

**ZDRAVJE OTROK
IN MLADOSTNIKOV**

**HEALTH OF CHILDREN
AND ADOLESCENTS**



Proceedings

Edited by Ana Petelin



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Zdravje otrok in mladostnikov

Health of children and adolescents

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The importance of systematic planning and implementation of physical education in the first three years of elementary school

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Abstract

Introduction: The purpose of this paper is to analyze the importance of systematic planning and implementation of physical education in the first three years of primary school for the development of endurance. The importance of physical education “in person” has already been proven in Slovenia by the fact that the general physical performance of students decreases when they return to school after a long period of distance learning. In this paper we analyze the importance of systematic planning and implementation of physical education for the development of aerobic power. *Methods:* In this research sample, we included two elementary schools that are located in a similar geographic environment (lake, mountains, proximity to forests and meadows, proximity and variety of safe routes, etc.) but have different ways of planning and implementing physical education. The first is the Slovenian elementary school, where 105 physical education lessons and 5 sports days are systematically planned and included in the annual curriculum each year. The second is the Austrian elementary school, where there are 105 physical education lessons in the first and second grades and 70 physical education lessons in the third grade, however they have no sports days in any class and there is a loose annual plan for physical education, without preparation of individual physical education lessons. The sample consists only of healthy students from the two elementary schools at the end of the first three years (i.e. 66 third grade students, 33 from Slovenia and 33 from Austria). The sample of variables represents a “beep test” for measuring aerobic power (Leger and Lampert, 1982). All participating students volunteered for the test. The procedure and method of motivation was the same for all. Students had to run a distance of 20 meters as many times as possible, taking into account the running pace, which increased by 0.5 km/h every minute at an initial speed of 8.5 km/h. Results were recorded as the sum of all partial distances the student could still run

at the forced pace. *Results:* Slovenian students completed an average of 33.4 (SD = 12.9) stages of the test, while Austrian students completed an average of 26.7 (SD = 11.8) stages. Analysis of the results shows that Slovenian students completed on average almost 7 more stages than Austrian students. Boys and girls did not differ among either Slovenian or Austrian students. Because of the abnormally distributed data, we used the alternative nonparametric Mann Whitney U test to detect statistically significant differences between students. Slovenian students performed statistically significantly better than Austrian students ($U = 373.0, p = 0.028$). *Discussion and conclusions:* Based on the results, we conclude that systematic planning of the subject of physical education, which requires in-depth and systematic planning by the teacher, contributes significantly to the development of aerobic power. Aerobic power is an indicator of endurance, which is one of the most important factors for health. Despite the many indirect influences on the development of aerobic power, we believe that the teacher plays a more important role in its development than he may realize.

Keywords: endurance, aerobic power, conception and implementation, first triad

Introduction

Endurance is a functional ability of a person that enables him or her to perform an activity for a long period of time without having to interrupt it due to fatigue (Škof, 2010; Retar, 2019). Endurance is usually divided into aerobic and anaerobic based on the predominant way the ATP molecule is obtained (Patel, 2017). Aerobic or cardiovascular endurance is increased in any activity that is performed over a long period of time, continuously, and in a cyclic loading pattern, as is typical for swimming, running, cycling, cross-country skiing, etc. (Bishop, 2010). The main limiting factor of aerobic endurance is maximal oxygen uptake (Ušaj, 2014), which is measured in laboratories using a special protocol and while wearing a special mask that allows calculation of oxygen consumption based on gas exchange (Insel, Walton, and Fahey, 2017).

Measuring aerobic endurance in the laboratory is obviously not possible in schools because of the large number of students. Therefore, a series of tests were developed and the results were compared with the results of the laboratory tests. The compared results indicated which tests should be performed with repetitive movements and in what manner in a natural environment to obtain the most comparable results. It turned out (Lang et al., 2016) that the “Beep Test” is the most reliable and widely used test for measuring aerobic performance in recent years, as it is performed in more than 50 countries and is also part of the EUROFIT measurement battery. Neville et al. (2021) state that the “Beep Test” is the so-called gold standard for measuring aerobic performance in schools. The same authors emphasize the ease of use in schools, the importance of performing the test with several students at the same time, the good control of performance, the affordability, the importance of proven compara-

bility with laboratory results, and the importance of comparison between different age groups, schools, countries, etc.

The “Beep Test” can be found under various names: Incremental Run, Multi-stage Fitness Test, Beep Test, Pacer Test, Leger Test, and 20-m Shuttle Run Test. They are exactly the same execution, namely that the participant runs a distance of 20 m, while the pace of the run is determined by a sound signal. The frequency of the sound signal increases by half a kilometer per hour every minute, starting at 8.5 km/h. If a person is unable to cross the 20-meter line after two consecutive tones, the test is over for them and the last distance traveled is recorded (Ruiz et al., 2010).

We use the test to determine the level of endurance or individual aerobic capacity of each student, which is the starting point for preparing physical education classes with the goal of developing endurance. Aerobic endurance is one of the functional abilities of a person that is positively related to the cognitive performance of an individual (Howie et al., 2015), so it is very important to develop it systematically in schools. There is a trend of decreasing endurance in schools (Starc et al., 2020), so experts are already warning of the consequences not only for health but also for the decline of cognitive functions.

At schools, there are various options for endurance training (running, cycling, in-line skating, swimming, cross-country skiing, hiking, etc.). Endurance training usually takes place outdoors, so geographic location (distance or proximity to lakes, mountains, forests, trails