited benefit from it during the last weeks of life (Koretz, 2007).

8. Discussion

To conclude, there is the unequivocal need for a multidisciplinary scientific approach to improve patients' life. Modern therapy proposes to prepare the patient on multiple levels, physically, mentally, before and after the treatment process, introducing thus the rehabilitation process. The recovery package is a set of interventions that the medical team uses to help improve the patient's experience of living. At the same time modern medicine targets to hopefully treat breast cancer in the near future, via introducing novel therapeutic approaches.

References

Abrahams, H. J. G., Gielissen, M. F. M., Verhagen, C. & Knoop, H. 2018. The relationship of fatigue in breast cancer survivors with quality of life and factors to address in psychological interventions: A systematic review. *Clin Psychol Rev,* 63**,** 1-11.

Alvarado, R., Lari, S. A., Roses, R. E., Smith, B. D., Yang, W., Mittendorf, E. A., Arun, B. K., Lucci, A., Babiera, G. V., Wagner, J. L., Caudle, A. S., Meric-Bernstam, F., Hwang, R. F., Bedrosian, I., Hunt, K. K. & Kuerer, H. M. 2012. Biology, treatment, and outcome in very young and older women with DCIS. *Ann Surg Oncol,* 19**,** 3777-84.

Andrea Marcella Désiron, H. 2010. Occupational therapy and return to work for breast cancer survivors. *World Federation of Occupational Therapists Bulletin,* 61**,** 45-51.

Ardizzone, A., Bavetta, D., Garo, M. L., Santangelo, D., Bongiorno, A. & Bono, M. 2022. Impact of the Cognitive-Behavioral Approach and Psychoeducational Intervention in Breast Cancer Management: A Prospective Randomized Clinical Trial. *Healthcare (Basel),* 10.

Arends, J., Baracos, V., Bertz, H., Bozzetti, F., Calder, P. C., Deutz, N. E. P., Erickson, N., Laviano, A., Lisanti, M. P., Lobo, D. N., Mcmillan, D. C., Muscaritoli, M., Ockenga, J., Pirlich, M., Strasser, F., De Van Der Schueren, M., Van Gossum, A., Vaupel, P. & Weimann, A. 2017. ESPEN expert group recommendations for action against cancer-related malnutrition. *Clin Nutr,* 36**,** 1187-1196.

Beck, M., Wanchai, A., Stewart, B. R., Cormier, J. N. & Armer, J. M. 2012. Palliative care for cancer-related lymphedema: a systematic review. *J Palliat Med,* 15**,** 821-7.

Bossi, P., Delrio, P., Mascheroni, A. & Zanetti, M. 2021. The Spectrum of Malnutrition/Cachexia/Sarcopenia in Oncology According to Different Cancer Types and Settings: A Narrative Review. *Nutrients,* 13.

Brudno, J. N. & Kochenderfer, J. N. 2019. Recent advances in CAR T-cell toxicity: Mechanisms, manifestations and management. *Blood Rev,* 34**,** 45-55.

Ezzo, J., Manheimer, E., Mcneely, M. L., Howell, D. M., Weiss, R., Johansson, K. I., Bao, T., Bily, L., Tuppo, C. M., Williams, A. F. & Karadibak, D. 2015. Manual lymphatic drainage for lymphedema following breast cancer treatment. *Cochrane Database Syst Rev***,** Cd003475.

Fahad Ullah, M. 2019. Breast Cancer: Current Perspectives on the Disease Status. *Adv Exp Med Biol,* 1152**,** 51-64.

Firkins, J., Hansen, L., Driessnack, M. & Dieckmann, N. 2020. Quality of life in "chronic" cancer survivors: a meta-analysis. *Journal of Cancer Survivorship,* 14.

Georgiou-Siafis, S. K., Miliotou, A. N., Ntenti, C., Pappas, I. S. & Papadopoulou, L. C. 2022. An Innovative PTD-IVT-mRNA Delivery Platform for CAR Immunotherapy of ErbB(+) Solid Tumor Neoplastic Cells. *Biomedicines,* 10**,** 2885.

Getu, M. A., Chen, C., Panpan, W., Mboineki, J. F., Dhakal, K. & Du, R. 2021. The effect of cognitive behavioral therapy on the quality of life of breast cancer patients: a systematic review and meta-analysis of randomized controlled trials. *Qual Life Res,* 30, 367-384.

Holick, C. N., Newcomb, P. A., Trentham-Dietz, A., Titus-Ernstoff, L., Bersch, A. J., Stampfer, M. J., Baron, J. A., Egan, K. M. & Willett, W. C. 2008. Physical activity and survival after diagnosis of invasive breast cancer. *Cancer Epidemiol Biomarkers Prev,* 17**,** 379-86.

Holtdirk, F., Mehnert, A., Weiss, M., Mayer, J., Meyer, B., Bröde, P., Claus, M. & Watzl, C. 2021. Results of the Optimune trial: A randomized controlled trial evaluating a novel Internet intervention for breast cancer survivors. *PLoS One,* 16, e0251276.

Hwang, N. K., Jung, Y. J. & Park, J. S. 2020. Information and Communications Technology-Based Telehealth Approach for Occupational Therapy Interventions for Cancer Survivors: A Systematic Review. *Healthcare (Basel),* 8.

Islami, F., Ward, E. M., Sung, H., Cronin, K. A., Tangka, F. K. L., Sherman, R. L., Zhao, J., Anderson, R. N., Henley, S. J., Yabroff, K. R., Jemal, A. & Benard, V. B. 2021. Annual Report to the Nation on the Status of Cancer, Part 1: National Cancer Statistics. *J Natl Cancer Inst,* 113**,** 1648-1669.

Jelvehzadeh, F., Dogaheh, E. R., Bernstein, C., Shakiba, S. & Ranjbar, H. 2022. The effect of a group cognitive behavioral therapy on the quality of life and emotional disturbance of women with breast cancer. *Support Care Cancer,* 30**,** 305-312.

Koretz, R. L. 2007. Do data support nutrition support? Part II. enteral artificial nutrition. *J Am Diet Assoc,* 107**,** 1374-80.

Lai, H. L., Chen, C. I., Lu, C. Y. & Huang, C. Y. 2021a. Cognitive Behavioral Therapy plus Coping Management for Depression and Anxiety on Improving Sleep Quality and Health for Patients with Breast Cancer. *Brain Sci,* 11.

Lai, L. L., Player, H., Hite, S., Satyananda, V., Stacey, J., Sun, V., Jones, V. & Hayter, J. 2021b. Feasibility of Remote Occupational Therapy Services via Telemedicine in a Breast Cancer Recovery Program. *Am J Occup Ther,* 75**,** 7502205030p1-7502205030p9.

Lavdaniti, M., Owens, D. A., Liamopoulou, P., Marmara, K., Zioga, E., Mantzanas, M. S., Evangelidou, E. & Vlachou, E. 2019. Factors Influencing Quality of Life in Breast Cancer Patients Six Months after the Completion of Chemotherapy. *Diseases,* 7.

Ma, S., Li, X., Wang, X., Cheng, L., Li, Z., Zhang, C., Ye, Z. & Qian, Q. 2019. Current Progress in CAR-T Cell Therapy for Solid Tumors. *Int J Biol Sci,* 15**,** 2548-2560.

Muscaritoli, M., Arends, J., Bachmann, P., Baracos, V., Barthelemy, N., Bertz, H., Bozzetti, F., Hütterer, E., Isenring, E., Kaasa, S., Krznaric, Z., Laird, B., Larsson, M., Laviano, A., Mühlebach, S., Oldervoll, L., Ravasco, P., Solheim, T. S., Strasser, F., De Van Der Schueren, M., Preiser, J. C. & Bischoff, S. C. 2021. ESPEN practical guideline: Clinical Nutrition in cancer. *Clin Nutr,* 40**,** 2898-2913.

Nounou, M. I., Elamrawy, F., Ahmed, N., Abdelraouf, K., Goda, S. & Syed-Sha-Qhattal, H. 2015. Breast Cancer: Conventional Diagnosis and Treatment Modalities and Recent Patents and Technologies. *Breast Cancer (Auckl),* 9**,** 17-34.

Palesh, O., Kamen, C., Sharp, S., Golden, A., Neri, E., Spiegel, D. & Koopman, C. 2018. Physical Activity and Survival in Women With Advanced Breast Cancer. *Cancer Nurs,* 41**,** E31-e38.

Pergolotti, M., Williams, G. R., Campbell, C., Munoz, L. A. & Muss, H. B. 2016. Occupational Therapy for Adults With Cancer: Why It Matters. *Oncologist,* 21**,** 314-9.

Petruseviciene, D., Surmaitiene, D., Baltaduoniene, D. & Lendraitiene, E. 2018. Effect of Community-Based Occupational Therapy on Health-Related Quality of Life and Engagement in Meaningful Activities of Women with Breast Cancer. *Occup Ther Int,* 2018**,** 6798697.

Pilleron, S., Alqurini, N., Ferlay, J., Haase, K. R., Hannan, M., Janssen-Heijnen, M., Kantilal, K., Katanoda, K., Kenis, C., Lu-Yao, G., Matsuda, T., Navarrete, E., Nikita, N., Puts, M., Strohschein, F. J. & Morris, E. J. A. 2022. International trends in cancer incidence in middle-aged and older adults in 44 countries. *J Geriatr Oncol,* 13**,** 346-355.

Pritschow, H. S., C. 2014. *Λεμφοίδημα. Διαχείριση και Ολοκληρωμένη Φυσική Αποσυμφορητική Θεραπεία,* Μοσχάτο.

Şahin, S. & Uyanık, M. 2019. The impact of occupation-based problem-solving strategies training in women with breast cancer. *Health Qual Life Outcomes,* 17**,** 104.

Schmidt, M. E., Wiskemann, J. & Steindorf, K. 2018. Quality of life, problems, and needs of disease-free breast cancer survivors 5 years after diagnosis. *Qual Life Res,* 27**,** 2077-2086.

Stanga, Z., Brunner, A., Leuenberger, M., Grimble, R. F., Shenkin, A., Allison, S. P. & Lobo, D. N. 2008. Nutrition in clinical practice-the refeeding syndrome: illustrative cases and guidelines for prevention and treatment. *Eur J Clin Nutr,* 62**,** 687-94.

Sun, H., Huang, H., Ji, S., Chen, X., Xu, Y., Zhu, F. & Wu, J. 2019. The Efficacy of Cognitive Behavioral Therapy to Treat Depression and Anxiety and Improve Quality of Life Among Early-Stage Breast Cancer Patients. *Integr Cancer Ther,* 18**,** 1534735419829573.

Todd, M. 2009. Managing lymphoedema in palliative care patients. *British journal of nursing (Mark Allen Publishing),* 18**,** 466, 468, 470 passim.

Toulouie, S., Johanning, G. & Shi, Y. 2021. Chimeric antigen receptor T-cell immunotherapy in breast cancer: development and challenges. *J Cancer,* 12**,** 1212-1219.

Wallis, A., Meredith, P. & Stanley, M. 2020. Cancer care and occupational therapy: A scoping review. *Aust Occup Ther J,* 67**,** 172-194.

Wirtz, P. & Baumann, F. T. 2018. Physical Activity, Exercise and Breast Cancer - What Is the Evidence for Rehabilitation, Aftercare, and Survival? A Review. *Breast Care (Basel),* 13**,** 93-101.

Structural organisation of talk between a child with autism and his therapist during a therapeutic session

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Abstract

The experience of conversing and interacting with a person who has autism is often described as unsatisfactory. The purpose of the present study was to highlight, through Conversation Analysis, the way in which a child with autism communicates. The conversation between the participants was transcribed and analysed using the methodology of Conversation Analysis. The analysis highlighted differences in conversational styles between the two participants based on features such as overlaps, fixations, repetitions, conversation interruptions and pauses, maintenance of eye contact, use of gestures and facial expressions, as well as repetitive patterns and use of verbal and non-verbal modes of communication. The identified means of communication had positive effect on the communication and the interaction between the child and the therapist. Shifting the focus from the person with autism as the source of a deficit in communication and refocusing on the interaction itself allowed the possibility of modifying the interaction in such a way as to enhance the communicative exchange for both participants. So, in the future we could develop interventions that will use the characteristics of communication of people with autism spectrum disorder (ASD) in such a way as to strengthen their communication skills and enhance their ability to interact. It is suggested that many of the features of the child's language may be well-motivated, while the therapist appeared to adopt a facilitative style in order to engage the child in speaking.

Keywords: Conversation Analysis, Autism, Interaction, Speech & Language Therapy

1. Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder of the brain, which accompanies the person throughout his life (McPartland et al., 2016). It causes people to have difficulties in social interaction and communication. More specifically, people with autism have behavioural problems, limited interests and activities. The symptoms of the disorder appear at an early developmental age (up to the age of 3 years) (APA, 2013).

According to the literature, the communication difficulties faced by people with ASD relate to delayed or absent speech development (Zelou, 2021). The difficulties people with ASD face are reflected in the establishment of relationships, presence of echolalia, lack of eye contact as well as absence of empathy and lack of understanding of metaphorical speech (Charman and Stone, 2006).

The way people with ASD communicate has been extensively studied. One of the methodologies presented for such qualitative studies is conversation analysis (Goodwin & Heritage, 1990) which aims to promote the understanding of how people with language disorders communicate in everyday life situations. Conversation analysis is a qualitative approach that focuses on the study of interaction (Kasper & Wagner, 2014). It mainly examines the social organisation of activities carried out in interaction through speech (Clift, 2019). This approach was developed by Harvey Sacks (1960) together with Emmanuel Schegloff and Gail Jeffersin (Sacks, 1992) and has been used to investigate populations with

language disorders (Edmonds & Haynes, 1998; Local & Wootton, 1995; Willcox & Mogford-Bevan, 1995). Conversation analysis is a set of methods that uses video and audio recordings of speech and social interaction and helps describe how people with disabilities interact (Clift, 2019; Sidnell, 2010).

Conversation analysis (Galanis, 2017) benefitsthe science of speech and language therapy since it promotes understanding of the disorder and may lead to the development of effective and personalised intervention techniques.

1.1 Literature review

The research of Dobbinson et al. (1998) determinedthe structural speech characteristics of a woman with autism, based on herconversation with a researcher, using conversation analysis methodology. Their conversation was described as unsatisfactory, as many differences between the two speakers' speech characteristics were observed. More specifically, the speech of the woman with autism presented more pauses, unexpected changes in topic, difficulty in maintaining the topic, overlaps and corrections.

Lake et al. (2011), who compared the frequencies of full pauses (use of 'hm' and 'ee' words), silent pauses, repetitions, and revisions in the spontaneous speech of individuals with high-functioning autism and their caregivers), also found similar results. In particular, the study through conversation analysis, showed that there was a large number of silent pauses and repetitions by the people with autism, although full pauses and revisions were fewer.

Wiklund and Laakso (2019) analysed the speech of pre-adolescents with autism during group therapy sessions using conversation analysis, to identify morphosyntactic errors (wrong endings, wrong tenses). The above deviations appeared to be related to prosodic features (abrupt changes in tone, volume and rate of speech) and to repeated pauses.

Moreover, according to the study of Stribling et al. (2007) who investigated the interactional organisation of repetition practices observed in the speech of an adolescent girl with autism through conversation analysis, the girl with autism performed: 1) repetitions of final lexical items by another speaker (direct echolalia) 2) repetitions of the first item within a line such that a line consisting entirely of repeated items is produced (repetition within the sequence). The research suggested that these repetition practices may be an adaptation to interacting with a limited lexicon.

The purpose of the present study was to define the structural organization of talk and the patterns of communication between a child with autism and his therapist during a therapy session. This research sought to contribute to a better understanding of the disorder and of the way it affects communication.

2. Methodology

2.1 Participants

This study involved a 5,2 year old boy, A.M. (pseudo-initials) with a diagnosis of autism and a speech and language therapist. A.M. was diagnosed with autism at the age of 3;4 and had been having speech and language therapy sessions ever since. According to his mother, he has no other medical issues. The child lives at home with his parents and the spoken language is Greek. A.M. can occasionally maintain eye contact, he understands spoken language and can

produce it with limitations. More specifically, he produces words and phrases up to 3 words, but he cannot form longer sentences and he cannot use spoken language spontaneously.

2.2 Data collection material

The data was collected in the form of videotaped conversations, from which the natural occurring interactions between the child and the therapist were observed. The therapist was not given specific questions to ask the child but was instructed to run the session as she normally would.

2.3 Design and Process

For the data collection process, a 45-minute session was held in which the child and the therapist took part. In order to record the video of the session, no training in tools was necessary. The video was recorded in a speech therapy office and the camera was placed in a bookshelf so as not to affect the interaction. The child was aware of the placement of the camera. To analyse the data, after the videotaped conversations were recorded, the data was transcribed using a recording template adopted from Damico & Simmons-Mackie (2002) and Goodwin (1979) as follows:

[	Marks overlap.
:	Prolongation on prior syllable.
=	Latching.
(1.5)	Lapsed time in seconds.
(.)	Un-timed micro-intervals.
.,?!↑	Intonation marking.
	. falling intonation
	, level intonation
	? rising intonation
	! animated intonation
	↑ rising or falling shifts preceding arrow
___	Stress syllable. Can be used for pitch or volume.
-	A 'cutoff' of the prior word or sound.
(h)	Explosive aspiration. Indicates laughter or breathlessness.
.h	Audible breathing. Indicates in-breath
h	Audible breathing. Indicates out-breath.
CAPITALS	Increased volume.
° °	Volume noticeably lower than surrounding talk.
( )	Unclear words.
(( ))	Audio material other than actual verbalizations.
x	Indicates the point the participants establish eye contact.
----	Indicates maintenance of gaze.
,,,	Indicates a shift of gaze from one direction to another.
Mid gaze	Indicates the specific direction of gaze.
(( ))	Indicates the specific gesture/body action noted.

Subsequently, a qualitative analysis of the data was carried out, in which the analytical methodology of conversation was applied (Goodwin & Heritage, 1990).

3. Results

The results of the analysis showed the way of communication between child and therapist in a cooperative and two-way conversation during the session. Furthermore, the way the interlocutors dealt with issues of repairs, repetitions, overlaps, restarts, pauses, interruptions of the conversation, maintenance of eye contact, use of gestures and facial expressions, repetitive stereotyped patterns, verbal and non-verbal means of communication were analyzed and discussed. The following extracts are indicative of such processes.

3.1 Extract 1 – (04:46 – 05:01)

(Where A.M. = The child with autism, T = Therapist)

((he points with his hand to the toys))

Indicates the specific direction of the gaze towards the games

1. A.M: There.

Eye contact with A.M.

2. T: What do you want?

,,, Indicates the specific direction of the gaze towards the toys ((continues to point to the toys)) ,,, Eye contact towards T.

3. AM: (1.0) There.

Eye contact with A.M.

4. T: What's there? (1.5)

,,, ---- Eye contact to T.

5. AM: (2.5) Good- (1.5) Ball.

---- Eye contact to A.M.

6. T: Aaaah you want the ball. Come on, let's get her.

In this extract the child tried to formulate his request (he asked for toys that are in the room). More specifically, A.M. indicated what he wanted through eye contact and gestures and the therapist with her questions encouraged A.M. to verbalize his request.

3.2 Extract 2 – (08:41 - 09:53)

((grabs the swing and pulls it))

Indicates the specific direction of the gaze towards the swing

7. AM:

Eye contact with A.M.

8. T: What do you want?

,,, Indicates the specific direction of gaze towards the swing ((continues to pull the swing and starts laughing)) ,,, Eye contact towards T.

9. AM:

((Grabs the swing)) ---- Eye contact with A.M.

10. T: Tell me what you want?

,,, ---- Eye contact to T. ((Points to the swing))

11. AM: (1.5) There.

---- Eye contact to A.M.

12. T: Swing? Do you want the swing?

    Indicates the specific direction of the gaze towards the swing
13. AM: Swing.
    Indicates the specific direction of gaze towards the swing ((Grabs the swing))
14. T: You want the swing.
    Indicates the specific direction of the gaze towards the swing
15. AM: You want the swing.
    ((holds the swing to climb up))
16. T: Okay, come on up. (1.0) Get on the swing.
    ((trying to get on the swing but can't and squeals))
17. AM:
    ---- Eye contact to A.M.
18. T: What happened? (1.0) What do you want?
    ((Points to the swing))
19. A.M: You want (2.5) swing.
    Eye contact with A.M.
20. T: Help? Shall I lift you up?
    ((Grabs the swing and T.'s hand))
21. AM: (2.0) Help.
    ((She grabs him and lifts him onto the swing))
22. T: I want help. Let me help you.

  Similarly, the child tried to formulate a request (to get into the crib) and the therapist used questions to prompt him to ask for what he wanted verbally. While A.M. at first indicated what he wanted through eye contact and gestures, after listening to the therapist's questions he tried to formulate his request verbally through echolalia.

3.3 Extract 3 – (31:07-33:49)

    ((Sticks a card to the wall and shows it)) ---- Eye contact to A.M.
1. T: What is the boy doing?
    ,,, ( ) ((Going to leave))
2. AM:
    Indicates the specific direction of the gaze towards the card ((Points to the card))
3. T: Come here. Look at the picture. What is he doing? (1.5) What is the boy doing?
    ---- Indicates the specific direction of looking at the card ((He touches the card with his hands and puts it on his face))
4. AM: (3.0) He laughs.
    ---- Eye contact to A.M.
5. T: He laughs! Yes! Give me the card.
    ( ) ((Has the card on his face))
6. AM:
    ((She holds out her hand and waits))
7. T: Give the card. (2.0)
    ((Gives the card to T.))
8. AM: Card.
    ((Takes the card and sticks it on the wall))

9. T: Card yes.
       ---- *Eye contact towards T. ((grabs T.'s hands))*
10. AM: (1.5) Card.
       ---- *Eye contact to A.M.*
11. T: Do you want another card?
       Indicates the specific direction of the gaze towards the wall
12. AM: Another card.
       ((Takes another card and sticks it on the wall next to the previous one)) ((Shows the card))
13. T: Oh, what's the girl doing?
       ((Takes the card and puts it on his face)) ( )
14. AM: (1.0) CRYING.
       ---- *Eye contact to A.M. ((Pretends to cry))*
15. T: Yes! Well done! She is crying.
       ----*Eye contact with T. ((Pretends to cry))*
16. AM:
       ((She holds out her hand and waits))
17. T: Well done! Yes! Give me the card.
       ((Continues to have the card on his face)) ( )
18. AM: Card.
       ((Holds hand out and waits))
19. T: Yes card. Give me the card.
       ((Gives the card))
20. AM:
       ---- *Eye contact to A.M. ((Takes another card and sticks it on the wall next to the previous one)) ((Shows the card))*
21. T: Well done! What is the girl doing;
       ---- *to the card*
22. AM: Eats (1.5) Ice cream.
       ---- *Eye contact to A.M.*
23. T: Yes! She eats ice cream. Yum Yum.

Finally, in extract 3, the participants did a picture naming activity. At first, A.M. did not want to do it. But then he seemed to like it, because through the repetition of the word "card" he asked to continue it.

Analysing the above examples, it became clear that both A.M. as well as the therapist, during the session made several pauses, had eye contact and used gestures and word repetitions. In addition, A.M. appeared to be performing corrections and overlaps.

4. Discussion

The present study describes a case study of a child with ASD receiving speech and languate therapy. Results indicatethat both participants engaged in repetitions of words/phrases, pauses, overlaps, repairs, use of eye contact and gestures. More specifically, from the analysis of the results, A.M. was observed to make frequent pauses. According to an earlier study by Lake, Humphreys and Cardy (2011), people with autism make quite frequently silent pauses.

However, the study did not seem to reach any conclusions as to why this is happening. In the case of A.M. the use of frequent pauses seemed to indicate a difficulty in word retrieval, as the pauses occurred before content words (Example 1, line 5; Example 2, lines 11, 19, 21; Example 3, lines 4 and 22).

In addition to this, research by Stribling, Rae, and Dickerson (2007) revealed that a girl with autism engaged in repetitions during her speech, which the researchers suggested may be used as a means of adapting to interaction with limited vocabulary. In contrast, in the present study, the frequent use of word/phrase repetition appeared to be used by A.M. for communicative reasons, because many times when he spoke he tried to make a request (Example 2, lines 13 and 15; Example 3, lines 8, 10 and 12), while at other times he tried to answer the therapist's questions (Example 2, lines 19 and 21). Similar results to the current paper were found in the Tarplee and Barrow's (1999) study, which showed that frequent use of word/phrase repetition can be used to initiate interaction sequences.

Furthermore, it was observed that A.M. performed overlaps. This appeared to occur when the child wanted to take or do something but had not yet verbally asked the therapist (Example 2, lines 8-9 and 16-7; Example 3, lines 1-2, 5-6 and 17-18). The therapist's lack of overlap showed how she facilitated A.M. during their conversations, giving him time to express a request or respond to her queries.

In addition, A.M. also appeared to make repairs (Example 1, line 5). The child, without any help from the therapist, made repairs for words before he could complete them. This occurred as he probably recognized that he would be using the "wrong" word. If the above claim is true, then it seems that A.M. was aware of his mistakes.

Regarding eye contact and gestures, A.M. used them in order to communicate to the therapist what he wanted (Example 1, line 1, 3, 5; Example 2, line 1, 11, 13, 19, 21). Therefore, it was perceived that he had the ability to use eye contact qualitatively, but he mainly did so when he wanted to ask for something.

Moreover, apart from the communication method of A.M. it is important to mention the facilitative style adopted by the therapist, as she appeared to use questions extensively, thus involving A.M. in conversation. Also, the therapist used repetitive speech a lot, mainly as a supporting means to enhance the interaction with A.M. In addition, the therapist was observed to pause when waiting for the child's response to her requests or questions (Example 1, line 4; Example 2, lines 16, 18; Example 4, line 3). Sometimes the therapist's speech took on characteristics that were more like AM's speech, which seemed to be due to an effort to engage him in conversation. Thus, the importance of diversity in the interlocutors' styles was highlighted, since without the therapist's facilitation the conversation could quickly come to an end.

Finally, similarly to the Dobbinson et al. (1998) study, conversational analysis highlighted differences in conversational styles between the two participants based on features such as topic movement, topic maintenance, repairs, interference from previous structures, and joint compositions, overlaps, locking and pauses. It is suggested that many of the features of the subject's speech that result in an overly repetitive style may be cognitively motivated.

5. Conclusion

The results of this study showed that during this particular therapy session, the two participants interacted through various means. More specifically, A.M. used pauses, repetitive

speech, overlaps, corrections but also eye contact and gestures. All these seemed to help him in his attempt to communicate. As far as the therapist is concerned, she made pauses to give the child time, while she also used repetitive speech as a supportive tool. Moreover, considering that the main mode of communication of people with autism is often repetitive speech, the use of this could be an effective conversational strategy. Therefore, treatment programs could be designed to include partner training on the use of repetitive speech as a means to enhance communication. It therefore became obvious that the use of all these means of communication when used in such a bidirectional and co-operative manner had a positive effect on the interaction between A.M. and his therapist. These findings could lead to the development of effective personalised intervention techniques.

In conclusion, the success of any conversation depends on the cooperation between the participants. Therefore, shifting the emphasis away from the person with autism as the source of a deficit in communication and refocusing on the interaction itself, allows for the possibility of modifying the interaction in such a way as to enhance the communicative exchange for both participants. For this reason, it is undoubtedly important to conduct more research that will contribute to a better understanding of the disorder. Such an understanding could lead to the development of intervention techniques that will help improve the deficits of individuals with autism. The findings of the present research may help with the above, but more studies are needed, as new evidence emerges.

References

Damico, J.S. and Simmons-Mackie, N.N. (2002). The base layer and the gaze/gesture layer of transcription. *Clinical Linguistics and Phonetics,* 16, 317-327.

Dobbinson, S., Perkins, M. and Boucher, J. (1998). ´Structural patterns in conversations with a woman who has autism´, Journal of Communication Disorders, 31 (2) pp. 113-134. doi 10.1016/s0021-9924(97)00085-3

Edmonds, P.E. and Haynes, W.O. (1998). ´Topic manipulation and conversational participation as a function of familiarity in school-age language-impaired and normal language peers´, Journal of Communication Disorders, 21 (3), pp. 209-228. doi 10.1016/0021-9924(88)90030-5

Freeth, M., Foulsham, T. and Kingstone, A. (2013). ´What Affects Social Attention? Social Presence, Eye Contact and Autistic Traits´, PLoS ONE, 8 (1), pp. 12-16. doi https://doi.org/10.1371/journal.pone.0053286

Goodwin, C. (1979). The Interactive Construction of a Sentence in Natural Conversation. In Psathas (Ed.). *Everyday Language: Studies in Ethnomethodology.* New York: Irvington Publishers. pp.97-121.

Goodwin, C. and Heritage, J. (1990). ´Conversation Analysis´, Annual review of anthropology, 19 (1), pp. 283-307. doi 10.1146/annurev.an.19.100190.001435

Hutchby, I. and Wooffitt, R. (2008) *Conversation Analysis.* Cambridge: Polity Press.

Kasper, G. and Wagner, J. (2014). ´Conversation Analysis in Applied Linguistics´, Annual Review of Applied Linguistics, 34 (1), pp. 171-212. doi https://doi.org/10.1017/S0267190514000014

Lake, J.K., Humphreys, J.R. and Cardy, S. (2011). ´Listener vs. speaker-oriented aspects of speech: studying the disfluencies of individuals with autism spectrum disorders´, Psychonomic bulletin & review, February, 18 (2), pp. 135-140. doi 10.3758/s13423-010-0037-x

Local, J. and Wootton, T. (1995). ´Interactional and phonetic aspects of immediate echolalia in autism: A case study´, Clinical Linguistics and Phonetics, 9 (1), pp. 155-184. doi https://doi.org/10.3109/02699209508985330

Wiklund, M. and Laakso, M. (2019). ´Ungrammatical utterances and disfluent speech as causes of comprehension problems in interactions of preadolescents with high functioning autism´, Clinical Linguistics & Phonetics, 33 (7), pp. 654-676. doi 10.1080/02699206.2019.1578415

Delay Discounting and Individuals with Attention-Deficit / Hyperactivity Disorder: A Meta-Analysis

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Abstract

Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterised by clinically severe deficits in attention, impulsivity and hyperactivity. An integral underlying process that may contribute to ADHD revolves around the interpretation of subjective value between immediate and delayed rewards. The present study is a meta-analysis examining the difference of immediate and delayed award preferences between typically developed individuals and those with an ADHD diagnosis, by quantitatively collecting findings across published studies. For the purpose of the paper, a literature search was conducted using PubMed and PsyInfo as databases for published studies. The phrases "Delay Discounting", "Attention Deficit Hyperactivity Disorder" and "ADHD" were used as search terms. Studies that were not "peer-reviewed" nor published in English were omitted from the pool of results. For inclusion in the analysis, the study had to be published between 2000 and 2020, the diagnosis of ADHD had to be given using the standard research diagnostic instruments and manuals, a control group had to be present in the study and Delay Discounting had to be calculated either through "AUC" or "K" methods. The search revealed 12 studies, with a total of 911 individuals (483 ADHD subjects; 428 control group subjects). A random-effects meta-analysis model was conducted to compute the results. The heterogeneity of the results was assessed using I2 and Cochran's Q. The findings of the study provide vigorous evidence which suggests that the process of "delay discounting" is significantly more apparent in individuals with ADHD rather their control-group counterparts.

Keywords: Delay Discounting, Attention-Deficit/Hyperactivity Disorder, meta-analysis

1. Introduction

1.1 Attention-Deficit/ Hyperactivity Disorder

Attention-Deficit/Hyperactivity Disorder (ADHD), is often cited as one of the most common neurodevelopmental entities. A considerable amount of research in the existing literature suggests that ADHD'S global prevalence rates vary from 2% up to 7%, with most of them agreeing on an average value of 5% (Sayal et al., 2018; Thomas et al., 2015).

Concerning its diagnostic features, ADHD is characterized by clinically severe deficits in attention, and abnormally high displays of impulsivity and hyperactivity, with an early onset (APA, 2013). The diagnostic features of ADHD are distributed in two axes. The first includes symptoms of "inattention" such as difficulty in following instructions and paying attention, inability of proper organization and carelessness while working on tasks. Correspondingly, on the second axis, which is related to impulsivity and hyperactivity, are listed symptoms such as frequent nervous hand movements, excessively frequent talking, interruption of others during conversations and generally impetuous behaviours (Thomas et al., 2015). Based on the prevalence of those symptoms, a diagnosis of ADHD can be specified as predominantly inattentive, predominantly hyperactive/impulsive or even as combined. These

aforementioned behavioural patterns have a pervasive nature, leading to various degrees of functional impairment for the individual that more often than not, can be apparent in professional, academic and social settings (Efron, 2019).

1.2 Delay Discounting

The notion of Delay Discounting can be traced back to the marshmallow experiment, an attempt by Walter Mischel (1974) to investigate whether a group of young children would prefer a small but immediate reward, in the form of candy, over a larger but delayed one.

The contemporary term of Delay Discounting concerns the cognitive process that determines the subjective value that an individual, gives to a commodity in relation to the timeframe in which it becomes available to him. In other words, an individual with high rates of Delay Discounting also named as steeper discounting, is more often than not unable to forgo the choice of an immediate reward, for the attainment of a far greater one down the road. As a construct, Delay Discounting appears to be heavily intertwined with the cognitive processes of self-regulation, inhibitory control and planning (Matta et al., 2012). The capacity to choose a delayed reward over an immediate one during the Delay Discounting process has shown a strong positive correlation with academic success, low criminal behaviour and healthier social relationships (Matta et al., 2012).

On the contrary, high levels of delay discounting have been heavily linked with various forms of psychopathology such as substance abuse disorders (Monterosso et al., 2007), bulimia nervosa (McClelland et al., 2016), borderline personality disorder (Barker et al., 2015) and of course, attention-deficit/hyperactivity disorder (Jackson and MacKillop, 2016).

More recently there have also been attempts to investigate how the delay discounting functions develop over time. In a longtitutional study conducted by Achterberg et al (2016), it became apparent that delay discounting functions do indeed develop from early childhood up to early adulthood, through the predictive value frontostriatal white matter integrity had on delay discounting task results.

1.3 Assessing Delay Discounting

In a typical delay discounting assessment, the examinee is faced with a series of dilemmas whose options varies incrementally as he progresses through the task (McKerchar and Renda, 2012). More specifically, at the beginning of the task, the examinee is asked to choose between two rewards, one of lesser value, which can be attained immediately and one of increased value, which will become available at a later time. More often than not, rewards are monetary and hypothetical in nature. As the examinee chooses the large but delayed option, the value between the two rewards decreases while at the same time the delay with which the examinee will receive it increases in a similar rate (McKerchar and Renda, 2012). The point where the individual becomes indifferent of the delayed reward's value and chooses the immediate one instead, is called "the indifference point". This value is essential for the calculation of the final Delay Discounting rate.

A common method of computing Delay Discounting is by adding the aforementioned indifference points to a hyperbolic model, like the one described by Mazur (1987). The model equation is expressed as $V = A/(1+kD)$. According to this, the larger the value of k, the steeper the rates in which an individual is discounting the delay.

Instead of hyperbolic models, many scholars have opted to calculate delay discounting by using the "area under the curve" (auc) (Myerson et al., 2001). According to this method, the delays noted by the participant during the task are plotted on an x-axis while the points of indifference on a y-axis. The curve formed corresponds to the individual's delay discounting rates. The final auc value can range between 0 and 1, with values close to the former being equal to greater rates of delay discounting, while values close to the latter, being equal to the opposite.

1.4 ADHD & Delay Discounting

Although a few studies in current literature have managed to find a legitimate relationship between ADHD and delay discounting (Jackson and MacKillop, 2016), there seem to be a few others that question or contradict the validity of that claim. More specifically, studies which have researched predominately adult populations, failed to link the existence of ADHD with high delay discounting rates (e.g., Todoroko et al., 2019; Wilbretz et al., 2012). This has not been the case with underaged samples where consistent evidence suggests that individuals with ADHD present with significantly higher delay discounting rates than their control group counterparts (Castellanos-Ryan et al., 2014; Norman et al., 2017). Lastly, a few of the original reports that supported the notion of steeper discounting rates in individuals with ADHD, were sometimes based on currently outdated diagnostic criteria (Byrne et al., 1998).

Taking those factors into consideration, the present study, being a meta-analysis, aims to quantitatively aggregate findings across recently published studies in order to examine the relationship between ADHD and delay discounting, regardless of age, and while taking into consideration diagnostic pitfalls of outdated manuals. Therefore, it is hypothesised that individuals with ADHD will present significantly higher delay discounting rates than their typically developed counterparts.

2. Methods

2.1 Search Strategy

The studies that were used in the final analysis, were obtained from the respective databases of PubMed and PsyInfo. Filtering tools were enabled, in order to establish a specific publication window and peer-review status. In addition, the following keywords were used: "delay discounting" or "delayed gratification" and "ADHD" ("Attention Deficit Hyperactivity Disorder") or ("attention" and "deficit" and "hyperactivity" and "disorder").

Concerning the inclusion criteria, the studies had to be published between 2000 and 2020, and the diagnosis of ADHD had to be given using the standard research diagnostic instruments and manuals (e.g., DSM-5, DSM-IV, ICD-10). Eligible studies had to be originally published in the English language in peer-reviewed journals. In cases where this criterion could not be met, an official translation had to be available. The age of the sample was unspecified. The way in which delay discounting could be tested, was unrestricted, whereas the method of computing had to be based on either k or auc scales. In terms of the methodological design, the selected studies had to include a control group, made up by the general populace and a group that consisted of individuals with an ADHD diagnosis without known comorbidities.

During the first phase of the search, 2162 articles were retrieved from the databases after applying the required filters and keywords. 194 duplicates were then identified and excluded,

reducing the number of original articles to 1968. After screening based on abstract, title and content, 1902 articles were excluded. The remaining 66 were assessed fully. Of these, 54 were excluded as they did not meet the established inclusion criteria. More specifically, 12 studies didn't include control groups, 33 used different models of assessing delay discounting while the remaining 9 did not include ADHD-only groups. Thus, the total number of studies included in the meta-analysis amounted to 12. A detailed depiction of the steps that were followed during the search process is provided in Figure 1 through the usage of the Prisma Flow Diagram.
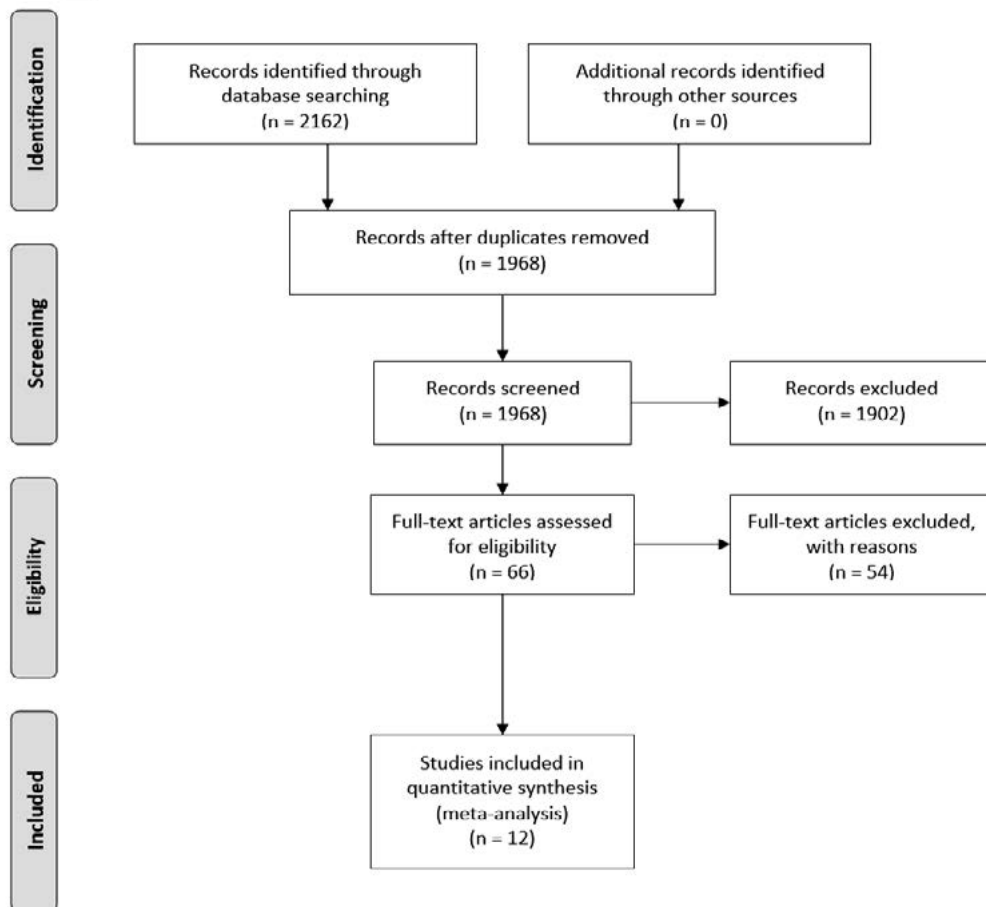

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) inclusion flow diagram.

2.2 Sample Characteristics

The total number of participants across all studies was $N = 911$ while the individual number of participants for each study ranged from $N = 14$ to $N = 95$. The age average of the total sample was estimated at 15.80 years of age.

Three (3) out of the twelve (12) studies used in the present meta-analysis performed multiple comparisons in the same sample as they used two separate delay discounting tasks, one using hypothetic rewards and another with actual ones. For the purpose of this study those three measurements will henceforth be regarded as distinct studies denoted by the letters "a" for the analysis conducted using hypothetical rewards and "b" for the analysis using actual ones. The number of studies that used the Area Under the Curve (auc) method to calculate Delay Discounting scale was 5. These 5 studies included 3 that performed duplicate measurements. Therefore, the number of measurements made based on the auc method amounted to 8. On the other hand, 7 were the studies that used the k model.

Table 1. Descriptive statistics of the studies included in the meta-analysis.

Published Study	N Control Group vs N ADHD Group	Age Range	Delay Discounting Index	Type of Reward	Medication	ADHD-Combined Subtype	ADHD-Hyperactivity Subtype	ADHD-Inattention Subtype	Diagnostic Manual
Antonini et al., 2015	30vs67	7-12	K	Hypo.	No	32	-	35	DSM-IV
Chantiluke et al., 2014	18vs18	11-17	K	Hypo.	No (for 48h)	18	-	-	DSM-IV
Demurie et al., 2012	46vs38	8-16	Auc	Hypo.	Yes	28	-	10	DSM-IV
Dias et al., 2015	63vs42	7-12	K	Hypo.	Yes	27	1	14	RDoC
Norman et al., 2017	20vs26	12-18	K	Hypo.	Yes	26	-	-	DSM-IV
Paloyelis et al., 2010 a.,b.	32vs36	11-20	Auc	Both	Yes	36	-	-	DSM-IV
Paraskevopoulou et al., 2020	62vs62	17.62	Auc	Real	No (for 48h)	Not Specified	Not Specified	Not Specified	-
Patros et al., 2018 a.,b.	59 vs 95	8-12	Auc	Both	No	Not Specified	Not Specified	Not Specified	DSM-IV
Todoroko et al., 2018	16vs14	31.7	K	Real	No	12	-	2	DSM-IV
Yu & Sonuga Barke, 2016 a.,b.	23 vs 23	7-12	Auc	Both	No	Not Specified	Not Specified	Not Specified	-
Wilbretz et al., 2012	28vs28	36.91	K	Hypo.	No	2O	-	8	DSM-IV
Wilson et al., 2011	31vs27	7-9	K	Hypo.	No (for 48h)	14	2	11	DSM-IV

2.3 Meta-Analytic Technique

To conduct the statistical analysis, random and fixed effects meta-analysis models were taken into consideration. It was deemed more appropriate to use the random effects model as it can predict studies with methodological heterogeneity with higher accuracy. The data for the analysis were drawn from the published forms of the studies and were related to the number of participants, the mean values of the group results and their standard deviations. As a summary statistic, Standardised mean difference (SMD) was used over Mean Difference (MD) since Delay Discounting was measured in two different ways, as discussed earlier. Before processing the analysis, the results calculated with the k scale were inverted to be consistent with those of the auc scale. Lastly, as a means of assessing the sample's heterogeneity, Cochran's Q and I^2 tests were applied.

3. Results

To determine whether there was a difference between the means of the two groups, a random effects model was used. The analysis showed a statistically significant difference between the ADHD and the control groups CI (0.131, 0.488, $p < 0.001$). This can also be inferred from the forest plot diagram of Figure 2 where the pooled 95% confidence intervals of the included studies, doesn't overlap with the line of no effect, which in this case passes through 0. At the same time, moderate heterogeneity was evident between the results of the studies (Q (14) = 29.930, I^2= 53.224, p = 0.008).

Observing each study individually, it is apparent that ten (10) studies found larger delay discounting rates in the participants of ADHD groups, since they were located at the right side of the line of no effect. Out of those, six (6) were determined as statistically significant; Norman et al., 2017 (CI = 0.288, 1.510), Chantiluke et al., 2014 (CI = 0.191, 1.558), Wilson et al., 2011 (CI = 0.085, 1.141), Yu & Sonuga Barke, 2020b (CI = 0.046, 1.231), Paloyelis et al., 2010a (CI = 0.111, 1.085) and Demurie et al. al., 2012 (CI = 0.349, 1.241). Conversely the remaining five (5) studies that can be seen on the left side of the line of no effect, found that control groups had steeper delay discounting rates albeit without statistical significance.
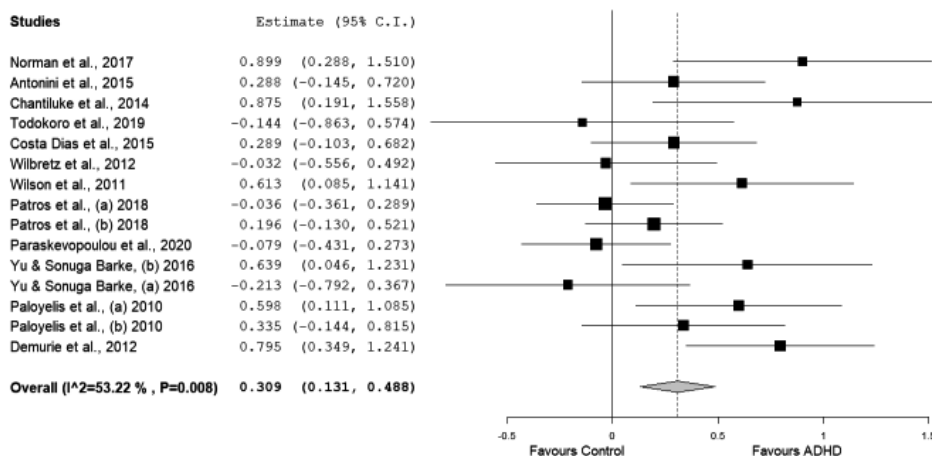

Figure 2. Forest Plot Diagram depicting differences of delay discounting between control and ADHD groups among studies

Discussion

As per the initial hypothesis, it can be inferred that individuals with ADHD do in fact prefer immediate rewards rather than delayed ones, despite the fact that in many situations the latter could be of far greater value. Nevertheless, the results also raise some questions with regards to how age could influence that relation. Most of the studies that showed no significant results in the meta-analysis (e.g., Todoroko et al., 2018; Wilbretz et al., 2012) were conducted primarily on an adult population. The reason behind these differences could be

attributed to the developmental course of ADHD, since there is a high probability that during adolescence or early adulthood a person will experience a decrease in the severity of the symptoms in the axis of impulsivity and hyperactivity. It can also be observed that there were several studies using the methodology k that did not find statistically significant differences between the two groups (e.g., Antonini et al., 2015; Dias et al., 2015; Todoroko et al., 2018; Wilbretz et al., 2012). This would be consistent with the fairly recent findings of Linhartova et al (2021) on scale efficiency. More specifically, they found that according to their model, the k method can measure with less reliability the variables that are intertwined with impulsivity compared to the auc method.

Perhaps the most important limitation of this study concerns the fact that publication bias was not accounted for. The existence of such an effect would mean that any unpublished articles could have significantly altered the results. It should also be noted that the existence of moderate heterogeneity in the sample raises some questions about the validity of the results, which could be investigated in future research. Lastly it should be mentioned that the analysis didn't take into consideration whether the ADHD groups of the studies were on medication.

Such results could possibly lay the foundation for the proposal and the development of cognitive rehabilitation programmes that are more accurately directed towards the deficits in reward processing, inhibitory control and impulsivity that are found in individuals with ADHD. Due to the inclusion of studies from various age groups, it can also be argued that the present study contributes towards a more detailed understanding of how ADHD symptoms evolve over the span of an individual's life. Lastly, the results bring forth important differences between the two methods that are commonly being used to determine delay discounting.

References

Achterberg, M., Peper, J.S., van Duijvenvoorde, A.C., Mandl, R.C. and Crone, E.A., 2016. Frontostriatal white matter integrity predicts development of delay of gratification: a longitudinal study. *Journal of Neuroscience*, *36*(6), pp.1954-1961. doi:10.1523/JNEUROSCI.3459-15.2016

American Psychiatric Association. 2013. *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.

Antonini, T.N., Becker, S.P., Tamm, L. and Epstein, J.N., 2015. Hot and cool executive functions in children with attention-deficit/hyperactivity disorder and comorbid oppositional defiant disorder. *Journal of the International Neuropsychological Society*, *21*(8), pp.584-595. doi:10.1017/s1355617715000752

Barker, V., Romaniuk, L., Cardinal, R.N., Pope, M., Nicol, K. and Hall, J., 2015. Impulsivity in borderline personality disorder. *Psychological medicine*, *45*(9), pp.1955-1964. doi:10.1017/s0033291714003079

Byrne, J.M., DeWolfe, N.A. and Bawden, H.N., 1998. Assessment of attention-deficit hyperactivity disorder in preschoolers. *Child Neuropsychology*, *4*(1), pp.49-66. doi:10.1076/chin.4.1.49.3193

Castellanos-Ryan, N., Struve, M., Whelan, R., Banaschewski, T., Barker, G.J., Bokde, A.L., Bromberg, U., Büchel, C., Flor, H., Fauth-Bühler, M. and Frouin, V., 2014. Neural and cognitive correlates of the common and specific variance across externalizing problems in young adolescence. *American Journal of Psychiatry*, *171*(12), pp.1310-1319.https://doi.org/10.1176/appi.ajp.2014.13111499

Chantiluke, K., Christakou, A., Murphy, C.M., Giampietro, V., Daly, E.M., Ecker, C., Brammer, M., Murphy, D.G., Rubia, K. and MRC AIMS Consortium, 2014. Disorder-specific functional abnormalities during temporal discounting in youth with Attention Deficit Hyperactivity Disorder (ADHD), Autism and comorbid ADHD and Autism. *Psychiatry Research: Neuroimaging*, *223*(2), pp.113-120.

Demurie, E., Roeyers, H., Baeyens, D. and Sonuga-Barke, E., 2012. Temporal discounting of monetary rewards in children and adolescents with ADHD and autism spectrum disorders. *Developmental science*, *15*(6), pp.791-800.

Dias, T.G.C., Iyer, S.P., Carpenter, S.D., Cary, R.P., Wilson, V.B., Mitchell, S.H., Nigg, J.T. and Fair, D.A., 2015. Characterizing heterogeneity in children with and without ADHD based on reward system connectivity. *Developmental cognitive neuroscience*, *11*, pp.155-174. https://doi.org/10.1016/j.dcn.2014.12.005

Efron, D., 2019. Attention deficit hyperactivity disorder: an overview. *Sleep and ADHD*, pp.1-28.

Jackson, J.N. and MacKillop, J., 2016. Attention-deficit/hyperactivity disorder and monetary delay discounting: a meta-analysis of case-control studies. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*, *1*(4), pp.316-325. https://doi.org/10.1016/j.dcn.2014.12.005

Matta, A.D., Gonçalves, F.L. and Bizarro, L., 2012. Delay discounting: Concepts and measures. *Psychology & Neuroscience*, *5*, pp.135-146. https://doi.org/10.3922/j.psns.2012.2.03

Mazur, J.E., 1987. An adjusting procedure for studying delayed reinforcement. *Quantitative analyses of behavior*, *5*, pp.55-73.

McClelland, J., Dalton, B., Kekic, M., Bartholdy, S., Campbell, I.C. and Schmidt, U., 2016. A systematic review of temporal discounting in eating disorders and obesity: Behavioural and neuroimaging findings. *Neuroscience & Biobehavioral Reviews*, *71*, pp.506-528. doi: 10.1016/j.neubiorev.2016.09.024

McKerchar, T.L. and Renda, C.R., 2012. Delay and probability discounting in humans: An overview. *The Psychological Record*, *62*(4), pp.817-834.

Mischel, W., 1974. Processes in delay of gratification. In *Advances in experimental social psychology* (Vol. 7, pp. 249-292). Academic Press. https://doi.org/10.1016/S0065-2601(08)60039-8

Monterosso, J.R., Ainslie, G., Xu, J., Cordova, X., Domier, C.P. and London, E.D., 2007. Frontoparietal cortical activity of methamphetamine-dependent and comparison subjects performing a delay discounting task. *Human brain mapping*, *28*(5), pp.383-393. doi: 10.1002/hbm.20281

Myerson, J., Green, L. and Warusawitharana, M., 2001. Area under the curve as a measure of discounting. *Journal of the experimental analysis of behavior*, *76*(2), pp.235-243. https://doi.org/10.1901/jeab.2001.76-235

Norman, L.J., Carlisi, C.O., Christakou, A., Chantiluke, K., Murphy, C., Simmons, A., Giampietro, V., Brammer, M., Mataix-Cols, D. and Rubia, K., 2017. Neural dysfunction during temporal discounting in paediatric attention-deficit/hyperactivity disorder and obsessive-compulsive disorder. *Psychiatry Research: Neuroimaging*, *269*, pp.97-105.https://doi.org/10.1016/j.pscychresns.2017.09.008

Paloyelis, Y., Asherson, P., Mehta, M.A., Faraone, S.V. and Kuntsi, J., 2010. DAT1 and COMT effects on delay discounting and trait impulsivity in male adolescents with attention deficit/hyperactivity disorder and healthy controls. *Neuropsychopharmacology*, *35*(12), pp.2414-2426. https://doi.org/10.1038/npp.2010.124

Paraskevopoulou, M., van Rooij, D., Schene, A.H., Scheres, A.P., Buitelaar, J.K. and Schellekens, A.F., 2020. Effects of substance misuse and family history of substance use disorder on delay discounting in adolescents and young adults with attention-deficit/hyperactivity disorder. *European addiction research*, *26*(4-5), pp.295-305.

Patros, C.H., L. Sweeney, K., Mahone, E.M., Mostofsky, S.H. and Rosch, K.S., 2018. Greater delay discounting among girls, but not boys, with ADHD correlates with cognitive control. *Child Neuropsychology*, *24*(8), pp.1026-1046. doi: 10.1080/09297049.2017.1359525

Sayal, K., Prasad, V., Daley, D., Ford, T. and Coghill, D., 2018. ADHD in children and young people: prevalence, care pathways, and service provision. *The Lancet Psychiatry*, *5*(2), pp.175-186. https://doi.org/10.1016/S2215-0366(17)30167-0

Thomas, R., Sanders, S., Doust, J., Beller, E. and Glasziou, P., 2015. Prevalence of attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. *Pediatrics*, *135*(4), pp.e994-e1001. doi: 10.1542/peds.2014-3482

Todokoro, A., Tanaka, S.C., Kawakubo, Y., Yahata, N., Ishii-Takahashi, A., Nishimura, Y., Kano, Y., Ohtake, F. and Kasai, K., 2018. Deficient neural activity subserving decision-making during reward waiting time in intertemporal choice in adult attention-deficit hyperactivity disorder. *Psychiatry and Clinical Neurosciences*, *72*(8), pp.580-590. https://doi.org/10.1111/pcn.12668

Yu, X. and Sonuga-Barke, E., 2016. Childhood ADHD and delayed reinforcement: A direct comparison of performance on hypothetical and real-time delay tasks. *Journal of attention disorders*, *24*(5), pp.810-818.

Wilbertz, G., van Elst, L.T., Delgado, M.R., Maier, S., Feige, B., Philipsen, A. and Blechert, J., 2012. Orbitofrontal reward sensitivity and impulsivity in adult attention deficit hyperactivity disorder. *Neuroimage*, *60*(1), pp.353-361.

Wilson, V.B., Mitchell, S.H., Musser, E.D., Schmitt, C.F. and Nigg, J.T., 2011. Delay discounting of reward in ADHD: application in young children. *Journal of Child Psychology and Psychiatry*, *52*(3), pp.256-26.

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The Genetics of Caffeine in Cognitive Performance and Neurodegeneration

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Abstract

Although the stimulant properties of caffeine are widely accepted, research on its specific effects on the brain and its protective role in age-related neurodegenerative diseases remains controversial. A recent systematic review provided evidence that variability in genes associated with caffeine metabolism (*CYP1A2*) and caffeine effect on the brain (*ADORA2A*) are associated with the effects of caffeine on cognition in healthy individuals. Moreover, several studies have also reported a protective role of caffeine on age-related cognitive decline, either limited to women or more pronounced in women than in men. A genome-wide search discovered that variations in the glutamate-receptor gene (*GRIN2A*) modulate the risk of developing Parkinson's Disease (PD) in heavy coffee drinkers. Other studies report that susceptibility to Alzheimer's Disease (AD) may be modulated by the N-Acetyltransferase 2 (*NAT2*) gene, which is implicated in caffeine metabolism and elimination. On the contrary, a recent Mendelian randomization study reported that genetically predicted higher plasma caffeine levels were marginally associated with a lower risk of PD. Future studies are warranted to investigate the specific genetic variants implicated in each cognitive function (simple vs complex) and each neurodegenerative disease, whether there are gender differences in disease predisposition and how habitual caffeine intake may influence the acute effects of caffeine.

Keywords: coffee, tea, genetics, cognition, brain health.

1. Introduction

Caffeine is the most widely consumed psychostimulant, being used habitually by more than 80% of the world population (Reyes and Cornelis, 2018). On average, adults consume 220 mg of caffeine daily, which is approximately two regular 125 ml cups of coffee (Nehlig, 2018). Caffeine is available in a variety of foods and beverages, such as tea, chocolate and energy drinks; however, coffee remains the primary dietary caffeine source in Europe and the United States (Reyes and Cornelis, 2018).

Caffeine has been attributed unique enhancing properties in cognitive function and physical performance, which explain its popularity, especially in shift workers, students, athletes and anyone generally seeking to overcome fatigue or prolong their capacity to complete everyday activities (Rogers *et al.*, 2010; Cappelletti *et al.*, 2015; Renda *et al.*, 2015). Caffeine has also been linked in epidemiological studies with protective effects on neurodegenerative disease progression such as dementia, Alzheimer's (AD) and Parkinson's disease (PD), suggesting that caffeine may have neuroprotective effects against cognitive decline (Yamada-Fowler and Söderkvist 2015, Ascherio and Chen 2003, Barranco Quintana et al. 2007).

Nevertheless, research on caffeine and cognitive performance and decline remains controversial (James, 2014; Cappelletti *et al.*, 2015; Panza *et al.*, 2015). In fact, a recent systematic review on caffeine and cognitive performance demonstrated controversial evidence, with some studies showing improvements in simple cognitive functions after

caffeine ingestion in doses 30-300 mg and others failing to find a significant association (McLellan *et al.*, 2016). Results from a systematic review on caffeine and neurodegeneration were also inconsistent, based on study design and follow-up periods (Panza *et al.*, 2015).

Apart from the methodological pitfalls commonly seen with dietary exposures and misclassification of self-reported caffeine intake (Smith, 2002; James, 2014), inconsistencies in caffeine research in cognition may stem from withdrawal reversal (Rogers *et al.*, 2010). Indeed, participants in randomised studies are often asked to abstain from caffeine overnight, which may hinder cognitive performance in habitual caffeine consumers (James, 2014). Nutrigenetics research has also found a considerable interindividual variability in the magnitude of caffeine effects in cognition, or in the lack of an effect when compared to placebo, suggesting that the inconsistencies in previous findings are also due to genetic variations (Nehlig, 2018).

With such widespread consumption of caffeine, the implications of this stimulant on brain health are of particular interest not only to the scientific community but also to most of the adult population worldwide. The present review discusses the associations between caffeine and cognitive performance and decline and how these associations may be modulated by genetics. Better understanding on this topic may provide a basis for further interdisciplinary approaches to inform personalised recommendations on an individual level aiming to stimulate cognition and delay age-related cognitive decline.

2. Caffeine Pharmacokinetics and Pharmacodynamics

The pharmacokinetics and pharmacodynamics of caffeine have been widely studied. More than 95% of caffeine (1,3,7-trimethylxanthine) biotransformation to its main metabolites paraxanthine, theophylline and theobromine occurs in the liver via the cytochrome P450 enzyme (CYP1A2) (Nehlig, 2018; Grzegorzewski *et al.*, 2021). Following ingestion of a single caffeine dose, caffeine is rapidly absorbed by the stomach and small intestine and peaks in the plasma within 30-60 minutes (Skinner *et al.*, 2013). The half-life of caffeine in the circulation is normally 2.5 to 5 h (Fredholm, 1995), with variations up to 9.9 having been reported (Blanchard and Sawers, 1983).

The interindividual variabilities in peak plasma and caffeine half-life may be partly explained by a genetic polymorphism associated with CYP1A2 enzyme activity. An A-to-C substitution at position 163 (rs762551) in the *CYP1A2* gene decreases enzyme inducibility as reflected by plasma or urinary metabolite ratios after caffeine intake (Sachse *et al.*, 1999). Carriers of the C allele, 54% of the population (AC and CC carriers) metabolise caffeine more slowly than individuals homozygous for the AA allele, who are considered rapid caffeine metabolisers and represent 46% of the population (Sachse *et al.*, 1999; Cornelis, El-Sohemy and Campos, 2007).

Caffeine's mechanism of action has been well established. Following absorption, caffeine is rapidly distributed to all tissues and readily crosses the blood-brain barrier to exert its effects (Fredholm, 1995). Because of their similar structure, caffeine blocks adenosine A1 and A2a receptors in the brain, competitively antagonising their binding with adenosine (Fredholm, 1995; Nehlig, 2018). Since adenosine is a neuromodulator that promotes sleep and suppresses arousal, caffeine antagonistic effects on adenosine results in triggering dopaminergic neurotransmission and promoting wakefulness (Fredholm, 1995; Cappelletti *et al.*, 2015; Nehlig, 2018).

The C-to-T substitution at nucleotide position 1976 (rs5751876) in the adenosine receptor (*ADORA2A*) gene is shown to impact caffeine-adenosine A2a receptor binding in a way that results in greater dopaminergic neurotransmission compared with the wild type (unchanged) gene, resulting in feelings of anxiety and sleep disturbance or insomnia (Alsene *et al.*, 2003; Childs *et al.*, 2008). Therefore, the rs5751876 variant in the *ADORA2A* gene has been used by authors to categorise individuals as having a 'high' (TT genotype, approximately 15-20% of population) or 'low' (CT/CC genotype) sensitivity to caffeine (Carswell *et al.*, 2020).

3. Gene x Caffeine Interactions in Cognitive Performance

Cognitive performance refers to an individual's mental abilities, including attention, learning, reasoning, thinking, decision making, memorising, and problem solving (Taylor *et al.*, 2016). All everyday activities require complex cognitive abilities, which are susceptible to improvement, as well as decline (Lamport *et al.*, 2014). Cognitive functions are categorised as either 'simple' or 'complex'. Simple functions require very simple perceptual motor skills (e.g., reaction time, short-term memory), whereas complex functions require a greater effort (e.g., executive function, working memory) (Taylor *et al.*, 2016). Genetic association studies on the effects of caffeine on specific functions of cognition are limited and are characterised by methodological heterogeneity.

The first systematic review on the genetics of caffeine and brain-related effects (Kapellou et al., 2022; currently under review) investigated how genetics may modulate the association between caffeine and brain-related outcomes: cognition, insomnia and anxiety. The findings of this systematic review on cognition are discussed below. Among the included studies, cognition was investigated alone, during sleep disturbance and during exercise.

3.1 Cognitive performance without co-interventions

Casiglia et al. (2017) in a large population-based study found that abstract reasoning, a complex cognitive function, was higher in the highest compared with the lowest and middle tertiles of habitual caffeine intake in the rs762551 CC homozygous only ('slow' metabolisers). Accordingly, an investigation from the UK Biobank found that the 'fast' metabolisers had lower cognitive performance with higher habitual coffee intake than those with AC or CC genotypes of the rs762551 (Cornelis, Weintraub and Morris, 2020a). After stratification by a genetic caffeine metabolism score (CMSG), in which higher scores indicated faster caffeine metabolism, the results suggested that habitual caffeine consumption was associated with lower cognitive performance in both simple and complex functions in those with higher CMSG compared with those with lower CMSG (Cornelis, Weintraub and Morris, 2020a). Nevertheless, in the same sample, caffeine consumed within the last hour before cognitive tasks was associated with improved reaction times the higher the CMSG (Cornelis, Weintraub and Morris, 2020b), indicating that recent caffeine drinking is linked with improved cognitive performance in simple cognitive functions, the faster the caffeine metabolism. Although the exact timing of intake is not known, these findings suggest that a faster caffeine metabolism would benefit simple cognitive functions when those are performed within an hour after caffeine intake (Southward *et al.*, 2018).

A limitation in the studies from the UK Biobank is that habitual and recent caffeine drinking estimates were based solely on coffee and tea, without considering quantity and other

caffeine sources. In the UK, for example, the major caffeine source in the diet is tea, with coffee and cola drinks in second place and energy drinks in third place (Reyes and Cornelis, 2018). Moreover, the CMSG was derived using two genetic variants that have been presented with the largest effect sizes in a single Genome-Wide Association Study (GWAS) of caffeine metabolites and lack replication, thus may have not provided a valid measure of genetic caffeine metabolism.

A randomised study investigating performance in simple functions found no differences in indices of cognition neither between caffeine and placebo conditions nor between rs762551 genotype groups (Salinero *et al.*, 2017). Nevertheless, participants were asked to rest for 60 min after caffeine ingestion and before they start the cognitive tests, and this could have surpassed peak plasma caffeine levels for 'fast' metabolisers. Finally, Renda et al. (2015) found that the CC homozygotes of the *ADORA2A* rs5751876 showed a significantly higher reaction time (RT) performance in orienting, while the TT homozygotes showed a higher RT performance in motor executive control after caffeine compared to placebo. However, only male subjects were included in the study making the results non-generalisable.

3.2 Cognitive performance in sleep disturbance

Whereas the mechanisms are not yet fully understood, changes in levels of adenosine in the brain appear to underly the sleep loss-induced reduction in cognitive functions (Retey *et al.*, 2006; Lo *et al.*, 2012). By blocking the binding of adenosine with the A2a receptors, caffeine countermeasures the detrimental effect of prolonged wakefulness by potentiating dopaminergic signalling, which leads to motor activation and subsequent alertness (Landolt, 2008). Hence, caffeine intake, particularly in the morning or early afternoon to enhance wakefulness in response to sleep restriction is very common (Martyn *et al.*, 2018).

Baur et al. (2021) found that caffeine attenuates the impairment in cognitive functions such as attention, orienting, memory and executive control caused by sleep deprivation in C homozygous of the *ADORA2A* rs5751876. Although the study tried to mimic real-life caffeine intakes which are very common in Europe (300 mg of caffeine through morning and midday coffee intake) (Reyes and Cornelis, 2018), only the CC group of the *ADORA2A* rs5751876 genotype was included. Although this selective recruitment was based on the notion that these individuals are genetically sensitive to the effects of caffeine on cognition in rested (Renda *et al.*, 2015) and sleep-deprived states (Retey *et al.*, 2006), yet did not allow for comparisons between distinct genotype groups.

Bodenmann et al. (2012) in a sample of male participants found that caffeine improves RT in a sleep-deprived state in non-HT4 haplotype carriers of *ADORA2A* compared with the HT4 haplotype. Haplotypes are often ambiguous because of unknown linkage within the gene and, although haplotype frequencies are suitable for case-control studies (binary traits), they cannot provide a method of testing the statistical significance with a specific trait (Schaid *et al.*, 2002). Further, Skeiky et al. (2020) found no differences in RT between A allele carriers and GG homozygotes of the *TNFα* G308A polymorphism after caffeine supplementation compared to placebo after 48 h of sleep deprivation. The A allele carriers of the *TNFα* rs1800629 polymorphism have been previously found to be relatively resilient to psychomotor vigilance impairment during sleep deprivation as compared to individuals homozygous for the G allele (Satterfield *et al.*, 2015).

3.3 Cognitive performance during exercise

Caffeine antagonises the effect of adenosine in the central nervous system, thereby decreasing feelings of tiredness and enhancing arousal and vigilance during exercise (Meeusen *et al.*, Spriet, 2013). In the only study up to date on the effects of caffeine and genetics on cognition during and post-exercise, caffeine improved cognitive performance in RT in 'fast' compared with 'slow' metabolisers based on *CYP1A2* genotype both during and after exercise, but no differences were observed between *ADORA2A* genotypes.

The findings on *CYP1A2* genotype are in line with the report from Cornelis et al. (2020a), who showed that recent caffeine drinking is linked to faster RT the faster the caffeine metabolism based on genetics. Nonetheless, cognition can be altered during exercise; although evidence suggests that moderate exercise intensities (40-60% of maximal heart rate – HRmax) enhance cognition, exercise at 70%–80% HRmax has been shown to degrade complex cognitive performance whereas simple cognitive functions such as RT remain unchanged (Stone *et al.*, 2020). In the study by Carswell et al. (2020), participants underwent a Psychomotor Vigilance Task (PVT) during a 20-min cycling trial at 70% VO_2 max and, although RT is a simple cognitive function, the discrepancy in the way exercise intensity is defined and measured across studies makes conclusions even more challenging.

Regarding the lack of significant findings based on the *ADORA2A* genotypes, the sample size, despite being deemed sufficient based on previous research on *CYP1A2* genotypes, provided only one heterozygous carrier of the *ADORA2A* C allele. Future studies with larger sample sizes are required to determine the influence of the *ADORA2A* genotypes on the cognitive effects of caffeine during exercise.

4. Gene x Caffeine Interactions in Neurodegenerative Diseases

Growing evidence suggests that caffeine has protective effects on neurodegeneration via several mechanisms, including reduction in excitatory neurotransmitter release (Rivera-Oliver and Díaz-Ríos, 2014). Hence, it has been postulated that caffeine may play a role in two of the most common forms of neurodegenerative disorders worldwide, Alzheimer's disease (AD) and Parkinson's disease (PD) (Yamada-Fowler and Söderkvist, 2015).

Nevertheless, epidemiological studies investigating these associations are scarce, and studies on the consumption of caffeine in relation to these diseases have yielded inconclusive findings (Larsson and Orsini, 2018). These inconsistencies may be related to methodological issues, such as residual confounding or misclassification of caffeine exposure. Furthermore, they may be partly attributed to genetic variations in genes implicated in caffeine metabolism and mechanism of action in the brain (Yamada-Fowler and Söderkvist, 2015; Yamamoto *et al.*, 2015).

The PEGASUS consortium combined data from five population-based case-control studies including 1,325 PD cases and 1,735 controls. This study demonstrated that PD risk was negatively associated with two *ADORA2A* variants: rs5751876 and rs3032740. Moreover, the coffee x PD association was strongest in 'slow' caffeine metabolisers (CC genotype of rs762551 in *CYP1A2*) compared with CA or AA carriers (Popat *et al.*, 2011).

In a GWAS on coffee consumption, the most significant signal for PD was found on rs4998386 in the glutamate receptor gene *GRIN2A,* which regulates excitatory neurotransmission in the brain and is modulated by adenosine receptors. The study reported

that *GRIN2A* was stronger than all significant PD susceptibility genes in the GWAS. The signal was found in heavy but not in light coffee drinkers (Hamza *et al.*, 2011). This association was replicated in a Swedish population, with significant evidence for *GRIN2A* x caffeine interaction with risk for PD (Yamada-Fowler et al., 2014).

A recent Mendelian Randomisation (MR) analysis leveraged genetic variants associated with caffeine metabolism to investigate the effect of plasma caffeine levels on the risk of both AD and PD. Genetic association estimates for disease outcomes were obtained from large international consortia. Genetically predicted higher plasma caffeine levels were associated with a non-significant lower risk of AD. A suggestive association was observed for genetically predicted higher plasma caffeine levels and lower risk of PD in the Finnish consortium only (Larsson, Woolf and Gill, 2022).

To summarise, although these findings suggest an interaction of genetics with caffeine in the progression of AD and PD, more studies are needed to understand this possible relationship, together with other potential factors influencing this relation.

5. Conclusions

In conclusion, there is growing evidence linking genetic variability in genes associated with caffeine metabolism and caffeine physiological effects on the brain with cognitive performance and cognitive decline. Nevertheless, it is not yet clear what specific genotypes are implicated in each cognitive function (simple vs complex) and each neurodegenerative disease, whether there are gender differences in caffeine effects and how variability in genes involved in brain neurotransmission interact to collectively influence individual responses to caffeine in cognition.

Future studies in this area are recommended to utilise interdisciplinary approaches to investigate the complex interactions between genetic and environmental factors on brain function. Careful design to overcome the common methodological challenges of caffeine research, such as issues of caffeine tolerance, caffeine withdrawal symptoms and withdrawal reversal. Moreover, there is need for more studies that examine brain-related effects of caffeine not based solely on single sessions or a period of days, but also for weeks, months and possibly years.

Declaration of Interest

Dr Leta Pilic is the founder of Optimyse Nutrition LTD, a personalised nutrition company offering nutrigenetic testing. Dr Yiannis Mavrommatis serves as a scientific consultant at MyHealthChecked, a wellness company specialised in personalised healthcare. Angeliki Kapellou serves as a Nutrigenomics Specialist at iDNA Genomics, a genetic testing company.

References

Alsene, K. *et al.* (2003) 'Association Between A 2a Receptor Gene Polymorphisms and Caffeine-Induced Anxiety', *Neuropsychopharmacology*, 28(9), pp. 1694–1702. Available at: https://doi.org/10.1038/sj.npp.1300232.

Ascherio, A. and Chen, H. (2003) 'Caffeinated clues from epidemiology of Parkinson's disease', *Neurology*, 61(11 Suppl 6), pp. S51-54. Available at: https://doi.org/10.1212/01.wnl.0000095213.86899.21.

Barranco Quintana, J.L. *et al.* (2007) 'Alzheimer's disease and coffee: a quantitative review', *Neurological Research*, 29(1), pp. 91–95. Available at: https://doi.org/10.1179/174313206X152546.

Blanchard, J. and Sawers, S.J. (1983) 'The absolute bioavailability of caffeine in man', *European Journal of Clinical Pharmacology*, 24(1), pp. 93–98. Available at: https://doi.org/10.1007/BF00613933.

Cappelletti, S. *et al.* (2015) 'Caffeine: Cognitive and Physical Performance Enhancer or Psychoactive Drug?', *Current Neuropharmacology*, 13(1), pp. 71–88. Available at: https://doi.org/10.2174/1570159X13666141210215655.

Carswell, A.T. *et al.* (2020) 'The effect of caffeine on cognitive performance is influenced by CYP1A2 but not ADORA2A genotype, yet neither genotype affects exercise performance in healthy adults', *European Journal of Applied Physiology*, 120(7), pp. 1495–1508. Available at: https://doi.org/10.1007/s00421-020-04384-8.

Childs, E. *et al.* (2008) 'Association between ADORA2A and DRD2 Polymorphisms and Caffeine-Induced Anxiety', *Neuropsychopharmacology : official publication of the American College of Neuropsychopharmacology*, 33(12), pp. 2791–2800. Available at: https://doi.org/10.1038/npp.2008.17.

Cornelis, M.C., El-Sohemy, A. and Campos, H. (2007) 'Genetic polymorphism of the adenosine A2A receptor is associated with habitual caffeine consumption', *The American Journal of Clinical Nutrition*, 86(1), pp. 240–244. Available at: https://doi.org/10.1093/ajcn/86.1.240.

Cornelis, M.C., Weintraub, S. and Morris, M.C. (2020a) 'Caffeinated Coffee and Tea Consumption, Genetic Variation and Cognitive Function in the UK Biobank', *The Journal of Nutrition*, 150(8), pp. 2164–2174. Available at: https://doi.org/10.1093/jn/nxaa147.

Cornelis, M.C., Weintraub, S. and Morris, M.C. (2020b) 'Recent Caffeine Drinking Associates with Cognitive Function in the UK Biobank', *Nutrients*, 12(7). Available at: https://doi.org/10.3390/nu12071969.

Fredholm, B.B. (1995) 'Adenosine, Adenosine Receptors and the Actions of Caffeine *', *Pharmacology & Toxicology*, 76(2), pp. 93–101. Available at: https://doi.org/10.1111/j.1600-0773.1995.tb00111.x.

Grzegorzewski, J. *et al.* (2021) 'Pharmacokinetics of caffeine: A systematic analysis of reported data for application in metabolic phenotyping and liver function testing'. bioRxiv, p. 2021.07.12.452094. Available at: https://doi.org/10.1101/2021.07.12.452094.

Hamza, T.H. *et al.* (2011) 'Genome-Wide Gene-Environment Study Identifies Glutamate Receptor Gene GRIN2A as a Parkinson's Disease Modifier Gene via Interaction with Coffee', *PLoS Genetics*, 7(8), p. e1002237. Available at: https://doi.org/10.1371/journal.pgen.1002237.

James, J.E. (2014) 'Caffeine and cognitive performance: persistent methodological challenges in caffeine research', *Pharmacology, Biochemistry, and Behavior*, 124, pp. 117–122. Available at: https://doi.org/10.1016/j.pbb.2014.05.019.

Lamport, D.J. *et al.* (2014) 'Fruits, vegetables, 100% juices, and cognitive function', *Nutrition Reviews*, 72(12), pp. 774–789. Available at: https://doi.org/10.1111/nure.12149.

Landolt, H.-P. (2008) 'Sleep homeostasis: a role for adenosine in humans?', *Biochemical Pharmacology*, 75(11), pp. 2070–2079. Available at: https://doi.org/10.1016/j.bcp.2008.02.024.

Larsson, S.C. and Orsini, N. (2018) 'Coffee Consumption and Risk of Dementia and Alzheimer's Disease: A Dose-Response Meta-Analysis of Prospective Studies', *Nutrients*, 10(10), p. E1501. Available at: https://doi.org/10.3390/nu10101501.

Larsson, S.C., Woolf, B. and Gill, D. (2022) 'Plasma Caffeine Levels and Risk of Alzheimer's Disease and Parkinson's Disease: Mendelian Randomization Study', *Nutrients*, 14(9), p. 1697. Available at: https://doi.org/10.3390/nu14091697.

Lo, J.C. *et al.* (2012) 'Effects of Partial and Acute Total Sleep Deprivation on Performance across Cognitive Domains, Individuals and Circadian Phase', *PLOS ONE*, 7(9), p. e45987. Available at: https://doi.org/10.1371/journal.pone.0045987.

Martyn, D. *et al.* (2018) 'Temporal patterns of caffeine intake in the United States', *Food and Chemical Toxicology*, 111, pp. 71–83. Available at: https://doi.org/10.1016/j.fct.2017.10.059.

McLellan, T.M., Caldwell, J.A. and Lieberman, H.R. (2016) 'A review of caffeine's effects on cognitive, physical and occupational performance', *Neuroscience and Biobehavioral Reviews*, 71, pp. 294–312. Available at: https://doi.org/10.1016/j.neubiorev.2016.09.001.

Meeusen, R., Roelands, B. and Spriet, L.L. (2013) 'Caffeine, Exercise and the Brain', *Limits of Human Endurance*, 76, pp. 1–12. Available at: https://doi.org/10.1159/000350223.

Nehlig, A. (2018) 'Interindividual Differences in Caffeine Metabolism and Factors Driving Caffeine Consumption', *Pharmacological Reviews*, 70(2), pp. 384–411. Available at: https://doi.org/10.1124/pr.117.014407.

Panza, F. *et al.* (2015) 'Coffee, tea, and caffeine consumption and prevention of late-life cognitive decline and dementia: a systematic review', *The Journal of Nutrition, Health & Aging*, 19(3), pp. 313–328. Available at: https://doi.org/10.1007/s12603-014-0563-8.

Popat, R.A. *et al.* (2011) 'Coffee, ADORA2A, and CYP1A2: the caffeine connection in Parkinson's disease', *European journal of neurology : the official journal of the European Federation of Neurological Societies*, 18(5), pp. 756–765. Available at: https://doi.org/10.1111/j.1468-1331.2011.03353.x.

Renda, G. *et al.* (2015) 'Genetic determinants of cognitive responses to caffeine drinking identified from a double-blind, randomized, controlled trial', *European Neuropsychopharmacology*, 25(6), pp. 798–807. Available at: https://doi.org/10.1016/j.euroneuro.2015.03.001.

Retey, J.V. *et al.* (2006) 'Adenosinergic Mechanisms Contribute to Individual Differences in Sleep Deprivation-Induced Changes in Neurobehavioral Function and Brain Rhythmic Activity', *Journal of Neuroscience*, 26(41), pp. 10472–10479. Available at: https://doi.org/10.1523/JNEUROSCI.1538-06.2006.

Reyes, C.M. and Cornelis, M.C. (2018) 'Caffeine in the Diet: Country-Level Consumption and Guidelines', *Nutrients*, 10(11), p. 1772. Available at: https://doi.org/10.3390/nu10111772.

Rivera-Oliver, M. and Díaz-Ríos, M. (2014) 'Using caffeine and other adenosine receptor antagonists and agonists as therapeutic tools against neurodegenerative diseases: A review', *Life sciences*, 101(0), pp. 1–9. Available at: https://doi.org/10.1016/j.lfs.2014.01.083.

Rogers, P.J. *et al.* (2010) 'Association of the Anxiogenic and Alerting Effects of Caffeine with ADORA2A and ADORA1 Polymorphisms and Habitual Level of Caffeine Consumption', *Neuropsychopharmacology*, 35(9), pp. 1973–1983. Available at: https://doi.org/10.1038/npp.2010.71.

Sachse, C. *et al.* (1999) 'Functional significance of a C→A polymorphism in intron 1 of the cytochrome P450 CYP1A2 gene tested with caffeine', *British Journal of Clinical Pharmacology*, 47(4), pp. 445–449. Available at: https://doi.org/10.1046/j.1365-2125.1999.00898.x.

Salinero, J.J. *et al.* (2017) 'CYP1A2 Genotype Variations Do Not Modify the Benefits and Drawbacks of Caffeine during Exercise: A Pilot Study', *Nutrients*, 9(3). Available at: https://doi.org/10.3390/nu9030269.

Santos, C. *et al.* (2010) 'Caffeine intake and dementia: systematic review and meta-analysis', *Journal of Alzheimer's disease: JAD*, 20 Suppl 1, pp. S187-204. Available at: https://doi.org/10.3233/JAD-2010-091387.

Satterfield, B.C. *et al.* (2015) 'TNFα G308A polymorphism is associated with resilience to sleep deprivation-induced psychomotor vigilance performance impairment in healthy young adults', *Brain, Behavior, and Immunity*, 47, pp. 66–74. Available at: https://doi.org/10.1016/j.bbi.2014.12.009.

Schaid, D.J. *et al.* (2002) 'Score Tests for Association between Traits and Haplotypes when Linkage Phase Is Ambiguous', *American Journal of Human Genetics*, 70(2), pp. 425–434.

Skinner, T.L. *et al.* (2013) 'Coinciding exercise with peak serum caffeine does not improve cycling performance', *Journal of Science and Medicine in Sport*, 16(1), pp. 54–59. Available at: https://doi.org/10.1016/j.jsams.2012.04.004.

Smith, A. (2002) 'Effects of caffeine on human behavior', *Food and Chemical Toxicology*, 40(9), pp. 1243–1255. Available at: https://doi.org/10.1016/S0278-6915(02)00096-0.

Southward, K. *et al.* (2018) 'The Role of Genetics in Moderating the Inter-Individual Differences in the Ergogenicity of Caffeine', *Nutrients*, 10(10), p. 1352. Available at: https://doi.org/10.3390/nu10101352.

Stone, B.L. *et al.* (2020) 'Understanding cognitive performance during exercise in Reserve Officers' Training Corps: establishing the executive function-exercise intensity relationship', *Journal of Applied Physiology*, 129(4), pp. 846–854. Available at: https://doi.org/10.1152/japplphysiol.00483.2020.

Taylor, L. *et al.* (2016) 'The Impact of Different Environmental Conditions on Cognitive Function: A Focused Review', *Frontiers in Physiology*, 6. Available at: https://www.frontiersin.org/article/10.3389/fphys.2015.00372 (Accessed: 19 June 2022).

Yamada-Fowler, N. and Söderkvist, P. (2015) 'Coffee, Genetic Variants, and Parkinson's Disease: Gene–Environment Interactions', *Journal of Caffeine Research*, 5(1), pp. 3–10. Available at: https://doi.org/10.1089/jcr.2014.0028.

Yamamoto, V.J. *et al.* (2015) 'Association study in Alzheimer's disease of single nucleotide polymorphisms implicated with coffee consumption', *Archives of Clinical Psychiatry (São Paulo)*, 42, pp. 69–73. Available at: https://doi.org/10.1590/0101-60830000000050.

The effect of a structured rehabilitation programme in post COVID-19, post critically ill patients

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Abstract

Patients suffering from a severe form of COVID-19 are admitted to the ICU for long periods of time and must deal with the consequences of prolonged mechanical ventilation, neuromuscular blockers and bed rest. The aim of the present study is to evaluate the effectiveness of a structured rehabilitation programme in the context of a recovery and rehabilitation center. We utilised a structured multimodal rehabilitation programme consisting of daily 45 minutes of Physical Therapy (respiratory physical therapy, strengthening, standing/upright position and gait retraining, balance, and proprioceptive exercises aerobic exercise) and Occupational Therapy (upper extremity joint strength and range of motion, ADL, functional activities). A total of 18 patients met the criteria and took part in the study. All participants successfully completed the rehabilitation programme. All patients suffered from some comorbidity of cardiovascular and/or respiratory etiology, diabetes or obesity. Significant improvement was observed in all variables: Barthel Index (14.72 ± 14.60 vs 90.28 ± 14.80), MoCA (22.28 ± 3.88 vs 27 ± 2.03), MRC (20.89 ± 6.01 vs 45.67 ± 4.89), 6MWT (23.11 ± 31.34 vs 319.61 ± 92.31) and Borg (dyspnea) (6.67 ± 1.14 vs 4.39 ± 0.85). In conclusion, post COVID-19, ICU survivors who presented with serious and debilitating sequalae, can benefit from the structured programs applied in post – ICU rehabilitation facilities.

Keywords: Post COVID-19, rehabilitation, post critically ill

1. Introduction

Increased survival rates of intensive care unit (ICU) patients over the recent decades have thrown light on the aftermath of their hospitalisation. Post-intensive care syndrome (PICS) consists of persistent physical, mental, and cognitive impairments impacting critical care survivors' quality of life and their ability to function, after their stay in the ICU (Rousseau et al., 2021).

Patients suffering from COVID-19 may present with acute respiratory distress syndrome (ARDS) resulting in admission to ICU for long periods of time and have to deal with the consequences of prolonged mechanical ventilation, neuromuscular blockers and bed rest (Belli et al., 2020; Thomas et al, 2020; Vitaca et al, 2020). A vast number of patients experience single or a combination of PICS symptoms after exiting ICU (Smith and Rahman, 2021). Physical symptoms affecting functionality and activities of daily living (ADL) such as fatigue, weakness and dyspnea are mostly present in the early phase, while cognitive and mental symptoms such as affected memory, concentration and executive functioning manifest later (Smith and Rahman, 2021; Simpson and Robinson, 2020). With regards to physical symptoms, ICU acquired weakness is one of the main drivers of the long-lasting impairments of PICS and is described as a generalised symmetrical muscle atrophy and weakness, not only of the limbs, but also in the muscles participating in swallowing and breathing. In reference to neurocognitive impairments, evidence suggest that hypo/hyperglycemia, previous cognitive

deficits, increased delirium duration and hypoxia correlate with an increased risk of cognitive problems post ICU (Smith and Rahman, 2021; Simpson and Robinson, 2020).

A high percentage of patients surviving critical illness related to COVID-19 will require further care in a rehabilitation focused facility. According to WHO (2021), rehabilitation is defined as "a set of interventions designed to optimise functioning and reduce disability in individuals with health conditions in interaction with their environment". Early rehabilitative interventions are of utmost importance to prevent disability and the adverse effects of immobilisation. They are feasible and safe in all stages of hospitalisation (Schweickert et al., 2009). Interventions are delivered by a broad range of specialists working together in multidisciplinary teams in order to promote the restoration of patient's physical, social and phycological functionality (Simpson and Robinson, 2020).

Evidence suggests that therapeutic exercise and pulmonary physiotherapy can induce great and fast improvements in exercise capacity among COVID-19 patients compared to non−COVID-19 patients rehabilitated after ICU admission due to respiratory failure. Moreover, large improvements in muscle strength, balance and psychosocial status are observed (Udina et al., 2021; Al Chikhanie et al., 2021). Regarding the difficulties in accomplishing ADL for this population, occupational therapists can assess the ability and performance in specific tasks and identify rehabilitation requirements of ADL, including possible cognitive impairments that may present during ADL performance (Christensen, Christensen and Eskildsen, 2022).

However, data regarding recovery in patients hospitalised in ICU after infection with COVID 19 are still insufficient. The aim of the present study is to evaluate the effectiveness of a structured rehabilitation programme in the context of a recovery and rehabilitation facility in post COVID-19, post critically ill patients.

2. Methods

The present study took place at Attica Rehabilitation Center, Greece and included a two-component rehabilitation protocol with physical therapy (PT) and occupational therapy (OT). Patient measurements took place from September 2020 to May 2021.

2.1. Eligibility Criteria

Eligible for inclusion were post critically ill patients who survived COVID-19, underwent mechanical ventilation and were admitted to High Dependency Unit of Attica Rehabilitation Center. Patients were excluded if they could not walk at all or walk unassisted pre-COVID for any reason. Patients with neuromuscular and/or neurodegenerative diseases were also excluded. Patients who met the eligibility criteria were informed for the context of the study and after their consent, they were enrolled.

2.2 Assessment

Patients were evaluated by PT and OT departments at baseline and exit. Reassessment at fixed time periods was not feasible due to the different duration of rehabilitation of each patient. Baseline evaluation included patients characteristics (age, gender, body mass index-BMI, days of ICU hospitalisation), functional status (Barthel Index), cognitive function (Montreal

Cognitive Assessment – MoCA), muscle strength (Medical Research Council - MRC score), exercise capacity (6-minute walk test) and dyspnea (Borg).

Figure 1.High Dependency Unit, Attica Rehabilitation Center.

2.3. Rehabilitation Protocol

2.3.1. Physical Therapy

Patients participated in a multimodal 45-minute, 5 day per week rehabilitation programme supervised by an expert PT that included respiratory physical therapy (manual techniques, ACBT, autogenic drainage, respiratory muscle retraining), strengthening (6 exercises, 2 sets of 8-10 repetitions), standing/upright position and gait retraining, balance and proprioceptive exercises (unstable surfaces, avoiding obstacles, direction change) and aerobic exercise (10-12 minutes constant or interval work, 3-6 Borg).
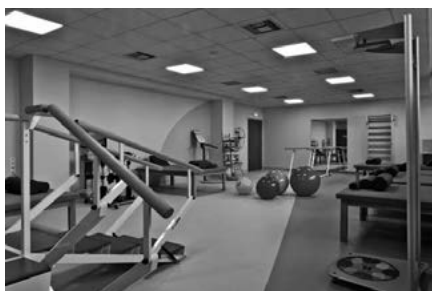

Figure 2. Physical therapy room.

2.3.2 Occupational Therapy

Within the framework of an integrated programme, the patients of the sample received a multimodal 45-minute, 3 days per week intervention from the occupational therapy department. Specifically, they performed activities aiming at increasing upper extremity joint strength and range of motion as well as facilitation and encouragement in performing ADLs, including the use of complex tools and tasks associated with work. Moreover, OT made adjustments in patients' environment to help them carry out ADLs, instructed patients on how to modify a task or adapt the performance of an activity in order to reduce the energy spent and avoid fatigue. Lastly, OT promoted functional activities (e.g., using a phone, brushing teeth

etc.) throughout the day and provided patients with exercises to augment their thinking skills including memory and attention.

Figure 3. Occupational Therapy.

   Outcome measures included duration of rehabilitation (days), Barthel Index score, MoCA score, MRC score, 6mwt distance, and dyspnea. The present study was a part of an ongoing trial regarding post COVID-19 rehabilitation in Attica Rehabilitation Center. Descriptive statistics and paired samples t test were utilised to compare the mean change in the outcomes between baseline and exit. All statistical analysis was carried out with IBM SPSS Statistics for Windows, Version 29 (Armonk, NY: IBM Corp, USA).

3. Results

A total of 18 post-ICU severe COVID 19 patients met the inclusion criteria and took part in the study protocol. From the 18 participants, 11 were males (61%) and 7 (39%) females. Patient characteristics are shown in Table 1. Sample's mean age was 55 years (54.56 ± 14.76). Mean BMI was 25 (25.11 ± 4.21). Mean duration of hospitalisation in the ICU was 78 days (77.83 ± 22.27). Baseline mean functional outcome was Barthel index 15 (14.72 ± 14.60, totally dependent), mean cognitive function was MoCA 22 (22.28 ± 3. 88, mild cognitive impairment - MCI), mean muscle strength MRC 21 (20.89 ± 6.01), mean exercise capacity of 23m 6MWT (23.11 ± 31.34) and mean dyspnea Borg level 7 (6.67 ±1.14).

Table 1. Baseline characteristics and measurements.

Variable	N	Minimum	Maximum	Mean	Std. Deviation
AGE	18	33	79	54.56	14.758
BMI	18	18	33	25.11	4.213
DAYS ICU	18	45	127	77.83	22.272
BARTHEL BASELINE	18	0	60	14.72	14.600
MOCA BASELINE	18	15	27	22.28	3.878
MRC BASELINE	18	11	30	20.89	6.009
6MWT	18	0	87	23.11	31.340
BORG BASELINE	18	4	8	6.67	1.138

All 18 participants completed the study protocol, with excellent adherence since all patients attended the prescribed sessions without adverse effects or severe limitations. Most of the patients had an underlying comorbidity including cardiorespiratory problems, diabetes and obesity. No deaths occurred during the hospitalisation and all patients were discharged. Mean duration of hospitalisation in the rehabilitation facility was 82 days (81.89 ± 24.19). Patients showed significant improvement in all physical and cognitive parameters comparing the baseline and final mean values (Table 2). The sample was characterised by serious limitations in exercise capacity (6MWT). PT produced a significant (p<0.001) improvement in 6MWT in our study group, although many off the patients exited the facility with the presence of physical impairments.

Table 2. Functional and cognitive outcomes.

Variable	Baseline	Exit	Difference	p-value
BARTHEL	14.72 (±14.60)	90.28 (±14.80)	75.56	<0.001
MOCA	22.28 (±3.88)	27 (±2.03)	4.72	<0.001
MRC	20.89 (±6.01)	45.67 (±4.89)	24.78	<0.001
6MWT	23.11 (±31.34)	319.61 (±92.31)	296.5	<0.001
BORG	6.67 (±1.14)	4.39 (±0.85)	-2.28	<0.001

4. Discussion

Post COVID-19 patients hospitalised in the ICU exhibit serious disabling consequences affecting their functionality and cognition (Belli et al., 2020; Thomas et al, 2020; Vitaca et al, 2020). The implementation of multimodal rehabilitation approach can produce beneficial results for these patients and help healthcare professionals systematise and put into order an appropriate intervention regimen.

In summary, our study group demonstrated a significant improvement in all parameters after the implementation of our multimodal rehabilitation programm. Our results are consistent with other studies that examined the effects of rehabilitation in previously critically ill post COVID-19 patients. Al Chikhanie et al (2021), showed a significant improvement in muscle strength and exercise capacity after the completion of a pulmonary rehabilitation (PR) programme in post-acute COVID-19 patients. Interestingly though, they observed a rapid and large recovery among those patients with only 27.6 days in PR. These findings deviate from our study, where patients stayed on average 82 days in rehabilitation. This finding may be due to the more serious limitations in exercise capacity our group demonstrated compared to the other study group (23.11 ± 31.34 vs 138.7 ± 144.4 distance in meters in the 6MWT pre rehab). Udina et al (2021), implemented a short rehabilitation programme (mean duration 8.2 days) in post-ICU, post-COVID-19 patients and demonstrated significant improvements in exercise capacity. Yet again, patients from the previous study exhibited notably better initial exercise capacity performance compared to our group. In our study we also demonstrated a mild cognitive impairment of post COVID-19 patients based on the results of MoCA, which resolved before patients were discharged. Intriguingly, Christensen et al (2022), demonstrated mild cognitive impairment in most cases at discharge which was accompanied with difficulties in performing ADL. Udina et al (2021) also noted baseline mild cognitive impairment, which may be related to delirium or a neurological aspect of COVID-19 primary infection.

Despite the high rate of post-COVID 19 admissions, the sample size of the present study was small. The reason for this limitation was the presence of comorbidities affecting patients' movement pre COVID-19, leading to a big number of excluded cases. Secondly, there were no in between evaluations to observe the trend that data followed through the course of rehabilitation. Thirdly, the absence of a control group may jeopardise the internal validity of the study and render our results questionable. Lastly, the lack of specialised instruments and equipment prevented us from obtaining a broader aspect of data and better understanding of the process of post COVID-19 patient rehabilitation.

In conclusion, post COVID-19 ICU survivors who present with serious and debilitating sequelae, can benefit from the structured programmes applied in post-ICU rehabilitation facilities. Evidence suggests that rehabilitation modalities are safe and effective in post-critical, post COVID-19 patients. Taking into consideration the severity of the initial physical and cognitive status of our patient group, we propose an earlier commencement of rehabilitation. Further research studies with better methodological quality and larger samples will help us pinpoint and understand the proper intervention parameters in order to reduce days of hospitalisation and disability.

Acknowledgements

References

Rousseau, A.-F., Minguet, P., Colson, C., Kellens, I., Chaabane, S., Delanaye, P., Cavalier, E., Chase, J.G., Lambermont, B. and Misset, B. (2021). Post-intensive care syndrome after a critical COVID-19: cohort study from a Belgian follow-up clinic. Annals of Intensive Care, 11(1), p.118.

Belli, S., Balbi, B., Prince, I., Cattaneo, D., Masocco, F., Zaccaria, S., Bertalli, L., Cattini, F., Lomazzo, A., Dal Negro, F., Giardini, M., Franssen, F.M.E., Janssen, D.J.A. and Spruit, M.A. (2020). Low physical functioning and impaired performance of activities of daily life in COVID-19 patients who survived hospitalisation. The European Respiratory Journal, 56(4).

Thomas P., Baldwin C., Bissett B. (2020). Physiotherapy management for COVID-19 in the acute hospital setting: clinical practice recommendations. Journal of Physiotherapy. 66(2), 73–82.

Vitacca, M., Lazzeri, M., Guffanti, E., Frigerio, P., D'Abrosca, F., Gianola, S., Carone, M., Paneroni, M., Ceriana, P., Pasqua, F., Banfi, P., Gigliotti, F., Simonelli, C., Cirio, S., Rossi, V., Beccaluva, C.G., Retucci, M., Santambrogio, M., Lanza, A. and Gallo, F. (2020). Italian suggestions for pulmonary rehabilitation in COVID-19 patients recovering from acute respiratory failure: results of a Delphi process. Monaldi Archives for Chest Disease, 90(2).

Simpson, R. and Robinson, L. (2020). Rehabilitation following critical illness in people with COVID-19 infection. American Journal of Physical Medicine & Rehabilitation, 99(6), p.1.

Udina, C., Ars, J., Morandi, A., Vilaró, J., Cáceres, C. and Inzitari, M. (2021). Rehabilitation in adult post-COVID-19 patients in post-acute care with Therapeutic Exercise. The Journal of Frailty & Aging, pp.1–4.

Christensen, K.A., Christensen, J. and Eskildsen, S.J. (2022). Exploring the Ability to Perform Activities of Daily Living and Cognitive Status after Hospitalization with COVID-19: A Multiple Case Study. Occupational Therapy International, 2022, pp.1–17.

Schweickert, W.D., Pohlman, M.C., Pohlman, A.S., Nigos, C., Pawlik, A.J., Esbrook, C.L., Spears, L., Miller, M., Franczyk, M., Deprizio, D., Schmidt, G.A., Bowman, A., Barr, R., McCallister, K.E., Hall, J.B. and Kress, J.P. (2009). Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomised controlled trial. The Lancet, 373(9678), pp.1874–1882.

Al Chikhanie, Y., Veale, D., Schoeffler, M., Pépin, J.L., Verges, S. and Hérengt, F. (2021). Effectiveness of pulmonary rehabilitation in COVID-19 respiratory failure patients post-ICU. Respiratory Physiology & Neurobiology, 287, p.103639.

Assessment of school readiness using the platform of Kinems in preschool children: A pilot study

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Abstract

Aim of study: Considering reliable and valid assessment tools, the aim of this study is to try and create a series of tasks in the digital environment of Kinems to assess school readiness in preschool children. **Methods:** 6 children were included, 3-6 years of age without any diagnosis of neuromuscular or cognitive impairments. They performed 4 tasks from the reliable and valid Movement Assessment Battery for Children 2nd Ed. (MABC-2) and 4 tasks using Kinems where the games were mimicking the tasks from MABC-2 in order to determine if there is a consistency between the results from the tasks from MABC-2 and those of Kinems. **Results:** The results showed that there was not a significant difference between the tasks assessing "one-leg balance" on MABC-2 and Kinems. In addition, there was consistency between the results with p=1.000. However, the rest of the tasks of the MABC-2 and Kinems, which assessed fine motor skills and the ability of jumping, did not have consistency between them (0.256, 0.250 και 0.115 respectively). **Conclusion:** Kinems could be used in assessing balance since the results were consistent with those of the MABC-2. On the contrary, the rest of the tasks used in Kinems, despite their importance in school readiness and the academic achievement, cannot be used since there was no consistency between the results. Future studies are needed with better configuration to assess the consistency of the other tasks as well.
Keywords: School readiness, neurophysiology of school readiness, Kinems, Microsoft Kinect, neurophysiology of exergames.

1.   Introduction

The transition from kindergarten to school is a very important part of a child's life (Jones et al. 2021). During their enrollment, 1 in 4 children will display some form of developmental delay in verbal communication, language, motor skills and/or social skills (Madigan et al. 2019). A difficulty or deficit in one or more of the aforementioned parameters can challenge the child during their transition into school which can negatively impact their academic achievement. Moreover, deficits in gross motor skills have been associated with reduced self-regulation, hyperactivity and reduced collaboration with their peers and teachers (Jones et al. 2021). School readiness is a broad concept which is based on the readiness of the child, the school setting, and the teachers with the purpose for a smooth transition of the child from kindergarten to school (Williams et al. 2019). Surprisingly, executive functions, motor skills and motor coordination are interconnected (Fels et al. 2014). Therefore, deficits or difficulty in motor control has been correlated with psychosocial, mathematical and grammatic difficulties (Schmidt et al. 2017). Motor skills and physical activity are also associated with school readiness because increased physical activity such as running, jumping, walking, swimming etc. can enhance motor skills which in turn can help children get more prepared for the school environment (Jones et al. 2021). In addition, eye-motor integration and fine motor skills that have to do with copying figures and objects, calligraphy and writing have been

associated with long term academic achievement especially in mathematics (Oberer et al. 2018). Taking all the above into consideration, it is very important to assess a child before entering school so if a motor delay or motor deficit exists then early intervention can take place to help with the above. Such assessments and interventions will limit children entering the school setting when they are not ready and subsequently minimise the chance of them dropping out of school because of the difficulties they may encounter. There are several assessment tools that can evaluate gross and fine motor skills such as the Denver developmental screening test (Perera, 2005) and Early Screening Inventory-Revised (Cameron et al. 2012), but some children might find them boring or not engaging because they are time-consuming and encompass a large number of questions and tasks (Shahshahani et al. 2010).

Thankfully, the development of technology and software applications gives the research community the ability to develop apps for monitoring movement and create games that can assess movement. This can make children more engaging and more curious which can help with coherence (Phelan et al. 2021). Also, it is fun for the children, which will get them more involved. These types of games require active and physical involvement to develop and train motor and cognitive skills (Read and Shortell 2011). Based on Microsoft Kinect, there is a platform with educational games based on movement called Kinems. Kinems games encourage children in verbal, mathematic, cognitive, and motor learning via the movement of their hands (Kourakli et al. 2017). These games have been used in children with developmental disorders such as autism spectrum disorder, attention deficit/hyperactivity disorder and dyslexia and have been found to enhance their cognitive skills (Kourakli et al. 2017). Furthermore, Kinems has been found to improve motor skills in children with learning and motor disorders (Kosmas et al. 2017). Therefore, considering a reliable and valid assessment tool, the aim of this study is to try and create a series of tasks in the digital environment of Kinems to assess school readiness in preschool children.

2.   Methodology

2.1 Objective and hypothesis

The aim of this pilot study is to create a series of tasks to assess school readiness in the digital environment of Kinems considering an already standardised, reliable and valid assessment tool in preschool children. The hypothesis 1 (H1) is that there will be consistency between the results of Kinems games and the assessment tool and therefore Kinems could be used to assess school readiness. The null hypothesis (H0) is that there will be no consistency and therefore Kinems will not be suitable for assessing school readiness.

2.2 Moral and Ethics

During this study all ethical issues had been taken into consideration. More specifically, the parents of children were present during the assessment and consented to the activities involved. Before any kind of measurement, a consent form and an explanation of why this study was being conducted was given to the parents and their children (Sim, 2010). There was always the choice of withdrawal, and personal data remained anonymous and hidden for confidentiality (Henley and Frank 2006). Finally, the assessment tasks did not endanger the psychological or physical state of children (Sim, 2010).

2.3 Population and inclusion/exclusion criteria

Six children between 3-6 years of age were included in the study. The inclusion criteria were the following: Children of 3-6 years of age, without any known intellectual disability and neurodevelopmental, muscular, or neurological disorder.

2.4 Assessment tool

Databases such as Pubmed, Science Direct and Medline were thoroughly searched for reliable and valid standardised assessment tools for gross and fine motor skills to create a series of tasks that can be optimised for the virtual environment of Kinems for it to take place as an assessment tool for school readiness. The assessment tool Movement Assessment Battery for Children Second Edition (MABC-2) was chosen for the assessment of gross and fine motor skills. Based on Brown and Lalor (2009), MABC-2 is good, reliable, valid, and a widely used assessment tool, which is not time consuming and easy to use for the examiner.

2.5 Design of the tasks used for Kinems

From MABC-2 the tasks "one-leg balance", "posting coins", "jumping onto mat" and "drawing trail" were chosen. Meanwhile, a Microsoft Excel table consisting of the movements being taken place during these tasks was sent by the team of Kinems. Inside the platform of Kinems based on the movements held within each task there were game options that fulfil these movements. So, games that imitate best the MABC-2 tasks were chosen. More specifically, for the task "one-leg balance", the game "Do Like" was chosen. For the task "posting coins", the game "Space motif" was chosen. For the task "jumping onto mats", the game "Yeti jump" was chosen and for the "drawing trail" task, the game "Zoko write" was chosen.

2.6 Measurement process of Kinems

The Kinect camera was placed on a chair at 70 cm from the floor so the child was accurately detected. The child was placed 1,5-2 meters away from the Kinect camera based on the Kinect manual. On the floor, the distance between the camera and the area of the child's movement was marked by tape so the child could see it and stay in the right position. Their hand of preference was used.

Next, the child was placed at the spot with the tape and then the measurement began. Instructions were given and then the child performed it on its own. If there was a misunderstanding or a difficulty with what the child needed to do, further explanation was given. There was also a chair for the child to rest between games if needed.

2.7 Measurement process of MABC-2

After the completion of the Kinems games, an assessment with MABC-2 with the tasks chosen from it (one-leg balance, drawing trail, posting coins, jumping onto mat) took place to see if there was any kind of correlation between the measurement of the Kinems with those of the MABC-2. After each task the child sat on a chair to rest for a couple of minutes if needed. During each task, instructions of what the child needed to do were given and the results of the tasks were written down by the researcher.

3.   Statistical Analysis

This series of games in Kinems was designed to determine if the tasks that Kinems measure can be correlated with the equivalent task of the MABC-2. But since correlation concerns paired values, the following tests were used based on the data needed to manage (Shapiro-Wilk, McNemar and Wilcoxon sign rank). SPSS 26.0 (IMB Corp. Released 2019. IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp) was used for the statistical analysis of the data. The categorical variables were described with relative (%) frequency distribution and the continuous variables with mean value (M) and standard deviation (SD) or, in the case of the absence of normal distribution tested with Shapiro-Wilk, with median value (Md) and inter-quartile range (IQR). The Shapiro-Wilk test was selected for the examination of normal distribution in the continuous variables such as those in "Yeti jump", "Jumping on mats", "Zoko write", "Drawing trail", "Space motif" and "Posting Coins" activities. The reason that Shapiro-Wilk test was chosen is because the number of subjects used in the study was less than 50 (Mishra et al. 2019). McNemar test for related sample was used to check the consistency between the measurements of Kinems and MABC-2 in categorical data such as in those in "One-leg balance" and "Do Like" activities (Fagerland et al. 2013).

The Student's t test for related samples was used to check the difference of the mean values in the continuous data. If the conditions for normality allocation was violated then, the non-parametric test Wilcoxon signed ranks was used (Kim 2014). The t test was used for the data of "Posting coins", "Space motif", "Drawing trail" and "Zoko write" activities since normality was not being violated and Wilcoxon sign ranks test was used for the data of "Yeti jump" and "Jumping on mats" activities since there was violation of the normality. In all the data, $\alpha=0,05$ was defined as the rejection baseline of the null hypothesis. In the results of the Student's t test an absolute value of correlation coefficient r between 0 and 0.19 signified "very weak", between 0.2 and 0.39 signified "weak", between 0.40 and 0.59 signified "moderate", between 0.60 and 0.79 signified "strong" and between 0.80 and 1 signified "very strong" correlation (Bland and Altman 1986).

4.   Results

The results of McNemar test showed absolute consistency between the measurements of Kinems and MABC-2 in the ''Do like'' and ''One leg balance'' activities in both legs (p=1) which point out the reliability of the measurement (Table 1).

Table 1. Task 1: McNemar test results

		SD1LB_**Right**		Total	P value
		Success	Failures		
New 1LB_ Right	Success	3 (75%)	1 (50%)	4 (66,7%)	1.000
	Failure	1 (25%)	1 (50%)	2 (33,3)	
	Total	4 (100%)	2 (100%)	6 (100%)	
		SD1LB_**Left**			
		Success	Failures	Total	P value
New 1LB_ Left	Success	2 (66,7%)	2 (66,7%)	4 (66,7%)	1.000
	Failure	1 (33,3%)	1 (33,3%)	2 (33,3)	
	Total	3 (100%)	3 (100%)	6 (100%)	

The two methods for the 2nd task (in seconds) presented moderate negative correlation (r=-0.446) which was not statistically significant (Student's t test p=0.376) (Table 2). The average score of Kinems was 37.6 points higher than the score of MABC-2 [95% confidence interval (CI): -112.8, 37.7] but it was not statistically significant. [t (5) =-1.283, p=0.256].

Table 2. Task 2: Paired sample t test results

	Mean			Paired Differences							Pair Correlation	
	Mean	Standard Deviation	Standard error Mean	Mean Differ ence	Standard Deviation	Standard error Mean	95% Confidence		t	df	P value	Correlation Coefficient	P value
							Lower	Upper					
New _sec.	68.9	67.1	27.4	-37.6	71.7	29.3	-112.8	37.7	-1.283	5	0.256	-0.446	0.376
SD sec.	31.4	9.2	3.7										

The two methods for the 3rd task did not differ significantly (Wilcoxon signed rank test p=0.250). The median for the Kinems and MABC-2 was 1.00 (IQR=0,10) and 0.90 (IQR=1,00) respectively. The Kinems score was the same as the one in MABC-2 for 3 of the 6 cases. For the other 3 it was higher but in no circumstance was lower (Table 3).

Table 3. Task 3: Results of Wilcoxon signed rank test

	Mean						Arrangement			
	Mean	Standard Deviation	Median	IQR	Lower	Upper	Cases (n) which new was lower to SD	Cases (n) which new was the same as SD	Cases (n) which new was higher to SD	P value (exact)
New_Ratio	0.93	0.16	1.00	0.10	0.60	1.00	0	3	3	0.250
SD_Ratio	0.63	0.50	0.90	1.00	0.00	1.00				

The two methods for the 4th task showed weak positive correlation (r=0.126) which was not statistically significant (Student's t test, p=0.813). On average, the Kinems score was 15.8 points higher than the score of MABC-2 [95% confidence interval (CI): -40.1, 8.5], but the difference was not statistically significant [t (5) = -1.676, p= 0.155] (Table 4).

Table 4. Task 4: Results of paired sample t test

	Mean			Paired Differences								Pair Correlation	
	Mean	Standard Deviation	Standard error Mean	Mean Differ ence	Standard Deviation	Standard error Mean	95% Confidence		t	df	P value	Correlation Coefficient	P value
							Lower	Upper					
New_ Sec	25.0	23.2	9.5	-15.8	23.1	9.4	-40.1	8.5	-1.676	5	0.155	0.126	0.813
SD Sec	9.2	5.6	2.3										

5. Discussion

The results of the tasks "one-leg balance" and "Do Like" showed absolute consistency between their measurements for all 6 subjects (p=1.000). The reason for this consistency between the two might be because the parameters of Kinems are very similar with "one-leg balance" since in both cases the participants are asked to lift their leg and try to maintain balance.

This is quite important because balance is part of gross motor function which is crucial during the life of a developing child. It helps the child run, jump, swim, throw a ball and remain independent during their life. Also, it can help in school for example when playing with their friends, do their preferred sport and socialise which drives them to a better academic course (Barnett et al. 2016) since gross motor function has been linked to better academic achievement, self-regulation, and social behaviour (Jones et al. 2021). Balance is also crucial for the child because everyday activities and important tasks such as walking, climbing up and down stairs (which schools often have) and jumping (which children tend to do when playing) rely on balance (Verbecque et al. 2021).

Kinems can assess balance early on in a fun and not time-consuming way. Moreover, different games or configurations can assess dynamic balance as well as static balance (Verbecque et al. 2021). The positive results of this study suggest that physiotherapy can be implemented in school, since it can intervene with motor deficits and delays, by performing functional and strengthening exercises and activities in the school yard with the child's peers aiming at enhancing their motor skills (McCoy et al. 2018). Kinems could contribute to such interventions.

In tasks 2 (Space motif and posting coins), 3 (Yeti jump and jumping on mats) and 4 (drawing trail and Zoko write) there was no statistical significance between MABC-2 and Kinems measurements (p=0.256, p=0.250 and p=0.115 respectively). This indicated that there was no consistency between the two approaches.

For task 2, and specifically the ''posting coins'' activity, Kinems uses a different configuration to MABC-2 which focuses on the child's fine motor skills and eye-hand coordination to grab and insert the coin into the coin box. In the MABC-2 "Space motif" activity, to move the objects needed, the child uses the whole upper limb to insert the object into the tube. Furthermore, technological limitations associated with the camera sensor may also increase negative performance by failing to detect a child's movement correctly. This could be overcome with different configuration and with a game based on fine motor skills that mimics "posting coins" more accurately.

With regards to task 3, again there were differences between Kinems and MABC-2. Although both approaches involve jumping, in the case of MABC-2 the child did 5 consecutive forward jumps whereas in Kinems, after selecting the desired answer, the child did a vertical jump. Therefore, the Kinems assessed the cognitive ability of the child as well as its physical ability to jump. However, regardless of physical performance, if the answer to the question was wrong, the outcome of the task was negative. An alternative configuration in Kinems with a game that does not assess the cognitive ability and measures only jumping would overcome this association.

Task 4 is also different between the Kinems and MABC-2 approaches. In the "drawing trail" task the participant holds a pencil and uses their fine motor skills to draw the line whereas in the "Zoko write" activity the participant uses their whole upper arm to virtually draw the path. Again, technological limitations associated with the camera sensor may lead to erroneous results due to failure to detect movement which negatively influences the game and the data. Perhaps with different configuration in Kinems settings and with a game that uses fine motor skills in a way that imitates more accurately the "drawing trail" activity, the results would be different.

The present study indicates that only 4 tasks from MABC-2 could be configured for Kinems. Therefore, there is a need for a different valid and reliable assessment tool that comprises activities which can be configured to Kinems. This would lead to a more holistic assessment of the child with possibly better results. Therefore, future studies are needed with a larger sample size and with Kinems games that mimic more accurately the activities of the assessment tool used so school readiness can be better assessed.

References

Bland, J.M. and Altman, D.G. (1986) 'Statistical methods for assessing agreement between two methods of clinical measurement', Lancet, pp. 307-310.

Brown, T. and Lalor, A. (2009) 'The Movement Assessment Battery for Children-Second Edition (MABC-2): A Review and Critique', Physical & Occupational Therapy In Pediatrics, 29(1), pp. 86-103.

Cameron, C.E., Brock, L.L., Murrah, W.M., Bell, L.H., Worzalla, S.L., Grissmer, D. and Morrison, F.J. (2012) 'Fine motor skills and executive function both contribute to kindergarten achievement', Child Development, 83(4), pp. 1229-1244.

Fagerland, M.W., Lydersen, S. and Laake, P. (2013) 'The McNemar test for binary matched-pairs data: mid-p and asymptotic are better than exact conditional', BMC Medical Research Methodology, 13(91), pp. 1-8.

Fels, I.M.J., Wierike, S.C.M., Hartman, E., Elferink-Gemser, M.T., Smith, J. and Visscher, C. (2014) 'The relationship between motor skills and cognitive skills in 4–16 year old typically developing children: A systematic review', Journal of Science and Medicine in Sport, 18(6), pp. 697-703.

Forrest, C.B., Bevans, K.B., Riley, A.W., Crespo, R. and Louis, T.A. (2011) 'School Outcomes of Children With Special Health Care Needs', Pediatrics, 128(2), pp. 303-312.

Fryar, C.D., Kruszon-Moran, D., Gu, Q., Carroll, M, and Ogden, C.L. (2021) 'Mean Body Weight, Height, Waist Circumference, and Body Mass Index Among Children and Adolescents: United States, 1999–2018', National Health Statistics Reports, no. 160, pp. 1-24.

Henley, L.D. and Frank, D.M. (2006) 'Reporting Ethical Protections in Physical Therapy Research', Physical Therapy, 86(4), pp. 499-509.

Jones, D., Innerd, A., Giles, E.L. and Azevedo, L.B. (2021) 'The Association between Physical Activity, Motor Skills and School Readiness in 4–5-Year-Old Children in the Northeast of England', International Journal of Environmental Research and Public Health, 18(22), pp. 1-13.

Kim, H.Y. (2014) 'Statistical notes for clinical researchers: Nonparametric statistical methods: 1. Nonparametric methods for comparing two groups', Restorative Dentistry & Endodontics, 39(3), pp. 235-239.

Kourakli, M., Altanis, I., Retalis, S., Boloudakis, M., Zbainos, D. and Antonopoulou, K. (2017) 'Towards the improvement of the cognitive, motoric and academic skills of students with special educational needs using Kinect learning games', International Journal of Child-Computer Interaction, 11, pp. 28-39.

Madigan, S., Browne, D., Racine, N., Mori, C. and Tough, S. (2019) 'Association Between Screen Time and Children's Performance on a Developmental Screening Test', JAMA Pediatrics, 173(3), pp. 244-250.

McCoy, S.W., Effgen, S.K., Chiarello, L.A., Jeffries, L.M. and Tezanos, A.G.V. (2018) 'School-based physical therapy services and student functional performance at school', Developmental Medicine & Child Neurology, 60, pp. 1140-1148.

Mishra, P., Pandey, C.M., Singh, U., Gupta, A., Sahu, C. and Kashri, A. (2019) 'Descriptive Statistics and Normality Tests for Statistical Data', Annals of Cardiac Anaesthesia, 22(1), pp. 67-72.

Oberer, N., Gashaj, V. and Roebers, C.M. (2018) 'Executive functions, visual-motor coordination, physical fitness and academic achievement: Longitudinal relations in typically developing children', Human Movement Science, 58, pp. 69-79.

Read, J.L. and Shortell, S.M. (2011) 'Interactive games to promote behavior change in prevention and treatment', Journal of the American Medical Association, 305(16), pp. 1704-1705.

Shahshahani, S., Vameghi, R., Azari, N., Sajedi, F. and Kazemnejad, A. (2010) 'Validity and Reliability Determination of Denver Developmental Screening Test-II in 0-6 Year-Olds in Tehran', Iranian Journal of Pediatrics, 20(3), pp. 313-322.

Schmidt, M., Egger, F., Benzing, V., Jager, K., Conzelmann, A., Roebers, C.M. and Pesce, C. (2017) 'Disentangling the relationship between children's motor ability, executive function and academic achievement', PLoS One, 12(8), pp. 1-19.

Sim, J. (2010) 'Addressing Confl icts in Research Ethics: Consent and Risk of Harm', Physiotherapy Research International, 15(2), pp. 80-87.

Verbecque, E., Klingels, K., Rameckers, E., Ferguson, G. and Smits-Engelsman, B. (2021) 'The construct of balance control in primary school-aged children: Unidimensional and task-specific', Human Movement Science, vol. 79.

Williams, P.G., Lerner, M.A., Council of early childhood. and Council on school health. (2019) 'School Readiness', Pediatrics, 144(2), pp. 1-17.

Dementia Counselling Center, Municipality of Iraklion Attica-Greece Objectives & Interventions

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Abstract

The term healthy and active ageing defines the process through which the physical, social and mental health of the elderly is ensured, so that they continue to live without restrictions and are provided with equal opportunities for work and social participation. This is the direction that the programme 'Dementia friendly communities: Building Counselling Services network for Dementia within municipalities all over Greece' moves. It is implemented under the responsibility and cooperation of the Athens Alzheimer Association, the Hellenic Healthy Cities Network of W.H.O. and the Municipality Health Prevention Centers. The Municipality of Iraklio Attica, inaugurated the operation of such a structure, in April 2019. The Dementia Counselling Center aims in the effective intervention of the community, through the development of mental empowerment groups. The intervention extends to three levels: Firstly, the evaluation through scientific tools such as MMSE, CDT and GDS, secondly the operation of Mental Empowerment Groups (memory exercises, attention, speech, orientation exercises, material re-learning) and thirdly the interconnection with specialised mental health services. The general objectives achieved with the operation of mental empowerment groups utilise the Local Government structures such as day centers for the elderly, day care centers for the elderly etc., for direct access to the target group. The specific goals achieved through the programme, are social, psychological, mental, physical, while the ultimate goal remains the creation of an ageing and dementia friendly community through the transition to a society where people will be treated equally and will be able to use their potential.

Keywords: Dementia, Counselling Center, Third Age, Mental Empowerment

1. Introduction

One of the most significant changes of our times, is the increasing rate of elderly individuals each year. According to Eurostat, 18.5% of the EU population is over 65 years old and 5% is over 80 years old. Furthermore, in 2080 the percentage of over 80 is expected to be around 12%. The figures mentioned above, demonstrate the necessity for the creation of a society friendly to people over the age of 60 years. Through this goal, terms like healthy ageing and active ageing were originated.

Healthy ageing is defined as the process of maximising opportunities for physical, social and mental health so that older people are able to actively participate in society without discrimination and enjoy an independent and good quality life.

Active ageing means that life goes on without restrictions and therefore society should value and honour at increasing rates the contribution of older people and provide them with opportunities to continue working and sharing their experiences and expertise with younger people, to continue to actively participate in society as equal members, and to live as healthy

and active as possible, enjoying a better quality of life. (Papathanasopoulou, 2015; World Health Organization-W.H.O.).

1.1 Axes

The main axes of the policy for the active ageing of a healthy city are (Papathanasopoulou, 2015):

- Health-physical and mental-Promotion, Prevention and Health Education
- Social Environment-Problems, needs
- Equality
- Economic environment.
- Urban Environment-Accessibility and infrastructure of the city. Elderly-friendly cities
- Transport
- Safety
- Sport
- Culture
- Entertainment
- New technologies

As mentioned above, healthy, and active ageing is defined as the process through which the physical, social, and mental health of older people is ensured, so that their lives continue without restrictions, and they are provided with equal opportunities for work and social participation.

- The Dementia Counselling Center of the Municipality of Iraklion Attica is moving in this direction:
- Project: "Dementia-Friendly Communities: "Building Counselling Services network for
- Dementia within municipalities all over Greece"
- Implementation: Athens Alzheimer Association, W.H.O. Hellenic Healthy Cities
- Network (EDDYPPY) and the Municipality Health Prevention Centers.
- Documentation: Dementia, the most common form of Alzheimer's disease, is a major medical, social, and economic problem due to the increase in life expectancy.

1.1.1 Activities

The visualisation of the innovative service model came into reality trough execution of the targets of the programme. The training of the executives of the municipality of Iraklion, Attica who are responsible for the operation of the center, began at the beginning of 2018. The education was based on a theoretical modern and asynchronous training and practical level by the Athens Alzheimer Association.

The selection and preparation of the A' KAPI (Day Center for the Elderly) site, as the space that will host the station happened due to the proximity to the city center and the autonomy it provides for the implementation of the action. The inauguration of the Dementia Counselling Station under the auspices of the Athens Alzheimer Association and EDDYPPY with the cooperation of the Municipality of Iraklion, Attica took place in April 2019. Furthermore, during May of 2019, the executives gave speeches in the other 4 day centers for the elderly of the municipality, to inform and raise awareness of the members on the issue of dementia prevention and the operation of the Counselling Center, in the city (Karampetsou and Plaka, 2019).

2. Methodology

2.1 Level of Interventions

- The evaluation of the individuals included in the groups is carried out through the scientific tools MMSE, CDT and GDS.
- Due to the increased participation and the great impact that the structure had on the reference population, there are 2 mental empowerment groups in A' KAPI and 2 additional groups in the C' Day Center for the elderly.
- Networking and interconnection with specialized health and mental health services (Karampetsou and Plaka, 2019).

2.2 Mental Empowerment Programmes

Mental empowerment programmes are one of the most effective non-pharmaceutical interventions and aim at stabilising or even improving the mental state of the individual through the utilisation of mental functions that remain at a satisfactory level (Alzheimer's Society of Athens).

The programmes include the following:
- exercises of memory, attention, speech, etc.
- orientation in space, time, and timeliness.
- re-learning of material (names of acquaintances, objects, etc.).
- training in the application of mnemonic techniques and the use of external mnemonic aids, etc. (Athens Alzheimer Association).

2.3 Project Objectives

- The implementation of an innovative service model for dementia.
- The utilisation of structures belonging to the Local Government such as KAPIs, Day Care Centers for the elderly (K.I.F.I), etc. but also of human resources such as health professionals, social caregivers, etc.
- Minimisation of costs, management at the local and sub-local level and direct access to the target group.
- The prevention, maintenance, and improvement of the mental and functional level of the individual through his/her involvement in individualised and purposeful activities. (Karampetsou and Plaka, 2019).

- Through the participation of the individual in the empowerment groups, the following specific goals are achieved (Karampetsou, 2000):

- Social:
- Creating social and interpersonal relationships, skills and values; avoiding social isolation
- Training or retraining the individual to function in a team and to co-operate in harmony with other team members
- Making creative use of one's free time
- Psychological:
- Psychological and emotional relief and expression.

- Developing empathy
- Developing the sense of self-esteem
- Intellectual:
- Maintaining the level of cognitive functions such as memory and perception
- Improving attention span.
- Developing individual's initiative and responsibility.
- Providing opportunities for creative expression.
- Physical:
- Improving the general physical condition of the individual.
- Improving the coarse and fine mobility.
- Maintaining or increasing muscle strength and endurance.
- Improvement of motion coordination and especially of the visual – motor coordination (Karampetsou, 2000).

2.4 Ultimate goal

Creating a friendly city for both older people and those suffering from dementia, by moving towards a society where people are treated equally and are able to exploit their potential.

3. Results

Today Iraklio Municipality operates:

- 4 mental strengthening groups for prevention
- 1 group of physical empowerment (Karampetsou and Plaka, 2019).

The beneficiaries of mental empowerment groups exceed 110.

Already, all participants in the programmes have significantly improved their functions on a mental, psychological, spiritual, social, and physical level.

Even in the period of the pandemic of Covid-19 and its consequences, the Department of Public Health Protection of Iraklion, recognising the often-insurmountable difficulties faced by people of the third age, ensured that they received timely material at home. This helped them creatively engaged in order to maintain their mental functions, despite all the adverse conditions and the complete isolation to which they were forced.

4. Discussion

The Dementia Counselling Center of the Municipality of Iraklion, Attica, is now officially an example of good practice, featured in the relevant good practice bulletin on the website of the Panhellenic Union of General Secretaries of Local Government "Kleisthenis" (see: http://kleisthenis.org/, http://www.otapractices.gr/).

The Dementia Counselling Center of the Municipality of Iraklion, Attica is an example of good practice both for Greece and abroad. Indicatively, we mention that a delegation of Iranian officials and high-ranking officials of the World Health Organization (W.H.O.), paid a visit to our city in January 2020, and were informed about the goals and results from the operation of the station (Karampetsou and Plaka, 2019).

4. Conclusion

The maintenance of good physical, spiritual and mental health of older people in a structured social environment requires collaborations at an interdisciplinary level. Achieving this will decisively contributes to the maintenance of social cohesion and the optimisation of the quality of life of the elderly, as well as the population of the city as a whole (Karampetsou and Plaka, 2019).

References

Athens Alzheimer's Association. Retrieved from: https://alzheimerathens.gr/chriazome-enimerosi/, (09/12/2020).

Best OTA practices. Retrieved from: http://www.otapractices.gr/, (09/12/2020).

Karampetsou, M., (2000), Occupational Therapy Intervention in patients with Alzheimer's disease in KAPI and at home in "Gerontology and Geriatrics-Addendum", publications: Synedron. Athens.

Karampetsou, M., Plaka, A., (2019), Dementia Center for the elderly of the Municipality of Iraklion, Attica. Objectives & interventions, 15th Panhellenic Conference of the W.H.O.- Hellenic Healthy Cities Network (EDDYPPY), November 2019.

World Health Organization (W.H.O.). Retrieved from:

https://unric.org/el/%CF%80%CE%B1%CE%B3%CE%BA%CE%BF%CF%83%CE%BC%CE%B9%CE%BF%CF%83-%CE%Bfp%CE%B3%CE%B1%CE%BD%CE%B9%CF%83%CE%BC%CE%BF%CF%83-%CF%85%CE%B3%CE%B5%CE%B9%CE%B1%CF%83-%CF%80%CE%BF%CE%B9%CF%8C%CF%82-%CE%B5%CE%AF/, (09/12/2020).

Panhellenic Association of General Secretaries of Local Government. Retrieved from: http://kleisthenis.org/, (09/12/2020).

Papathanasopoulou, D., (2015), Main pillars of healthy cities for the 6th phase, 2014-2019, 11th Panhellenic Conference of the W.H.O.- Hellenic Healthy Cities Network (EDDYPPY), June 2015.

A machine learning implementation to multiple sclerosis signal conduction through nervous system for decision support

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Abstract

Research in Multiple Sclerosis (MS) has attracted extensive attention from the scientific field of machine learning due to its dependency on a variety of medical parameters. Therefore, a vast amount of produced clinical data can shed light on the nature of MS disease in terms of evaluation and classification through a machine learning exploration framework. Accordingly, the current work elaborates on the behaviour of neural conduction between two points of the nervous system through machine learning information analysis provided from a published multi-year dataset. Such data has been derived by motor evoked potential (MEP) measurements carried out during medical visits of MS patients. Based on the aforementioned MEP measurements, the present work suggests a prediction model quantifying the damage to the central nervous system through the Expanded Disability Status Scale (EDSS) parameter. To achieve this, different machine learning regression models were utilised, having as essential input parameters the properties of the propagating signal in the central nervous system. The obtained accuracy of the prediction model is 96%.

Keywords: machine learning, multiple sclerosis, EDSS, prediction models, gradient boosting, polynomial regression, hyperparameter tuning

1. Introduction

Multiple sclerosis (MS) is a chronic autoimmune disease that causes progressive demyelination and degeneration of the central nervous system. Patients gradually develop severe neurological disease and a progressive degree of disability. The actual causes of the disease are not yet clear, although medical research has advanced and achieved remarkable results (Carr et al, 2010).

There are several diagnostic tests for MS, such as blood tests, MRI scans, neurological examinations, lumbar punctures, and evoked potential tests. Evoked potential tests are divided into four main categories depending on the type of stimulus: visual (VEP), auditory (AEP), somatosensory (SSEP), and motor evoked potentials (MEP). Motor evoked potentials can result from an activated number of motor units stimulating the motor area of the brain (Fernández et al, 2013).

In the present work, we use a dataset (Fernández et al, 2013) consisting of measurements of MEP from four different systems. Technically, the MEP method requires an electromyography (EMG) unit connected to a magnetic stimulator and an external trigger system to synchronise EMG and stimulator. The overall MEP signal is represented by the sweep of the oscilloscope when the gain of the amplifier is properly set for each individual

case to be assessed. In addition, the coil of the stimulator must be correctly positioned on the area of interest (Fernández et al, 2013).

1.1 Related work

Recently, several important research works have been conducted applying machine learning techniques to data related to different MS metrics to contribute to the prediction of disease progression as well as to the correct behaviour towards MS patients in crowded rooms. Some of the most important works follow.

The present work is based on a dataset created by Yperman et al., 2020. The work was a first approach to ML techniques on MS data, where widely used ML methods were applied, namely random forest and logistic regression classifiers, to predict disability progression of MS patients after two years. Additional time series features were included in the dataset to improve the performance of the algorithms evaluated, with the Random Forest (RF) algorithm found to be the most efficient.

Hu et al, 2022 have applied ML classification methods to raw data provided by embedded sensors in building walkways to distinguish MS patients from the rest of the walkers, as their gait differs from that of standard walkers. The Support Vector Machine (SVM) model was used as the main classifier for eleven variables of the standard gait feature set and achieved high accuracy and precision in terms of classification. The work in Garcia-Martin et al, 2021 presents an analysis of data recorded by optical coherence tomography (OCT) to diagnose early-stage MS by analyzing retinal thickness. The proposed method used Cohen's d effect size to determine the layers with the largest capacity, while Support Vector Machine (SVM) and Feed-Forward Neural Network (FFNN) were the main classifiers. Brugnara et al, 2020 trained a neural network using an MRI dataset of 334 MS patients, consisting of F1 scores, DICE coefficients, and concordance correlation coefficients (CCC). Subsequently, a dataset from another institution with 82 patients of the same type of metrics was tested, with successful results in terms of accurate assessment of disease burden. Eitel et al, 2019 presents a Convolutional Neural Network (CNN) training method with Alzheimer's disease data based on Layer-wise Relevance Propagation (LRP) and investigates whether the transparency approach could be a reliable decision-making method in MRI-based diagnosis for MS patients.

The rest of this paper is organised as follows: In section 2, the structure of the provided dataset is described in concert with the metadata regarding the visits of the patients to the hospital. The three different mathematical models which were applied to the dataset with some of their key features are also presented in the same section. In section results, the accuracy and different metrics of the developed prediction models are thoroughly described. Finally, concluding remarks and proposals for future work are given in the last section of discussion.

2. Methodology

2.1 Dataset Analysis

A brief description of the provided dataset (Yperman et al, 2022) is required in order to specify the goal and the contribution of the current work. In this context, the provided dataset consists of approximately 100000 MEP measurements obtained from 963 patients, 582 of whom have at least one Expanded Disability Status Scale (EDSS) measurement, namely a

parameter that quantifies the disability of the patient due to MS. The total number of hospital visits is 5586, and the data recording time window is six years in a row. It should be noted that for each hospital visit, a complementary set of metadata related to the patients' characteristics, such as age, time of visit, type of machine used to conduct a MEP measurement etc., was being created. Therefore, the combination of the provided dataset and metadata illuminate all the aspects of the MS behavior.

To this context, the entire dataset contains 18 attributes captured through a well-structured relational database model providing detailed information about the signal measurements conducted both in the hands and in the feet. The aforementioned measurements focused on the stimulation of nervous system by having launched a signal pulse from one place and measured it at some other point of the nervous system (hands and feet). The characteristics of the measured signal, such as peak-to-peak amplitude, latency or pulse width correlated with similar measured signals, are used to either quantitatively assess patient disability or define the MS type that the patient belongs to. The analysis of signal conduction either in frequency or time domain provided an alternative approach of categorising MS patients while it enhanced the cross-validation process of the produced results.

In particular, the current dataset provides a great number of amplitude values for each received signal which lay in a time slot of 100 ms. Some representative resulting signals of the provided dataset are depicted in Figure 1. It should be highlighted that signals with no readable data or with a different type of discrepancies in their shape along the time window were not taken into consideration in our data analysis. Besides, all the existing spikes at the beginning of the signal, caused by the machines conducting the MEP measurements, were removed during the pre-processing stage.
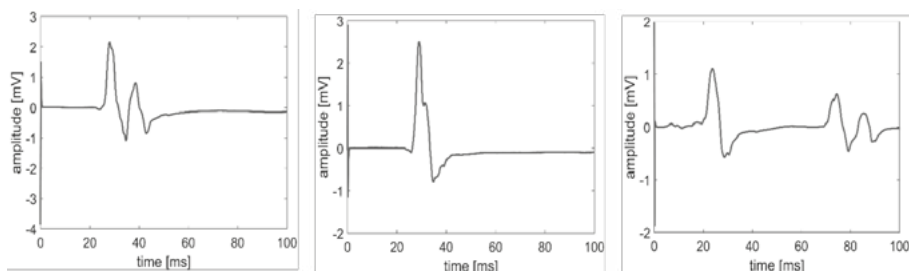

Figure 1. Representative resulting signals of the current work.

As there is a great variety of signals in terms of pulse shapes and voltage peaks, it is necessary to track down the most effective and critical features of each pulse. Thus, an in-depth analysis of the signal pulse, either in the time or frequency domain, plays a critical role for such type of data mining. To this end, the derived information from the former data analysis is utilised as input parameters to the applied regression models constituting the train and the test dataset.

Figures 2-3 represent in every detail all the input parameters regarding the properties of the propagating signal along the nervous system. Note, that apart from the maximum and minimum voltage peaks in concert with the timepoint that occurs, the current study has imported into its analysis the energy of the pulse, the number of maximum/minimum locals

as well as their location in the time domain having as a reference the timepoint of maximum and minimum peak respectively. Hence, the sign of the former time difference indicates whether the local maximums/minimums occur after or before the maximum/minimum peak. Therefore, this approach facilitates an implicit analysis of the signal in the frequency domain. It should be noted that there are three categories of local maximum/minimum depending on their voltage peak, as shown in the Table 1.
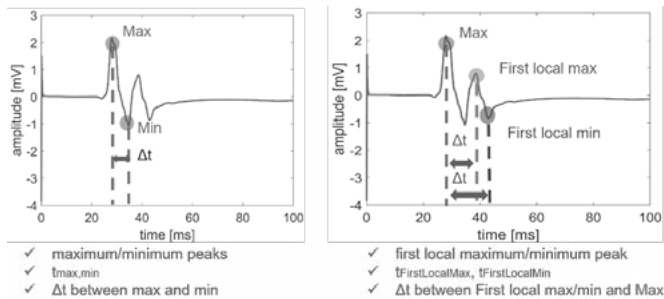

Figure 2. Input parameters regarding the voltage peaks with the corresponding timepoints that occur.
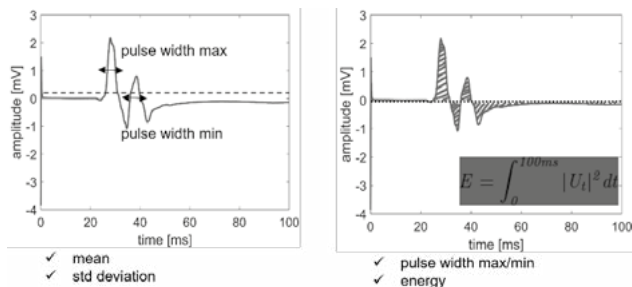

Figure 3. Additional input parameters.

Table 1. Definition of three categories of local maximum/minimum.

category-1	category-2	category-3
voltage peak >=0.75 maximum	voltage peak >=0.5 maximum	voltage peak >=0.25 maximum
voltage peak <=0.75 minimum	voltage peak <=0.5 minimum	voltage peak <=0.25 minimum

Note that there are additional input parameters which have been derived from the provided metadata, such as age, gender, anatomy (hand or foot), the team that conducted the MEP measurement etc. The total amount of input parameters that have been taken into consideration throughout the current work is 35. An indicative representation of the distribution of the utilised input parameters is presented in the following Figure 4. Due to the vast amount of input parameters, it is not feasible to present all their distributions in the current paper.

In this context, Figure 4 shows that the distributions of the input parameters are described either by a close to Uniform or Gaussian distribution. Besides, there are small differences between the mean and median values facilitating the development of an accurate and robust prediction model. Similarly, a few extreme events occur at the tail of the distributions, which enhances the convergence of the employed machine learning models.
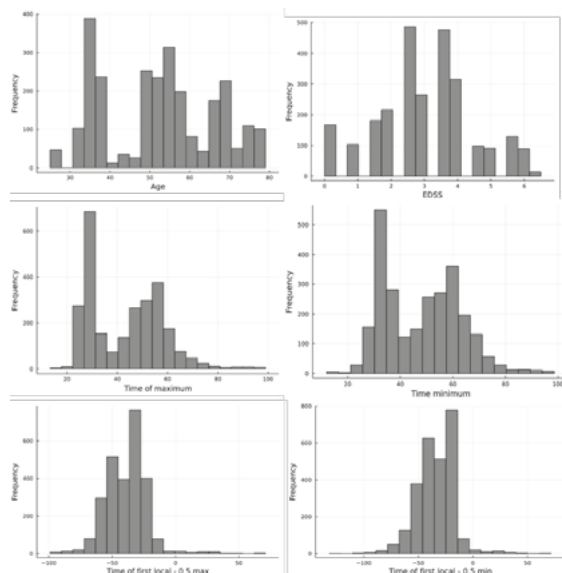

Figure 4. Distribution patterns of the most significant input parameters. Uniform and Gaussian patterns are clearly shown.

2.2 Description of Machine Learning Models

The following models for approximating Features-Target relationship has been employed. For each one model, the following computations are carried out:

- The accuracy among the Prediction and Target-variable, for the Train and Test Sets.
- Error analysis:
    - Residual Errors vs Target diagrams,
    - Probability Density Functions,
    - Cumulative Density Functions, for the Train and Test Sets as well. The former approach is beneficial for detecting specific patterns occurring in the prediction and, hence, enhancing the generalization capability and reliability of the model.
- Linear Regression as a baseline model for the next ones.
- Polynomial Regression. As it is necessary to select from a vast pool of potential nonlinear features along with their number, the ITSO (Bakas et al, 2021) as well as PROS (Plevris et al, 2021) Optimisation Algorithms for Feature Selection have been adopted, which have also been found experimentally vastly efficient.
- Gradient Boosting with hyperparameter tuning. Particularly, the grid search method with cross-validation has been utilized (Chen et al, 2016).

3. Results

The first set of simulation results regarding the linear model is presented in Figure 5. As it can be observed, the skewness of the residual errors indicates that the linear model overestimates small values for EDSS and under-estimate higher ones. Therefore, more sophisticated models are necessary to be implemented, such as the polynomial regression model (Figure 6). Although the polynomial model exhibits similar behaviour to the linear model regarding the prediction error, there is a partial convergence during the validation process.
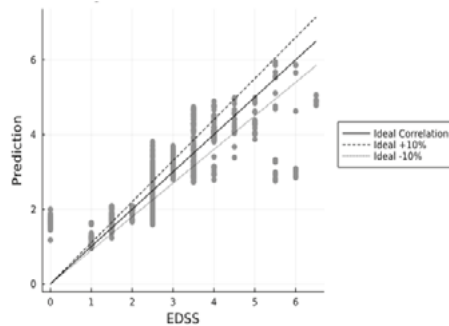

Figure 5. Predicted values of EDSS, derived from the linear regression model, versus the actual ones (target) which were provided by the published dataset.
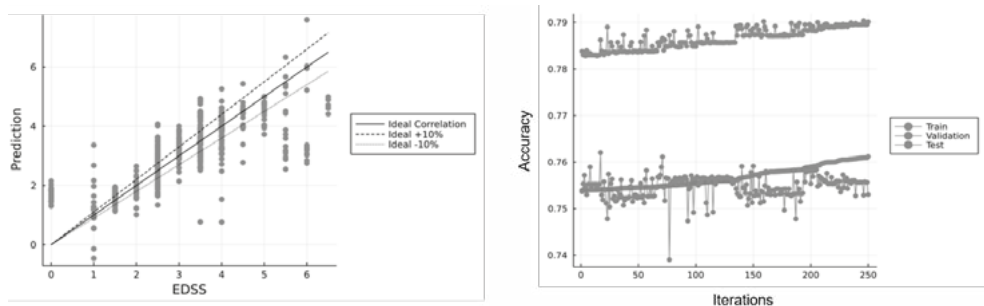

Figure 6. Predicted values of EDSS, derived from the polynomial regression model, versus the actual ones provided by the dataset as shown in the left part of the figure, whereas the right part depicts the evolution of accuracy of the prediction model along the iterations.

As a final step, the machine learning regression approach of the XGBoost model with cross-validation has been implemented. Such type of regression models was expected to produce a more efficient and robust performance. Indeed, the mean absolute error between the predicted value of EDSS and the actual one obtained a value of 8.4% in terms of mean percentage error (MAPE), whereas the Pearson correlation accuracy converged to 96% as shown in Figure 7.
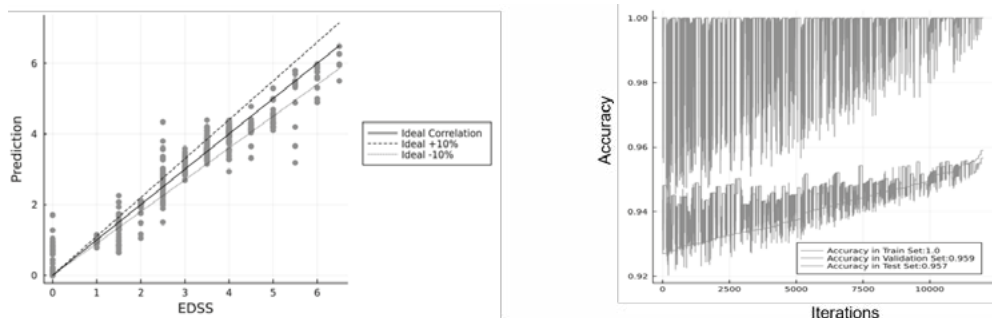
Figure 7. Predicted values of EDSS, derived from XGBoost regression model, versus the actual ones provided by the dataset as shown in the left part of the figure, whereas the right part depicts the evolution of accuracy of the prediction model along the iterations.

4. Discussion

A prediction model of 96% accuracy has been developed in the current work based on a specific, published dataset (Yperman et al, 2022). According to the presented preliminary results of the current research analysis, the most appropriate model to predict the value of EDSS from a propagating signal on the nervous system is XGBoost, as shown in the inset of Figure 8. The most effective input parameters of the prediction model are shown in Figure 8, where the age, anatomy and maximum peak are the prominent ones. Among the former significant input parameters are also the energy, time difference of local peaks as well as the timepoint that local maximum/minimum occurs.

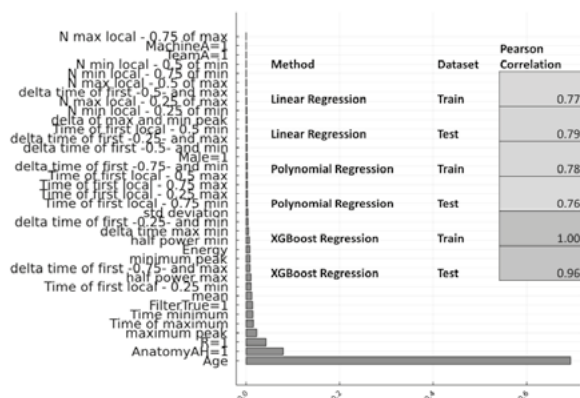| Method	Dataset	Pearson Correlation
Linear Regression	Train	0.772
Linear Regression	Test	0.798
Polynomial Regression	Train	0.788
Polynomial Regression	Test	0.764
XGBoost Regression	Train	1.000
XGBoost Regression	Test	0.960

Figure 8. XGBoost features' importance. The inset shows a table of the obtained Pearson Correlation for linear, polynomial and XGBoost regression models.

Following the early results of the current analysis, input parameters such as the energy and the number of local maximums/minimums are well promising to extend the current work in a more demanding goal which is the prediction of the forthcoming evolution of EDSS for a certain MS patient. Hence, the most on-time appropriate medical treatment will be provided to the patient ensuring long-term quality of life.

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References

Bakas, N.P., Plevris, P., Langousis, A., and Chatzichristofis, S.A., 2021. Itso: A novel inverse transform sampling-based optimization algorithm for Stochastic Search. *Stochastic Environmental Research and Risk Assessment*, 36(1), pp. 67–76. Available at: https://doi.org/10.1007/s00477-021-02025-w.

Brugnara, G., Isensee, F., Neuberger, U., Bonekamp, D., Petersen, J., Diem, R., Wildermann, B., Heiland, S., Wick, W., Bendszus, M., Maier-Hein, K. and Kickingereder, P., 2020. Automated volumetric assessment with artificial neural networks might enable a more accurate assessment of disease burden in patients with multiple sclerosis. *European Radiology*, 30(4), pp. 2356–2364. Available at: https://doi.org/10.1007/s00330-019-06593-y.

Carr, J.H. and Shepherd, R.B., 2010. *Neurological rehabilitation e-book: Optimizing Motor Performance*. 2nd edn. Churchill Livingstone.

Chen, T. and Guestrin, C., 2016. XGBoost: A Scalable Tree Boosting System. In *Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining. KDD '16*. New York, NY, USA: ACM, pp. 785–794. Available at: http://doi.acm.org/10.1145/2939672.2939785.

Eitel, F., Soehler, E., Bellmann-Strobl, J., Brandt, A., Ruprecht, K., Giess, R., M., Kuchling, J., Asseyer, S., Weygandt, M., Haynes, J., D., Scheel, M., Paul, F. and Ritter, K., 2019. Uncovering convolutional neural network decisions for diagnosing multiple sclerosis on conventional MRI using layer-wise relevance propagation. *NeuroImage: Clinical*, 24, p. 102003. Available at: https://doi.org/10.1016/j.nicl.2019.102003.

Fernández, V., Valls-Sole, J., Relova, J.,L.,Raguer, N., Miralles, F., Dinca, L., Taramundi, S., Costa-Frossard, L., Ferrandiz, M., Ramio-Torrenta, L., Villoslada, P., Saiz, A., Calles, C., Antiguedad, A., Alvarez-Cermen, J.,C., Prieto, J.,M., Izquierdo, G., Montalban, X. and Fernandez, O., 2013. Recommendations for the clinical use of motor evoked potentials in multiple sclerosis. *Neurología (English Edition)*, 28(7), pp. 408–416. Available at: https://doi.org/10.1016/j.nrleng.2013.09.003.

Garcia-Martin, E., Ortz, M., Boquette, L., Sanchez-Moria, E.,M., Barea, R., Cavaliere, C., Vilades, E., Orduna, E. and Rodrigo, M.,J., 2021. Early diagnosis of multiple sclerosis by OCT analysis using Cohen's D method and a neural network as classifier. *Computers in Biology and Medicine*, 129, p. 104165. Available at: https://doi.org/10.1016/j.compbiomed.2020.104165.

Hu, W., Combden, O., Jiang, X., Buragadda, S., Newell, C.,J., Williams, M.,C., Critch, A.,L. and Ploughman, M., 2022. Machine Learning Classification of multiple sclerosis patients based on raw data from an instrumented walkway. *BioMedical Engineering OnLine*, 21(1). Available at: https://doi.org/10.1186/s12938-022-00992-x.

Plevris, V., Bakas, N.P. and Solorzano, G. (2021) "Pure Random Orthogonal Search (PROS): A plain and elegant parameterless algorithm for global optimization," *Applied Sciences*, 11(11), p. 5053. Available at: https://doi.org/10.3390/app11115053.

Yperman, J., Becker, T., Valkenborg, D., Popescu, V., Hellings, N., Wijmeersch, B.,V. and Peeters, M.,L., 2020. Machine learning analysis of motor evoked potential time series to predict disability progression in multiple sclerosis. *BMC Neurology*, 20(1). Available at: https://doi.org/10.1186/s12883-020-01672-w.

Yperman, J., Popescu, V., Wijmeersch, B.,V., Becker, J. and Peeters, M.,L., 2022. Motor evoked potentials for multiple sclerosis, a multiyear follow-up dataset. *Scientific Data*, 9(1). Available at: https://doi.org/10.1038/s41597-022-01335-0.

Fully Immersive Virtual Reality and Rehabilitation of Hemiplegic Upper Limb in Stroke Patients: A Systematic Review

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Abstract

Stroke is the second leading cause of death in people over 60 years worldwide. Survivors of such an episode experience serious dysfunctions, including hemiplegia/hemiparesis of the affected limb (upper extremity, lower extremity), thus limiting their independence in daily activities. Different techniques are used by rehabilitation therapists to improve the mobility of the hemiplegic upper limb. One of these techniques is Virtual Reality. The purpose of this systematic review is to determine the potential therapeutic benefits of Fully Immersive Virtual Reality in hemiplegic upper extremity rehabilitation after a stroke. A search was performed on the Pubmed database during the period 1/12/2020-31/1/2021.In the study 4 randomised controlled trials and a clinical trial phase III were included, with adult patients after stroke in the experimental group and the intervention tool was Immersive Virtual Reality. The surveys were evaluated according to the Pedro scale. The results concern patients with hemiplegic upper limb after hemorrhagic and ischemic stroke, in the subacute and chronic phase of rehabilitation. In a fully immersive Virtual Reality environment, targeted activities designed to address patients' strengths and weaknesses in combination with conventional Occupational Therapy or Physiotherapy can help improve the mobility of the hemiplegic upper extremity, in the chronic phase of rehabilitation. Although the number of the studies of this systematic review is small (n = 5), the type of research included has strong research power.

Keywords: Stroke, Hemiplegic Upper limb, Immersive Virtual Reality, Head Mounted Display

1. Introduction

Stroke is one of the leading causes of death in people over 60 worldwide (Go et al. 2014). The most common deficit after a stroke is the hemiparesis of the upper limb (AlMousa et al., 2017). Virtual Reality (VR) has been recently used in rehabilitation programmes for patients with neurological damage. The main advantages are the creation of goal-directed activities and the possibility of performing many repetitions in one activity (Saldana et al., 2020). VR systems can be classified into 3 major categories: non immersive VR, fully immersive VR (FIVR) and semi-immersive VR depending on the means (hardware and software) used by the user in each type. These means refer to immersion (the user maximally experiences a virtual experience as real) and the type of interfaces and components used by each system (Perez-Cruzado et al., 2016). Most studies use non-immersive VR systems (Bevilacqua et al., 2019; Lee et al., 2019) and the results show that the use of such media can be effective, usually as an adjunctive strategy to conventional therapy or in patients who are in a specific phase of rehabilitation. In a FIVR therapy, patients perform activities that require functions such as reaching, grasping, manipulating, and releasing objects. This helps them to relearn how to perform daily activities. More research is needed to investigate whether other types of VR systems, such as FIVR, can be effective in the rehabilitation of the hemiplegic upper limb.

2. Aim of the study

The aim of this study is to make a systematic review of the clinical trials concerning the use of fully immersive VR in the rehabilitation of the hemiplegic upper limb in patients with stroke, so as to investigate its possible benefits in the rehabilitation of the patients.

3. Methodology

3.1 Inclusion – Exclusion criteria

To prepare the study, a critical review of articles in the existing literature was carried out. The inclusion criteria of the articles used are as follows:
☐ The articles had to be written in the English language.
☐ Hemiplegic upper limb had to be reported in patients only after a stroke (ischemic, hemorrhagic, transient ischemic), or in the acute, subacute and chronic phases of their recovery.
☐ Patients had to be adults.
☐ The publication date of the articles had to be from 2010-2021.
☐ The type of research had to be clinical trials.
☐ The VR intervention in the experimental group had to include an output device that would provide the user with full immersion, such as a head mounted display.

Studies that did not meet the above criteria were removed during the initial stages of the search.

3.2 Search Strategy

The Pubmed database was searched between 1/09/2020-31/1/2021. The search terms used for the Pubmed database were: stroke [Title/Abstract] OR cerebrovascular accident [Title/Abstract] OR hemiplegic upper limb [Title/Abstract] OR hemiplegic upper extremity [Title/Abstract] OR rehabilitation [Title/Abstract] AND virtual reality [Title/Abstract] OR immersive virtual reality [Title/Abstract] OR 3D immersive virtual reality [Title/Abstract].

4. Results

The initial search without filters identified 2,221 articles. Screening for studies that did not meet the inclusion criteria removed 2,001 articles, leaving 220 that potentially investigated interventions using immersion PE. The titles of the remaining studies were then read. Of these, 168 were removed as they referred to another diagnosis (e.g. Parkinson's), another body structure (lower limb) or another physical function (gait). The abstract of 52 studies was read. Also due to the fact that words such as "immersive" or "HMD" were not present in either titles or abstracts, a full reading of some of the 52 studies was performed. Thus, a further 47 studies were rejected as they used other non-immersive forms of VR as a means of rehabilitation. Finally, the total number of studies in this systematic review is 5 articles.

All studies refer to the use of FIVR in rehabilitation of hemiplegic upper limb after a stroke. The methodological quality of the studies was assessed with the Pedro scale which evaluates 11 criteria (see Appendix 1). Specifically, a study is given one point (1) if it meets the criterion

stated each time and no point (0) if this criterion is not identified in the survey. The appropriateness criterion element does not contribute to the total score, so the overall PEDro score ranges from 0 to 10, and the higher the score, the better the methodological quality of the clinical trial (Moseley et al., 2002). Randomised controlled trials and one clinical trial with a methodological quality of 3–8 according to the Pedro scale were included in this systematic review. Two studies (Crosbie et al., 2012; Ögün et al., 2019) had high methodological quality (8/10), two studies (Mekbib et al., 2021; Conelly et al., 2010) had moderate methodological quality (6/10) while one study, which used healthy subjects as a control group (Subramanian and Levin, 2011) had low methodological quality quality (3/10).

Table 1. Pedro Scale Scores of the studies

Study	Score	1	2	3	4	5	6	7	8	9	10	11
Crosbie et al. (2012)	8	1	1	1	1	0	0	1	1	1	1	1
Ögün et al. (2019)	8	1	1	1	1	1	0	1	1	0	1	1
Mekbib et al. (2021)	6	1	1	1	1	0	0	1	0	0	1	1
Conelly et al. (2010)	6	1	1	1	1	1	0	0	0	0	1	1
Subramanian et al. (2011)	3	1	0	0	0	0	0	0	1	0	1	1

Discussion

In two studies (Crosbie et al., 2012; Ogun et al., 2019) where the experimental groups were given FIVR and the control groups were given conventional treatment (Crosbie et al., 2012; Ögün et al., 2019) and FIVR (Ögün et al., 2019), no significant difference in the improvement of HUL functionality was observed between the two groups. In one study (Crosbie et al., 2012) no improvement was observed before and after intervention in the experimental group regarding HUL functionality, while in another (Ögün et al., 2019), a statistically significant difference was observed before and after intervention. The only study that concluded that the experimental group showed a statistically significant difference in the improvement of HUL functionality compared to the control group was that of Mekbib et al. 2021, while in the same study no difference was found in the independence of patients in performing activities of daily living between the two groups (experimental and control).

Also, in another randomized clinical trial, in which both groups participated in a rehabilitation program with FIVR, the participants of the groups showed statistically significant differences

in upper limb functionality and dexterity at the end of the intervention (Connelly et al., 2010). Furthermore, two studies demonstrated that the combination of FIVR with conventional therapy helps people with stroke to regain HUL functionality (Connelly et al., 2010; Mekbib et al. 2021).

In contrast, in another study, which examined the accuracy of movements of patients with hemiplegia after stroke, it was found that the movements of participants in the experimental group were slower and less accurate with the use of HMD than with the use of virtual glasses. However, it was shown that patients with moderate to severe hemiparesis moved their hand more quickly in a virtual reality environment with the use of a HMD, making this tool useful for this patient population (Subramanian and Levin, 2010).

In most studies, the FMA scoring scale and specifically the specific part FMUE was used as a tool to assess upper limb mobility before and after the intervention (Ögün et al., 2019, Mekbib et al. 2021, Connelly et al., 2010; Subramanian and Levin, 2010). This assessment is used in many research papers due to its simple administration (it does not involve performing functional activities) and scoring. It is designed to assess motor function, balance, sensation and joint function in patients with hemiplegia after stroke (Rabadi and Rabadi, 2006). Also, for upper limb mobility, the ARAT upper limb motricity was used to assess upper limb strength (Crosbie et al. 2012; Ögün et al., 2019) , CSI to assess the degree of spasticity in the upper limb (Subramanian and Levin, 2011) and functional magnetic resonance imaging to examine brain reorganization (Mekbib et al., 2021). Other tools used were the BI for the assessment of activities of daily living (Mekbib et al., 2021) and the FIM, PASS-IADL, PASS-BADL for the same reason (Ögün et al., 2019).

This systematic review used mainly patients in the chronic phase of rehabilitation (Crosbie et al. 2012; Connelly et al., 2010; Ögün et al., 2019; Subramanian and Levin, 2011) and one (Mekbib et al., 2021) used patients in the subacute phase of rehabilitation. One study used only patients with ischemic stroke (Ögün et al., 2019), others (Crosbie et al. 2012; Mekbib et al., 2021) used patients with hemorrhagic and ischemic stroke while for two studies (Connelly et al., 2010; Subramanian and Levin, 2011) no data on the type of stroke of the patients in the experimental group are given.

The total duration of treatments varies between studies. In particular, there are studies that have been conducted at 2 weeks (Mekbib et al., 2021), 3 weeks (Crosbie et al. 2012) and 6 weeks (Conelly et al., 2010; Ögün et al., 2019) . The duration of treatments was 30-45 minutes (Crosbie et al. 2012) and 1 hour for three surveys (Conelly et al., 2010; Mekbib et al., 2021; Ögün et al., 2019).

Consequently, in a fully immersive VR environment, goal-directed activities in combination with conventional Occupational Therapy or Physiotherapy can help improve the mobility of the hemiplegic upper limb, in the chronic phase of rehabilitation. Also, it is an appropriate tool as it arouses the interest of patients to participate in the treatment.

5. Limitations of the study

In this work there are also some limitations that should be mentioned. First, although the included studies were randomised controlled trials and one clinical trial, the number of participants in either the experimental or control group was small (total number of participants = 150). Also, a meta-analysis of the data could be done, but this would require a different research approach. Finally, in terms of research methodology, other databases could

be searched in order to investigate possible articles that could be included in this systematic review. In the future, it is suggested that randomised controlled trials be conducted comparing the effectiveness of FIVR versus non-immersive VR or semi-immersive VR. Also, the investigation of the benefits of fully immersive VR in the acute and sub-acute phase of rehabilitation should be considered.

References

AlMousa, M., Al-Khalifa, H. S., & AlSobayel, H. (2017). Requirements elicitation and prototyping of a fully immersive virtual reality gaming system for Upper Limb Stroke Rehabilitation in Saudi Arabia. *Mobile Information Systems*, *2017*, 1–12. https://doi.org/10.1155/2017/7507940

Bevilacqua, Maranesi, Riccardi, Donna, Pelliccioni, Luzi, Lattanzio, & Pelliccioni. (2019). Non-immersive virtual reality for rehabilitation of the older people: A systematic review into efficacy and effectiveness. *Journal of Clinical Medicine*, *8*(11), 1882. https://doi.org/10.3390/jcm8111882

Connelly, L., Jia, Y., Toro, M. L., Stoykov, M. E., Kenyon, R. V., & Kamper, D. G. (2010). A pneumatic glove and immersive virtual reality environment for hand rehabilitative training after stroke. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, *18*(5), 551–559. https://doi.org/10.1109/tnsre.2010.2047588

Crosbie, J., Lennon, S., McGoldrick, M., McNeill, M., & McDonough, S. (2012). Virtual reality in the rehabilitation of the arm after hemiplegic stroke: A randomized controlled pilot study. *Clinical Rehabilitation*, *26*(9), 798–806. https://doi.org/10.1177/0269215511434575

Go, A. S., Mozaffarian, D., Roger, V. L., Benjamin, E. J., Berry, J. D., Blaha, M. J., Dai, S., Ford, E. S., Fox, C. S., Franco, S., Fullerton, H. J., Gillespie, C., Hailpern, S. M., Heit, J. A., Howard, V. J., Huffman, M. D., Judd, S. E., Kissela, B. M., Kittner, S. J., Lackland, D. T., … American Heart Association Statistics Committee and Stroke Statistics Subcommittee (2014). Heart disease and stroke statistics--2014 update: a report from the American Heart Association. *Circulation*, *129*(3), e28–e292. https://doi.org/10.1161/01.cir.0000441139.02102.80

Hatem, S. M., Saussez, G., della Faille, M., Prist, V., Zhang, X., Dispa, D., & Bleyenheuft, Y. (2016). Rehabilitation of motor function after stroke: A multiple systematic review focused on techniques to stimulate upper extremity recovery. *Frontiers in Human Neuroscience*, *10*. https://doi.org/10.3389/fnhum.2016.00442

Lee, H. S., Park, Y. J., & Park, S. W. (2019). The effects of virtual reality training on function in chronic stroke patients: A systematic review and meta-analysis. *BioMed Research International*, *2019*, 1–12. https://doi.org/10.1155/2019/7595639

Mekbib, D. B., Debeli, D. K., Zhang, L., Fang, S., Shao, Y., Yang, W., Han, J., Jiang, H., Zhu, J., Zhao, Z., Cheng, R., Ye, X., Zhang, J., & Xu, D. (2021). A novel fully immersive virtual reality environment for upper extremity rehabilitation in patients with stroke. *Annals of the New York Academy of Sciences*, *1493*(1), 75–89. https://doi.org/10.1111/nyas.14554

Moseley, A. M., Herbert, R. D., Sherrington, C., & Maher, C. G. (2002). Evidence for physiotherapy practice: A survey of the physiotherapy evidence database (Pedro). *Australian Journal of Physiotherapy*, *48*(1), 43–49. https://doi.org/10.1016/s0004-9514(14)60281-6

Ögün, M., Kurul, R., Yaşar, M., Turkoglu, S., Avci, Ş. & Yildiz, N. (2019). Effect of leap motion-based 3D immersive virtual reality usage on upper extremity function in ischemic stroke patients. *Arquivos de Neuro-Psiquiatria*, *77*(10), 681–688. https://doi.org/10.1590/0004-282x20190129

Rabadi, M. H., & Rabadi, F. M. (2006). Comparison of the action research arm test and the FUGL-meyer assessment as measures of upper-extremity motor weakness after stroke. *Archives of Physical Medicine and Rehabilitation*, *87*(7), 962–966. https://doi.org/10.1016/j.apmr.2006.02.036

Saldana, D., Neureither, M., Schmiesing, A., Jahng, E., Kysh, L., Roll, S. C., & Liew, S.-L. (2020). Applications of head-mounted displays for virtual reality in adult physical rehabilitation: A scoping review. *The American Journal of Occupational Therapy*, *74*(5). https://doi.org/10.5014/ajot.2020.041442

Subramanian, S. K., & Levin, M. F. (2011). Viewing medium affects arm motor performance in 3D Virtual Environments. *Journal of NeuroEngineering and Rehabilitation*, *8*(1), 36. https://doi.org/10.1186/1743-0003-8-36

Appendix 1: Pedro scale criteria

1. eligibility criteria were specified	*no yes*
2. subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received)	*no yes*
3. allocation was concealed	*no yes*
4. the groups were similar at baseline regarding the most important prognostic indicators	*no yes*
5. there was blinding of all subjects	*no yes*
6. there was blinding of all therapists who administered the therapy	*no yes*
7. there was blinding of all assessors who measured at least one key outcome	*no yes*
8. measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups	*no yes*
9. all subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by "intention to treat"	*no yes*
10. the results of between-group statistical comparisons are reported for at least one key outcome	*no yes*
11. the study provides both point measures and measures of variability for at least one key outcome	*no yes*

PUBLICATION	SAMPLE	TYPE OF STUDY	INTERVENTIONS IN CONTROL AND EXPERIMENTAL GROUP	ASSESSMENT TOOLS	RESULTS
Crosbie et al. (2012)	n=18 Control Group(n=9) Age:66.4+7.4 Experimental Grup (n=9) Age:56.1+14.5 1	RCT	Control Group: conventional therapy (30-45 min., 3/week x3 weeks) Experimental Group: specific immersive VR activities (target approach, approach and capture) (30-45 min., 3/week, 3 weeks) 2	ARAT, Upper Limb Motricity Index	No differences were found according to the research means between the two groups. No significant improvement in both groups before and after the intervention. Two participants from the Experimental Group experienced transient dizziness and headache 3
Ögün et al. (2019)	n=65 Control Group (n=32) Age:59.75+8.07 Experimental Group (n=33) Age:61.48+10.92 4	RCT	Control Group: conventional therapy (45 min., 3/week, 6 weeks) + Immersive VR (15 min., 3/week, 6/weeks) Experimental Group: Immersive VR games (grip function, hand and forearm movement to handling items and complete complex gesture) through HMD with Leap Motion (60 min., 3/week, 6 weeks) 5	FMUE, ARAT, FIM, PASS-IADL, PASS-BADL	Statistically significant difference in the improvement of upper extremity mobility in both groups (p<0.05) according to FMUE, ARAT, FIM scales There was no statistically significant difference between groups (p>0.05) 6

Table 2. Descripion of studies.

Study	Sample / Age	Study type	Intervention	Outcome measures	Results
Mekbib et al. (2021)	n=23 Control Group (n=11) Age:61±7.69 Experimental Group (n=12) Age: 52.17±13.26 — 7	RCT	Control Group: conventional OT (2 hours, 4/week,2 weeks) Experimental Group: Immersive VR intervention+ OT. Activities of approaching, catching and releasing objects. (1 hour Immersive VR+ 1 hour OT, 4/week, 2 weeks) — 8	FMUE, BI, fMRI	Statistically significant difference (p=0.007) in the Experimental Group according to FMUE compared to Control Group. There was no statistically significant difference (p=0.193) between the two groups according to the BI scale
Connelly et al. (2010)	n=14 Control Group (n=7) Age: 54±10 Experimental Group (n=7) Age: 57±18 — 9	RCT	Control Group: Activities in the virtual environment using HMD (30 min., 3/week, 6 weeks) and manual activities without HMD (30 min. in the real world, 3/week, 6 weeks) Experimental Group: Activities in the virtual environment using HMD and PneuGlove and manual activities with Pneuglove and without HMD (30 min. in the virtual environment + 30 min. in the real world, 3/week, 6 weeks) — 10	FMA, Box and Blocks Test, palmar pinch strength	While changes in the two groups were not statistically different, the group using the PneuGlove did show greater mean improvement on each of these measures, such as gains of 3.7 versus 2.4 points on the hand/wrist portion of the Fugl-Meyer Assessment and 14 N versus 5 N in palmar pinch
Subramanian and Levin (2011)	n=30 Control Group (n=10) Age: 53.6±17.2 Experimental Group (n=20)Age: 66.2±11.3 — 11	Level III non randomized clinical trial — 12	Control Group: healthy subjects / same as the Experimental Group Experimental Group: (two subgroups according to the impairment of hemiplegic upper limb: Performance of target-specific movements with HMD on a computer screen and with VR glasses on a large screen) — 13	FMA, CSI	Subjects' movements in both groups were less accurate using HMD in a horizontal field of view compared to using VR glasses Patients with moderate to severe hemiparesis moved their hand faster with HMD than with VR glasses — 14

* HMD-VR= Head Mounted Display Virtual Reality, ARAT=Action Research Arm Test, FMUE = Fugl-Meyer Upper Extremity Assessment, FIM =Functional Independence Measure , PASS-IADL = Performance Assessment of Self Care Skills – Instrumental Activities of Daily Living, PASS-BADL= Performance Assessment of Self Care Skills – Basic Activities of Daily Living, BI = Barthel Index, CSI = Composite Spasticity Index, SPS = Screen Projection System .

Heart Disease Prevention Using Machine Learning Algorithms

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Abstract

Nowadays, data is widely regarded as the most valuable asset in terms of decision-making. It is, therefore, essential to implement methods and techniques to effectively utilise the volumes of data generated on a daily basis. Data mining and machine learning (ML) techniques are now used in various fields, such as business, e-commerce, banking, and healthcare, offering enormous potential for future applications. The present work is an analysis of heart disease prediction using data mining techniques and machine learning algorithms. The supervised learning dataset consists of 11 different features that are used to predict whether a patient has heart disease or not. Three different machine learning algorithms are used to develop the classification models: Random Forest, Support Vector Machine, and Adaptive Boosting. After a comparative analysis, it is shown that the Adaptive Boosting algorithm has the highest accuracy in predicting heart disease with an accuracy of 94%.

Keywords: Data Mining, Machine Learning, Algorithms, Supervised Learning, Heart Disease Prediction

1. Introduction

The healthcare sector collects large volumes of data every day, which must be harnessed with the help of appropriate methods to discover valuable information and make effective decisions. According to the latest statistics from the World Health Organization, cardiovascular diseases are the leading cause of death worldwide, with approximately 17.9 million deaths per year, while they are estimated to contribute to 32% of total deaths worldwide (WHO, 2022).

Therefore, based on the worldwide increasing mortality brought by the various forms of heart disease, the large volume of patient medical data and the scientific research may contribute significantly to the extraction of useful knowledge for the early detection and prevention of heart disease, concomitant with a reduction in deaths. The most commonly used data-mining techniques in medical data include classification, mining association rules to find frequent patterns, and clustering.

The present work involves the analysis of the selected cardiac measurement recording dataset to identify predictors of heart disease in new and unknown patient medical data. Representative classifiers of different kinds have been implemented for this purpose such as Random Forest, SVM, and Adaptive Boost.

2. Related work

In the literature, there is a wealth of scientific research articles on the prediction of heart disease, applying data mining technique, in order to support the work of healthcare professionals. Various machine learning algorithms are used, and each study evaluates the performance of the generated models according to selected performance metrics. The relevant research works have been filtered based on their year of publication (2015-2022).

Almustafa concluded that a reliable method for selecting the most important features can significantly improve the classification result, compared to using all available variables in the dataset (Almustafa, 2020).

In Junaid and Kumar's research, the results, in terms of heart disease prediction, showed that the hybrid prediction models work more effectively, compared to the results of the individual algorithms, showing the best accuracy. These hybrid models are a combination of multiple techniques in order to achieve maximum problem accuracy. In this particular study, the results of Naive Bayes, SVM and ANN algorithms were combined, yielding an overall accuracy of 88.54% (Junaid & Dr. Kumar, 2020).

Rajender Singh Chhillar studied the diagnosis of cardiovascular disease using two structurally similar datasets (Cleveland and Statlog) using WEKA software. Each data set was tested with 8 different algorithms (SVM, Naive Bayes, Decision Tree, Random Forest, Logistic Regression, Artificial Neural Network, Adaptive boosting and KNN), while the algorithm showing the highest accuracy against the two data sets is SVM, with 84.15% for Cleveland overall and 84.07% for Statlog, thus identifying the optimal over-level. At the same time, it was shown that the logistic regression algorithm presents the best ROC region, in view of the binary classification of the data sets (Rajender Singh Chhillar, 2021).

In their research paper, Pushpavathi, Kumari and Kubra, implement three machine learning algorithms (KNN, Naive Bayes, Random Forest) and one Deep Learning algorithm (CNN). The highest accuracy of this particular study is presented by CNN with 99.6%, while among the machine learning algorithms, the most accurate in comparison is Random Forest with 81.6% (Pushpavathi, Kumari & Kubra, 2021).

In Uma's recent study, two sets of patient data were again analysed with the aim of predicting heart disease. In this research, the Anaconda Jupyter Notebook was used as a tool, while the results showed that the Logistic Regression algorithm brought the highest accuracy for both datasets (89.18% in the Framingham dataset and 90% in the Cleveland dataset) (Uma, 2022).

3. Methodology

3.1 Dataset Analysis

The data file used contains data of 1,190 patients with 11 different characteristics and the last column "target", which is the so-called class or target variable value. This is a dataset from the Kaggle website, which was combined from five different and independent datasets (Cleveland, Hungarian, Switzerland, Long Beach VA, Stalog Heart) (Siddhartha, 2019). As mentioned above, it is a supervised learning dataset, with the class variable being binary, because it captures whether the patient suffers from heart disease (1) or not (0).

The rest of the characteristics that appear in the dataset, in addition to age and gender, basically concern various clinical tests related to heart diseases, such as the level of blood pressure at rest, the type of chest pain, blood sugar levels, cholesterol values and more. In Figure 1 the relevant outliers have already been removed. Therefore, the dataset contains 1162 patient records after removing outliers.
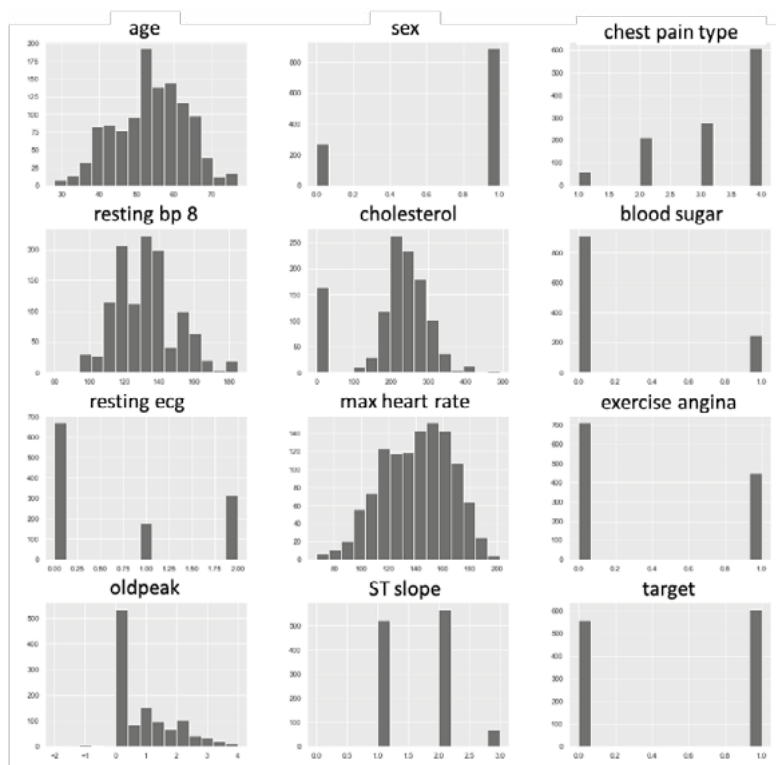
Figure 1. Distribution of variables in a histogram

Regarding the target variable, as depicted in the 12th graph of Figure 1, the percentage of patients who do not have any heart disease is 47.8% (556 patients), while the percentage of patients diagnosed with heart disease is 52.2% (606 patients) of the total. Therefore, we can say that the data set is balanced because the distribution of the target binary variable fluctuates approximately at the same levels (Tripathi, 2019).

3.2 Description of used Models

3.2.1 Random Forest (RF) algorithm

It is a supervised learning method, which falls into the Ensemble Learning family, and can be used for both classification and regression. It consists of multiple trees, and each tree is trained independently and randomly. The results of the different trees are then combined in order to derive the best possible prediction result (Albon, 2018). More specifically, the Random Forest algorithm creates n trees, each with a random sample from the data set, thus obtaining the best possible result by combining the results of all trees (Bowles, 2020). Each individual and random decision tree makes a prediction, and then the forest has the average value of the output leaves (in the case of regression) or the result obtained by the majority of

the trees (in the case of classification) as the final (Averaging/Majority Voting) (Soo & Upneja, 2021) & (Wei & Chiu, 2015). However, this is only true if the trees are uncorrelated with each other, causing errors in one tree to be compensated by other decision trees, changing the final outcome of the Random Forest. Figure 2 depicts the rationale of the RF algorithm.
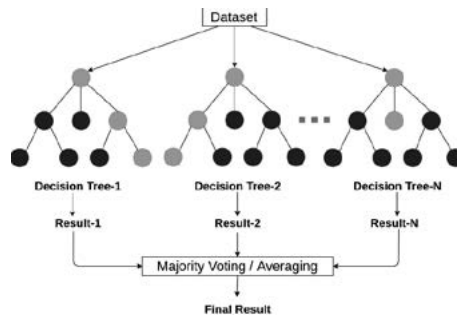

Figure 2. The basic structure of the Random Forest algorithm (Kalchuri, 2021)

3.2.2 Support Vector Machne (SVM)

The Support Vector Machine (SVM) algorithm can be used both for classification (linear and non-linear separable data) and for regression, while it is mostly applied to data sets with binary classification (Harrison, 2021). The training data is plotted in an n-dimensional space, while the goal of the algorithm is to draw a boundary (a straight line or a curve) that can be used to best separate the classes. In the example of a binary classification, one should therefore separate the two classes in such a way that each new point can be correctly assigned to one of these two available classes. The SVM algorithm tries to find a so-called hyperplane that separates these two classes by the largest possible margin, in order to achieve as accurate a classification of new points as possible, thus making the model more robust (Dobilas, 2021). If the classes are completely linearly separable, a hard margin can be used, otherwise, a soft margin between the classes is required (Figure 3.). While the points that lie within the margin are called support vectors.
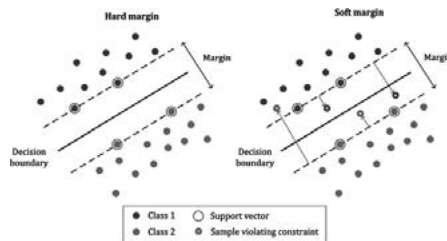

Figure 3. The separation between fixed and loose margin (Medium, 2019)

3.2.3 Adaptive Boosting (AdaBoost) Algorithm

Adaptive Boosting is a machine learning algorithm used for classification as well as for regression analysis. The rationale of the algorithm focuses on the use of a weak classification algorithm in a certain way according to the ensemble technique, so that it becomes strong

and effective. A tree-based algorithm can be used as the base estimator for Adaboost and the logic of the algorithm is that, each individual tree must be trained to classify the misclassifications (errors) of the previous one (Siddharth Misra, 2020) (Figure 4).
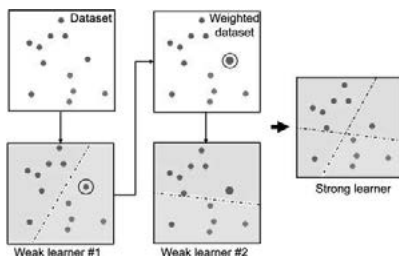

Figure 4. The separation between fixed and loose margin (Siddharth Misra, 2020)

4. Results

The following measures are used to evaluate the model, and which are calculated according to the classification results of the confusion matrix (Ghoneim, 2019):

a) **Accuracy:** It is the percentage of accuracy of predictions correctly classified by the model (TP and TN).

b) **Precision:** It calculates from all patients predicted by the model to have heart disease (TP + FP), how many of them actually have heart disease (TP)**.**

c) **Recall:** Unlike the Precision index, the Recall index provides information about the percentage of all patients with heart disease that the model was able to identify.

d) **F1-Score:** It is an evaluation method, which combines the two metrics (Precision and Recall) presenting the average of these two, in order to measure the performance of the model.

4.1 Random Forest results

This particular algorithm proved to be quite effective in predicting the heart disease class, showing comparatively slightly higher accuracy rates. Apart from the Recall index, which is also slightly higher than the rest of the evaluation metrics, the performance of the algorithm with fewer features performs slightly better than with the introduction of all variables. The high performance of this particular algorithm may be due to the fact that it does not assume a normal distribution, since, in the data set under consideration, most features show skewness.

Table 1. Random Forest performance.

Efficiency metrics	12 attributes
Accuracy	0.917
Precision	0.914
Recall	0.929
F1-Score	0.921

Table 2. SVM performance.

Efficiency metrics	12 attributes
Accuracy	0.880
Precision	0.865
Recall	0.912
F1-Score	0.888

4.2 SVM results

The SVM-supervised learning algorithm achieves fairly high accuracy using non-linear features (kernel = 'rbf'). It is observed that before the selection of the features, i.e. entering all the variables in the algorithm, the results of the metric performances are slightly better, compared to the results brought by the algorithm with the 12 features. As a next step, it was interesting to investigate why this particular algorithm performs best when all features are entered into the model, and does not seem to improve after feature selection, as was the case with the rest of the algorithms examined.

4.3 Adaptive Boosting results

The adaptive boosting algorithm, like most algorithms of this type, is a strong classifier. It uses a base learner algorithm, usually a weak tree-based classifier, to perform its classification process or any classification algorithm (Lv Yuanxin , 2022) as a base estimator. In the present evaluation, the Random Forest was used as the base estimator with n_estimator = 60, while the Adaboost was n_estimator = 100 and produced better results than the decision tree algorithm (DT). The decision tree base estimator was set with max_depth=10.

Table 3. AdaBoost classifier performance

Efficiency metrics	Base Estimator *Random Forest*	Base Estimator *Decision Tree*
Accuracy	**0.941**	0.924
Precision	**0.956**	0.944
Recall	**0.930**	0.908
F1-Score	**0.942**	0.926

4.4 AdaBoost Important features

In figure 5 the feature importance score is depicted as formed from the Adaptive Boosting algorithm in descending order. The prominent features are the ST slope, the chest pain type, the max heart rate, the cholesterol value, and the oldpeak.
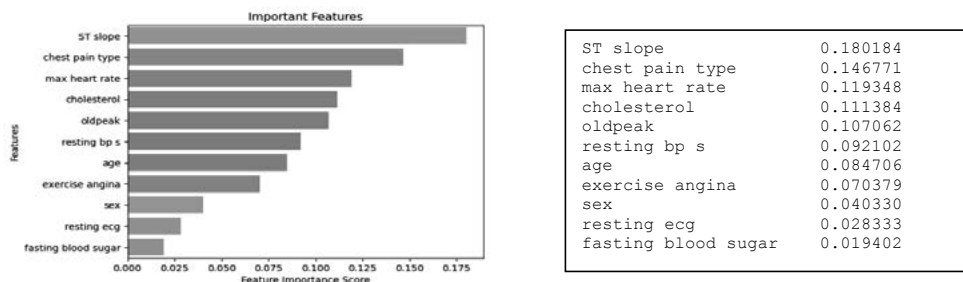

ST slope	0.180184
chest pain type	0.146771
max heart rate	0.119348
cholesterol	0.111384
oldpeak	0.107062
resting bp s	0.092102
age	0.084706
exercise angina	0.070379
sex	0.040330
resting ecg	0.028333
fasting blood sugar	0.019402

Figure 5. AdaBoost important features

The overall evaluation of the models showed that Adaboost with Random Forest as the base estimator had the best performance. According to the logic of this algorithm, a weak classifier, such as a simple decision tree, is normally used as the base estimator. However, in this case, a strong classifier (random forest) was used, which showed the best performance for the specific dataset, unlike the decision tree. Figure 6 illustrates the overall performance of the models.
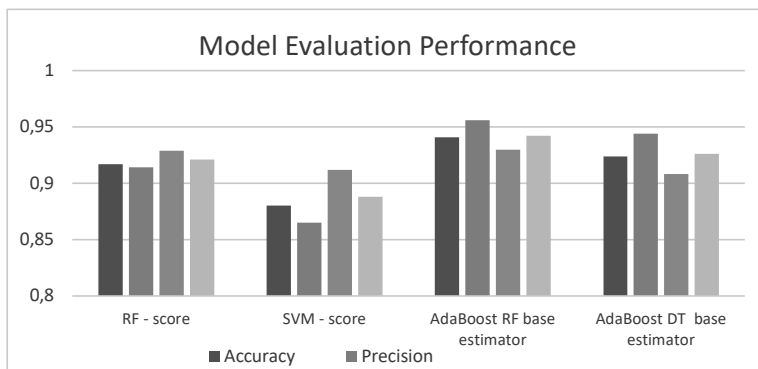

Figure 6. The overall performance of the models

5. Discussion

Three machine-learning models were evaluated on data related to heart disease. The AdaBoost classifier showed a higher performance with 94% accuracy when tested with Random Forest as the base estimator, prevailing to the Decision tree which showed the second-best overall performance while the Random Forest third and SVM the forth. As future work we would like to evaluate the same ML models on a different dataset of cardiac measurements. In addition, a different boosting model could be applied to determine a possible increase in overall performance for prediction.

References

Albon Chris (2018). Machine Learning with Python Cookbook: Practical Solutions from Preprocessing to Deep Learning, First Edition, pp. 239-280, ISBN-10: 9781491989388

Almustafa Khaled Mohamad (2020). Prediction of heart disease and classifiers 'sensitivity analysis. Almustafa BMC Bioinformatics (2020) 21:278. https://doi.org/10.1186/s12859-020-03626-y

Bowles Michael (2020). Machine Learning with Spark™ and Python Essential Techniques for Predictive Analytics. Second Edition. ISBN: 978-1-119-56193-4

Dobilas Saul (2021). SVM Classifier and RBF Kernel — How to Make Better Models in Python. Jan 17, 2021 https://towardsdatascience.com/svm-classifier-and-rbf-kernel-how-to-make-better-models-in-python-73bb4914af5b [ανακτήθηκε στις 23/7/2022]

Ghoneim Salma. (2019). Accuracy, Recall, Precision, F-Score & Specificity, which to optimize on? Apr 2, 2019. https://towardsdatascience.com/accuracy-recall-precision-f-score-specificity-which-to-optimize-on-867d3f11124 [ανακτήθηκε στις 25/7/2022]

Harrison Matt (2021). Machine Learning – Die Referenz Mit strukturierten Daten in Python arbeiten 1. Auflage. ISBN: PDF 978-3-96010-408-7

Junaid Mohammed Jawwad Ali, Dr. Kumar Rajeev (2020). Data Science And Its Application In Heart Disease Prediction. 2020 International Conference on Intelligent Engineering and Management (ICIEM)

Kalchuri Prajeet Singh (2021). Decision Tree & Random Forest Explained With Project. Apr 27, 2021. https://medium.com/geekculture/decision-tree-random-forest-explained-with-project-c2c8ef1597ee [ανακτήθηκε στις 6/8/2022]

Lv, Y., Shi, X., Ran, L., Shang, M. (2020). Random Forest-Based Ensemble Estimator for Concrete Compressive Strength Prediction via AdaBoost Method. In: Liu, Y., Wang, L., Zhao, L., Yu, Z. (eds) Advances in Natural Computation, Fuzzy Systems and Knowledge Discovery. ICNC-FSKD 2019. Advances in Intelligent Systems and Computing, vol 1075. Springer, Cham. https://doi.org/10.1007/978-3-030-32591-6_60

Medium (2019). Math behind SVM(Support Vector Machine). Feb 13, 2019. https://ankitnitjsr13.medium.com/math-behind-svm-support-vector-machine-864e58977fdb (Accessed:23/7/2022)

Pushpavathi T P, Kumari Santhosh & Kubra N K (2021). Heart Failure Prediction by Feature Ranking Analysis in Machine Learning. Proceedings of the Sixth International Conference on Inventive Computation Technologies [ICICT 2021] IEEE Xplore Part Number: CFP21F70-ART; ISBN: 978-1-7281-8501-9

Rajender Singh Chhillar Aman (2021). Analyzing Predictive Algorithms in Data Mining for Cardiovascular Disease using WEKA Tool. (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 12, No. 8, 2021

Siddhartha Manu (2019). Heart Disease Dataset (Comprehensive). Source: Kaggle. https://www.kaggle.com/datasets/sid321axn/heart-statlog-cleveland-hungary-final/metadata (Accessed: 11/6/2022)

Siddharth Misra, (2020), Machine Learning for Subsurface Characterization, Chapter 9 - Noninvasive fracture characterization based on the classification of sonic wave travel times

Tripathi, Himanshu (2019). What Is Balanced And Imbalanced Dataset? Techniques To Convert Imbalanced Dataset Into Balanced Dataset. https://medium.com/analytics-vidhya/what-is-balance-and-imbalance-dataset-89e8d7f46bc5 [ανακτήθηκε στις 01/7/2022]

UMA K. Prediction of Heart Disease using Data Mining Classifiers, 28 June 2022, PREPRINT (Version 1) available at Research Square [https://doi.org/10.21203/rs.3.rs-1790774/v1]

Wei Yu, Chiu (David Chiu) (2015). Machine Learning with R Cookbook. ISBN 978-1-78398-204-2

WHO (2022). Cardiovascular diseases. https://www.who.int/health-topics/cardiovascular-diseases#tab=tab_1 [Accessed: 18/8/202]

Investigation of nutritional intake, eating habits and knowledge of sports dietary recommendations in young elite Greek football players

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Abstract

The purpose of this study was to assess energy intake and evaluate eating habits and sports nutrition knowledge in elite adolescent Greek footballers. A total of 196 young elite football players, aged 10-20yrs (U10-U12, U13-U15, U16-U19), participated in the study. Daily energy and macronutrients intake were assessed through 24-hour recall. A multiple-choice questionnaire assessed eating habits, general nutrition knowledge and specifics in sports nutrition. Results showed that the highest energy intake was found in U16 group (2242 kcal/ day), while the lowest intake was found in U13 (1815 kcal/ day). The highest daily protein intake was found in the U13 group (1.6g/kg BW) and the lowest in the U15 (1.2g/kg BW). The highest carbohydrate daily intake was found in the U14 (4.1g/kg BW) and the lowest in the U15 and U16 groups (3.5g/kg BW). Fourteen athletes from all categories stated that they didn't eat breakfast every day; eleven of which were from the U13-15 group (p= 0.013). Regarding the type of snacks consumption, "Biscuits/ Cakes/ Sweets" option was mostly favored in the U10-12 group (p <0.001). "Water" was the most popular option in the U16-19 group as a pre-workout fluid (98.6%), (p= 0.008). Also, group U16-19 mentioned high percentages of "Meat/ Fish/ Chicken" consumption (65.7%), "Eggs" (35.7%), "Potatoes" (27.1%), "Yoghurt/Milk" (35.7%) and "Vegetables" (31.4%) (p<0.05 for all), as after match food choices. Although percentages of under-reporting and misreporting may be high in these ages, data suggest that elite football players in academies may well achieve current guidelines for daily protein and fat intake but not carbohydrate. The educational strategy on nutrition needs to be implemented with vigilance in these ages as it is of high importance.

Keywords: nutrition, knowledge, intake, football, elite, adolescent

1. Introduction

A football match usually lasts 90 minutes, in which an athlete is estimated to cover a total distance of about 10 km at an average speed of 7 km/h (Goto, et al., 2015). It is estimated that during a match energy expenditure is equivalent to 1300-1600 kcal (Riddell, 2008). Nutritional needs of young athletes differ from those of adults because of the critical growing period (Riddell, 2008). More specifically, young athletes spend approximately 25% more calories in their activities than their adult counterparts (Bangsbo et al., 2006). Therefore, changes in anatomical, physiological, and metabolic parameters will likely affect players' daily energy needs in relation to both training and match days (Desbrow et al., 2014). Based on current sports nutrition guidelines, soccer players should aim for a carbohydrate intake of 3-8 g/kg body mass (BM), every day depending on the training load, to support high intensity exercise

and to facilitate the recovery of muscle glycogen (Collins, et al., 2021). The day before the upcoming match carbohydrate intake should increase at 6-8gr/kg BM (Murray et al., 2017). Furthermore, players should consume a carbohydrate-rich meal 1-3 g/kg BM 3-4 hours pre-match to ensure that they will store adequate glycogen (Collins et al., 2021). In addition, protein needs are increasing during adolescence, with a recommended daily intake of 1.6 g/kg BM or more from dietary sources (Desbrow et al., 2014). Moreover, young footballers are quite prone to dehydration compared to adults, therefore it is advised that a good hydration strategy should be followed especially pre-match (Armstrong et al., 2014).

Although young players need more nutritional care, they do not seem to receive it. Findings from studies in young elite football players show that both energy intake and macronutrient intake are lower than required during the season (Briggs, et al, 2015). Also, studies which have explored players' habits, have generally reported lower energy intake than estimated energy expenditure (Caccialanza, et al., 2007). It is proposed that sports nutrition knowledge may be a useful tool to prevent poor dietary choices and advance good daily eating practices (Croll et al., 2006). However, there is limited literature assessing the nutritional knowledge of elite adolescent football players. Specifically, Rosenbloom et al. (2002) examined sports nutrition knowledge of 111 19-year-old professional teen football players. The total response score was 52% for boys and 54% for girls on a scale of 100. Also, more than 50% of the participants knew that the main source of energy for sports is carbohydrates, although an equally high percentage (50%) considered the same for protein consumption (Rosenbloom et al., 2002). Similarly, two recent studies evaluated sports nutrition knowledge in 54 and 46 professional young soccer players aged 14-19 y (Werner et al., 2020; Noronha et al., 2020). Werner and colleagues (2020) concluded that young footballers had an overall sports nutrition knowledge score of 57% while in the study by Noronha et al. (2020) the rate was 64.8%.

These findings do not reassure scientists about the level of nutritional knowledge of young elite footballers. The lack of nutritional understanding can have both short-term and long-term negative effects on performance, physical development, injury prevention and immune, brain and hormonal functions of adolescent athletes (Croll et al., 2006). A detailed examination of dietary intake and nutritional knowledge is therefore necessary, in order to establish a balanced diet plan, which will be a key foundation for the overall health maintenance of young players. Therefore, the purpose of this study was to investigate nutritional intake, eating habits and knowledge of sports dietary recommendations in elite adolescent Greek football players.

2. Methods

2.1 Study Population and Design

The present study was conducted by Metropolitan College in Athens. A total of 196 young professional elite Greek footballers from 9 different categories (U10, U11, U12, U13, U14, U15, U16, U17 and U19) were classified into three main ones (U10-12, U13-15 and U16-19) for the purposes of the study. Participants and their parents gave their informed consent according to Helsinki Declaration, 1975. At the time of the study, the squads were in the middle of the competitive season (5 days training per week, 1,5 h per day, plus one League match per week). An online multiple-choice questionnaire, especially designed for football athletes was used to

assess nutritional knowledge. The questionnaire was divided into three sections, the first consisted of questions regarding personal information (anthropometrics, age, position they play and time spent on physical activity other than football). The second part referred to general questions on nutritional knowledge (breakfast frequency, type of lunch and dinner, consumption of snacks between meals and consumption of alcohol). The third section comprised questions on sports nutrition knowledge and hydration (consumption of liquids before, during and after exercising), (food consumption timing, and type). Also, a question was asked with reference to food supplements. In addition, fifty-four players (aged 12-15years, U13-U16) from the total sample were evaluated for their daily dietary intake. A two-day guided 24-hour recall has been used (including the match day), where participants were asked to provide as much details as possible, food and beverage type, cooking/ preparation methods and the consumption timing. Commercially available software was used to analyse the diet records for total energy intake and macronutrients (Diet Analysis plus, United Kingdom) and total energy expenditure (TEE) was calculated using the equation [(TEE = physical activity level (PAL) x resting metabolic rate (RMR)].

2.3 Statistical analysis

The statistical analysis was conducted using IBM SPSS (SPSS Statistics for Windows: IBM Corporation, Version 23.0. Armonk NY, 2015) and a statistical significance of $p<0.05$ was set. For the analysis, descriptive statistics of quantitative variables was applied (age, weight, height, BMI), which were expressed using averages and standard deviations. Age groups were evaluated using one-way analysis of variance (ANOVA). Post hoc analysis was performed using the Bonferroni correction t-tests. An independence test x^2 (Pearson Chi-square) was developed to determine the relation (dependent or independent) of the nominal variables.

3. Results

No significant differences were found between categories in weight, height and body mass index (Table 1).

Table 1. Anthropometric characteristics of participants, by category. Data is presented as means and standard deviations (Mean ± SD)

n=196	Age (years)	Weight (kg)	Height (cm)	BMI (kg/m^2)
U10-U12 (n=42)	10.8 ± 0.3	36.7 ± 6.1	144.5 ± 7.4	17.7 ± 1.7
U13-U15 (n=84)	13.7 ± 0.3	54.0 ± 8.5	166.1 ± 8.9	19.4 ± 1.8
U16-U19 (n=70)	16.9 ± 0.5	71.8 ± 7.0	178.3 ± 6.3	22.5 ± 1.3

3.1 General nutrition knowledge

In group 10-12 and 16-19, 97.6% (41 participants) and 98.6% (69 participants) respectively, stated that they consume breakfast "Every day", while in the category 13-15, the percentage was 86.9% (p= 0.013). Concerning the question on snacks consumption, 100% of 10-12 and

16-19 groups, (42 and 72 people respectively) stated that they consume snacks between meals, while in 13-15, 94.0% (79 people) answered positively (p= 0.007). Regarding the type of snacks consumption, the largest percentage of each category chose "Fresh/ Dried Fruits". More specifically, the selection rates for this answer were 57.1%, 63.1% and 73.4% for 10-12, 13-15 and 16-19 groups respectively. Also, a statistically significant difference was observed (p <0.001), in the option "Biscuits/ Cakes/ Sweets", in the 10-12 category (31%), in relation to the other categories.

3.2 Sports nutrition knowledge

All categories highly considered water as the main option of fluid before a match, although age category 16-19 had the highest percentage (98.6%) and reached statistical significance (p= 0.008) compared to the other categories. During exercise the preferred option was water with the category 10-12 having a selection rate of 100% (p= 0.014). Also, group 16-19 showed p <0.001 (32.9%) and p= 0.049 (8.6%), in the option's "sports drink" and "electrolytes" respectively. A relatively high percentage (10.7%) of the age category 13-15 answered that they consume "Nothing" during training. After exercise, the majority of the answers were given to the option "Water", while statistical significance was observed only in the answer "sports drink" in the category 16-19 (20%) (p= 0.03).

3.3 Type of food before exercise

In the 13-15 group before exercise there was a high percentage (76.2%) observed in the option "Fresh / Dried fruits" (p <0.001). Also, in the category 16-19, high percentages were found for the answers "Meat/ Fish / Chicken" (65.7%), "Eggs" (35.7%), "Potatoes" (27.1%), "Yoghurt / Milk" (35.7%) and in the option "Vegetables" (31.4%) (p<0.05 for all). Age category 16-19 showed the highest percentages in the "Bread/ Bun" (36.7%) and "Pasta/ Rice" options (42.9%) compared to the other categories, without reaching statistical significance.

3.4 Type of food after exercise

Category 16-19 showed a high percentage (75.7%) in the option "Meat/ Fish/ Chicken" (p= 0.002) and (82.9%) in the answer "Pasta / Rice" (p= 0.007), in after exercise food choices.

3.5 Supplement intake

Regarding supplements, the most common answer seemed to be the option "None", with the 10-12 group recording the highest percentage (81%) (p< 0.001). On the contrary, in the option "Protein/ Amino Acid Supplement" the 16-19 group scored a percentage of 32.9%, p <0.001.

3.6 Energy Intake- Energy Expenditure

The highest energy intake was found in U16 group (2242 kcal/ day), while the lowest intake was found in U13 (1815 kcal/ day). The highest carbohydrate intake was found in U14 (4.1 g/ kg BW) and the lowest in the U15 and U16 groups (3.5 g/ kg BW). The highest protein intake was found in the U13 group (1.6 g/ kg BW) and the lowest in U15 (1.2 g/ kg BW). The highest fat intake was found in U13 group (81.1g/ day) and the lowest in U15 group (65.7g/ day) (Table 2). The average values of energy requirements were significantly different between groups (U13: 2698 ± 280; U14: 2761 ± 314; U15: 3144 ± 498; U16: 3201 ± 528 kcal/ day), (p = 0.007).

Post hoc analysis revealed that there was a significant difference between groups U13 and U15 (p = 0.023), U13 and U16 (p = 0.007), U14 and U15 (p = 0.028) and U14 and K16 (0.007).

Table 2: Intake of macronutrients in g/day, g/kg BM and in percentage (%) of energy intake per group, expressed as Mean ± SD

Macronutrients	U13 (n=9)	U14 (n=14)	U15 (n=13)	U16 (n=18)
Carbohydrates				
(g/day)	216,9 ± 118,2	192,4 ± 113	220,1 ± 204	207,3 ± 271
(g/kg BM)	3,9 ± 3,9	4,1 ± 2,4	3,5 ± 4,1	3,5 ± 4,5
% Energy Intake	48 ± 9	47,5 ± 11	50 ± 10	51,5 ± 11
Proteins				
(g/day)	79,6 ± 21,2	82,2 ± 23,2	68,5 ± 24,8	84,6 ± 26,1
(g/kg BM)	1,6 ± 0,6	1,5 ± 0,5	1,2 ± 0,6	1,4 ± 0,4
% Energy Intake	19 ± 5	16 ± 4,6	16 ± 5,5	19 ± 5,8
Fat				
(g/day)	81,1 ± 27,8	73,4 ± 22,5	65,7 ± 38	70,9 ± 48,4
(g/kg BM)	1,66 ± 0,8	1,37 ± 0,6	1,08 ± 0,6	1,1 ± 0,8
% Energy Intake	26±8,2	36±7,8	34±6,7	30±9,3

4. Discussion

The findings of the present research show that the energy intake may be less than the calculated daily energy requirements on specific days of the macrocycle. These findings may hold true for some days within the microcycle, however, for longer periods they could be biased by methodology issues or the tendency of athletes to misreport regarding energy intake (Manore et al., 2017). Concerning macronutrients, protein was adequately covered, as well as fat was within the range of normal recommendations. Carbohydrates were within the normal level, but on the lowest range. Regarding nutritional knowledge we found that in several cases, the young football players of all three age categories had a relatively high percentage of nutritional knowledge. It was observed that they were aware of the importance of eating breakfast and home-cooked food and the need to eat snacks between meals. Group 13-15 didn't seem to understand the importance of hydration in relation to the other groups. Concerning the type of food before and after exercise, the oldest age group (16-19) presented with answers closer to the recommendations.

Almost all participants (94.3%), consumed breakfast daily, which contrasts with earlier research in which only 53.5% of high school youth football players seem to recognise the

importance of breakfast (Manore et al., 2017). When referring to snack consumption between meals, most athletes chose fruits (63.8%) whereas, the research of García-Rovés and colleagues (2014) found that soccer players of different ages chose not to consume snacks both in the morning and in the afternoon. Also, a significant percentage (31%) of the 10-12 group chose cookies and sweets, which indeed proves wrong and unhealthy food choices in a relatively high percentage in the younger ages in our study.

Considering hydration in our study, a large percentage of athletes (93.1%) knew that it is important to drink water before exercise. The largest percentage (98.6%) was observed in the 16-19 group which in combination with zero consumption of soft drinks results may indicate high sports nutrition knowledge or the possibility that athletes largely recorded expected responses. However, special attention needs to be given in the 13-15 group whose players answered that they do not consume water during training (10.7%), a fact that indicates poor nutritional knowledge. Additionally, after exercise, the responses were consistent with water intake, with the 16-19 category reporting a higher consumption (95.7%) and a higher possibility of choosing a sports drink (20%). Our findings are consistent with Rosenbloom et al. (2002) research where 94% of male soccer players were aware that dehydration reduces performance and the need to replace lost fluids after training.

Carbohydrate intake, which is characterised as highly important, was found low in most squads. All players had a carbohydrate intake of 3.5 – 4.1 g/ kg BW/day or 47.5 – 51.5%, although, the percentage of energy from carbohydrates should be 55-65%, in line with recommendations (Chryssanthopoulos et al., 2009). This fact indicates a critical lack of basic knowledge of sports nutrition in these ages. The results of Anderson and colleagues (2017), who evaluated the energy intake of professional soccer players during the competitive season, are also in agreement. In particular, a relatively small amount of carbohydrate consumption (6.4 ± 2.2 g/ kg BW) was observed on the day of the match but also on training days (4.2 ± 1.4 g/ kg BW). An increase on match days was observed, which was nevertheless not enough to meet recommendations for all players (Anderson et al., 2017). As for protein intake, current study findings of 1.2-1.4 g/ kg BM/ day were close to the recommendations. Players in the U15 group were below the recommended intake, but the rest of the players had a protein intake within the recommended range in order to optimize recovery and growth, which was mainly consumed through poultry and dairy foods. The total energy intake from fat was 26% to 36%, which is very close to the recommended range (20 - 35%) of total energy intake (Clark, 1994). Increased fat intake is common in adolescents and according to the research of Iglesias-Gutiérrez, et al., (2005), the percentage of energy derived from fat was found at 38% of the daily intake.

In the choice of food after exercise, the majority of the participants of all categories chose, in order of popularity, meat, pasta, fruit, bread, eggs, vegetables and finally legumes. More specifically, the 16-19 group better recognised the need to consume pasta (82.9%), bread (37.1%), fruit (30%) and vegetables (40%) compared to the rest. Therefore, after exercise the participants seem to have a better knowledge of the necessity of carbohydrates as well as proteins for faster recovery. However, again 16-19 tend to outperform in knowledge and list better overall outcome scores.

Regarding nutritional supplements, most participants used vitamins (22.6%). Also, the 16-19 group makes use of a protein and amino acid supplement, while the largest percentage of participants, within the first age category, do not make use of any supplement. An important

finding is the selection of all available supplements from the 13-15 group. This fact intensifies the need for systematic nutritional education of adolescents, so that they can adopt good nutritional practices at the level of completely covering their requirements in macro andmicronutrients from food (Burke, 2006).

From the 24-hour recall analysis it was observed that the adolescents followed a diet limited in vegetables and fish. The main sources of carbohydrates were bread, potatoes, pasta and fruit. It was also observed that the meal that was served at school was usually a fatty meal such as pizza or cheese pie. Similarly, in the evening after the match, junk food was sometimes chosen, such as pizza or souvlaki. These findings contrast with some answers given in the questionnaire such as poultry, fish and vegetables which were popular answers for other players. It is therefore possible that some players tended to avoid answers which include junk food and unhealthy choices.

Although percentage of under-reporting and misreporting may be high in these ages, these data suggest that elite football players in academies may well achieve current guidelines for daily protein and fat intake. However, total energy and carbohydrate intake was not in accordance with guidelines to promote muscle glycogen storage. Data on nutritional knowledge suggests a tendency for the older athletes giving more suitable answers concerning sport nutrition knowledge and habits. As a conclusion, the implementation of an educational strategy on nutritional needs starting from the young squads of athletes is of high importance. It is evident that future research should focus on the effectiveness of different educational protocols.

References

Anderson, L., Orme, P., Di Michele, R., Close, G. L., Morgans, R., Drust, B., & Morton, J. P. (2016). Quantification of training load during one-, two- and three-game week schedules in professional soccer players from the English Premier League: implications for carbohydrate periodisation. Journal of sports sciences, 34(13), 1250–1259.

Armstrong, D. G., Hanft, J. R., Driver, V. R., Smith, A. P., Lazaro-Martinez, J. L., Reyzelman, A. M., Furst, G. J., Vayser, D. J., Cervantes, H. L., Snyder, R. J., Moore, M. F., May, P. E., Nelson, J. L., Baggs, G. E., Voss, A. C., & Diabetic Foot Nutrition Study Group (2014). Effect of oral nutritional supplementation on wound healing in diabetic foot ulcers: a prospective randomized controlled trial. Diabetic medicine: a journal of the British Diabetic Association, 31(9), 1069–1077.

Bangsbo, J., Mohr, M., & Krustrup, P. (2006). Physical and metabolic demands of training and match-play in the elite football player. Journal of sports sciences, 24(7), 665–674.

Briggs, M. A., Cockburn, E., Rumbold, P. L., Rae, G., Stevenson, E. J., & Russell, M. (2015). Assessment of Energy Intake and Energy Expenditure of Male Adolescent Academy-Level Soccer Players during a Competitive Week. Nutrients, 7(10), 8392–8401.

Burke L. (1995). Practical issues in nutrition for athletes. Journal of sports sciences, 13 Spec No, S83–S90.

Burke S., Kevin C. Stagl, Cameron Klein, Gerald F. Goodwin, Eduardo Salas, Stanley M. Halpin (2006). What Type of Leader Behaviors Are Functional in Teams? A Meta-Analysis. The Leadership Quarterly, 17(3), 288-307.

Caccialanza, R., Cameletti, B., & Cavallaro, G. (2007). Nutritional Intake of Young Italian High-Level Soccer Players: Under-Reporting is the Essential Outcome. *Journal of sports science and medicine* , pp. 538-542.

Chryssanthopoulos, C., Kontzinos, K., Petridou, A., & Maridaki, M. (2009). Nutritional intake of semi-professional soccer players during a week in the competitive season. *Serbian Journal of Sports Sciences* , pp. 19-27.

Clark, K. (1994). Nutritional guidance to soccer players for training and competition. *Journal of sports and sciences* , pp. 43-50.

Collins, J., Maughan, R. J., Gleeson, M., Bilsborough, J., Jeukendrup, A., Morton, J. P., Phillips, S. M., Armstrong, L., Burke, L. M., Close, G. L., Duffield, R., Larson-Meyer, E., Louis, J., Medina, D., Meyer, F., Rollo, I., Sundgot-Borgen, J., Wall, B. T., Boullosa, B., Dupont, G., … McCall, A. (2021). UEFA expert group statement on nutrition

in elite football. Current evidence to inform practical recommendations and guide future research. British journal of sports medicine, 55(8), 416.

Croll, J. K., Neumark-Sztainer, D., Story, M., Wall, M., Perry, C., & Harnack, L. (2006). Adolescents involved in weight-related and power team sports have better eating patterns and nutrient intakes than non-sport-involved adolescents. Journal of the American Dietetic Association, 106(5), 709–717.

Desbrow, B., McCormack, J., Burke, L. M., Cox, G. R., Fallon, K., Hislop, M., Logan, R., Marino, N., Sawyer, S. M., Shaw, G., Star, A., Vidgen, H., & Leveritt, M. (2014). Sports Dietitians Australia position statement: sports nutrition for the adolescent athlete. International journal of sport nutrition and exercise metabolism, 24(5), 570–584.

García-Rovés, P. M., García-Zapico, P., Patterson, A. M., & Iglesias-Gutiérrez, E. (2014). Nutrient intake and food habits of soccer players: analyzing the correlates of eating practice. Nutrients, 6(7), 2697–2717

Goto, H. M. (2015). Motion analysis of U11 to U16 elite English Premier League Academy players. . *Journal of sports sciences* , pp. 1248-1258.

Iglesias-Gutiérrez, E., García-Rovés, P. M., Rodríguez, C., Braga, S., García-Zapico, P., & Patterson, Á. (2005). Food Habits and Nutritional Status Assessment of Adolescent Soccer Players. A Necessary and Accurate Approach. Canadian journal of applied physiology, pp. 18-32.

Manore, M. M., Patton-Lopez, M. M., Meng, Y., & Wong, S. S. (2017). Sport Nutrition Knowledge, Behaviors and Beliefs of High School Soccer Players. Nutrients, 9(4), 350

Maughan, R. J., Watson, P., Cordery, P. A., Walsh, N. P., Oliver, S. J., Dolci, A., Rodriguez-Sanchez, N., & Galloway, S. D. (2016). A randomized trial to assess the potential of different beverages to affect hydration status: development of a beverage hydration index. The American journal of clinical nutrition, 103(3), 717–723.

Murray, N. B., Gabbett, T. J., Townshend, A. D., Hulin, B. T., & McLellan, C. P. (2017). Individual and combined effects of acute and chronic running loads on injury risk in elite Australian footballers. Scandinavian journal of medicine & science in sports, 27(9), 990–998.

Noronha, D. C., Santos, M., Santos, A. A., Corrente, L., Fernandes, R., Barreto, A., Santos, R., Santos, R. S., Gomes, L., & Nascimento, M. (2020). Nutrition Knowledge is Correlated with a Better Dietary Intake in Adolescent Soccer Players: A Cross-Sectional Study. Journal of nutrition and metabolism, 2020, 3519781.

Riddell M. C. (2008). The endocrine response and substrate utilization during exercise in children and adolescents. Journal of applied physiology (Bethesda, Md:1985), 105(2), 725–733.

Rosenbloom, C. A., Jonnalagadda, S. S., & Skinner, R. (2002). Nutrition knowledge of collegiate athletes in a Division I National Collegiate Athletic Association institution. Journal of the American Dietetic Association, 102(3), 418–420.

Werner, E. N., Guadagni, A. J., & Pivarnik, J. M. (2020). Assessment of nutrition knowledge in division I college athletes. Journal of American college health: J of ACH, 1–8. Advance online publication.

Investigating the probable correlation between working memory in Farsi and vocabulary development in Afghan students that acquire Greek in kindergarten

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Abstract

Multiple studies have examined the correlation between working memory and vocabulary development in various languages. The significant flow of immigrants in Greece implies the increase of children in the Greek school system. The correlation between working memory in Farsi and vocabulary development in Greek was investigated in the Malakasa refugee camp. A total of 29 4–6-year-old Afghan students participated. The analysis showed statistically significant correlation (p=0.018) during the fourth and (p=0.002) during the sixth week. The results have psycholinguistic, socio-economic and cross-cultural implications and suggest improvements in the functioning and environmental interaction of the Afghan refugees with the Greek educational system.

Keywords: Working memory, Persian language, Greek language, vocabulary development, intercultural education

1. Introduction

Working memory and more specifically phonological short-term memory, is related to children's language development (Karousou, 2015). Working memory is responsible for performing a cognitive task and consists of the central executive unit, the phonological circuit and the visual-spatial notebook (Baddeley, 1986; Baplekou, 2003; Groome, 2014). In addition, it includes a subsystem of phonological and articulatory word representation. It seems that this subsystem is related to children's lexical development, because it processes phonological information (Karousou, 2015). The relationship between children's short-term memory and vocabulary development has been investigated in relation to education in a second, foreign language (Masoura and Gathercole, 2005). Based on research, students from Finland (Service and Kohonen, 1995), China (Cheung, 1996), France (Thorn and Gathercole, 1999), Germany (Engel de Abreu et al, 2011) and Spain (Mariscal and Gallego, 2013) showed correlation results between performance on word and pseudoword repetition tests in the native language and on tests of expressive and receptive vocabulary in the second, foreign language. Also, there appears to be limited literature on the characteristics of the Persian language during children's linguistic and cognitive development (Kazemi et al, 2015 · Seadatee-Shamir and Siavoshi, 2014;Afshar et al, 2017). Furthermore, there is no research on the relationship between working memory in Persian and vocabulary development in Greek as a second language (Kazemi et al, 2015).

In Greece since 2015, there has been a significant inflow of refugees through the eastern shores of the Aegean (Ministry of Education, 2017). This influx significantly affects the socio-cultural and educational environment of Greece (Geraris, 2011). In particular, the inclusion of refugee students in Greek public schools increases the need to create intercultural education programmes with modern strategies and methods, such as cooperative teaching and the

adoption of the culture of all students studying in a class (Georgoyiannis, 2016). Therefore and based on the principles of intercultural education, it is important to include bilingual education in the education plan of refugee students, i.e. the utilisation of pre-existing knowledge in the faster learning of the second, academic language (Skourtou et al, 2004). In kindergarten, Afghan children are required to follow a programme in Greek and to learn Greek as a second academic/school language so that they can later join a primary class in Greek public schools. The present research will investigate the correlation of working memory in Farsi[1] and vocabulary development in the learning of Greek as a second language in the open structure kindergarten of Malakasa.

1.1 Purpose of Research

It is important to examine the relationship between working memory and vocabulary development in other languages, such as Farsi, because each language has unique characteristics that may affect children's performance on working memory tests (Masoura and Gathercole, 2005). Also it is necessary to design a specialised intervention programme because the students attending the kindergarten are refugees and may have special educational needs. Finally, students' prior knowledge may accelerate the learning of the academic target language and explore students' cognitive and language skills (Skourtou et al, 2004). Therefore, the present study investigates working memory skills with a word-pseudoword repetition test in Farsi, but also aims at developing faster vocabulary skills with a receptive naming test in Greek. In addition, the word and pseudoword repetition test can be used for early detection of specific learning difficulties or language disorders (Bishop et al, 1996; Yanneli, 2011). It is worth mentioning that Afghan refugees belong to the category of vulnerable groups, due to the fact that they have suffered post-war or repatriation trauma and need a safe environment (Lamb, 2018).

2. Methodology

2.1 Sample

The sample that participated in the research was of non-equal probability and specifically, a convenience sample (Papageorgiou, 2015). A total of 29 out of 47 children aged 4-6 years, of Afghan or Iranian origin, 15 boys and 14 girls, were selected. For inclusion in the study children had to be within the age limits and to have at least one parent of Afghan or Iranian origin. In addition, their mother tongue should be Farsi. Children with motor, neurological, emotional or social developmental difficulty were excluded. Similarly children diagnosed with a neurodevelopmental disorder were excluded from the study. The decision to enrol children in the study involved the completion of a bilingual questionnaire.

2.2 Materials

The word and pseudoword repetition test was used informally in the research and included the following criteria: 15 words with a semantic field in Farsi (Karousou, 2015), 5 pseudowords

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[1]*Farsi, or the Persian language, is an Indo-European language spoken in countries such as Iran, Afghanistan and Iraq (Sedighi and Shabani-Jadidi, 2018).*

that resemble real Farsi words (Munson, 2001), 5 pseudowords with phoneme sequences frequently used in Farsi (Edwards et al, 2004) and 5 pseudowords based on Farsi phonology (Masoura et al, 2004).For example, two of the words with a semantic field in Farsi were: khob (=well) and didan (=look). A pseudoword that looks like a real word in Farsi was: baridar (looks like the word baradar meaning brother). A phoneme sequence pseudoword often used in Farsi was: silom, because this sequence is present in many Farsi words such as salam (=hello) and sila (female name).

The standardised test of receptive vocabulary administered is called the British Picture Vocabulary Scale (2nd edition) by Dunn et al (1997). The child was asked to match the picture with the word given orally by the examiner. The BPVS-II is appropriate for the present research because it tests vocabulary comprehension in students who cannot read and do not speak the target language. The test has been translated into Greek for the needs of research relating phonological short-term memory to vocabulary acquisition by Masoura et al (2004).Due to the fact that kindergartens have not opened since September 2020 in the hosting structure and due to the restrictive measures against the transmission of COVID-19, a supplementary and helpful YOUTUBE video was given to the caregivers of the participants that included vocabulary learning in Greek by the researcher. The video consisted of 40 words presented in pictures.25 words used in the BPVS-II test and 15 random atypical words with a high frequency in Greek were selected. Two words were avoided, because they are of low frequency and are not suitable for the acquisition of Greek vocabulary as a school language for non-native preschool students (Yanneli and Stavrou, 2008). The video can be viewed from the following link: https://youtu.be/qDcokJJrwmY.

3. Results

The findings of the present research support the correlation between working memory in the Persian language and vocabulary development in Greek, as a school language. More specifically, a decrease was seen in the mean average of the participants' errors in the words and pseudowords test (Week 1: M.A.=9.45; Week 4: M.A.= 6.86; Week 6: M.A.= 5.45) and a reduction in participants' mean errors on the receptive vocabulary test (Week 1: M.A.=7.83; Week 4: M.A.=4.17; Week 6: M.A. =2.62) during the conduct of the research. A statistically significant correlation was observed, of a moderate degree, as well as a positive relationship between the number of errors in the word and pseudoword test and number of errors in the receptive vocabulary test with a clinical significance index of p=0.018 (2-tailed) at the fourth week and p=0.002 (2-tailed) at the sixth week (p>0.05).

Table 1: Mean and standard deviation of participants' number of word and pseudoword repetition test errors per week.

W.PS.ER.	Mean	SD
Week 1	9,45	4,09
Week 4	6,86	4,05
Week 6	5,34	3,43

Table 2: Mean and standard deviation of participants' number of receptive vocabulary test errors per week.

R.V.ER.	Mean	SD
Week 1	7,83	1,83
Week 4	4,17	2,24
Week 6	2,62	1,84

The Pearson (r) correlation test was performed to correlate the number of errors on the word and pseudoword repetition test and the number of errors on the receptive vocabulary test at the first, fourth and sixth week.
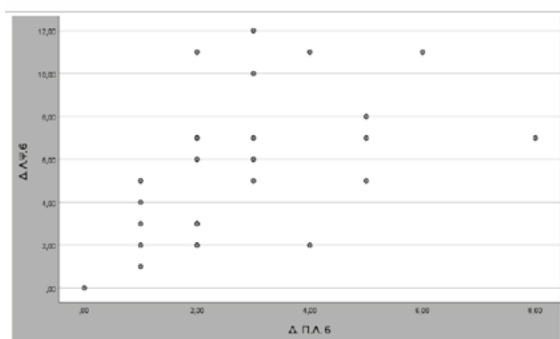

Figure 1. Scatter plot of the number of errors on the word and pseudoword repetition test and the number of errors on the receptive vocabulary test at week six.

Table 3. Correlation between the number of errors on the word and pseudoword test and the number of errors on the vocabulary test in weeks one, four and six.

Pearson Correlation (r)	Week 1		Week 4		Week 6	
	W.PS.ER.	R.V.ER.	W.PS.ER.	R.V.ER.	W.PS.ER	R.V.ER
Pearson Correlation	1	,282	1	,436	1	,543
Sig. (2-tailed)		,138		,018		,002
Pearson Correlation	,282	1	,436	1	,543	1
Sig. (2-tailed)	,138		,018		,002	

Table 3 shows a statistically significant correlation on the sixth week, of moderate degree r(27)=0.543, p=0.002 (2-tailed) with a level of statistical significance p=0.05.

4. Discussion

Our research proved that practicing working memory in the mother tongue can contribute to the development of vocabulary in a second, foreign language. In this way, it verifies the findings of Masoura and Gathercole (2005), Service and Kohonen (1995), Cheung (1996) and Mariscal and Gallego (2013). In addition, it presents findings on the characteristics of the Greek language in terms of lexical development, such as the studies of Chrysochoou et al (2013), Karousou (2015) and (Masoura et al, 2004). At the same time, it presents original psycholinguistic findings regarding the performance of Persian speakers in a test of working and verbal short-term memory in Farsi and primary cross-cultural findings regarding the relationship between working memory in the Persian language and lexical development in Greek as a second language.

Furthermore, the clinical effectiveness of the research lies in the fact that it presents evidence regarding the learning methods, the working memory and the academic skills of refugee students, who may have suffered repatriation trauma and present special educational needs (Lamb, 2018;Kaplan et al, 2016). More specifically, the Words and Pseudowords Test presented significant findings regarding students' working memory in their native language.The results showed that the Afghan students reduced their number of errors when repeating words and pseudowords over six weeks, so it seems that this test is effective in enhancing working memory in this population.

In addition, the test also functioned as an early detection of specific learning difficulties or language disorders (Bishop et al, 1996;Yanneli, 2011). Through the test but also through the completion of the bilingual questionnaire by parents/guardians of the participants, it was found that several students (14.8%) were excluded from the research due to: a) speech and language delay based on chronological age, b) cleft palate c) emotional and social difficulties such as selective muteness, anxiety and distraction and d) phonological processes due to bilingualism or trilingualism given that the participants have experienced constant repatriation during their early developmental years (Kaplan et al,2016).As a result, it was proposed to include a speech therapist in the kindergarten of the Malakasa accommodation structure, specialising in language disorders in bilingual kindergarten students, as well as in children with psychosocial difficulties such as repatriation trauma or post-war trauma. This would allow early interventionand help students develop their academic skills so that they are properly prepared for elementary school.

Similarly, the Test of Receptive Vocabulary presented significant findings regarding vocabulary development in Greek as a school language, in bilingual or trilingual refugee students. In the present study, Afghan students showed a reduction in the number of errors in the vocabulary test over a six-week period. From the literature, it appears that the development of a second language is helpful in the later academic course of children because it strengthens skills such as reading and writing ability (Seadatee-Shamir and Siavoshi, 2014). Thus, naming objects with a picture as a visual aid is found to be effective for vocabulary learning and faster bilingual academic development in this population.

However, systematic measurement errorsand researcher bias errors may have occured because the data was collected by one reseacher (Yaglis, 2014;Babbie, 2011). Also the convenience sample was small in size and therefore, it is not representative and the results cannot be generalised to the respective population (Papageorgiou, 2015;Panagiotakos, 2011). The word-pseudoword test was not evaluated by a specialised group of scientists as for example in the compared case by a Persian language psycholinguist, in order to determine the content validity of the test (Yaglis, 2014;Babbie, 2011). Moreover, COVID-19-related restrictive measures limited the execution of the study (Government Gazette 2020). The lack of interpersonal contact and the addition of the mask and visor by the researcher, as well as the socialdistancing measure, further limited the interaction with the participants during the sessions (Nobrega et al, 2020).

Acknowledgments

References

Afshar, M.R., Ghorbani, A., Rashedi, V., Jalilevand, N, Kamali, M. (2017), Working memory span in Persian-speaking children with speech sound disorders and normal speech development. In: International Journal of Pediatric Otorhinolaryngology, October 101, p.p. 117-122.

Babbie, E. (2011), ΕισαγωγήστηνΚοινωνικήΈρευνα, (μτφρ.),Αθήνα: ΕλληνικάΓράμματα.

Baddeley, A. (1986), Oxford psychology series, No. 11. Working memory. Washington, DC: Clarendon Press/Oxford University Press.

Bishop, D.V., North, T., Donlan, C. (1996), Nonword repetition as a behavioral marker for inherited language impairment: evidence from a twin study. In: Child Psychology Psychiatry, vol. 37, no. 4, p.p. 391-403.

Byers-Heinlein, K., Lew-Williams, C. (2013), Bilingualism in the Early Years: What the Science Says. In: Learning landscapes, vol. 7, no. 1, p.p. 95–112.

Γεράρης, Η. (2011), Ένταξη και αποδοχή των αλλοδαπών μαθητών μέσω της διαπολιτισμικής αγωγής. Στο: Τα εκπαιδευτικά, 99-100, σ.σ. 24-32.

Γεωργογιάννης, Π. (επιμ.) (2016), Διαπολιτισμική Εκπαίδευση. Ελληνικά ως δεύτερη ή ξένη γλώσσα. Πρακτικά 11ου Διεθνούς Συνεδρίου (Πάτρα 11-13 Ιουλίου 2008). Πάτρα: Ελεύθερο Πανεπιστήμιο Πολιτών. Στο: http://pgeorgogiannis.inpatra.gr/praktika/2008_11o_vo1.pdf(προσπελάστηκε στις 6 Ιουνίου 2020).

Γιαγλής, Γ. (2014), Στοιχεία Ψυχομετρίας. Πανεπιστημιακές Σημειώσεις. Στο: https://eclass.uoa.gr/modules/document/file.php/PRIMEDU306/giglis_psyxometria_08_04_2014.pdf (προσπελάστηκε στις 10 Μαΐου 2021).

Γιαννέλη, Π. (2011), Σύγκριση γλωσσικού προφίλ ελληνόφωνου και αλλοδαπού νηπίου (5-6 ετών). Διδακτορική Διατριβή του Πανεπιστημίου Ιωαννίνων. Τμήμα Επιστημών Αγωγής. Τμήμα Παιδαγωγικό Νηπιαγωγών.

Γιαννέλη, Π, Σταύρου, Π. (2008), Σύγκριση γλωσσικού προφίλ του αλλοδαπού και ελληνόφωνου νηπίου (5-6 ετών) στο ελληνικό νηπιαγωγείο. Πρακτικά του 6ου Πανελλήνιου Συνέδριου της Ελληνικής Παιδαγωγικής Εκπαιδευτικής Έρευνας, τόμος Α, σσ. 507-515. Αθήνα: Εκδόσεις Ατραπός.

Cheung, H. (1996), Non-word span as a unique predictor of second-language vocabulary learning. In: Developmental Psychology, vol. 32, no. 5, p.p. 867-873.

Chrysochoou, E., Bablekou, Z., Masoura, E., Tsigilis, N. (2013), Working memory and vocabulary development in Greek preschool and primary school children. In: European Journal of Developmental Psychology, vol. 10, p.p. 417-432.

Dunn, L., Dunn, M., Whetton, C., Burley, J. (1997). British Picture Vocabulary Scale, 2nd Edn. (BPVS-II). Windsor: NFER-Nelson.

Edwards, J., Beckman, M.E., Munson, B. (2004), The interaction between vocabulary size and phonotactic probability effects on children's production accuracy and fluency in nonword repetition. In: Journal of Speech, Language, and Hearing Research, vol. 57, p.p. 421– 436.

Engel de Abreu, P.M.J. (2011), Working memory in multilingual children: Is there a bilingual effect? In: Memory, vol. 19, p.p. 529-537.

Gathercole, S.E., Baddeley, A.D. (1989), Evaluation of the role of phonological STM in the development of vocabulary in children: A longitudinal study. In: Journal of Memory and Language, vol. 28, no. 2, p.p. 200–213.

Groome, D. (2014), An introduction to Cognitive Psychology (3rd Edition). New York, NY: Psychology Press. Available from: https://books.google.gr/books?id=A7JiAgAAQBAJ&pg=PA408&lpg=PA408&dq=groome+2010+working+memory&source=bl&ots=HHJWv6ZEe-&sig=ACfU3U15WOGbcgo8vCtyPQy095PcskW5nQ&hl=en&sa=X&ved=2ahUKEwid4s_qtOrpAhWCqIsKHXd6B1kQ6AEwCnoECAkQAQ#v=onepage&q=groome%202010%20working%20memory&f=false (viewed on 4 May 2021).

Kaplan, I., Stolk, Y., Valibhoy, M., Tucker, A., Baker, J. (2016), Cognitive assessment of refugee children: Effects of trauma and new language acquisition. In: Transcultural Psychiatry, vol. 53, no. 1, p.p. 81–109. Available from: https://doi.org/10.1177/1363461515612933 (viewed on 2 May 2021).

Καρούσου, Α. (2015), Η εκτίμηση της φωνολογικής βραχύχρονης μνήμης σε Ελληνόφωνα παιδιά 2 και 3 ετών: στοιχεία για τη σχέση της με την ανάπτυξη της γλώσσας. Στο: PreschoolandPrimaryEducation, τόμος 3, σ.σ. 117-135. Στο: https://www.researchgate.net/publication/292996755_H_ektimese_tes_phonologikes_brachychrones_mnemes_se_Ellenophona_paidia_2_kai_3_eton_stoicheia_gia_te_schese_tes_me_ten_anaptyxe_tes_glossas (προσπελάστηκε στις 5 Ιουνίου 2020).

Kazemi, Y., Stringer, H., Klee, T. (2015), Study of child language development and disorders in Iran: A systematic review of the literature. In: Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences, vol. 20, no. 1, p.p. 66–77.

Lamb, C.S. (2018), Working with children with refugee-related trauma: An ecological approach. In: *C and K Early Education and Care Conference*. Brisbane, Australia, 30 June 2018.

Mariscal, S., Gallego, C. (2013), La imitación como herramienta para investigar y evaluar el desarrollo lingüístico temprano: un estudio piloto de repetición de palabras y pseudopalabras. En: Revista de Investigación en Logopedia, vol. 3, no. 1, p.p. 53-75.

Μασούρα, Ε., Gathercole, S.E., Μπαμπλέκου, Ζ. (2004), Η συμβολή της φωνολογικής βραχύχρονης μνήμης στην απόκτηση λεξιλογίου. Στο: Ψυχολογία, τομ. 11, νο. 3, σ.σ. 341-355.

Masoura, E., Gathercole, S.E. (2005), Contrasting contributions of phonological short-term memory and long-term knowledge to vocabulary learning in a foreign language. In: Memory, vol. 13, no. 3/4, p.p. 422-429.

Ministry of Education, Research and Religious Affairs, (2017), Refugee Education Project. Athens: Scientific Committee of the Ministry of Education, Research and Religious Affairs, p.p. 1-33. Available from: https://www.minedu.gov.gr/publications/docs2017/CENG_Epistimoniki_Epitropi_Prosfygon_YPPETH_Apotimisi_Protaseis_2016_2017_070__.pdf (viewed on 6 June 2020).

Μπαμπλέκου, Ζ. (2003), Η ανάπτυξη της μνήμης : Γνωστική διαδρομή στην παιδική ηλικία. Αθήνα: Τυπωθήτω.

Munson, B. (2001), Phonological pattern frequency and speech production in adults and children. In: Journal of Speech, Language, and Hearing Research, vol. 44, p.p. 778– 792.

Nobrega, M., Opice, R., Lauletta, M.M., Nobrega, C.A. (2020), How face masks can affect school performance. In: International journal of pediatric otorhinolaryngology, vol. 138, 110328. Available from: https://doi.org/10.1016/j.ijporl.2020.110328 (viewed on 10 May 2021).

Παπαγεωργίου, Ι. (2015), Θεωρία δειγματοληψίας. Αθήνα: Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. [viewed 4 June 2020]. Στο: ΘΕΩΡΙΑ ΔΕΙΓΜΑΤΟΛΗΨΙΑΣ - 02_chapter_01.pdf (kallipos.gr) (προσπελάστηκε στις 4 Ιουνίου 2020).

Παναγιωτάκος, Β.Δ. (2011), Μεθοδολογία της Έρευνας και της Ανάλυσης Δεδομένων για τις Επιστήμες της Υγείας. Αθήνα: Δίόνικος.

Seadatee-Shamir, A., Siavoshi, Z. (2014), Reading Performance and Academic Achievement in Early Childhood Bilingual and Monolinguals. In: Open Journal of Applied Sciences, vol. 4, p.p. 347-353.

Sedighi, A., Shabani-Jadidi, P. (2018).The Oxford Handbook of Persian Linguistics. Oxford: Oxford University Press.

Service, E., Kohonen, V. (1995), Is the relation between phonological memory and foreign language learning accounted for by vocabulary acquisition? In: Applied Psycholinguistics, vol. 16, no. 2, p.p. 155-172.

Σκούρτου, Ε., Βρατσάλης, Κ., Γκόβαρης, Χ. (2004), Μετανάστευση στην Ελλάδα και Εκπαίδευση: Αποτίμηση της Υπάρχουσας Κατάστασης. Προκλήσεις και Προοπτικές Βελτίωσης. Πανεπιστήμιο Αιγαίου. Ινστιτούτο Μεταναστευτικής Πολιτικής. Στο: https://docplayer.gr/9272644-Metanasteysi-stin-ellada-kai-ekpaideysi-apotiuisi-tis-yparhoysas-katastasis-prokliseis-kai-prooptikes-veltiosis-eupeirognouosyni.html (προσπελάστηκε στις 6 Ιουνίου 2020).

Thorn, A.S., Gathercole, S.E. (1999), Language-specific knowledge and short-term memory in bilingual and non-bilingual children. In: Quarterly Journal of Experimental Psychology, vol. 52A, p.p. 303–324.

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L.E.I.SURE SKILLS (sociaL inclusion for mEntal dIsability and leiS-SURE SKILLS)

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Abstract

The Leisure Skills Project is an ongoing project financed by Erasmus+, that brings together organisations and institutions from across seven different European nations (Greece, Portugal, Spain, Cyprus, France). This programme focuses on the significance of occupational justice for individuals with intellectual disabilities and granting them the ability to exercise personal choice by engaging in meaningful leisure activities. **PURPOSE:** The project's aim is to help persons with mental and/or developmental disabilities learn how to manage their leisure time effectively. To accomplish the aforementioned purpose, a toolkit (IO1) based on educational tools (IO4) is to be created. This toolkit will be made available to trainers, academics, professionals, and parents as a supporting resource. **METHOD:** A total of 66 male and female adults, 18-65 years old with neurodevelopmental disorders from borderline to moderately intellectual and functional level were interviewed with the Leisure Skills Questionnaire. Qualitative data were collected by using Gibb's Model of Reflection. **MAIN RESULTS:** Activities involved some social interaction and participation, facilitating the desired participation in family and community activities that include social interaction. Quiet Leisure is scored lower than performance or satisfaction and Active Leisure is limited and considered as extremely important and satisfactory. The majority of participants were able to score their agreement with the five questions on Quality of Life, however 12% to 26% disagreed with the question or were unsure of their response.

Keywords: Leisure, Quality of Life, Quiet Leisure, Active Leisure, Satisfaction

1. Introduction

The Leisure Skills Project is an ongoing project funded by Erasmus+ which brings together organisations and institutions from across seven different European countries. Leisure activities comprise joyful and not required activities. Those activities are intrinsically motivated and carried out during leisure time that is not devoted to necessary occupations (OTPF,2020; McColl, Law, Doubt, Pollock, & Stewart, 2003; McColl et al., 2014). This incorporates quiet recreation, active recreation, and socialisation of personal choice. Even though they are considered a crucial component of occupational performance, leisure activities are severely underutilised within this population. As a consequence, there is a lack of community integration, significant skill loss as people age, emotional instability, and an increased need for support (Brewster & Coleyshow 2010).

The representatives of the programme are PEGKAP-NY, Metropolitan College of Athens, DK-BEL of France, CSI-CYPRUS, INTRAS of Spain, SCMP of Portugal that implement the program entitled LEISURE SKILLS "SOCIAL INCLUSION FOR MENTAL DESABILITY AND LEISURE SKILLS", funded by Erasmus + of the European Union, with the National Authority, the Foundation for State Scholarships. The programme is intended for adults with disabilities, particularly those who have mental disabilities, as well as for educators, special education academics and families with disabilities. The project's goals are to explore and clarify the value of leisure time for individuals with intellectual disabilities as a component of their welfare and to improve

these individuals' leisure time management abilities. The long-term goal is to create easily accessible digital resources that will help people with disabilities confront the underlying issues that are pulling them out of society. More specifically, this programme concentrates on innovation with an engaging toolkit (IO1), based on educational tools (IO4), where it will be available to educators, professionals, parents, and trainees as engaging and motivating content to accomplish the aforementioned objective.

The qualitative data were collected by using Gibb's Model of Reflection. The reflections were recorded and analysed using Gibb's Model of Reflection. The Gibbs Reflective Cycle was developed by Graham Gibbs in 1988 to systematise learning from experiences. Given that it is cyclical, it lends itself particularly well to repeated encounters and gives a framework for analysing events. This allows to build plans from both favorable and unfavorable circumstances (Patterson & Chapman 2013).

1.1 Leisure Skills Questionnaire Part-I & Part-II

Also, through Leisure Skills Questionnaire, the recreational behaviours of people with intellectual disability are elucidated. The Leisure Skills Questionnaire Part-I is based on the Canadian Model of Occupational Performance - Engagement and the Canadian Occupational Performance Measure. The model was initially released in 1983, and revisions were made in 1991, 1997, and 2002 (DNHW/CAOT, 1983; CAOT 1991, 1997, 2002, 2007). It emphasises a person-centered approach and makes clear that occupational therapists are interested in both occupational engagement and occupational performance.

Leisure Skills Questionnaire Part-I includes the rating of performance and satisfaction. The participant is asked to select up to five activities they believe to be most significant on the performance, importance, and satisfaction rating scales. The development of an interview questionnaire that provides information on how participants spend their leisure time and if this is a result of personal choice was crucial. It also offers as many suggestions or options as possible regarding how they would like to spend their free time and the implications for their quality of life. The participants were questioned about their leisure activities as the process's first phase and listed activities they were interested in. The first enquiries focus on the stated needs of the participants, and the second enquiries deal with "performance" and "satisfaction." After this, Leisure Skills Questionnaire Part-II followed which included The Brunnsviken Brief Quality of life scale (BBQ) that is a self-rating measure for subjective quality of life that was created by academics at Stockholm University and the Karolinska Institutet. The BBQ measures total self-experienced quality of life and is short and simple to conduct and score (Linder et al. 2016).

The research questions, that emerge through the purpose of the research, are: "What are the preferences and needs of the beneficiaries in their free time?", "How satisfied are they through their personal interests and choices?", "What is the participation, importance and execution of these projects?", "What impact does personal choice of the activities they desire and the satisfaction they receive have on their quality of life?".

2. Method

The study, which uses a single factor design, is looking into how participants feel about their quality of life and performance during leisure time. Regarding participants, the Leisure Skills

Questionnaire Part I: Rating Performance & Satisfaction and Part II: Brunnsviken Brief Quality of life scale (BBQ) was administered to 66 males and females with neurodevelopmental disorders from the collaborating organisations. Their ages ranged from 18 to 65 years, and their levels of intellectual and functional functioning ranged from borderline to moderate impairment. The collected qualitative data represented the perspectives of both the trainers and the recipients of the training programmes that were held in various nations and were collected by using Gibb's Model of Reflection has six stages which are Description, Feelings, Evaluation, Analysis, Conclusion and Action Plan.

3. Results

Gibb's Model of Reflection (Patterson & Chapman 2013) was used to record and analyse the reflections in the training process "1-5 NOVEMBER GREECE", "21-25 FEBRUARY SPAIN" and "4-8 APRIL GREECE". Their reflections are analysed in the above six stages.

3.1 1-5 NOVEMBER GREECE

Description: All activities took place indoors except the activity of horse riding. The purpose of activities was Leisure, Satisfaction and Improving Quality of Life. **Emotions:** Mostly there were positive emotions, such as joy, excitement from the beginning to the end of the activities, except for the horse-riding activity, where they felt fear and stress due to the size of the horse. **Evaluation:** The good thing about this experience was that there was a good preparation for every activity and there were positive emotions about the occupational performance. **Analysis:** The whole procedure went well because there was good guidance from the therapists to the users, which made it easy to explain the procedure. **Conclusion:** In conclusion, the occupations were successfully completed, giving satisfaction and joy to the users who stated that they would like to do it again.

3.2 21-25 FEBRUARY SPAIN

Description: Two activities took place indoors (music therapy, dancing, art therapy) except the activities of football, planting and animal shelter activity. The purpose of activities was Leisure, Satisfaction and Improving Quality of Life. **Emotions:** Mostly there were positive emotions, such as joy and excitement from the beginning to the end of the activities. **Evaluation:** The good thing about this experience was that there was a good preparation for every activity. **Analysis:** The whole procedure went well because there was good guidance which made it easy to explain the procedure. **Conclusion:** In conclusion, the occupations were successfully completed, giving satisfaction and joy.

3.3 4-8 APRIL GREECE

Description: All activities took place indoors except the activity of horse riding, which did not take place. The purpose of activities was Leisure, Satisfaction and Improving Quality of Life. **Emotions:** Mostly there were positive emotions, such as joy and excitement from the beginning to the end of the activities. **Evaluation:** The good thing about this experience was that there was a good preparation for every activity to users and there were positive emotions about the occupational performance. Also, the beneficiaries themselves were more prepared and organised because they remembered better than the first time the process and steps of

each activity. **Analysis:** The whole procedure went well because there was good guidance from the therapists to the users, which made it easy to explain the procedure, as well as the images this time were quite helpful. **Conclusion:** In conclusion, the occupations were successfully completed, giving satisfaction and joy to the users.

The Leisure Skills Questionnaire showed the leisure activities and the rating of performance, satisfaction and importance of Active Leisure (Fatih 2020) and Quiet Leisure (Melboe & Ytterhus 2016). The interview data of Part I were divided in 2 sections and presented in Table 1.

Table 1: Leisure Skills Questionnaire Results: Performance, Importance & Satisfaction of Active & Quiet Leisure Time.

TABLE 1

		ACTIVE LEISURE PERIFORMANCE	ACTIVE LEISURE IMPORTANCE	ACTIVE LEISURE SATISFACTION	QUIET LEISURE PERIFORMANCE	QUIET LEISURE IMPORTANCE	QUIET LEISURE SATISFACTION
N	Valid	66	66	66	26	26	26
	Missing	0	0	0	40	40	40
Mean		34,4242	**44,3788**	39,1364	22,8462	22,8077	**18,8846**
Std. Deviation		6,06899	9,25330	10,15705	4,61902	6,15805	5,94190
Sum		2272,00	2929,00	2583,00	594,00	593,00	491,00

The motivation to participate in community and family activities that include social situations with others was supported by the involvement of some socialising and social participation in all activities. The initial data analysis supports a theory put forth by the project partners. The service that was attending, which was evaluated as extremely important and satisfactory, is the only one that is limited and mostly offered in Active Leisure. On the other hand, Quiet leisure is typically performed at home and is not as important or as satisfying as performance or satisfaction.

As for Quality of Life, participants were required to rate their level of agreement with five questions on the Linkert scale that related to quality of life and leisure time.

3.4 Quality of Life Results

The majority of participants were able to assess their level of agreement with the five questions, which is fascinating, but for each of the five questions, there was a number of participants who either disagreed with the question or were unsure of their response, ranging from 12% to 26%. An additional analysis of this percentage may reveal intriguing information about the measure's sensitivity, the interviewer's training, the knowledge they have received, or how they are performing in terms of quality of life.

5 QUESTIONS:
- ☐ I am satisfied with my leisure time: I have the opportunity to do what I want in order to relax and enjoy myself.
- ☐ I am satisfied with the opportunities to be creative: to get use my imagination in my everyday life, in a hobby, in my job, or in my studies.

☐ I am satisfied my learning: I have the opportunity and desire to learn new, exciting things and skills that interest me.
☐ I am satisfied with friends and friendship: I have friends that I associate with and who support me (as many friends as I want and need).
☐ Friends and friendship are important for my quality of life.

4. Discussion

The Leisure Skills Project is an ongoing Erasmus+ funded programme with interprofessional collaboration between organisations and agencies in seven different European countries. The aim of the project is to examine and define the significance of leisure time for individuals with intellectual disabilities as a component of their wellbeing and to advance their leisure time management skills.

The Leisure Skills Questionnaire and the initial analysis of the pilot data confirm that the services and policy makers should focus on the leisure time and leisure performance area for individuals with neurodevelopmental disorders. Despite the fact that they may have little opportunities for leisure, service users nonetheless rate it as important and satisfactory for their quality of life. It appears that people's leisure time at home is primarily spent watching TV or, in some situations, engaging in hobbies that they enjoy, but they do not consider to be as significant as their structured, organised, and primarily services-organised physical leisure activities (such as sports or sightseeing). The latter are probably seen as more significant and fulfilling since they offer the chance for engagement and social interaction. People with intellectual and neurodevelopmental issues who are restricted in their leisure activities are likewise restricted in their engagement and participation in society. Deeper insights into this population's leisure activities and leisure performance will be provided by further questionnaire modification and thorough data analysis.

According to this programme, people with disabilities will be able to interact with others in a mutually satisfying manner, exhibit social behaviour that eliminates psychopathology, and demonstrates responses that benefit them personally as socially capable people. Furthermore, professionals and academics will have accessibility to these outcomes by the portal, project reference framework, data and tool utilisation in research. Essentially, this programme focuses on the importance of occupational justice to remove obstacles for people with intellectual disabilities as well as to give them the opportunity of personal choice through meaningful leisure activities. Thus, through the study, certain benefits emerge, which the beneficiaries gain, such as asserting the right to freedom of choice and justice in the free time projects that have meaning and value for them. This offers them the opportunity to participate in activities in this field, like any typical developing person, without being limited. Also, they are able to create and maintain their occupational identity, in terms of free time, with results such as a greater sense of independence, personal satisfaction, participation and involvement in occupations with meaning and purpose, enhanced self-esteem, increased motivation, reduced stress levels, self-improvement, more socialisation, as well as better well-being and quality of life.

Essentially, the programme is expected to change the everyday life of the present population, with more opportunities that positively affect quality of life. That is, by facilitating and encouraging individuals to choose the entertainment projects that make sense,

facilitating both the benefit of both independence and participation as an active member of the community as a whole. Finally, the development and preservation of an identity and justice of occupation, thus claiming their rights to personal choice, satisfaction, participation and involvement in leisure time occupations.

References

Bambra, C., Gibson, M., Sowden, A., Wright, K., Whitehead, M., Petticrew, M., 2010. Tackling the wider social determinants of health and health inequalities: evidence from systematic reviews. *Journal of Epidemiological Health*. April, vol. 64, no. 4, pp. 284-291 [viewed 3 September 2022]. Available from: https://pubmed.ncbi.nlm.nih.gov/19692738/

Brewster, S. & Coleyshow, L., 2010. Participation or exclusion? Perspectives of pupils with autistic spectrum disorders on their participation in leisure activities. *British Journal of Learning Disabilities* [online]. December, vol. 39, no. 4, pp. 284-291 [viewed 5 September 2022]. Available from: https://www.researchgate.net/publication/229960705_Participation_or_exclusi-on_Perspectives_of_pupils_with_autistic_spectrum_disorders_on_their_participation_in_leisure_activities

Lindner, P., Frykheden, O., Forsstrom, D., Andersson, E., Ljotsson, B., Hedman, E., Andersson, G., Carlbring, P., 2017. The Brunnsviken Brief Quality of Life Scale (BBQ): Development and Psychometric Evaluation. Cognitive Behavior Therapy [online]. April, vol. 45, no. 3, pp. 182-195 [viewed 9 September 2022]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4867878/

Fatih, H., 2020. Recreation Activities In Adolescents With Intellectaul Disability. *Science, Movement and Health* [online]. June, no. 2, pp. 117-121 [viewed 6 September 2022]. Available from: https://www.researchgate.net/publication/344266693_RECREATION_ACTIVITIES_IN_ADOLESCENTS_WITH_INTELLECTAUL_DISABILITY

Hoskins, B. & Kerr, D., 2012. *Final Study Summary and Policy Recommendations. Participatory Citizenship in the European Union*. European Commission, Europe for Citizens Programme. Available at: http://ec.europa.eu/citizenship/pdf/report_4_final_study_summary_and_policy_recommendations_.pdf

Melboe, L. & Ytterhus, B., 2016. Disability leisure: in what kind of activities, and when and how do youths with intellectual disabilities participate?. *Scandinavian Journal of Disability Research* [online]. June, vol. 19, no. 3, pp. 245-255 [viewed 3 September 2022]. Available from: https://www.tandfonline.com/doi/abs/10.1080/15017419.2016.1264467

Mccoll, M. A., Law, M. C., Doubt, L., Pollock, N., Stewart, D., 2003. *The theoretical basis of occupational therapy* (2nd ed.). Thorofare NJ: Slack Inc.

Mccoll, M. A., Law, M. C., Doubt, L., Pollock, N., Stewart, D., 2003. *The theoretical basis of occupational therapy* (3rd ed.). Thorofare NJ: Slack Inc.

Occupational Therapy Practice Framework: Domain And Process-Fourth Edition, 2020. American Journal of Occupational Therapy [online]. August, vol. 1, no. 74 [viewed 3 September 2022]. Available from: https://pubmed.ncbi.nlm.nih.gov/34780625/

Paterson, C. & Chapman, J., 2013. Enhancing skills of critical reflection to evidence learning in professional practice. *Physical therapy in sport: official journal of the Association of Chartered Physiotherapists in Sports Medicine* [online]. August, vol. 14, no. 3, pp. 133–138 [viewed 4 September 2022]. Available from: https://pubmed.ncbi.nlm.nih.gov/23643448/

Pollard, N., Sakellarioiu, D., Kroneberg, F., 2008. *A political practice of occupational therapy*. Edinburgh: Churchill Livingstone/ Elsevier.

COUNCIL OF EUROPE, 2008. *White Paper on Intercultural Dialogue "Living Together As Equals in Dignity"*. Available at: http://www.coe.int/t/dg4/intercultural/source/white%20paper_final_revised_en.pdf

WORLD HEALTH ORGANISATION, 2012. *World report on disability*. Available at: http://whqlibdoc.who.int/publications/2011/9789240685215_eng.pdf

WORLD FEDERATION OF OCCUPATIONAL THERAPISTS, 2009. *Guiding Principles on Diversity and Culture*. Available from: www.wfot.org

WORLD HEALTH ORGANISATION, 2008. *Closing the Gap in a Generation: Health Equity Through Action on the Social Determinants of Health.* Available at: http://www.who.int/social_determinants/thecommission/finalreport/en/index.html

WORLD FEDERATION OF OCCUPATIONAL THERAPISTS, 2006. *Position Statement on Human Rights.* Available from: www.wfot.org

The role of occupational therapy in the inclusion into the community of citizens with mental illnesses through the occupation of work-A Research Proposal

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Abstract

Background/aims: Occupational therapy is a client-centered profession that promotes health and well-being through participation in meaningful occupations. The main goal of occupational therapists is to create an environment that will promote the engagement and participation of individuals in occupations. There is a gap in the mental health field regarding occupational therapy profession, the occupational science and especially the social inclusion through work. The purpose of this paper is to reveal the gap that exists in the mental health system in Greece of the social inclusion of citizens with mental illness through the occupation of work. It refers to the perspective and experiences of the citizens and the role of occupational therapy from the point of view of the individuals as well as of the occupational therapists themselves. Looking back at the Greek healthcare system, the lack of occupational therapy interventions is reflected as well as the difficulty of involving individuals in the occupation of work.

Materials and Methods: The current proposal focuses on adults diagnosed with mental illness, living in the community and occupational therapists that work with individuals in the community. An interpretative phenomenological analysis (IPA) could be chosen to analyse the information that will be collected. **Discussion:** The current proposal aims to reveal whether occupational therapists in Greece know their role, whether there are effective interventions and whether the individuals themselves can recognise the benefits of occupational therapy.

Keywords: Mental Health, Occupational Therapy, Social Inclusion, Occupation, Greece

1. Introduction

Mental illness affects one in four people at some point in their lives and the incidence is increasing. However, institutions prevent the mentally ill from having an integrated life in the community (Chrysikou and Savvopoulou, 2019). In this way social inclusion has been replaced by social exclusion. Work is an important instrument of economic and social participation in adulthood, yet high unemployment rates of 70-80%, lifelong disrupted participation and economic marginalisation are evident (Williams et al., 2016). Individuals report receiving minimal help in finding a job, showing that more needs to be done in this area (Williams et al., 2016). People diagnosed with mental health disorders face deprivation of occupation. The factors can be social, environmental, economic, geographical, cultural, political, or interpersonal (Durocher, Gibson and Rappolt, 2014). It is useful to mention that stigma is recognised as the main obstacle in the therapeutic treatment of mental disorders and the improvement of the quality of life (Economou, Bechraki and Charitsi, 2020). The World Health Organization (WHO) defines mental health as a state of well-being in which the individual can recognise their abilities, cope with normal stress levels, work productively and contribute to their community. It is a dynamic state of inner equilibrium that enables people to use their abilities following socially desirable ideals (Galderisi et al., 2015).

On the contrary, mental disorder refers to situations that affect knowledge, emotion, and behaviour. Individuals find it difficult to regain their daily lives and roles (Manderscheid et al., 2010). The goal is full participation in the community, even in the presence of ongoing symptoms (Manderscheid et al., 2010). Regardless of the country, the current problem faced by occupational therapists working in this field is to take on new responsibilities that expand the nature of the profession. They are called upon to do increasingly different and non-traditional work, thus changing the definition of the role of occupational therapists. By expanding their knowledge in community and adopting a community-focused practice they could help new populations and get new skills (Phillips, 2021). Mental health practices have advanced from the medical model to community-based care (Phillips, 2021). In this way, two added terms are introduced: social inclusion and community-centerd practice.

Social inclusion is a recent policy, which aims to create equal opportunities for engagement and participation. It focuses on marginalised groups, such as people with mental disorders. The aim is for users of mental health services to be able to live together and within society. This is a main goal that is in line with the values of occupational therapy (Smyth et al., 2011). By easing access to services and integration into communities, occupational therapists could promote occupational justice and social inclusion and help those with mental health problems regain their routines, roles, and occupations. However, there is little evidence to suggest that this exists (Smyth et al., 2011). To assume that a person feels that he/she is actively involved, they need to be able to create an image of themselves outside and beyond their disorder (Boutillier and Croucher, 2010). Full participation requires engagement in occupations, and this is the connection with occupational therapy. It recognises that engaging in meaningful occupations is fundamental to human life (Harrison and Sellers, 2008; Skaltsi et al., 2016).

1.1 Mental healthcare system in Greece

The field of mental healthcare system in Greece began with the establishment of the first public mental health hospitals in the country at the end of the 19th century. It became notorious due to the great psychiatric asylum of Leros (Giannakopoulos and Anagnostopoulos, 2016). In the early 1980s, psychiatric care relied heavily on nine overcrowded, understaffed public psychiatric hospitals and some private ones. Community mental health services were underdeveloped (Madianos and Christodoulou, 2007). In 1981, Greece joined the European Community and 3 years later, the Commission of the European Communities supplied financial and technical help under Regulation (EEC) No 815/84 on the modernisation of the Greek mental healthcare system (Anargyros et al, 2021). The aim was the development of the community, the deinstitutionalisation of patients with long-term hospitalisation and the improvement of conditions in public mental health hospitals (Madianos and Christodoulou, 2007). Over the past 20 years, public sector psychiatry in Greece has made remarkable progress in deinstitutionalisation and the development of rehabilitation services. In 1997 a new multidimensional programme, called Psychargos, was submitted to the European Union (EU) and approved in 1998. The main goal was the deinstitutionalisation of the remaining 3000 long-term patients, while developing a total of 616 mental health services, alternative homes, and rehabilitation units (Madianos, 2019). Unfortunately, few of the patients who receive vocational rehabilitation education eventually find work. However, in 1999, the most progressive mental health law 2716 set the basic principles of mental health practice in Greece, identified the "mental health units" and introduced the concept of "social cooperative

units", which would provide people the opportunity to work and ideally make a living from their job (Giannakopoulos and Anagnostopoulos, 2016). Despite these changes, the work sector for users of mental health services is still difficult. Participation in work, paid or not, has been recognised as a key determinant of health as it is related not only to economic factors but also to social status.

Occupational therapists have been encouraged to create an environment of access to a wide range of occupations, considering that all occupations can have a potential impact on human health and well-being (Farrell and Bryant, 2009). However, the occupational therapy profession is restricted in the Greek mental healthcare system. Although the programmes support the inclusion of occupational therapists, they do not refer separately to the role and the benefits they may offer. The dilemma that occupational therapists must face is how to balance their practice between supporting people who face obstruction in occupations and dealing with systems and structures that prevent them from moving forward and engaging in them (Kirsh, 2015). They have the potential to facilitate and drive change at all levels, both by working with service users and with health and social care providers, launching innovative projects in communities (Harrison and Sellers, 2008). The profession needs political and social awareness in order to build partnerships and take part in an expanded role to enable access to occupations (Harrison and Sellers, 2008).

1.2 Literature Review

According to the literature, there is an absence of a clear definition of the concept and scope of occupational therapy in the community. The scientific evidence gathered on the effectiveness of occupational therapy practices in this context is weak (Munar et al., 2021). Research on the effectiveness and the role of occupational therapy in community practice focuses on specific groups in geriatrics and mental health, excluding adults (Munar et al., 2021). In addition, the focus is on isolated interventions within the community, at the expense of actions aimed at promoting the health of communities and populations (Munar et al., 2021). In this way the community-centerd practice is missing. One element of the role of occupational therapy is to support individuals to meet the needs of being, belonging and becoming (Gruhl et al., 2020). As far as the experiences of mental health service users are concerned, the proposed work should match their stated professional preferences. Lack of interest or dissatisfaction was associated with job loss (Williams et al., 2016). Similar findings were reported in the qualitative study of Vukadin et al. (Vukadin et al., 2021). Moreover, there are reports where people leave work because of the supervisor's behaviour towards them. Working conditions, such as job security and access to benefits, were seen as supportive aspects (Williams et al., 2016). An issue that does not directly affect the involvement in work but is related to the social inclusion of people with mental health disorders in Greece is the lack of a sufficient number of community mental health facilities due to the complexity and duration of the licensing procedures. The research identified legislation as an obstacle to social inclusion (Chrysikou and Savvopoulou, 2019). In conclusion, the need for reliable findings on the exact role of occupational therapy and the identification of obstacles affecting the involvement of people with mental health disorders in the occupation of work is revealed. There is a gap in qualitative data related to the experiences of users of mental health services and the role of the occupational therapy profession in the Greek mental healthcare system.

The proposed research aims to investigate the views of mental health service users about social inclusion, work, and the factors they believe support or prevent their engagement. Some studies have collected important quantitative data, but qualitative data are needed to enhance the power of the findings (Smyth et al., 2011). There is also a need to explore the role of occupational therapy and consolidate its benefits (Phillips, 2021).

2. Methodology

2.1 Study Design

The social inclusion or exclusion that a person with mental health disorder may experience, the difficulty of getting involved in the occupation of work and the factors that strengthen it cannot be easily measured by quantitative data. Some studies have collected important quantitative data but qualitative data are needed (Smyth et al., 2011). For that reason, phenomenology should be the preferable qualitative method. This method is often used to support research in the field of health and social care. It is proposed as suitable for issues dealing with capturing the complexity of occupational therapy practice (Starks and Trinidad, 2007).

2.2 Study setting and potential participants

The data collection process should consist of two stages where participants allow themselves to understand their world, while the researcher tries to understand the experiences of the participants (Davis, Bulter and Mayers, 2009). The first method of data collection to be applied is semi-structured interviews. Semi-structured interviews will take place individually with each participant, based on a questionnaire. There will be 2 questionnaire forms: the first will refer to the service users and the second to occupational therapists.

The second way of collecting data is focus groups. Focus groups help the researcher understand the views of the participants as well as what is happening in their lives. There should be 3 focus groups. The first focus group refers to service users with mental health disorders who experience deprivation in the work, the second refers to those who once worked but are now experiencing disruption of the occupation and the third to occupational therapists who work in structures in the community. The questions will be open-ended (Κυριαζόπουλος και Σαμαντά, 2011

The research population will include people with mental health disorders who are in the age range of 18-45 years and occupational therapists working with people with mental health disorders. The population will be selected according to the Purposeful Sampling method. Also, with respect to occupational therapists, only those who work with individuals with mental health disorders in some structure in the community will be included.

3. Discussion

The present proposal intends to explore the beliefs of mental health service users about social inclusion and work and juxtapose it with information on the role of occupational therapy and its benefits. The usefulness and necessity of conducting this research is considered absolutely important. As has already been mentioned, work not only provides an income but also

promotes social inclusion. People with mental health disorders need to feel members of society (Drosos and Theodoroulakis, 2019).

A nationwide study, which took place in Greece, showed that 50% of the participants would not like to work in the same place as a person diagnosed with schizophrenia. Also, a survey of 1601 Greeks showed that the majority of men would not wish to receive professional services from people with mental illness due to a lack of trust in them (Economou et al., 2020). Difficulties in finding a job are related to personal desires, social and institutional factors (Boardman and Rinaldi, 2013).

Mental health has been severely affected by the multitude of socio-economic crises experienced by people in Greece (Triliva et al., 2013). In recent years, the development of supported employment programmes has been recognised as a necessity and was announced as the main goal of the "Psychargos" programme. Nevertheless, the only significant progress in terms of supported employment in Greece was the establishment of the Employment Support Office and the implementation of the "Bridges for Employment" project (Drosos and Theodoroulakis, 2019).

In general, the professional rehabilitation of users of mental health services is insufficiently addressed, as a comprehensive framework for the provision of mental health care has not been established (Koutra et al., 2022). As far as occupational therapy is concerned, it is a profession that is obviously absent from the mental health system. It is necessary to formulate a clear role and definition regarding occupational therapy and mental health in the community. Interventions should improve the quality of life, promote the occupational identity, role, and a sense of belonging (Wimpenny et al., 2014). In order to achieve the above, occupational therapists themselves need to know the importance of their profession and what their role is in terms of mental health.

Community-centerd occupational therapy practices are becoming increasingly important globally. However, occupational therapists do not feel sufficiently prepared to work in community-based practice environments, particularly those that require a focus on community development (Rensburg, 2018). Through this research, it will be determined whether occupational therapists in Greece know their role, whether there are effective interventions and whether the service users themselves can recognise the benefits of occupational therapy. Finally, the experiences of users of mental health services on the issue of work and social inclusion in Greece will be revealed.

A potential limitation of the study concerns the recruitment of occupational therapists working in the field of mental health in Greece and specifically in the community. It is difficult to find enough professionals with these features. This limitation enhances the usefulness of research, as through the results can generate interest in working in this field by occupational therapists.

References

Anderson, C. (2010). 'Presenting and Evaluating Qualitative Research,' *American Journal of Pharmaceutical Education,* 74 (8), pp.1-6.

Anargyros, K.P., Christodoulou, N.G. and Lappas, A.S. (2021). 'Community Mental Health Services in Greece: Development, Challenges and Future Directions,' *Consortium Psychiatricum*, 2(4), pp. 35-40.

Boutillier, C. and Croucher, A. (2010). 'Social inclusion and mental health,' *British Journal of Occupational Therapy*, 73(3), pp. 136-139.

Boardman, J. and Rinaldi, M. (2013). 'Difficulties in implementing supported employment for people with severe mental health problems,' *The British Journal of Psychiatry*, 203, pp.247-249.

Chrysikou, E. and Savvopoulou, E. (2019). 'Residential Facilities for Psychosocial Rehabilitation: Planning Permit Regulations and Social Inclusion,' *Architecture_MPS*, 16(3), pp. 1-13.

Davis, J.C., Butler, A. and Mayers, C. (2009). 'Occupational therapy and interpretative phenomenological analysis: comparable research companions?' *British Journal of Occupational Therapy,* 72(8), pp. 332-338.

Durocher, E., Gibson, B.E. and Rappolt, S. (2014). 'Occupational Justice: A Conceptual Review,' *Journal of Occupational Science*, 21(4), pp. 418-430.

Drosos, N. and Theodoroulakis, M. (2019). 'Employment as an Integral Part of Social Inclusion: The Case of Mental Health Patients in Greece,' *Promoting Social Inclusion (International Perspectives on Inclusive Education),* 13, pp. 221-237.

Economou, M., Bechraki, A. and Charitsi, M. (2020). 'The stigma of mental illness: A historical overview and conceptual approaches', *Quarterly Journal of the Hellenic Psychiatric Association,* 31(1), pp.36-46.

Farrell, C. and Bryant, W. (2009). 'Voluntary Work for Adults with Mental Health Problems: An Exploration of the Perspectives of Recruiters,' *British Journal of Occupational Therapy,* 72(5), pp. 188–196.

Galderisi, S., Heinz, A., Kastrup, M., Beezhold, J. and Sartorius, N. (2015). 'Toward a new definition of mental health,' *World psychiatry: official journal of the World Psychiatric Association,* 14(2), pp. 231-233.

Giannakopoulos, G. and Anagnostopoulos, D.C. (2016). 'Psychiatric reform in Greece: an overview,' *BJPsych Bull,* 40(6), pp. 326-328.

Gruhl, K.R., Boucher, M. and Lacarte, S. (2020). 'Evaluation of an occupation-based, mental-health program: Meeting being, belonging and becoming needs,' *Australian Occupational Therapy Journal,* 68(1), pp.78-89.

Harrison, D. and Sellers, A. (2008). 'Occupation for Mental Health and Social Inclusion,' *British Journal of Occupational Therapy*, 71(5), pp. 216-219.

Kirsh, B.H. (2015). 'Transforming values into action: Advocacy as a professional imperative,' *Canadian Journal of Occupational Therapy,* 82(4), pp. 212-223.

Κυριαζόπουλος, Π. και Σαμαντά, Ε. (2011) *Μεθοδολογία Έρευνας Εκπόνησης Διπλωματικών Εργασιών.* 1η εκδ. Αθήνα: Σύγχρονη Εκδοτική.

Koutra, K., Mavroeides, G. and Triliva, S. (2022), 'Mental Health Professionals Attitudes Towards People with Severe Mental Illness: Are they Related to Professional Quality of Life?', *Community Mental Health Journal,* 58(4), pp. 701-712.

Madianos, M.G. and Christodoulou, G.N. (2007). 'Reform of the mental healthcare system in Greece, 1984–2006', *Int Psychiatry,* 4(1), pp. 16-19.

Manderscheid R.W., Ryff, C.D., Freeman, E.J., McKnight-Eily, L.R., Dhingra, S. and Strine, T.W. (2010). 'Evolving Definitions of Mental Illness and Wellness,' *Preventing Chronic Disease*, 7(1), pp. 1-6.

Madianos, M.G. (2019). 'The adventures of psychiatric reform in Greece: 1999–2019', *BJPsych International,* 17(2), pp. 26-28.

Munar, M.F.E., Valverde, M.A.T., Gomez, A.I.S., Alvarez, L.J.M. and Miralles, P.M. (2021). 'The Effectiveness of Community Occupational Therapy Interventions: A Scoping Review,' *International Journal of Environmental Research and Public Health,* 18(6), pp.1-16.

Pruzan, P. (2016) Research Methodology the Aims, Practices and Ethics of Science. 1st ed. Springer. Available at: https://link.springer.com/book/10.1007/978-3-319-27167-5

Phillips, H. (2021) *Occupational Therapists' Perspectives on Working in Mental Health Roles.* Student Scholarship. Elizabethtown College. Available at: https://jayscholar.etown.edu/otstu/30/.

Rahman, S. (2016). 'The Advantages and Disadvantages of Using Qualitative and Quantitative Approaches and Methods in Language "Testing and Assessment" Research: A Literature Review,' *Journal of Education and Learning*, 6(1), pp. 102-112.

Rensburg, E.J. (2018). 'A framework for occupational enablement to facilitate social change in community practice,' *Canadian Journal of Occupational Therapy,* 85(4), pp. 318-329.

Starks, H. and Trinidad, S.B. (2007). 'Choose Your Method: A Comparison of Phenomenology, Discourse Analysis, and Grounded Theory,' *Qualitative Health Research,* 10(17), pp, 1372-1380.

Smyth, G., Harries, P. and Dorrer, G. (2011). 'Exploring mental health service users' experiences of social inclusion in their community occupations,' *British Journal of Occupational Therapy,* 74(7), pp. 323-331.

Σκαλτσή, Π., Τσινιά, Ν. και Διαμαντοπούλου, Ε. (2016). 'Κατηγοριοποίηση και ανάλυση – σύνθεση ανθρώπινου έργου', στην: Σκαλτσή, Π., Τσίπρα, Ι., Χαριτάκη, Α. και Τσινιά. (1η εκδ.). *Η Συμβολή Της Εργοθεραπείας Στην Ψυχιατρική Θεραπευτική.* Αθήνα: Επιστημονικές Εκδόσεις Παρισιάνου, σελ. 102-116.

Scharp, K. and Sanders, M.L. (2019). 'What is a theme? Teaching thematic analysis in qualitative communication research methods,' *Communication Teacher*, 33(2), pp. 117-121.

Triliva, S., Fragkiadaki, E. and Balamoutsou, S. (2013). 'Forging partnerships for mental health: The case of a prefecture in crisis ravaged Greece,' *European Journal of Psychotherapy & Counselling*, 15(4), pp. 375-390.

Vukadin, M., Schaafsma, F.G., Michon, H., Berkholf, M. and Anema, J.R. (2021). 'Experiences with Individual Placement and Support and employment – a qualitative study among clients and employment specialists,' BMC Psychiatry, 21(181), pp. 1-12.

Wimpenny, K., Baden, M. and Cook, C. (2014). 'A qualitative research synthesis examining the effectiveness of interventions used by occupational therapists in mental health,' *British Journal of Occupational Therapy*, 77(6), pp. 276–288.

Williams, A.M., Fossey, E., Corbiere, M., Paluch, T. and Harvey, C. (2016). 'Work participation for people with severe mental illnesses: An integrative review of factors impacting job tenure,' *Australian Occupational Therapy Journal*, 63, pp. 65–85.

The Role of Dynamic Contrast Enhanced MRI perfusion imaging in post treatment surveillance of patients with high grade gliomas

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Abstract

Neuroimaging is a valuable diagnostic and surveillance tool for high-grade gliomas. DCE-MRI is a perfusion imaging technique, which can quantitatively evaluate tumour biology, concentrating mostly on the microcirculation and the enhancement patterns in the surrounding tissue. This retrospective observational study consisted of 48 post-treatment patients having been diagnosed with high-grade glioma of the brain. Measurements were taken using DCE-MRI at baseline and at 3-month, 6-month, 9-month and 12-month follow-ups. All data was collected from the UCLH electronic health records. Perfusion maps, BF, AUC, Ktrans, Kep, Ve and Vp, were generated and processed using commercially available software. Eight survival analysis models differentiated progression from stable disease and pseudo-progression from true progression, across the 6- and 12-month timepoints. Models 1 through 4 assessed disease progression based on the initial baseline scan, while models 5 through 8 assessed progression based on the baseline and the 3-month DCE-MRI scan. All survival analysis models were statistically significant with high sensitivity and specificity. The starting hypotheses were verified.

Key words: Glioma, Brain Cancer, DCE-MRI, Advanced Neuroimaging.

1. Introduction

1.1. High-grade gliomas and the role of neuroimaging

The incidence rate of high-grade, aggressive brain tumours is steadily rising, with survival rates averaging approximately 1 year, indicating that there is a need for a more proactive response during treatment and prevention (Philips et al., 2018). Currently, the gold standard of imaging techniques for the surveillance and management of high-grade gliomas is T1-weighted magnetic resonance imaging (MRI) with contrast and T2 or FLAIR (National Institute for Health and Care Excellence, 2018). However, this post-contrast method only indirectly reveals the biological activity of a tumour (Malara and Donato, 2019), being non-specific and unreliable in predicting subsequent tumour behaviour. The identification of disease progression can be confounded by pseudo-progression, which can be defined as a treatment related response seen in the tumour or the surrounding area. True progression and pseudo-progression can currently only be differentiated with certainty after 6, 9 or 12 months, when a true progression would continue to increase in size whilst a pseudo-progression would decrease in size.

Perfusion imaging, specifically Dynamic contrast enhanced magnetic resonance imaging (DCE-MRI), has been established to differentiate progressive or recurrent disease from stable disease (Seeger et al., 2013). However, as most MR imaging modalities can detect this

differentiation, a quintessential area of focus has been the differentiation of pseudo-progression and true progression. Some studies which evaluated the feasibility and validity of any differentiation between pseudo-progression and true progression, determined that DCE-MRI may indeed prove useful when determining disease status (Bisdas et al., 2011; Narang et al., 2011; Bisdas et al., 2014; Chung et al., 2013; Suh et al., 2013; Park et al., 2015; Thomas et al., 2015; Yun et al., 2015; van Dijken et al., 2017; Zhang et al., 2017; Zakhari et al., 2019).

1.2 Study objectives

Currently, DCE-MRI is the standard approach for the observation of cancers in many body organs (Onishi et al., 2020; Song et al., 2020; Zhu et al., 2021). This study's objective is to examine the usefulness, accuracy, and diagnostic role of DCE-MRI in the surveillance of patients with high-grade gliomas and associate the imaging findings to the clinical data. Additionally, this study aims to evaluate the added predictive and diagnostic value of implementing a secondary DCE-MRI exam after three months from the baseline DCE-MRI. The added value of the second DCE-MRI scan will be measured regarding survival prediction and differentiation between true progression and pseudo-progression. The primary hypothesis of this study is that the DCE-MRI would prove to be an accurate and clinically useful tool in the surveillance of high-grade gliomas, by being able to depict the differences, clearly and accurately, between tumour growth and treatment related changes, such as pseudo-progression. A further hypothesis is that the addition of the secondary DCE-MRI assessment will enhance the survival analysis prediction and subsequently the accuracy of the prognosis.

Table 1: Models: This table identifies relevant information to the study.

Model	Disease status	Time point	Maps included in the model	Threshold Sensitivity Specificity	p-value	Median survival time, high perfusion (months)	Median survival time, low perfusion (months)
Model 1	Stable/regression vs progression	6 months	Baseline: Ve, Vp	5.79 81% 68%	<0.0001	3.7	6.2
Model 2	Stable/regression vs progression	12 months	Baseline: Ve, Vp	6.24 74% 72%	<0.0013	3.1	10.5
Model 3	True progression vs pseudo progression	6 months	Baseline: BF, Ktrans, Ve, Vp	4.32 77% 65%	<0.0027	4.1	6
Model 4	True progression vs pseudo progression	12 months	Baseline: Vp	3.07 85% 75%	<0.003	3.9	7.8
Model 5	Stable/regression vs progression	6 months	Baseline: Ve, Vp 3-months: BF, Kep, Vp	8.2 91% 78%	<0.0071	4.7	6
Model 6	Stable/regression vs progression	12 months	Baseline: Ve, Vp 3-months: Kep, Vp	9.48 82% 81%	<0.0001	3.7	>12
Model 7	True progression vs pseudo progression	6 months	Baseline: BF, Kep, Ve 3-months: Vp	4.02 80% 76%	<0.0001	3.3	6.4
Model 8	True progression vs pseudo progression	12 months	Baseline: Vp 3-months: Kep, Vp	66.51 50% 81%	<0.0001	3.4	7.8

2. Methods and Materials

2.1 Patient selection and criteria

The study was approved by the National Hospital for Neurology and Neurosurgery and University College London institute of Neurology Joint Ethics Committee. Patients were retrospectively selected from the University College London Hospitals Electronic Health Records in accordance to the following inclusion criteria: a) patients had undergone image guided gross total tumour resection or tissue biopsy for histological examination of the mass b) histologically confirmed high-grade glioma, in accordance with the World Health Classification (WHO) specifications, at the date of the first DCE-MRI; c) baseline measurement was obtained between the timeframe 2015 to 2020; d) patients underwent chemoradiation protocol in accordance with NICE guidelines and when clinically necessary adjuvant chemotherapy treatments (National Institute for Health and Care Excellence, 2018); e) patients subsequently developed a progressively contrast enhanced enlarging region within the field of interest, identified in two or more consecutive MRI examinations; f) participants underwent, in addition to the baseline DCE-MRI scan, at least one additional DCE-MRI examination. Baseline and follow-up (3, 6 and 12 month) DCE-MR images were obtained from all patients.

2.2 Neuroimaging processing and analysis

Six parametric perfusion maps were generated per scan using the NordicIce (v. 2.3.12, NordicNeuroLab, Bergen, Norway).: (1) the blood flow (BF) map, which establishes the volume of blood passing through a fixed amount of tissue per unit of given time (Bonekamp, Degaonkar and Barker, 2011), (2) the Ktrans map (a kinetic parameter), which is the volume transfer rate and determines blood flow of the tissue and vessel permeability, (3) the Ve map, which is the volume of the extravascular, extracellular space and is a marker of cell density, (4) the Kep map (a kinetic parameter), which is the transfer rate constant extracellular extravascular space to the plasma, (5) the Vp map, which is the fractional volume of the plasma space, and reflects the distribution of contrast agent within a tissue voxel (Bazyar et al., 2016; Jansen, 2016), and lastly (6) the AUC map, which is not dependent on model selection or AIF, reflects permeability and perfusion, which are both associated with prognosis (Choi et al., 2013). Once T1-weighted structural images were co-registered with the six perfusion maps, the region of interest (ROI) mask was defined manually, using the pixel editing tool on the resampled structural data. MRI data were acquired on two types of scanners, a GE 1.5T and a Siemens 3T scanner. Pre-processing was conducted in accordance with literature (Brix et al., 1991; Jansen et al., 2017).

2.3 Statistical analysis

The survival analysis which was used classified the patients at 6 and 12 months in two ways: (1) stable/responding disease vs progressive disease; (2) true-progressive disease vs pseudo-progression. The survival analysis was performed with a univariate Cox proportional hazard regression to identify the significant variables and assessed at 6 and 12 months: (1) stable/responding disease vs progressing disease and (2) truly progressing disease vs pseudo-progressing disease. A threshold was established which divided the patients into two groups, patients with high perfusion values and patients with low perfusion values, where the median

survival time could be established, and the cumulative progression based on the perfusion values could be graphed using the Kaplan-Meier survival analyses (Etikan, 2018).

Eight models were generated, as detailed in Table 1. Models 1 to 4 only considered baseline DCE-MRI maps, whist models 5 to 8 included DCE-MRI maps at both baseline and 3-months. Models 1, 2, 5 and 6 differentiated stable/regression disease from pseudo-progression, whilst models 3, 4, 7 and 8 differentiated true progression from pseudo-progression. The DCE-MRI significant maps can be viewed in Table 1.

3. Results

3.1 Patient characteristics

Forty-eight patients met the inclusion criteria and were analysed within the time constraints of the study. The mean age of the patients was 49.85 □ 12.81 years, with a range of 24-76, with 58% of patients being male and 42% being female. At the 6-month follow up there were fifteen patients with enhancing lesions on their follow-up scans. 47% of those cases were determined to be pseudo-progressive. Furthermore, at the 12-month follow-up 46% of the progressive cases were deemed to be pseudo-progression.

3.2 Significance of perfusion maps and survival analysis

The two-sample Wilcoxon rank-sum (Mann-Witney) test, was insignificant, which signifies that the individual maps cannot distinguish between progression and stable disease or true progression and pseudo-progression. The correlations between BF and AUC, Ktrans and BF, Ktrans and AUC, Ve and BF, Ve and AUC, Ve and Ktrans, in addition to Ve and Kep are significant ($P<0.005$), however the relationships between the remaining maps were not significantly correlated. The Wilcoxon–Breslow–Gehan test conveyed that the probability for all models were statistically significant (table 1). The Kaplan-Meier survival curve for each model can be visualised in figures 1 to 8.

The comparison of Model 1 and Model 5 suggests the use of the baseline and 3-month DCE-MRI assessments combined provides a more accurate measurement of progression (higher sensitivity and specificity in Model 5, Table 1). Although both models evaluated identical patients during the same timeframe, the time to progression for patients with high perfusion values was 1.1-month later in Model 5 when compared to Model 1. The findings of Model 6 are similar to the findings of Model 2, which did not incorporate the perfusion maps of the 3-month measurement during the survival analysis, thus suggesting that the differentiation of stable disease and disease change or progression at 12 months is not dependant on a second assessment with DCE-MRI. The two models predict a different median survival time for the patients with low perfusion: 10.5 months for Model 2 and more than 12 months for Model 6. Moreover, models 5 and 6 had a higher sensitivity and specificity than models 1 and 2, suggesting a more accurate prediction of progression (differentiating it from stable/regressing disease) at both 6 months and 12 months when 3-months measurements are included in the models. Model 7 also had higher sensitivity and specificity than Model 3, however, Model 8, when compared to Model 4, produced a lower sensitivity, but a higher specificity. This indicates that the incorporation of the 3-month follow-up for the prediction of true progression was beneficial at 6 months, but it was not beneficial at 12 months.
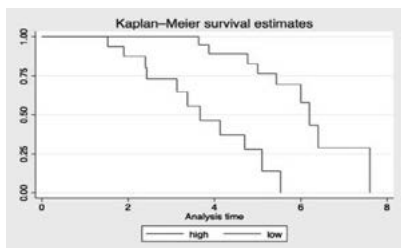
Figure 1: Model 1 Kaplan-Meier survival estimates: 0=progression, 1=stable disease. The period of interest is 0-6 months. The blue line indicates the group of patients with high perfusion values and the red line indicates the group of patients with low perfusion values.
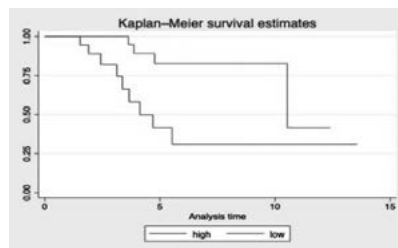

Figure 2: Model 2 Kaplan-Meier survival estimates: 0=progression, 1=stable disease. The period of interest is 0-12 months.
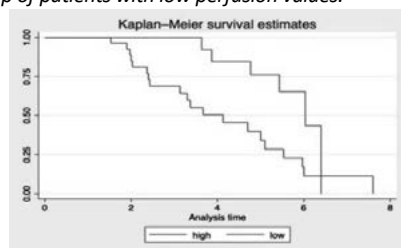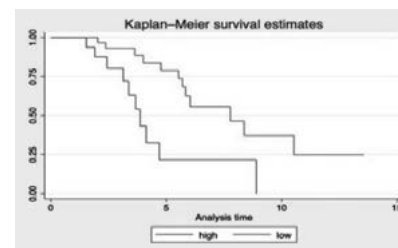

Figure 3: Model 3 Kaplan-Meier survival estimates: 0=true progression, 1=pseudo-progression or stable disease. The period of interest is 0-6 months.

Figure 4: Model 4 Kaplan-Meier survival estimates: 0=true progression, 1=pseudo-progression or stable disease. The period of interest is 0-12 months.
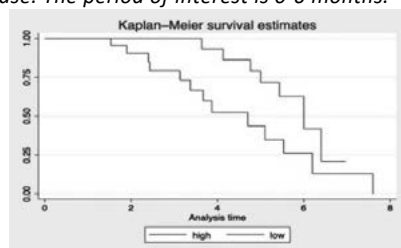

Figure 5: Model 5 Kaplan-Meier survival estimates: 0= progression, 1=stable disease. The period of interest is 0-6 months. The blue line indicates the group of patients with high perfusion values and the red line indicates the group of patients with low perfusion values.
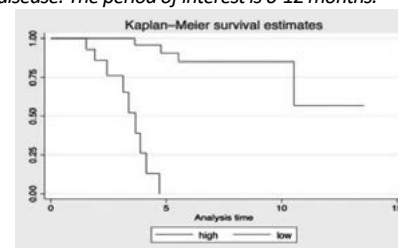

Figure 6: Model 6 Kaplan-Meier survival estimates: 0= progression, 1=stable disease. The period of interest is 0-12 months.
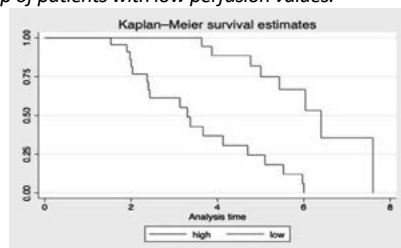

Figure 7: Model 7 Kaplan-Meier survival estimates: 0=true progression, 1=pseudo-progression. The period of interest is 0-6 months.
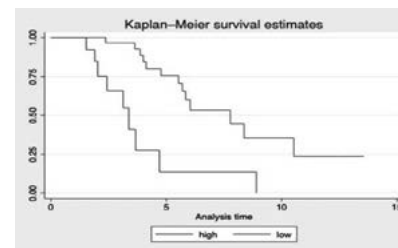

Figure 8: Model 8 Kaplan-Meier survival estimates: 0=true progression, 1=pseudo-progression. The period of interest is 0-12 months.

4. Discussion

This study adds to the existing literature and previous research (Bisdas et al., 2011; Narang et al., 2011; Larsen et al., 2012; Choi et al., 2013; Suh et al., 2013; Hamilton et al., 2014; Shin et al., 2014; Arevalo-Perez et al., 2015; Yun et al., 2015; Thomas et al., 2015; Abbasi et al., 2017; Zhang et al., 2017; Rowe et al., 2018; van Dijken et al., 2019; Zakhari et al., 2019; Filice, Ortenzia and Crisi, 2021), which have evaluated the effectiveness of DCE-MRI for the surveillance of high-grade gliomas, the diagnostic accuracy for progressive disease and the differentiation of pseudo-progression from true progression.

This study found that all models were statistically significant, thus showing that perfusion parameters can accurately and consistently distinguish tumour progression from stable disease and importantly true progression from pseudo-progression. This supports the first hypothesis stating that the DCE-MRI is an accurate and clinically useful tool in the surveillance of high-grade gliomas, by being able to depict the differences, clearly and accurately, between tumour growth and treatment related changes, such as pseudo-progression.

Furthermore, another finding was that the models using the 3-month DCE-MRI measurement in addition to the baseline measurements were statistically significant and had higher sensitivity and specificity, when compared to the models which only utilised the baseline DCE-MRI scan. This was true for the prediction of progression vs stable/regressing disease at both 6 months and 12 months and for the prediction of true progression vs pseudo-progression at 6 months. Thereby, supporting the second hypothesis that the use of the measurements from the secondary DCE-MRI scan will enhance diagnostic accuracy and subsequently more reliable results. Higher specificity but lower sensitivity was observed including the 3 months maps for the prediction of true vs pseudo-progression at 12 months, suggesting that the inclusion of the 3 months follow-up is more relevant for short term prediction than for long term predictions. Of particular interest is model 8 which indicated that the use of the baseline measurement alone is sufficient when only establishing true progression with the use of DCE-MRI. However, as the specificity in the model was higher when compared to model 4, the consecutive use of DCE-MRI and the incorporation of the 3-month measurement can more accurately differentiate between true progression and pseudo-progression.

4.1 Clinical application of DCE-MRI

Currently, DSC-MRI is a more widely accepted technique within perfusion imaging, as more studies have been conducted using this method of perfusion imaging (Blasel et al., 2015; Dongas et al., 2018). However, DCE-MRI can more accurately determine microvascular permeability and quantitively assess the blood brain barrier in comparison to the more widely available DSC-MRI. Furthermore, the higher spatial resolution provided by DCE-MRI allows for differentiation of artefacts, such as air, bone, and blood interfaces (Dongas et al., 2018). Moreover, previous research (Narang et al., (2011), Larsen et al., (2012), Bisdas et al., (2014), Suh et al., (2013), Hamilton et al., (2014), Yun et al., (2015), Thomas et al., (2015), Filice, Ortenzia and Crisi, (2021)) as well as this current study suggest that DCE-MRI has the potential or ability to differentiate pseudo-progression from true progression or recurring disease; therefore informing decision making in during management.

4.2 Limitations

Despite these interesting and optimistic results, some difficulties arise during the clinical application of DCE-MRI, as there are variations across institutions that cannot be accounted for in the realm of theoretical research. Some of these disparities can be seen relating to (i) MR scanners, (ii) imaging acquisition protocols, (iii) contrast administration, (iv) method of post-processing, (Zhang et al., 2017). Additionally, the lack if standardisation when post-processing and quantifying the images presents a disadvantage, as the optimal pharmacokinetic model is not known, leading to disparities in the measurements of the perfusion maps. This has already been determined for the Ktrans map (Sourbron and Buckley, 2013).

References

Abbasi, A.W., Westerlaan, H.E., Holtman, G.A., Aden, K.M., van Laar, P.J. and van der Hoorn, A. (2017). Incidence of Tumour Progression and Pseudoprogression in High-Grade Gliomas: a Systematic Review and Meta-Analysis. *Clinical Neuroradiology*, 28(3), pp.401–411.

Arevalo-Perez, J., Peck, K.K., Young, R.J., Holodny, A.I., Karimi, S. and Lyo, J.K. (2015). Dynamic Contrast-Enhanced Perfusion MRI and Diffusion-Weighted Imaging in Grading of Gliomas. *Journal of Neuroimaging*, 25(5), pp.792–798.

Bazyar, S., Ramalho, J., Eldeniz, C., An, H. and Lee, Y.Z. (2016). Comparison of Cerebral Blood Volume and Plasma Volume in Untreated Intracranial Tumors. *PLOS ONE*, 11(9), p.e0161807.

Bisdas, S., Naegele, T., Ritz, R., Dimostheni, A., Pfannenberg, C., Reimold, M., Koh, T.S. and Ernemann, U. (2011). Distinguishing Recurrent High-grade Gliomas from Radiation Injury. *Academic Radiology*, 18(5), pp.575–583.

Bisdas, S., Smrdel, U., Bajrovic, F.F. and Surlan-Popovic, K. (2014). Assessment of Progression-Free-Survival in Glioblastomas by Intratreatment Dynamic Contrast-Enhanced MRI. *Clinical Neuroradiology*, 26(1), pp.39–45.

Blasel, S., Zagorcic, A., Jurcoane, A., Bähr, O., Wagner, M., Harter, P.N. and Hattingen, E. (2015). Perfusion MRI in the Evaluation of Suspected Glioblastoma Recurrence. *Journal of Neuroimaging*, 26(1), pp.116–123.

Bonekamp, D., Degaonkar, M. and Barker, P.B. (2011). Quantitative cerebral blood flow in dynamic susceptibility contrast MRI using total cerebral flow from phase contrast magnetic resonance angiography. *Magnetic Resonance in Medicine*, 66(1), pp.57–66.

Brix, G., Semmler, W., Port, R., Schad, L.R., Layer, G. and Lorenz, W.J. (1991). Pharmacokinetic Parameters in CNS Gd-DTPA Enhanced MR Imaging. *Journal of Computer Assisted Tomography*, 15(4), pp.621–628.

Choi, H.S., Kim, A.H., Ahn, S.S., Shin, N., Kim, J. and Lee, S.-K. (2013). Glioma Grading Capability: Comparisons among Parameters from Dynamic Contrast-Enhanced MRI and ADC Value on DWI. *Korean Journal of Radiology*, 14(3), p.487.

Chung, W.J., Kim, H.S., Kim, N., Choi, C.G. and Kim, S.J. (2013). Recurrent Glioblastoma: Optimum Area under the Curve Method Derived from Dynamic Contrast-enhanced T1-weighted Perfusion MR Imaging. *Radiology*, 269(2), pp.561–568.

Dongas, J., Asahina, A.T., Bacchi, S. and Patel, S. (2018). Magnetic Resonance Perfusion Imaging in the Diagnosis of High-Grade Glioma Progression and Treatment-Related Changes: A Systematic Review. *Open Journal of Modern Neurosurgery*, 08(03), pp.282–305.

Etikan, İ. (2018). Choosing statistical tests for survival analysis. *Biometrics & Biostatistics International Journal*, 7(5).

Filice, S., Ortenzia, O. and Crisi, G. (2021). How tissue T1-variability influences DCE-MRI perfusion parameters estimation of recurrent high-grade glioma after surgery followed by radiochemotherapy. *Acta Radiologica*, p.028418512110359.

Hamilton, J.D., Lin, J., Ison, C., Leeds, N.E., Jackson, E.F., Fuller, G.N., Ketonen, L. and Kumar, A.J. (2014). Dynamic Contrast-Enhanced Perfusion Processing for Neuroradiologists: Model-Dependent Analysis May Not Be Necessary for Determining Recurrent High-Grade Glioma versus Treatment Effect. *American Journal of Neuroradiology*, 36(4), pp.686–693.

Jansen, J.F. (2016). Texture analysis on parametric maps derived from dynamic contrast-enhanced magnetic resonance imaging in head and neck cancer. *World Journal of Radiology*, 8(1), p.90.

Larsen, V.A., Simonsen, H.J., Law, I., Larsson, H.B.W. and Hansen, A.E. (2012). Evaluation of dynamic contrast-enhanced T1-weighted perfusion MRI in the differentiation of tumor recurrence from radiation necrosis. *Neuroradiology*, 55(3), pp.361–369.

Malara, N. and Donato, G. (2019). Blood-Brain Barrier Breakdown by Combined Detection of Circulating Tumor and Endothelial Cells in Liquid Biopsy. *Liquid Biopsy*.

Narang, J., Jain, R., Arbab, A.S., Mikkelsen, T., Scarpace, L., Rosenblum, M.L., Hearshen, D. and Babajani-Feremi, A. (2011). Differentiating treatment-induced necrosis from recurrent/progressive brain tumor using nonmodel-based semiquantitative indices derived from dynamic contrast-enhanced T1-weighted MR perfusion. *Neuro-Oncology*, 13(9), pp.1037–1046.

NICE guideline (2021). *Recommendations | Brain tumours (primary) and brain metastases in adults | Guidance | NICE*. [online] www.nice.org.uk. Available at: https://www.nice.org.uk/guidance/ng99/chapter/recommendations#management-of-glioma.

Onishi, N., Sadinski, M., Hughes, M.C., Ko, E.S., Gibbs, P., Gallagher, K.M., Fung, M.M., Hunt, T.J., Martinez, D.F., Shukla-Dave, A., Morris, E.A. and Sutton, E.J. (2020). Ultrafast dynamic contrast-enhanced breast MRI may generate prognostic imaging markers of breast cancer. *Breast Cancer Research*, 22(1).

Park, J.E., Kim, H.S., Goh, M.J., Kim, S.J. and Kim, J.H. (2015). Pseudoprogression in Patients with Glioblastoma: Assessment by Using Volume-weighted Voxel-based Multiparametric Clustering of MR Imaging Data in an Independent Test Set. *Radiology*, 275(3), pp.792–802.

Philips, A., Henshaw, D.L., Lamburn, G. and O'Carroll, M.J. (2018). Authors' Comment on "Brain Tumours: Rise in Glioblastoma Multiforme Incidence in England 1995–2015 Suggests an Adverse Environmental or Lifestyle Factor." *Journal of Environmental and Public Health*, [online] 2018, pp.1–3. Available at: https://www.hindawi.com/journals/jeph/2018/2170208/.

Pope, W.B. (2015). Genomics of Brain Tumor Imaging. *Neuroimaging Clinics of North America*, 25(1), pp.105–119.

Ribas, A. and Wolchok, J.D. (2018). Cancer immunotherapy using checkpoint blockade. *Science*, [online] 359(6382), pp.1350–1355. Available at: https://science.sciencemag.org/content/sci/359/6382/1350.full.pdf.

Seeger, A., Braun, C., Skardelly, M., Paulsen, F., Schittenhelm, J., Ernemann, U. and Bisdas, S. (2013). Comparison of Three Different MR Perfusion Techniques and MR Spectroscopy for Multiparametric Assessment in Distinguishing Recurrent High-Grade Gliomas from Stable Disease. *Academic Radiology*, 20(12), pp.1557–1565.

Song, X., Ren, J.-L., Zhao, D., Wang, L., Ren, H. and Niu, J. (2020). Radiomics derived from dynamic contrast-enhanced MRI pharmacokinetic protocol features: the value of precision diagnosis ovarian neoplasms. *European Radiology*, 31(1), pp.368–378.

Sourbron, S.P. and Buckley, D.L. (2013). Classic models for dynamic contrast-enhanced MRI. *NMR in Biomedicine*, 26(8), pp.1004–1027.

Suh, C.H., Kim, H.S., Choi, Y.J., Kim, N. and Kim, S.J. (2013). Prediction of Pseudoprogression in Patients with Glioblastomas Using the Initial and Final Area Under the Curves Ratio Derived from Dynamic Contrast-Enhanced T1-Weighted Perfusion MR Imaging. *American Journal of Neuroradiology*, 34(12), pp.2278–2286.

Thomas, A.A., Arevalo-Perez, J., Kaley, T., Lyo, J., Peck, K.K., Shi, W., Zhang, Z. and Young, R.J. (2015). Dynamic contrast enhanced T1 MRI perfusion differentiates pseudoprogression from recurrent glioblastoma. *Journal of Neuro-Oncology*, 125(1), pp.183–190.

van Dijken, B.R.J., van Laar, P.J., Holtman, G.A. and van der Hoorn, A. (2017). Diagnostic accuracy of magnetic resonance imaging techniques for treatment response evaluation in patients with high-grade glioma, a systematic review and meta-analysis. *European Radiology*, 27(10), pp.4129–4144.

van Dijken, B.R.J., van Laar, P.J., Smits, M., Dankbaar, J.W., Enting, R.H. and van der Hoorn, A. (2019). Perfusion MRI in treatment evaluation of glioblastomas: Clinical relevance of current and future techniques. *Journal of Magnetic Resonance Imaging*, [online] 49(1), pp.11–22. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6590309/ [Accessed 16 Apr. 2020].

Yun, T.J., Park, C.-K., Kim, T.M., Lee, S.-H., Kim, J.-H., Sohn, C.-H., Park, S.-H., Kim, I.H. and Choi, S.H. (2015). Glioblastoma Treated with Concurrent Radiation Therapy and Temozolomide Chemotherapy: Differentiation of True Progression from Pseudoprogression with Quantitative Dynamic Contrast-enhanced MR Imaging. *Radiology*, 274(3), pp.830–840.

Zakhari, N., Taccone, M.S., Torres, C.H., Chakraborty, S., Sinclair, J., Woulfe, J., Jansen, G.H., Cron, G.O., Thornhill, R.E., McInnes, M.D.F. and Nguyen, T.B. (2019). Prospective comparative diagnostic accuracy evaluation of dynamic contrast-enhanced (DCE) vs. dynamic susceptibility contrast (DSC) MR perfusion in differentiating tumor recurrence from radiation necrosis in treated high-grade gliomas. *Journal of Magnetic Resonance Imaging*, 50(2), pp.573–582.

Zhang, J., Liu, H., Tong, H., Wang, S., Yang, Y., Liu, G. and Zhang, W. (2017). Clinical Applications of Contrast-Enhanced Perfusion MRI Techniques in Gliomas: Recent Advances and Current Challenges. *Contrast Media & Molecular Imaging*, 2017, pp.1–27.

Zhu, G., Luo, J., Ouyang, Z., Deng, Y., Guan, Y., Du, G. and Zhao, F. (2021). The Assessment of Prostate Cancer Aggressiveness Using a Combination of Quantitative Diffusion-Weighted Imaging and Dynamic Contrast-Enhanced Magnetic Resonance Imaging. *Cancer Management and Research*, 13, pp.5287–5295.

Interprofessional management of Chronic Obstructive Pulmonary Disease in primary healthcare – the Swedish model

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Abstract

Chronic Obstructive Pulmonary Disease (COPD) is a leading cause of death globally and an important challenge for healthcare systems. The management of the disease requires an interprofessional approach, where the physician, the nurse, the physiotherapist, the occupational therapist and other healthcare professionals have an important contribution. This approach is well known to improve the quality of life and the prognosis of patients with COPD, compared to pharmacological treatment and smoking secession alone. In Sweden, the interprofessional management of COPD is mainly provided by asthma/allergy/COPD clinics that are integrated in primary healthcare centres. This model was introduced to the Swedish healthcare system more than twenty years ago and has blossomed in counties such as Skåne and Stockholm. The asthma/allergy/COPD clinic is driven by a specialised primary healthcare nurse, the asthma/allergy/COPD nurse, and a responsible primary healthcare physician, in close collaboration with physiotherapists, occupational therapists, dieticians and even psychologists. Interestingly, the focus of this interprofessional team is not limited only to diagnosis, smoking secession, pharmacological therapies and pulmonary rehabilitation of patients with COPD, but includes even educational and self-management interventions. It has been shown that patients with access to asthma/allergy/COPD clinics have reduced risk for exacerbations of COPD and hospitalizations, which leads even to reduced treatment costs for these patients. Notably, this quality of provided care in asthma/allergy/COPD clinics is secured through interprofessional continuing medical education. In conclusion, the Swedish model of asthma/allergy/COPD clinics in primary healthcare provides an effective interprofessional management of COPD and can be a source of inspiration for countries lacking organized healthcare for patients with this disease.

Keywords: interprofessional, primary healthcare, asthma/allergy/COPD clinic

1. Introduction

Chronic Obstructive Pulmonary Disease (COPD) is one of the three leading disease-related causes of death globally (WHO, 2020). The prevalence of the disease is about 6-8% of the total population, but the underdiagnosis of COPD exceeds 50% worldwide (Diab et al., 2018).

COPD is characterised by chronic airflow limitation due to inflammation in the airways, which in the industrialised countries is mainly related to long-term tobacco smoking. Patients with COPD present often several common comorbidities, such as cardiovascular diseases, type 2 diabetes mellitus and psychological disorders, which complicate their management and have a negative impact on their prognosis (Vanfleteren et al., 2016). Furthermore, the currently available pharmacological therapies for COPD are mainly symptom-relieving and prevent exacerbations, but fail to cure the disease (GOLD, 2021).

Due to this complexity, the management of COPD requires an interprofessional approach that is not restricted to pharmacological therapies and smoking secession. In this context, the physician, the nurse, the physiotherapist, the occupational therapist and other healthcare professionals collaborate in a structured way, aiming to provide patient-tailored healthcare. An essential part of this approach is pulmonary rehabilitation, which is defined by the American Thoracic Society (ATS) and the European Respiratory Society (ERS) as "a comprehensive intervention based on a thorough patient assessment followed by patient-tailored therapies that include, but are not limited to, exercise training, education, and behaviour change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviours" (Spruit et al., 2013). Additionally, the interprofessional management of COPD encourages and supports self-management interventions, such as written negotiated act plans that incorporate all aspects of the patient's treatment in stable disease and exacerbations. Put together all its parts, the interprofessional approach of COPD is well known to improve the patient's symptoms and health status, as well as to decrease the risk of exacerbations and hospitalisations. This improves further the quality of life and the prognosis of patients with COPD, compared to pharmacological therapies and smoking secession alone (GOLD, 2021).

2. Asthma/allergy/COPD clinics in Swedish primary healthcare

While the interprofessional management of COPD is of great importance, it is also a challenging task that requires well-organised clinics. The Swedish primary healthcare has a long tradition in diagnosing, treating, and following up the vast majority of patients with airway diseases, including COPD, asthma and respiratory allergies. In this context, the interprofessional management of COPD has been mainly provided by asthma/allergy/COPD clinics that are integrated in primary healthcare centres. This model was introduced to the Swedish healthcare system more than twenty years ago and has blossomed in counties such as Skåne and Stockholm, where it has been promoted through extra funding to the involved primary healthcare centres.

2.1 Quality criteria and organisation

The asthma/allergy/COPD clinics have to meet specific criteria that ensure high quality of the provided healthcare. These criteria are based on national and international guidelines but take also into consideration the structure of the Swedish healthcare system. Table 1 summarises the latest update of the above criteria, as published in 2020 by the National Workgroup for Asthma, COPD and Respiratory Allergies.

The asthma/allergy/COPD clinic is driven by a specialized primary healthcare nurse, the asthma/allergy/COPD nurse, and a responsible primary healthcare physician, who should be specialist in family medicine. The nurse and the physician work in the same primary healthcare center, and have close collaboration with the physiotherapist, the occupational therapist, the dietician and the psychologist, who are often employed in a nearby primary healthcare rehabilitation clinic. The patients are referred between these two healthcare units, while the involved healthcare professionals are in a continuous dialogue with each other, aiming to optimize the provided healthcare.

2.2 Duties of different healthcare professionals

The different healthcare professionals that constitute an asthma/allergy/COPD clinic have both distinct and partly overlapping duties, which ensure that all aspects of the interprofessional management of COPD are addressed. These duties are presented in Table 2 and are described in more detail below, with focus on COPD.

2.2.1 Primary healthcare physician

All primary healthcare physicians in Sweden are assigned the duty to investigate patients with airway symptoms and diagnose COPD. This is of great importance, not only due to the extensive underdiagnosis of the disease, but even because early diagnosis is related to better prognosis for the patient (Larsson et al., 2019). When the diagnosis is set, the physician prescribes appropriate pharmacological therapy, establishes a treatment plan and arranges the patient's follow-up. Additional investigations may also be initialised to identify and treat common comorbidities of COPD. The responsible physician for the asthma/allergy/COPD clinic has the additional duty to provide all other physicians in the primary health care center with guidance and updated knowledge in the field. If needed, other specialists, such as pulmonologists, may be consulted and the patient may be referred to them for further assessment.

2.2.2 Asthma/allergy/COPD nurse

The asthma/allergy/COPD nurse's duties include the responsibility to organise the practical aspects of the clinic but are not limited to that. This specialised nurse ensures that the tests required for the diagnosis and follow-up of COPD, such as spirometry, are of performed with good quality and therefore are trustworthy. The patient's treatment plan is followed-up and enriched by the asthma/allergy/COPD nurse with non-pharmacological interventions that meet the patient's individual needs. These interventions include support of smoking secession and self-management, patient education and symptom evaluation, and are prerequisite for an effective management of COPD. The asthma/allergy/COPD nurse has a close collaboration with the responsible for the clinic physician but supports even all other physicians in the primary healthcare centre and contributes to the education of other healthcare workers on COPD.

2.2.3 Physiotherapist

The physiotherapist measures and assesses the patient's physical capacity and activity. This is the ground of pulmonary rehabilitation, which includes the establishment of an individualised exercise programme both for the stable phase of COPD and for the periods of exacerbations. Additionally, the physiotherapist provides education on correct breathing technique and supports patient's self-care management. All the above interventions are included in the patient's treatment plan, which is evaluated regularly in collaboration with the asthma/allergy/COPD nurse and the responsible for the patient primary healthcare physician. In a similar manner with the nurse, the physiotherapist is responsible to introduce other healthcare workers in the management of COPD and educate them on the disease.

2.2.4 Occupational therapist

The occupational therapist's contribution to the interprofessional management of COPD includes the assessment of patient's activities of daily living and advising on energy conservation techniques, mainly in the cases with more severe disease. Home adaptation and assistive technology may also be provided, if needed.

2.2.5 Dietician

The dietician is engaged in the management of COPD to assess the nutritional status and energy needs of the patient. The risk of weight loss and development of malnutrition is increased in patients with COPD and becomes, successively, more pronounced as the disease progresses. Malnutrition has been associated with decreased physical capacity, poor quality of life, increased risk for hospitalisation and increased mortality (GOLD, 2021). Therefore, patients with suspected decreasing weight are identified by other healthcare professionals involved in treatment of COPD and are referred to the dietician for assessment, nutritional treatment and dietary advice.

2.2.6 Psychologist

Anxiety symptoms, depression and difficulties to accept the chronic character of COPD are also common in patients with the disease and affect their quality of life. The physician and the psychologist collaborate with each other to diagnose and treat these disorders. The psychologist encourages the use of crisis management strategies and provides supportive counselling, as well as cognitive behavioral therapy. In parallel, the physician is responsible for the pharmacological therapy, when this is indicated.

2.3 National Spirometry Driving License

Spirometry provides an objective measurement of the patient's lung function and is required for the COPD diagnosis and follow-up. However, there are various factors that affect the accuracy of this test and may lead to wrong conclusions. Therefore, spirometry should be performed and assessed by healthcare workers, who have received appropriate education/training.

To address this, the Swedish Primary Care Respiratory Group (NAAKA), the Swedish Association of Asthma, Allergy and COPD Nurses (ASTA) and the Swedish Association of Clinical Physiology have established a national course in spirometry, named National Spirometry Driving License. This course is certified by The Physicians' Institute for the Professional Development of Healthcare (Lipus) and is provided today in several counties of Sweden. A national committee regularly revises the course material and educates new course instructors. The National Spirometry Driving License is mainly focused on primary healthcare workers and is a prerequisite for asthma/allergy/COPD nurses and primary healthcare physicians responsible for asthma/allergy/COPD clinics. However, it is possible even for other physicians, physiotherapists and other healthcare professionals to attend this course.

2.4 Quality evaluation - Continuing medical education

The evaluation of the quality of healthcare provided in asthma/allergy/COPD clinics is regular and grounded on data that are continuously reported to Swedish national registries, most commonly the Swedish National Airway Register. For instance, previously published data on 21.361 patients with COPD revealed that access to asthma/allergy/COPD clinics in Swedish primary healthcare was associated with 27% less risk for exacerbations of the disease, 37% less hospitalisations annually and consequently reduction by 37% of the annual cost of pharmacological therapies and healthcare contacts for these patients (Lisspers et al., 2014).

The high quality of provided healthcare in asthma/allergy/COPD clinics is secured through interprofessional continuing medical education. This education is a requirement for the responsible for the clinic physician, the asthma/allergy/COPD nurse and the involved physiotherapist, as presented in Table 1. These professionals have a duty to spread the acquired updated knowledge to their colleagues and, consequently, ensure that their respective clinics continue to provide high-quality healthcare to patients with COPD.

The interprofessional continuing medical education in COPD, asthma and allergies is assigned by most Swedish counties to a specific authority of their jurisdiction, e.g. the Academic Primary Healthcare Centre (APC) in Stockholm county and the Primary Healthcare's Unit of Education (PUE) in Skåne County. This does not exclude other sources of continuing education, such as NAAKA and ASTA, which deliver complementary education to the one provided by the counties.

3. Discussion

In summary, COPD is a chronic inflammatory airway disease and a common cause of death globally. The management of COPD requires an interprofessional approach that, apart from pharmacological therapies and smoking secession, integrates even pulmonary rehabilitation, self-management interventions and treatment of comorbidities.

To address this challenging task, Sweden has developed the model of asthma/allergy/COPD clinics in primary healthcare centres. These clinics are based on the close collaboration among asthma/allergy/COPD nurses, primary healthcare physicians, physiotherapists, occupational therapists, dieticians and even psychologists. There is evidence that this model provides healthcare of high quality to patients with COPD. This quality is maintained through continuing education for the involved healthcare professionals and through regular analysis of data from registries.

In conclusion, the asthma/allergy/COPD clinics in Swedish primary healthcare is a well-established, effective, and qualitative model for interprofessional management of COPD and, therefore, can be a source of inspiration for countries lacking organised healthcare for this group of patients.

Table 1. Criteria for certification of asthma/allergy/COPD clinics in Swedish primary healthcare (translated from Swedish) (National workgroup for asthma, COPD and respiratory allergies, 2020).

	Responsible for the clinic primary healthcare physician	Asthma, allergy and COPD nurse	Physiotherapist
Competence	Specialist in family medicine	Studies of at least 15 credit points in asthma, allergy and COPD	Studies of at least 7,5 credit points in asthma, allergy and COPD are recommended
Continuing medical education	Two days per year and profession, preferably as a team		
Interprofessional collaboration	Occupational therapist Dietician Psychologist Smoking cessation specialist (if none of the above healthcare professionals has this competence)		
Time aspect	Responsibility for the clinic, 2 hours/week	Scheduled appointments and telephone advice, 4,8 hours/week per 1000 listed patients	Scheduled appointments, 1,3 hours/week per 1000 listed patients
National Spirometry Driving License	Required	Required	Recommended
Equipment	Spirometer, FEV_1/FEV_6-meter, pulse oximeter, spacer, nebulizer, oxygen, skin and/or blood test for diagnosis of IgE mediated allergies. Information and education material for the patients.		
The Swedish National Airway Register	Continuous registration of data (at least monthly) Analysis of own statistic (at least every six months)		

Table 2. Duties of different healthcare professionals involved in asthma/allergy/COPD clinics in Swedish primary healthcare (translated from Swedish) (National workgroup for asthma, COPD and respiratory allergies, 2020).

Primary healthcare physician	Asthma/allergy/COPD nurse	Physiotherapist
□Assess and investigate the patient's symptoms □Set the diagnosis of asthma, allergy or/and COPD and initiate pharmacological therapy □Establish a treatment plan in dialogue with the patient □Follow-up the pharmacological therapy □Diagnose and treat any comorbidities □Refer the patient to other specialists, e.g. pulmonologist, if needed	□Organize the asthma/allergy/COPD clinic □Perform the required tests (e.g. spirometry) for asthma, allergy and COPD investigation □Establish/follow-up the treatment plan in dialogue with the patient □Follow-up the symptoms and the treatment □Have responsibility for patient education and to support patient's self-management □Support smoking secession □Introduce/educate other healthcare workers	□Measure/assess patient's physical capacity/activity and breathing technique □Plan, support and evaluate exercise in stable disease and after exacerbation □Individualize patient's physical activity/exercise and breathing technique □Follow-up patient's physical activity/exercise and breathing technique □Contribute to patient education and support patient's self-management □Introduce/educate other healthcare workers
Occupational therapist	**Dietician**	**Psychologist**
□Assess patient's activities of daily living (ADL) □Provide advice on energy conservation techniques □Test and prescribe assistive technology □Provide home adaptation	□Assess patient's nutritional status and energy needs □Provide nutritional treatment, inclusive written nutrition plan □Evaluate the nutritional treatment □Provide patient education about nutrition in different states of the disease □Provide nutritional interventions in the case of food allergies	□Diagnose anxiety, depression and difficulties to accept chronic disease □Support crisis interventions, inclusive coping mechanisms □Supportive counselling □Provide treatment for anxiety and depression

References

Diab, N., Gershon, A. S., Sin, D. D., Tan, W. C., Bourbeau, J., Boulet, L. P. & Aaron, S. D. 2018. 'Underdiagnosis and Overdiagnosis of Chronic Obstructive Pulmonary Disease'. *Am J Respir Crit Care Med,* 198**,** 1130-1139.

GOLD. 2021. 'Global strategy for prevention, diagnosis and management of COPD: 2022 Report' [Online]. Available: https://goldcopd.org/2022-gold-reports-2/ [Accessed 06 October, 2022].

Larsson, K., Janson, C., Stallberg, B., Lisspers, K., Olsson, P., Kostikas, K., Gruenberger, J. B., Gutzwiller, F. S., Uhde, M., Jorgensen, L. & Johansson, G. 2019. 'Impact of COPD diagnosis timing on clinical and economic outcomes: the ARCTIC observational cohort study'. *Int J Chron Obstruct Pulmon Dis,* 14**,** 995-1008.

Lisspers, K., Johansson, G., Jansson, C., Larsson, K., Stratelis, G., Hedegaard, M. & Stallberg, B. 2014. 'Improvement in COPD management by access to asthma/COPD clinics in primary care: data from the observational PATHOS study'. *Respir Med,* 108**,** 1345-54.

National workgroup for asthma, COPD and respiratory allergies. 2020. Certifiering av astma-, allergi- och KOL-mottagning' [Online]. Swedish Association of Local Authorities and Regions (SALAR). Available: https://registercentrum.blob.core.windows.net/lvr/r/Certifiering-mottagning-astma-kol-allergi-2020-06-10-Byg7_oodNw-SkgvmxfNBc.pdf [Accessed 06 October, 2022].

Spruit, M. A., Singh, S. J., Garvey, C., ZuWallack, R., Nici, L., Rochester, C., Hill, K., Holland, A. E., Lareau, S. C., Man, W. D., Pitta, F., Sewell, L., Raskin, J., Bourbeau, J., Crouch, R., Franssen, F. M., Casaburi, R., Vercoulen, J. H., Vogiatzis, I., Gosselink, R., Clini, E. M., Effing, T. W., Maltais, F., van der Palen, J., Troosters, T., Janssen, D. J., Collins, E., Garcia-Aymerich, J., Brooks, D., Fahy, B. F., Puhan, M. A., Hoogendoorn, M., Garrod, R., Schols, A. M., Carlin, B., Benzo, R., Meek, P., Morgan, M., Rutten-van Molken, M. P., Ries, A. L., Make, B., Goldstein, R. S., Dowson, C. A., Brozek, J. L., Donner, C. F. & Wouters, E. F., on behalf of the ATS/ERS Task Force on Pulmonary Rehabilitation. 2013. 'An official American Thoracic Society/European Respiratory Society statement: key concepts and advances in pulmonary rehabilitation'. *Am J Respir Crit Care Med,* 188**,** e13-64.

Vanfleteren, L. E. G. W., Spruit, M. A., Wouters, E. F. M. & Franssen, F. M. E. 2016. 'Management of chronic obstructive pulmonary disease beyond the lungs'. *The Lancet Respiratory Medicine,* 4**,** 911-924.

WHO. 2020. 'The top 10 cases of death, World Health Organization' [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death [Accessed 06 October, 2022].

The effects of different types of stretching during an active warm-up on hip and ankle range of motion

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Abstract

Active warm-up can bring about positive responses in the body such as increasing the range of motion of the joints (ROM). The purpose of this study was to examine the effects of the different types of stretching during the execution of an active warmup protocol on hip (flexion, external rotation) and ankle (dorsiflexion) ROM. The participants (n=17, age 24±4 yrs) were subjected to two experimental conditions, a) static stretching b) dynamic stretching, with a random order and an intervening interval of 48 hours. The warm-up protocol consisted of track running, self-myofascial release with a foam roller, stretching and activation exercises. ROM measurements were undertaken before the start of the experiment on a different day (baseline) and after the end of each warm-up protocol. Results showed a statistically significant difference (p<0.05) between the baseline and experimental measurements in the means of all ROM variables. A statistically significant difference in ROM during dorsiflexion of the right ankle (Z=-2,179, p=0.029<0.05) (Static Stretching 12.76±3.865 deg vs Dynamic Stretching 15.81±2.949 deg) was also observed. Application of static and dynamic stretching while performing an active warm-up protocol is equally effective in increasing hip and ankle ROM with application of dynamic stretching showing a greater increase contralaterally.

Keywords: active warm-up, static stretching, dynamic stretching, ROM

1. Introduction

Warm-up is now universally accepted as an integral part of training aimed at physically and psychologically preparing the athlete before exercise or competition (Bishop 2003). A properly structured warm-up programme can bring about many positive responses in the body that contribute to the optimisation of athletic performance (Bishop 2003, Sale 2002). These responses are categorised into a) temperature-related and b) non-temperature-related (Bishop 2003). Temperature-related responses consist of hyperaemia-induced increases in core and muscle temperature, neural tissue excitability, muscle fiber conduction rate, muscle metabolism, and connective tissue elasticity (Gray et al 2011; McGowan et al 2015; Pearce et al 2012). The non-temperature-related responses consist of increased tissue oxygen consumption at rest and enhanced performance due to post-activation potentiation (Burnley and Jones 2007; Sale 2002).

The two warm-up methods applied are passive and active. For passive warm-up, hot water, sauna and heated pads are used to increase core and muscle temperature without extensive energy expenditure. However, the practical application of passive methods is not always feasible for practitioners and positive warm-up responses are only achieved using active methods (Asmussen et al 1976; Bishop 2003; McArdle et al., 2010).

Active warm-up consists of two periods, the general and the specific warm-up (Fradkin et al 2010). The general warm-up begins with 5 minutes of low-intensity physical activity (cycling, running, swimming) and aims to increase heart and respiratory rate (DeVries Housh, Terry, 1994). Then, self-myofascial release is applied using a foam roller to achieve tissue hydration

and increase muscle blood flow (Beardsley and Škarabot, 2015; Schleip and Müller, 2013; Sullivan et al, 2013). Afterwards, the application of stretching helps to increase the range of motion of the joints (ROM) to properly perform the movements of the main activity or competition. Lastly, after the end of the general warm-up, the specific warm-up follows, which includes low-intensity exercises to activate all the muscle groups that produce or stabilise the movements of the body during the main part of training and exercise drills to learn or practise the technique of the sport (Jeffreys, 2007; Young and Behm 2002).

The active warm-up programme should progress smoothly and be performed with a correct quantification of the intensity to achieve the necessary adaptations without fatigue and a dramatic decrease in the energy reserves of the practitioner. Thus, the ideal warm-up duration is defined between 10 and 20 min, while at the same time it is suggested to be completed no later than 15 min before the start of the upcoming activity (McArdle et al., 2010).

1.1 Types of Stretching

Stretching is performed actively or passively and is divided into static, ballistic, dynamic and the PNF method. Static stretching is performed with the exerciser holding the final position firmly for 15 to 30sec resulting in autogenic relaxation of the muscle being stretched (Bandy et al, 1997; Bandy and Irion, 1994). Due to the slow manner of execution, there is no activation of the myotatic reflex resulting in less potential for injury compared to other methods (Corbin, 1981). Furthermore, according to the existing literature, it appears to be an effective method for increasing ROM (Behm et al, 2016; Behm and Chaouachi, 2011; Brodowicz et al, 1996; Lempke et al, 2018; Medeiros et al, 2016).

Ballistic stretching requires muscle activation to perform explosive movements without pausing in the final position and quickly returning to the initial position (Sady et al, 1982). This method is usually used during the warm-up before the start of the main activity. In cases where the exerciser cannot achieve proper control of the movement, there is a potential for muscle or connective tissue injury (Corbin, 1981).

Dynamic stretching or mobility exercises are the execution of controlled movements throughout the ROM according to the characteristics and requirements of the main activity or sport (Fletcher, 2010). When designing warm-up programmes, the application of this method is recommended because it is effective for improving dynamic flexibility, increasing core and muscle temperature, and activating the nervous system (Behm and Sale, 1993; Bishop, 2003; Fletcher and Jones, 2004).

The proprioceptive neuromuscular facilitation (PNF) method was originally developed as part of neurological rehabilitation programmes for the relaxation of hypertonic muscles (Sharman et al, 2006). To perform this method, assistance from another person is usually required as the techniques include passive and active movements. The application of PNF seems to produce better results in increasing the ROM compared to other stretching methods because it facilitates the activation of the inhibitory mechanisms of the neuromuscular system (Sady et al, 1982; Surburg and Schrader, 1997; Tanigawa 1972). However, this method is usually not applied during the warm-up because it can be a painful experience for the practitioner and at the same time requires the intervention of a specialised person (Butterfield and Herzog, 2006).

1.2 Myofascial Release

Fascia is a three-dimensional formation of fibrous connective tissue that covers the entire human body surrounding muscles, bones, organs, blood vessels and other structures (Findley, 2009). In cases of injury, inflammation or immobility, the fascia loses its elasticity leading to reduced joint functionality, pain, dysfunction of the venous and lymphatic system, and the formation of trigger points (Schleip and Müller, 2013). In recent years, the use of the foam roller as a tool for myofascial release has been widespread, as the intervention of a health professional is not necessary for the application of this method. The exerciser uses his body weight to move on the roller exerting pressure on all the muscle groups of the body. According to literature findings, the use of this method appears to have a positive effect on increasing ROM and flexibility, reducing delayed onset muscle soreness (DOMS) and optimising warm-up (Aboodarda et al, 2015; Cafarelli and Flint, 1992; Pearcey et al, 2015).

1.3 Purpose of the Study

The purpose of this study was to examine the effects of different types of stretching during the execution of an active warm-up on hip and ankle ROM. We assumed that:
1. performing static stretches will increase ROM
2. performing dynamic stretches will increase ROM
3. performing dynamic stretches will result in a greater increase in ROM compared to static stretches.

2. Material & Methods

2.1 Participants

A total of 17 trained healthy men aged 24±4 years without musculoskeletal injuries took part in the present study. Before conducting the experimental conditions, the participants were informed in detail about the purpose and methodology of the research and signed the consent form that was given to them after the approval of the Metropolitan College Research and Ethics Committee. The evaluation and measurement procedures took place at the Sports Center of Thessaloniki, Greece.

2.2 Procedures

Participants were subjected to two experimental conditions:
A. 5min running with an intensity of 50-60% of the maximum heart rate (HRmax), 10 slow repetitions with the Grid Foam Roller of the company Trigger Point© on the muscle groups of the lower limb contralaterally, static stretching performed for 30sec, and two sets of 15 repetitions of "hip thrusts" using medium resistance mini bands from the company Blackroll© and "squats" without external resistance.
B. 5min running with an intensity of 50-60% of HRmax, 10 slow repetitions with the Grid Foam Roller of the company Trigger Point© on the muscle groups of the lower limb contralaterally, dynamic stretching performed for 10 repetitions, and two sets of 15 repetitions of "hip thrusts" using a medium resistance mini band from the company Blackroll© and "squats" without external resistance.

The calculation of the heart rate during the performance of the physical activity was carried out with the equation (220 – age) X intensity % (Nes et al, 2012) and its recording using the Band 6 activity tracker of the company Huawei©. In Table 1, the active warm-up protocols of the two experimental conditions are presented in detail.

Table 1. Active warm-up protocols.

General Warm-up	5min track running 50-60% HRmax	
Self-myofascial Release with Foam Roller	10 slow repetitions on each leg: gastrocnemius, hamstrings, quadriceps, adductors (knee bent), glutes (legs crossed	
	Static Stretching	**Dynamic Stretching**
Stretching	*30sec each leg* gastrocnemius/soleus standing stretch (hands against the wall) iliopsoas/rectus femoris stretch box stretch (rear knee touches the floor) hamstrings box stretch (leg straight parallel to the ground) adductors box stretch (knee bent, torso points forward)	*10 reps each leg* half kneeling position hip-knee-ankle flexion kneeling position hip external-internal rotation (hands against the wall) Hip Hinge Lateral Squats
Specific Warm-up	*2x15 (3-1-X)* Hip Thrusts with mini band Squats *30sec rest between sets* *1min rest between exercises*	

Prior to performing the experimental protocols, participants underwent a baseline measurement of passive ROM of the hip during flexion in the transverse axis and external rotation in the longitudinal axis, and of the ankle during dorsiflexion in the transverse axis in both legs using an analog goniometer from the company Gima©. This procedure was performed on a different day at the beginning of the measurement period with the participants abstaining from intense physical exercise for 48 hours. Then, they took part in the two experimental conditions where 5min after the end of the warm-up protocol the passive ROM of the joints was also measured in the same way. The execution of the experimental conditions was carried out in a random order on different days and an intervening interval of 48 hours.

2.3 Statistical Analysis

The IBM SPSS Statistics version 26 software was used for the statistical analysis of the data. Kruskal-Wallis test was performed in order to investigate the differences between the baseline measurements and the two experimental conditions. Wilcoxon test for dependent samples was performed to determine the differences between the two experimental conditions. The level of significance was defined as $p < 0.05$.

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3. Results

The results of the study are presented as means of ROM values ± their standard deviation as recorded during the baseline measurements and after the end of the two experimental conditions.

A statistically significant difference between the baseline measurements and the experimental conditions was observed (Table 2).

Table 2. Means & standard deviations of range of motion variables.

	Baseline	Static Stretching	Dynamic Stretching
Right Ankle Dorsiflexion	8.59±7.168 deg	12.76±3.865 deg*	15.81±2.949 deg*
Left Ankle Dorsiflexion	5.18±7.780 deg	8.47±3.085 deg*	11±4.2430 deg*
Right Hip Flexion	112±14.756 deg	121.29±5.599 deg*	121.88±7.606 deg*
Left Hip Flexion	111.82±7.544 deg	120.18±6.803 deg*	122.69±6.819 deg*
Right Hip External Rotation	23.12±4.820 deg	31.71±7.346 deg*	31.94±5.744 deg*
Left Hip External Rotation	23.82±4.953 deg	32.59±9.125 deg*	32.25±6.330 deg*

A statistically significant difference between the two experimental conditions was also evident in the means of the variable Right Ankle Dorsiflexion (Z=-2,179, p=0.029<0.05) while there was no statistically significant difference in the means of the other ROM variables (Table 3).

Table 3. Means & standard deviations of experimental range of motion variables.

	Static Stretching	Dynamic Stretching
Right Ankle Dorsiflexion	12.76±3.865 deg	15.81±2.949 deg*
Left Ankle Dorsiflexion	8.47±3.085 deg	11±4.2430 deg
Right Hip Flexion	121.29±5.599 deg	121.88±7.606 deg
Left Hip Flexion	120.18±6.803 deg	122.69±6.819 deg
Right Hip External Rotation	31.71±7.346 deg	31.94±5.744 deg
Left Hip External Rotation	32.59±9.125 deg	32.25±6.330 deg

4. Discussion

According to the existing literature, the application of stretching while performing an active warm-up protocol can result in increased ROM (Gray et al, 2011; McGowan et al, 2015, Pearce et a,l 2012). Static and dynamic stretching bring about an improvement in flexibility (Behm et al, 2016; Behm and Chaouachi, 2011; Fletcher and Jones, 2004). Furthermore, performing a general warm-up at the start of the protocol consisting of 5 min of low-intensity physical activity and self-myofascial release is deemed necessary to increase core and muscle temperature (Beardsley and Škarabot, 2015; DeVries et al., 1994; Schleip and Müller, 2013; Sullivan et al 2013) as well as performing a specific warm-up consisting of activation exercises to smoothly transition into the main part of the training or match (Jeffreys, 2007,;Young and Behm ,2002).

The purpose of the present study was to examine the effect of different types of stretching during the execution of an active warm-up protocol on hip ROM during flexion in the transverse axis and external rotation in the longitudinal axis, and ankle ROM during dorsiflexion in the transverse axis. During data analysis, a statistically significant difference was presented between the baseline measurements and the two experimental conditions (Table 2), verifying the first and second research hypotheses as the application of static and dynamic stretching resulted in increased ROM.

The mean values of ROM after the application of the warm-up protocol were greater during the experimental condition of dynamic stretching (Table 3), verifying the third research hypothesis. However, the results of the statistical analysis showed that there was a statistically significant difference in ROM during dorsiflexion of the right ankle. Therefore, both active warm-up protocols are equally effective in increasing ROM, with the application of dynamic stretching showing a greater increase contralaterally.

6.1 Research Suggestions

Applying an active warm-up protocol that includes a combination of static and dynamic stretching is likely to have a greater effect on increasing ROM, as is applying a long-term warm-up programme. However, it should be examined whether the above intervention can affect the athletic performance of the participants by measuring the rate of force development and the maximum force production during the execution of the main part of training. Finally, the selection of a larger sample is considered necessary for the generalisation of the results.

5. Conclusions

An active warm-up can bring about positive responses in the body such as increasing ROM. According to the findings of the present study, the application of static and dynamic stretches while performing an active warm-up protocol is equally effective in increasing hip ROM during flexion and external rotation and ankle ROM during dorsiflexion as the application of dynamic stretching shows a greater increase contralaterally.

Acknowledgments

References

Aboodarda, S.J., Spence, A.J. and Button, D.C. (2015) 'Pain pressure threshold of a muscle tender spot increases following local and non-local rolling massage.', *BMC musculoskeletal disorders*, 16, p. 265. Available at: https://doi.org/10.1186/s12891-015-0729-5.

Asmussen, E., Bonde-Petersen, F. and Jorgensen, K. (1976) 'Mechano-elastic properties of human muscles at different temperatures.', *Acta physiologica Scandinavica*, 96(1), pp. 83–93. Available at: https://doi.org/10.1111/j.1748-1716.1976.tb10173.x.

Bandy, W.D. and Irion, J.M. (1994) 'The effect of time on static stretch on the flexibility of the hamstring muscles.', *Physical therapy*, 74(9), pp. 842–845. Available at: https://doi.org/10.1093/ptj/74.9.845.

Bandy, W.D., Irion, J.M. and Briggler, M. (1997) 'The effect of time and frequency of static stretching on flexibility of the hamstring muscles.', *Physical therapy*, 77(10), pp. 1090–1096. Available at: https://doi.org/10.1093/ptj/77.10.1090.

Beardsley, C. and Škarabot, J. (2015) 'Effects of self-myofascial release: A systematic review.', *Journal of bodywork and movement therapies*, 19(4), pp. 747–758. Available at: https://doi.org/10.1016/j.jbmt.2015.08.007.

Behm, D.G. *et al.* (2016) 'Acute effects of muscle stretching on physical performance, range of motion, and injury incidence in healthy active individuals: a systematic review.', *Applied physiology, nutrition, and metabolism = Physiologie appliquee, nutrition et metabolisme*, 41(1), pp. 1–11. Available at: https://doi.org/10.1139/apnm-2015-0235.

Behm, D.G. and Chaouachi, A. (2011) 'A review of the acute effects of static and dynamic stretching on performance.', *European journal of applied physiology*, 111(11), pp. 2633–2651. Available at: https://doi.org/10.1007/s00421-011-1879-2.

Behm, D.G. and Sale, D.G. (1993) 'Velocity specificity of resistance training.', *Sports medicine (Auckland, N.Z.)*, 15(6), pp. 374–388. Available at: https://doi.org/10.2165/00007256-199315060-00003.

Bishop, D. (2003) 'Warm up I: potential mechanisms and the effects of passive warm up on exercise performance.', *Sports medicine (Auckland, N.Z.)*, 33(6), pp. 439–454. Available at: https://doi.org/10.2165/00007256-200333060-00005.

Brodowicz, G.R., Welsh, R. and Wallis, J. (1996) 'Comparison of stretching with ice, stretching with heat, or stretching alone on hamstring flexibility.', *Journal of athletic training*, 31(4), pp. 324–327.

Burnley, M. and Jones, A.M. (2007) 'Oxygen uptake kinetics as a determinant of sports performance', *European Journal of Sport Science*, 7(2), pp. 63–79. Available at: https://doi.org/10.1080/17461390701456148.

Butterfield, T.A. and Herzog, W. (2006) 'Effect of altering starting length and activation timing of muscle on fiber strain and muscle damage.', *Journal of applied physiology (Bethesda, Md.: 1985)*, 100(5), pp. 1489–1498. Available at: https://doi.org/10.1152/japplphysiol.00524.2005.

Cafarelli, E. and Flint, F. (1992) 'The role of massage in preparation for and recovery from exercise. An overview.', *Sports medicine (Auckland, N.Z.)*, 14(1), pp. 1–9. Available at: https://doi.org/10.2165/00007256-199214010-00001.

Corbin, C.B. (1981) *Concepts in physical education, with laboratories and experiments / Charles B. Corbin ... [et al.]*. 4th ed., *Concepts in physical education, with laboratories and experiments*. 4th ed. Dubuque, Iowa: W.C. Brown Co.

DeVries Housh, Terry J., H.A. (1994) *Physiology of exercise for physical education, athletics, and exercise science*. Madison, Wis.: WCB Brown & Benchmark.

Findley, T.W. (2009) 'Second international fascia research congress.', *International journal of therapeutic massage & bodywork*, 2(2), pp. 1–6. Available at: https://doi.org/10.3822/ijtmb.v2i2.52.

Fletcher, I.M. and Jones, B. (2004) 'The effect of different warm-up stretch protocols on 20 meter sprint performance in trained rugby union players.', *Journal of strength and conditioning research*, 18(4), pp. 885–888. Available at: https://doi.org/10.1519/14493.1.

Fradkin, A.J., Zazryn, T.R. and Smoliga, J.M. (2010) 'Effects of warming-up on physical performance: a systematic review with meta-analysis.', *Journal of strength and conditioning research*, 24(1), pp. 140–148. Available at: https://doi.org/10.1519/JSC.0b013e3181c643a0.

Gray, S.R. *et al.* (2011) 'Skeletal muscle ATP turnover and single fibre ATP and PCr content during intense exercise at different muscle temperatures in humans.', *Pflugers Archiv: European journal of physiology*, 462(6), pp. 885–893. Available at: https://doi.org/10.1007/s00424-011-1032-4.

Jeffreys, I. (2007) 'Warm up revisited@the@ ramp method of optimising performance preparation', in.

Lempke, L. *et al.* (2018) 'The Effectiveness of PNF Versus Static Stretching on Increasing Hip-Flexion Range of Motion.', *Journal of sport rehabilitation*, 27(3), pp. 289–294. Available at: https://doi.org/10.1123/jsr.2016-0098.

McArdle Katch, Frank I., Katch, Victor L., W.D. (2010) *Exercise physiology: nutrition, energy, and human performance*. Baltimore, MD: Lippincott Williams & Wilkins.

McGowan, C.J. *et al.* (2015) 'Warm-Up Strategies for Sport and Exercise: Mechanisms and Applications', *Sports Medicine*, 45(11), pp. 1523–1546. Available at: https://doi.org/10.1007/s40279-015-0376-x.

Medeiros, D.M. *et al.* (2016) 'Influence of static stretching on hamstring flexibility in healthy young adults: Systematic review and meta-analysis.', *Physiotherapy theory and practice*, 32(6), pp. 438–445. Available at: https://doi.org/10.1080/09593985.2016.1204401.

Nes, B. *et al.* (2012) 'Age-predicted maximal heart rate in healthy subjects: The HUNT Fitness Study', *Scandinavian journal of medicine & science in sports*, 23. Available at: https://doi.org/10.1111/j.1600-0838.2012.01445.x.

Pearce, A.J., Rowe, G.S. and Whyte, D.G. (2012) 'Neural conduction and excitability following a simple warm up.', *Journal of science and medicine in sport*, 15(2), pp. 164–168. Available at: https://doi.org/10.1016/j.jsams.2011.09.001.

Pearcey, G.E.P. *et al.* (2015) 'Foam rolling for delayed-onset muscle soreness and recovery of dynamic performance measures.', *Journal of athletic training*, 50(1), pp. 5–13. Available at: https://doi.org/10.4085/1062-6050-50.1.01.

Sady, S.P., Wortman, M. and Blanke, D. (1982) 'Flexibility training: ballistic, static or proprioceptive neuromuscular facilitation?', *Archives of physical medicine and rehabilitation*, 63(6), pp. 261–263.

Sale, D.G. (2002) 'Postactivation potentiation: role in human performance.', *Exercise and sport sciences reviews*, 30(3), pp. 138–143. Available at: https://doi.org/10.1097/00003677-200207000-00008.

Schleip, R. and Müller, D.G. (2013) 'Training principles for fascial connective tissues: scientific foundation and suggested practical applications.', *Journal of bodywork and movement therapies*, 17(1), pp. 103–115. Available at: https://doi.org/10.1016/j.jbmt.2012.06.007.

Sharman, M.J., Cresswell, A.G. and Riek, S. (2006) 'Proprioceptive neuromuscular facilitation stretching: mechanisms and clinical implications.', *Sports medicine (Auckland, N.Z.)*, 36(11), pp. 929–939. Available at: https://doi.org/10.2165/00007256-200636110-00002.

Sullivan, K.M. *et al.* (2013) 'Roller-massager application to the hamstrings increases sit-and-reach range of motion within five to ten seconds without performance impairments.', *International journal of sports physical therapy*, 8(3), pp. 228–236.

Surburg, P.R. and Schrader, J.W. (1997) 'Proprioceptive Neuromuscular Facilitation Techniques in Sports Medicine: A Reassessment', 32(1), pp. 34–39.

Tanigawa, M.C. (1972) 'Comparison of the hold-relax procedure and passive mobilization on increasing muscle length.', *Physical therapy*, 52(7), pp. 725–735. Available at: https://doi.org/10.1093/ptj/52.7.725.

Young, W.B. and Behm, D.G. (2002) 'Should static stretching be used during a warm-up for strength and power activities?', *Strength and Conditioning Journal*, 24(6), pp. 33–37. Available at: https://doi.org/10.1519/00126548-200212000-00006.

Depression and Anxiety as factors of Alcohol consumption during the period 2021-22 of the Covid19 Pandemic

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Abstract

Covid-19 appearance had major effects in everyday life. It was a difficult period for all, during which many people experienced symptoms of anxiety and depression. In many cases Covid-19 and quarantine life also altered peoples' personal habits, including alcohol consumption. This research attempted to investigate the relationship between alcohol consumption and the manifestations of anxiety and depression symptoms, during the Covid-19 pandemic. More specifically, the present study investigated whether gender, education and annual income had an impact in alcohol consumption in young adults (18-39 years old) from Greece. Alcohol was used as a dependent variable, whereas the rest of the variables were treated as independent. A total of 153 people participated in the study (64 men and 89 women). Participants filled: a) Beck's Anxiety Inventory-BAI, b) Beck's Depression Inventory-BDI and c) Alcohol Use Disorders Identification Test-AUDIT by WHO. Spearman rank revealed a statistically significant correlation between anxiety, depression, and alcohol consumption. One- and Two-way ANOVA were also carried out. Demographics did not have any significant effect on alcohol consumption. Nevertheless, and even though there was no statistically significant result, men seemed to consume more alcohol than women, regardless of their age group. It is worth noting, that 18 participants recorded extremely high levels of alcohol consumption, which is probably related to alcohol addiction. To conclude, the present study has shown that anxiety and depression may be contributing factors to alcohol consumption during pandemics. Future studies should further highlight the importance of rehabilitation strategies across countries.

Keywords: anxiety, depression, alcohol, covid-19, rehabilitation

1. Introduction

The recent pandemic condition (Covid-19) changed our daily lives. It was a stressful period often accompanied by stress and depression symptoms, which may affect or modify our personal habits, such as alcohol consumption. More specifically, the prevailing situation with health, economic and social crisis, is gradually internalised. As a result, individuals often seek a way out and other ways to maintain their mental health. The outbreak of the pandemic, the evolution of the virus, the forced confinement at home, the suspension of social and professional life, led to a simple but extremely important realisation that nothing can be taken for granted (Petras, 2020).

Many people during the outbreak of the pandemic, felt helpless, inadequate, weak and frequently experienced fear, anxiety, stress and sadness. In order to cope with all these negative emotions, they unconsciously resorted to denying and avoiding reality. Often, they developed unhealthy behaviours including the consumption of psychoactive substances and/or the excessive consumption of alcoholic beverages. These behaviors are used as defense mechanisms, as the individuals feel that substance abuse will help them feel better and forget their problems. It is only natural to feel distressed, anxious and scared when

experiencing a social crisis. But according to Petras (2020) after a period of time people often seek more reasonable solutions and maintain their composure.

1.1 Anxiety

The concept of anxiety, in modern reality, is confused with the concept of stress, despite the fact that these are two completely different terms. Stress is defined as a specific reaction of the body to any situation that the individual is unable to manage effectively. In short, it is a realistic and exaggerated concern caused by various life circumstances (Hawton et al., 1989).

Objective anxiety involves a more complex internal reaction to an expected damage, caused by an external risk and its degree of intensity is proportional to the magnitude of the risk. In the neurotic-clinical form of anxiety, the source of the anxiety is not external. Feelings of tension are present and the subject is not consciously aware of the stressor. More generally, anxiety is defined as an unpleasant emotional state governed by subjective feelings of tension and fear and by the stimulation of the autonomic nervous system (Han, 2009).

1.2 Depression

One in ten people may be affected at some point in their lives by depression. Some of the secondary symptoms of depression are difficulty in maintaining and establishing interpersonal relationships, with a risk ofsubstance dependence-addiction, causing traffic accidents and others. All of the above can affect not only the depressed person, but also the people in their immediate environment. Depression can be externalised in many different ways, such as hypochondria, sexual dysfunction, insomnia, hypertension, anorexia, bulimia, aggression (Christodoulou, 2005).

Clinical depression disrupts the cognitive functions, the behaviour and all normal functions of the subjects. Due to depression, a person often feels pessimistic, guilty, and non-functional. Moreover, he/she is neglectful of appearance, lacking in interests and manifesting disturbances in sleep, food and water intake (Westbrook et al., 2010). At least half of the diagnosed alcoholics experience depression. Most alcoholics drink in order to improve their low mood. However, it is difficult to differentiate whether alcohol contributes to the onset of depressive symptoms or if some symptoms of depressive disorder are predominantly manifested in people who are addicted to alcohol (Humia, et al., 2019; Kilaberia, 2012).

1.3 Related Research

Alcohol addiction is an issue of concern around the world, as it has been shown to be one of the leading causes of disease and death. According to surveys, the consumption of alcoholic beverages is more prevalent among young people than in other age groups. More specifically, young people, compared to the adult population, drink more on certain occasions, but the amounts they consume are excessive and have been associated with a range of problems, such as poor academic performance, unacceptable sexual behaviour, physical assaults, aggression and road accidents. The extent of alcohol consumption varies across gender, with men appearing to consume alcohol in greater quantity and frequency than women (Martin et al., 2020; World Health Organization, 2018).

The Covid-19 pandemic and subsequent quarantine have had a significant impact on people's daily lives and social interactions and, by extension, on their drinking habits and mental health. The quarantine prohibiting measures are directly correlated with internalised

symptoms of depression and anxiety (Carvalho et al., 2020; McPhee et al., 2020). During the pandemic, individuals who experienced symptoms of depression and anxiety also appeared to have consumed larger amounts of alcohol. Therefore, anxiety and depression disorders are two parameters that may help to explain the observed changes in alcohol use during the pandemic (Schmits & Glowacz, 2021).

1.4 Purpose of the Study

The present study attempted to investigate the impact of the Covid-19 pandemic on the mental health of young people. The aim was specifically to clarify whether depression and anxiety promote alcohol consumption during the 2021-2022 period of the Covid-19 pandemic, in adults between 18-39 years in Greece. Scientific findings of the specific field in Greece are yet extremely limited and there is a need for further investigation and documentation. This study aims to contribute to these gaps.

Based on a literature review of previous research, we hypothesised that anxiety and depression, during the 2021-22 pandemic, will affect alcohol consumption. In addition, we assumed that there would be correlations between demographics and alcohol consumption. Finally, the consumption of alcoholic beverages was expected to increase due to the Covid-19 pandemic in 2021-2022.

2. Methodology

2.1 Participants

The participants of the present study were 153 residents of Greece, of which 89 were women (58.17%) and 64 were men (41.83%). Their age range was from 18 to 39 years, of which 52 people (33.99%) were 18 to 24 years old, 48 people (31.37%) were 25 to 31 years old and 53 people (34.64%) were 32 to 39 years old. Twenty-four participants (15.69%) had basic education (high school), 47 participants (30.72%) were university students, 54 participants (35.29%) were university graduates, and 28 participants (18.30%) were holders of a Master's or PhD degree.

The participants of the study were found from Facebook. A link accompanied with relevant information was posted on Facebook, redirecting to electronic questionnaires in Google Forms. The participation was voluntary, and no payment was given to any of the subjects. Participants had different backgrounds and occupations. The sampling of this study was done using a random-event technique (Field, 2016).

2.2 Design

A non-experimental design for quantitative research was used for data analysis of the study. The variables examined were alcohol consumption (dependent), anxiety and depression (independent) and the demographic descriptors, gender, age, education level, annual income (independent). In this study, the statistical analysis techniques applied were descriptive statistics for the qualitative and quantitative variables, the non-parametric Spearman correlation coefficient, the parametric one-factor analysis criterion (One-way ANOVA) and the parametric two-factor criterion (Two-way ANOVA).

2.3 Tools

The tools used for data collection in this study were three questionnaires. First, the 21-question self-report questionnaire on depressive symptoms of the Beck Depression Inventory (BDI) (Beck et al., 1961). Second, the Beck Anxiety Inventory (BAI) (Beck et al., 1988), which consists of 21 questions graded on a four-point Likert scale (0: not at all, 1: bothered me a little, 2: bothered me a lot, 3: bothered me a lot). Thirdly, the Alcohol Abuse Disorders Detection - Alcohol Dependence Disorders (AUDIT) questionnaire, which consists of 10 multiple-choice questions and was created by the World Health Organization (WHO) in 1989. All questionnaires show increased internal relevance and high validity (a_BDI = 0.60 – 0.90, a_BAI = 0.92 – 0.94, a_AUDIT = 0.75 – 0.94).

Table 1. Score for Depression and Anxiety.

Levels	Depression	Anxiety
Low - Minimal	0 – 9	0 – 7
Mild	10 – 16	8 – 15
Moderate	17 – 29	16 – 25
Severe	30 - 63	26 – 63

2.4 Procedure

People who read the Facebook invitation, developed an interest, clicked the link and completed the online questionnaires, comprised the final sample of the study (opportunistic sampling). Participants were able to firstly redirect via google forms to Information and Consent Forms based on the BPS (British Psychological Society) Code of Ethics and Conduct. Subsequently, subjects completed on the same google form the depression, anxiety and alcohol consumption, questionnaires. Subjects were asked to fill in the questionnaires based on - thinking about - the events of the year 2021- 022. Completion of the questionnaires took about 15 to 20 minutes.

Each participant had a personal unique password for anonymity and confidentiality reasons. After completing the Google Forms questionnaires, the participants had the opportunity to read the Debriefing Form, on which the possibility of creating a unique Google Forms password was indicated. Each participant had the option to withdraw at any time he/she wished, and there was also an option to delete their data if they wished. Participants were able to contact the researchers via Google Forms whether they had any questions or if they wished to withdraw from the survey, by giving their unique personal password. The data collected from Google Forms was imported into Excel, and then into IBM SPSS statistics for the statistical analysis process (quantitative). The research was approved by the Research Ethics Committee of Metropolitan College.

2.5 Ethical Issues

The study did not pose any risks to the participants and did not harm their physical and mental integrity. There was no misleading, concealment, or deception of the participants with regards to the information related to this research. All information had been clearly provided through the forms (invitation of interest, information, consent and uninformed consent). The forms

had been created based on the British Psychological Society (BPS) rules as set out in the BPS Code of Ethics (CoE) abiding to anonymity, confidentiality and the law on the protection of participants' data. Moreover, the rights of individuals as stated in the protocol of the BPS's KID were not violated. For confidentiality reasons, the questionnaire information was stored on an external disk and only the researchers had access to it. Upon completion of the survey, data was destroyed from the data set. Research tools questions did not affect, nor caused any discomfort to the participants. Nevertheless, if anyone wished to withdraw from the study, they were free to do so at any time without any repercussions.

3. Results

3.1 Descriptive Data

Results showed (Table 2) that the majority of the participants experienced mild levels of anxiety and depression and low risk consumption of alcohol. It is worth mentioning, however, that 34 of 153 participants experienced severe anxiety levels (score 26 – 63) in Becks Anxiety Inventory (BAI) and 23 of 153 people experienced severe levels of depression (score 30 - 63) in Becks Depression Inventory (BDI).

Table 2. Descriptive Statistics for Anxiety, for Depression and for Alcohol.

	N	Minimum	Maximum	M	SD
Anxiety	153	0	62	**16.44**	12.52
Depression	153	0	49	**16.55**	10.93
Alcohol	126	0	29	**6.50**	6.42

Out of the 153 participants only 126 (82.4%) consumed alcohol during the pandemic. The majority of them (58.2%) were defined as low risk in alcohol consumption levels. Eighteen participants were most likely alcohol dependent (score 15-40) and 19 people were of high risk of developing a dependency according to the AUDIT Questionnaire (Table 3).

Table 3. Participant percentages of alcohol consumption levels.

Levels of Alcohol Consumption	N	f	score
Low risk	89	58.2 %	1 – 7
High risk	19	12.4 %	8 – 14
Dependance-abuse	18	11.8 %	15 – 40

3.2 The relationship between Depression, Anxiety and Alcohol

With regards to to the relationship between anxiety, depression and alcohol consumption it was found through Shapiro-Wilk test of normality, that the data were not normally distributed ($p<0.05$, anxiety $p=0.00$, depression $p= 0.00$, alcohol $p=0.002$). Thus, a non-parametric Spearman correlation was performed.

The relationship between anxiety and depression was not significant (*F_depression * alcohol* $(7,112) = 0.566$, $p = 0.782 > 0.05$). A significant positive correlation was found between anxiety and depression in relation to alcohol consumption (*rho_anxiety* $(124) = 0.293$, $p =$

0.001 < 0.05 and *rho_depression* (124) = 0.234, *p* = 0.008 < 0.05). A Two-way ANOVA between the above three variables showed that depression and anxiety levels affected the levels of alcohol consumption (*F anxiety levels* (3, 112) = 2.801, *p* = 0.043 < 0.05, *F depression levels* (3, 112) = 2.7, *p* = 0.05 < 0.05).

Using the Post Hoc Bonferroni test, it was found that minimum to medium (*MD* = -5.30, *p* = 0.001) and minimum to severe (*MD* = -4.75, *p* = .011) levels of anxiety seem to define participants' alcohol consumption. Results showed that medium and high levels of anxiety decreased the levels of alcohol consumption during the pandemic. In terms of depression a significant difference was found between lower and higher levels of depression (*MD* = -7.69, *p* = 0.00). Moreover, severe levels of depression are related to higher levels of alcohol consumption (Table 4).

Table 4. Alcohol consumption levels in relation to anxiety and depression levels

Mean Alcohol Score	Mean Anxiety	Mean Depression
Low levels	4	4
Mild levels	4	5
Medium levels	10	7
High levels	9	12

3.3 The relationship between alcohol consumption age, gender, education and income

A One-way ANOVA revealed no statistically significant relationship between alcohol consumption and education (*F* (3,122) = 2.041, *p* = 0.112 > 0.05) and between alcohol consumption and income (*F* (2,123) = 1.216, *p* = 0.3 > 0.05). In regard to the income however, it is worth mentioning that 40 of 153 participants (26.1%) declared that they would have bought more alcoholic drinks if they had a higher income at the specific period or in general in their daily life. Similar results were found between age and gender as they had no significant effect on alcohol consumption (*F_age* (2,120) = 0.041, *p* = 0.96 > 0.05, *F_gender* (1,120) = 2.773, *p* = 0.098 > 0.05). Although gender did not significantly affect the participants' alcohol consumption, it was found that men consume more alcohol than women in all age groups. It is also noteworthy that the 25-31 male group consumed excessive amounts of alcohol during the Covid-19 pandemic period.

Table 5. Alcohol consumption according to gender

	Men		Women	
Age	Mean	N	Mean	N
18-24	7.3	20	6.5	22
25-31	8.5	16	4.6	20
32-39	7.2	15	5.9	33

4. Discussion/ Conclusion

The present study aimed to investigate the impact of the Covid-19 pandemic on the mental health of young people and specifically to clarify weather depression and anxiety are contributing factors in promoting alcohol consumption in adults from Greece who were 18-39 years old. The study was conducted during the 2021-2022 period of the Covid-19 pandemic.

We hypothesised that anxiety and depression would affect alcohol consumption. We also hypothesised that gender, age, income and educational level would most likely be associated with alcohol consumption.

The results from the data analysis conducted revealed that both anxiety and depression affected alcohol consumption during the pandemic period. In addition, moderate to high anxiety and severe depression levels were associated with higher alcohol consumption. Even though the overall sample was at a low risk of alcohol consumption, there was a significant proportion of participants who might have been suffering from alcohol dependence or abuse.

Demographic characteristics such as gender, age, income, and education had no significant effect on alcohol consumption. However, and even though there was no statistical significance, it was found that men tend to consume increased amounts of alcohol compared to women. Especially men aged 25 to 31 years had the highest alcohol consumption in contrast to women.

The present study agrees with other reports (Carvalho et al., 2020; Clay & Parker, 2020; McPhee et al., 2020; Schmits & Glowacz, 2021) correlating anxiety and depression with increased alcohol consumption during the Covid-19 pandemic. However, while it was shown that 25–31-year-old males consumed more alcohol than females, the results were not statistically significant as in the following studies (Britton et al., 2015; Moussas et al., 2010; WHO, 2018; Windle, 2016). The discrepancies may be due to different sample sizes and different ages of the participants.

4.1 Limitations

The present study includes several limitations that should be taken into consideration. The opportunistic sampling technique, the sample size, the numerical heterogeneity between genders might result in a less representative sample necessary for producing significant findings. A sample from large urban centers may have given different rates of anxiety, depression and alcohol due to the constant pressure in large cities, compared to the present study where a large proportion of participants were from the island of Rhodes. In addition, anxiety and depression scores are likely to have been affected not only by the Covid-19 pandemic period, but also by the war in Ukraine (questionnaires were forwarded at the beginning of the war, so it is possible that the sample was emotionally affected by this so called "chaos") or even by pre-existing mental health problems.

4.2 Future Directions

It is important to emphasise the effects of Covid-19 on peoples' mental health and alcohol consumption. Prevention measures and rehabilitation techniques and programmes should be established across the world. This will help scientists and governments worldwide to respond more adequately in a future pandemic or crisis.

References

Britton, A., Ben-Shlomo, Y., Benzeval, M., Kuh, D., Bell, S. (2015) 'Life course trajectories of alcohol consumption in the United Kingdom using longitudinal data from nine cohort studies', *BMC medicine, 13*(1), Article 47. https://doi.org/10.1186/s12916-015-0273-z
Carvalho, P. M. de M., Moreira, M. M., de Oliveira, M. N. A., Landim, J. M. M., & Neto, M. L. R. (2020) 'The psychiatric impact of the novel coronavirus outbreak', *Psychiatry Research, 286*, 112902.

Clay, J. M., and Parker, M. O. (2020) 'Alcohol use and misuse during the COVID-19 pandemic: A potential public health crisis?', *Lancet Public Health, 5*(5), e259. https://doi.org/10.1016/S2468-2667(20)30088-8

Han, H. (2009) 'Measuring anxiety in children: A methodological review of the literature', *Asian Nursing Research, 3*(2), pp. 49- 62. https://doi.org/10.1016/S1976-1317(09)60016-5

Hawton, K., Salkovskis, P. M., Kirk, J., & Clark, D. M. (Eds.). (1989) '*Cognitive behaviour therapy for psychiatric problems: A practical guide*', Oxford University Press. https://psycnet.apa.org/record/1989-98569-000

Humia, B. V., Santos, K. S., Barbosa, A. M., Sawata, M., Mendonça, M. D. C., & Padilha, F. F. (2019) 'Beer molecules and its sensory and biological properties: A review', *Molecules*, *24*(8), pp. 1568.

Martin, J. L., Ferreira, J. A., Haase, R. F., Martens, M. P., Coelho, M., Martins, J., Jome, L. M., & Santos, E. R. (2020) 'The influence of personality and drinking motives on college student binge drinking in the US and Portugal', *European Journal of Health Psychology, 27*(1), pp. 30-42.

McPhee, M. D., Keough, M. T., Rundle, S., Heath, L. M., Wardell, J. D., & Hendershot, C. S. (2020) 'Depression, environmental reward, coping motives and alcohol consumption during the COVID-19 pandemic', *Frontiers Psychiatry, 11*, pp. 1128. https://doi.org/10.3389/fpsyt.2020.574676

Moussas, G. I., Karkanias, A. P., Papadopoulou, A. G. (2010) 'Psychological dimension of cancer genetics: Doctor-Patient communication', *Psychiatric., 21*(2), pp. 148-157. https://pubmed.ncbi.nlm.nih.gov/22214921/

Schmits, E., & Glowacz, F. (2021) 'Changes in alcohol use during the COVID-19 pandemic: Impact of the lockdown conditions and mental health factors', *International journal of. Mental health addiction, 20*, pp. 1147-1158. https://doi.org/10.1007/s11469-020-00432-8

Windle, M. (2016) 'Drinking over the lifespan: Focus on early adolescents and youth', *Alcohol research: Current Reviews, 38*(1), pp. 95-101. https://pubmed.ncbi.nlm.nih.gov/27159816/

World Health Organization (2018) '*Global Status Report on Alcohol and Health 2018*', World Health Organization. https://apps.who.int/iris/bitstream/handle/10665/274603/9789241565639-eng.pdf

Investigation of coach's perceptions for Attention Deficit Hyperactivity Disorder to young female rhythmic gymnastics athletes and study of techniques to modify problematic behaviors

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Abstract

The attention deficit hyperactivity disorder (ADHD) creates deficits to children in various functions of their lives, mainly in the intellectual, physical and psycho-emotional domains. Gymnastics and specifically rhythmic gymnastics are activities linked to physical and mental abilities, and positively affect the mental health, personality and social relationships of children. The target of this survey, in which 77 female rhythmic gymnastics coaches of various ages and years of work experience participated, was to investigate ADHD difficulties and intervention in rhythmic gymnastics. The average number of female athletes, showing symptoms of ADHD, is 2 athletes per training groups of 11-20. The majority of survey's questionnaires were answered concerning athletes aged 6, 8 and 10 years. Results showed a prevalence for the combined type of ADHD in athletes. Finally, it was observed, that coaches choose and apply the appropriate intervention techniques to modify non-typical behaviours during trainings.

Keywords: Attention Deficit Hyperactivity Disorder (ADHD), symptoms of ADHD, combined type of ADHD, intervention techniques, rhythmic gymnastics.

1. Introduction

The target of this survey concerned the investigation of coach's perceptions of rhythmic gymnastics athletes, who display problematic behaviours, specifically attention deficit hyperactivity disorder (ADHD). With this position as a starting point, techniques were studied for modifying the problematic behaviours of female athletes with ADHD. This research is important for sports and especially for rhythmic gymnastics, as all the previous research that has been done concerns only the non-typical behaviour of students in school environment (Kalantzi-Azizi et al., 2012). In sports, similar research has been carried out in the sport of taekwondo (Koraka, 2018) with ADHD students with intervention techniques during the practice of taekwondo.

2. Methodology

The quantitative method was followed in this survey. Questionnaires were administered, which is one of the most effective methods of gathering information for research purposes (Papanis, 2012). The questionnaires were distributed to 77 coaches, who worked in rhythmic gymnastics at different sport teams mainly in Athens.

The questionnaire comprised three parts. The first part addressed demographic data, of female rhythmic gymnastics coaches. Questions related to age, academic studies, years of service, while other questions targeted information of the percentage of female athletes, who had been officially diagnosed with ADHD and whether the female coaches had received

relevant training in their studies. Questions were only addressed to female gender, as the evaluation concerned cases of girls.

In the second part of the questionnaire, each coach was invited to record the athlete's age for statistic evaluation and note her behaviour during the last six months according to DSM-V (Papanastasiou, 2019). This part of the questionnaire allows teachers to identify children, who are likely to display the specific disorder. The first 18 questions were borrowed from the DSM-V ADHD Screening-Assessment Sheet published by Papanastasiou (2019), previously used in a pilot study in the Greek population.

The questionnaire scale to complete was based on a four-point Likert scale (where 0=almost never, 1=rarely, 2=sometimes, 3=almost always). There were 9 questions for the Attention Deficit subscale and 9 questions for the Hyperactivity/Impulsivity subscale, which female coaches answered and related to the frequency occurrence of the athlete's behaviour for the last six months. It is worth noting, that symptoms of the two factors were placed alternately, as they were of similar content and there was a possibility of confusing participants (Kalantzi-Azizi et al., 2012). The initial score was calculated by summing even-numbered question scores for the Attention Deficit subscale and odd-numbered questions for the Hyperactivity/Impulsivity subscale. The total score was finalised by summing the initial scores of the two subscales.

Finally, the third part of the questionnaire intended to detect trainers' knowledge on techniques for modifying non-typical behaviours. These were based on the DSM-V questionnaire (Papanastasiou, 2019) and on the intervention techniques of ADHD based on Kakouros & Maniadaki (2012) and Panagakos (2014). Data analysis and evaluation of results were achieved using the statistical tool SPSS22.

3. Results

Statistical analysis of demographic data showed that the questionnaire was mostly completed by female coaches, who were between the age of 20-30 (54.5%). 31.2% of coaches were between the age of 31-40 while 14.3% were between 41-50 years old (Table 1).

Table 1: Demographic characteristics of participant coaches.

Variable	Category	Frequency	Rate
Age	20-30	42	54.5
	31-40	23	31.2
	41-50	11	14.3
Education	Other	2	2.6
	Bachelor	60	77.9
	Master	14	19.5
Years of service	0-5	18	23,4
	6-11	31	41,6
	Above 11	27	35,1

Regarding the coaches' education level, analysis showed that 77.9% of female coaches holds a Bachelor's degree and 19.5% of the sample also had a Postgraduate degree. With respect to working experience, 41.6% of coaches had been working for 6-10 years in rhythmic gymnastics. Next in line was the category with more than 11 years of service with 35.1% and finally 23.4% worked for 0-5 years (table 1).

Table 2: Number of female athletes in mass sports departments.

Number of children in each group	Frequency	Rate
0-10	9	11.7
11-20	61	**79.2**
21-30	4	5.2
30+	3	3.9
Total	77	100.0

Table 3: Number of children with ADHD.

Number of children with ADHD	Frequency	Rate
0	2	2.6
1	14	18.2
2	43	**55.8**
3	12	15.6
4	3	3.9
5	1	1.3
Total	77	100.0

Concerning general questions about coaching departments (specifically the female athletes of each training group), it was observed that the majority of the sample answered positively. On the one hand, manifestation of non-typical behaviours in their athlete group and on the other hand, appearance of symptoms of ADHD with a common rate of 97.4%. It is worth mentioning, that half of the female coaches (50,6%), have not attended any course on ADHD, nevertheless the largest percentage (93.5%) applied techniques to modify atypical behavior during training. Additionally, it was emerged from the research, that female athletes

of rhythmic gymnastics numbered 11-20 (table 2) in each training group (79.2%). Children who may manifest ADHD were 2 on average (table 3).

In questions from the Screening-Assessment Sheet for ADHD according to DSM-V from Papanastasiou's questionnaire (2019), most female coaches filled in the questions mainly mentioning ages 6, 8 and 10 years. It can be easily observed that female trainers could strongly identify the symptoms in these ages, because children in these ages study in the three most difficult grades of primary school and face common difficulties in school as in activities. According to the literature, if a child faces some difficulty in an environment, such as school, they will have the same kind of difficulty or non- typical behaviour in a sports activity.

It was observed that in the 9 questions for the Hyperactivity-Impulsivity subscale, which were found in odd questions, the most frequent answer was «Sometimes», while in the remaining three was «Almost always» (Papanastasiou, 2019). More precisely, the symptoms, which appeared "Sometimes", concerned nervous movement of hands, leaving a position, climbing into abnormal positions, inability to participate in recreational activities with a quiet manner, answering without waiting for the question and finally, interrupting others in conservations. The three symptoms that were evident "Almost always" involved the athlete appearing tired during training, talking excessively and having difficulty waiting her turn in any activity (Figure 1).

Regarding the attention deficit subscale, out of the 9 questions, seven symptoms had «Sometimes» as the most frequent answer and two symptoms were recorded to occur «Almost Always». More specifically, the seven symptoms included the athlete's failure to pay particular attention to detail, appeared not to listen when addressed to her, was unable to follow instructions, had difficulty organising tasks, avoided those involving mental fatigue and lost and forgot things in daily activities. On the other hand, the two symptoms, which were «Almost Always» displayed by the female athletes, related to the distraction from external stimuli and difficulty with sustaining attention (Figure 2).
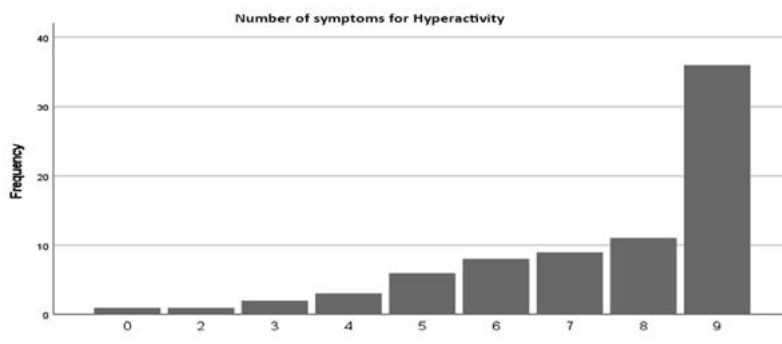

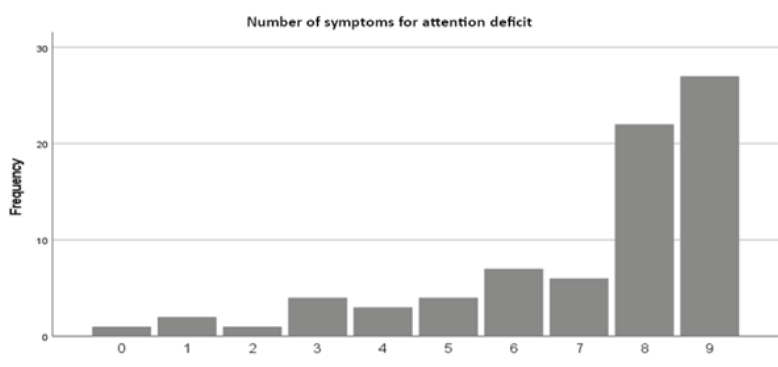*Figure 1: Number of symptoms for Hyperactivity symptoms in young athletes.*

Figure 2: Number of symptoms for attention deficit symptoms in young athletes.

The target of the research was to study the number of female athletes, which showed at least 6 symptoms of attention deficit, as well as at least 6 symptoms of Hyperactivity. To be clearer, according to DSM-V, a child before the age of 12 should exhibit at least six of the symptoms in either category and for a period of time longer than six months, to belong to either one of the two categories of attention deficit disorder or to display the combined type (Maniadaki & Kakouros, 2016). In order to derive the combined type, the symptoms from the two categories had to be added and be 6 or 12 in total.

It is worth noting that most of the female athletes were identified with the combined type of ADHD, according to the sum of the two subscales of attention deficit in even numbering and hyperactivity in odd numbering. More specifically, as the survey was carried out at the end of the sports year, female athletes who showed more than six symptoms in total in the two subscales and for a period of time more than six months (APA, 2013), were 72.73% (Figure 3). On the other hand, a percentage of girls (9.1%) was found, which did not belong to any type. It therefore follows that they represented the mild form of ADHD in which the symptoms are minimal and cannot be diagnosed (Schuch et al., 2014). Also, there were female athletes, who manifested either only symptoms of attention deficit, which consequently showed the Inattentive type, or only symptoms of hyperactivity, which resulted in the Hyperactivity/Impulsivity type.
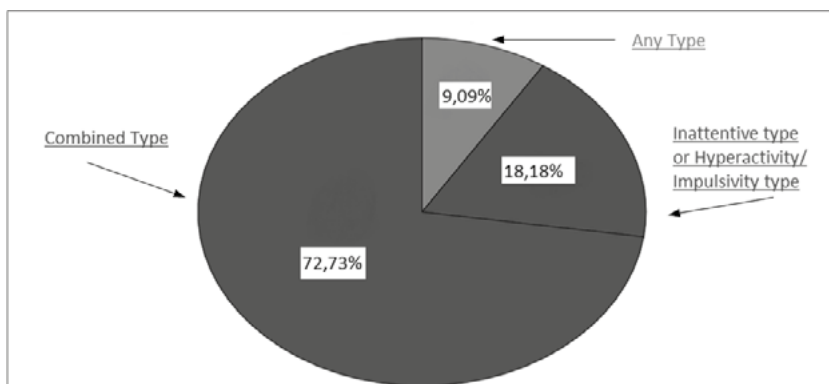

Figure 3. Percentage of young female athletes with the combined type of ADHD.

To investigate the internal consistency of the ADHD assessment scale for the female coaches, Cronbach's Alpha indices were calculated for the two assessment subscales, meaning Attention Deficit and Hyperactivity. For the total score Cronbach's Alpha mark was 0.817 for the Attention Deficit subscale with the even-numbered questions and 0.843 for the Hyperactivity-Impulsivity subscale with odd-numbered questions, which proves the reliability and validity of the results.

In addition, it was found that coaches chose correct and appropriate techniques to deal with non-typical behaviours of their female athletes during training. Specifically, they reported they would «Sometimes» use positive reinforces-rewards in a percentage of 49.4% and «Almost Always» in 41.6% of the cases. This is a behavioural technique where the reward should be given immediately and can be in any material, verbal, social or playful form (Maniadaki & Kakouros, 2016). The percentage of 85.7% would also «Almost Always» explain the behavioural rules for training.

It is worth mentioning the fact that coaches involved the child in activities within training, which are part of the cognitive approaches, since in this way children will begin to acquire mechanisms of self-control and self-management (Bates, 2015). Class activities include becoming an assistant to the coach, helping her with the distribution of instruments, gym mats, and in observing the behaviour of the other female athletes. With these techniques, female athletes will be assisted to reduce ADHD symptoms and non-typical behaviours, while they will begin to apply the behavioural rules of the context more consistently (Miller et al., 2016).

The results of the research showed that coaches would «Sometimes» apply individualised teaching with a percentage of 46.8% and «Almost Always» with 11.7%. Therefore, they do not know exactly what individualized instruction is, how it can be used, and how positive results can have for the athletes.

Moreover, it was observed that the technique of modifying non-typical behaviour through the thinking chair for 2' is used as a method by the coaches to a greater extent, compared to the rest of the non-pedagogical methods.

4. Discussion

Every coach has her own personality, just like every athlete. As a result, every trainer before applying any technique must think about whether this technique suits to the athlete. The trainers should not simply apply techniques, which they have studied through references (Pontifex et al., 2013). Since the coach of rhythmic gymnastics has made it clear to the students with non-typical behaviour, which times they will receive a positive reinforcement, and which will be deprived of them depending on their behaviour during the training. This technique helps students become aware of their inappropriate behaviour and develop self-control.

The intervention programmes mentioned in the questionnaire and the bibliography can have short-term results for the athletes in training if not combined with behaviour modification techniques (Mckay et al., 2015). It is important that intervention programmes not only include rewarding and positive reinforcement, as they will lead to a temporary improvement of the athlete's behaviour. Rather the coach must employ more often techniques, which build skills based on the consequences of athlete's behaviours according to the rules and limits of class (Pontifex et al., 2013).

The non-pedagogical methods of punishments, threats and having the athletes sit for two minutes in the thinking chair were not utilised by the female coaches that participated in the present study. Coaches, just after explaining the rules of appropriate behaviour, should also inform athletes about the consequences of not following these rules, through daily examples or other sports (Kourkoutas, 2017). Thinking chair for 2' is a technique, which is done through negative reinforcement to eliminate the athlete's non-typical behaviour (Miller et al., 2016). The low rate from individualised teaching is because female coaches have not attended any courses about ADHD during their undergraduate studies.

In conclusion, the percentage of female athletes, who display any of the three types of ADHD in a rhythmic gymnastics section, is quite high. Given that the present research only concerned female athletes and compared to the epidemiological data of earlier researchers, it is observed that the percentage of girls showing symptoms of ADHD has increased. Boys have reportedly three times higher possibility of showing some forms of ADHD compared to girls. However, this ratio seems to be decreasing (Swanson et al., 2013).

References

American Psychiatric Association (2013). 'Diagnostic and statistical manual of mental disorders' (5th ed.). Arlington, VA: American Psychiatric Publishing.

Bates, A. W. (Tony) (2015). Teaching in a Digital Age. Guidelines for designing teaching and learning for a digital age. Vancover: Tony Bates Associates Ltd. Retrieved.

Kakouros, E., & Maniadaki, K. (2012). Attention deficit hyperactivity disorder (ADHD): theoretical approaches and therapeutic management. Athens: Gutenberg.

Kalantzi-Azizi, A., Angeli, K., & Efstathiou, G. (2012). Greek faculty evaluation scale/Y-IV. Scale for parents-Scale for teachers. Athens: Pedio.

Koraka, N.I. (2018). The impact of a TAEKWONDO intervention program on the motor, cognitive and psychological characteristics of children with ADHD.

Kourkoutas, H. (2017). Emotional and behavioral disorders. Clinical and Psychopedagogical interventions in the family and the school. Athens: TOPOS Publications.

Maniadaki, K., & Kakouros, E. (2016). The management of ADHD. From theory to practice. Athens: Gutenberg.

McKay, D., Sookman, D., Neziroglu, F., Wilheim, S., Stein, D.J., Kyrios, M., Matthews, K., & Veale, D. (2015). 'Efficacy of cognitive-behavioral therapy for obsessive disorder', Psychiatry Research, 225 (3), 236-246.

Miller, F. G., & Lee, D. L. (2013). Do functional behavioral assessments improve intervention effectiveness for students diagnosed with ADHD?: A single-subject meta-analysis. Journal of Behavioral Education, 22, 253-282.

Panagakos, I. (2014). Managing Behavior Problems in the School Classroom: Prevention and Intervention Techniques. Panhellenic Conference of Education Sciences, 2014, 350-365.

Papanastasiou, F. (2019). It's infuriating. A practical guide for parents and teachers. Support and Intervention Program for children with attention deficit and/or hyperactivity disorder (ADHD). Athens; Pedio.

Papanis, E. (2012). Research Methodology and the Internet. Athens: Sideri Publications

Pontifex, M. B., Saliba, B. J., Raine, L. B., Picchieti, D. L., & Hillman, C. H. (2013). Exercise improves behavioral, neurocognitive, and scholastic performance in children with attention-deficit/hyperactivity disorder. Journal of Pediatrics, 162, 543-551.

Schuch, J. J., Roest, A. M., Nolen, W. A., Penninx, B. W., & de Jonge, P. (2014). Gender differences in major depressive disorder: results from the Netherlands study of de-pression and anxiety. J. Affect. Disord 156, 156-163.

Swanson, J. M., Lakes, K., Wigal, T., & Volkow, N. D. (2013). Multiple origins of sex differences in attention deficit hyperactivity disorder. In D. W. Pfaff & Y. Christen (Eds.), Multiple origins of sex differences in brain (pp. 103-122). New York: Springer.

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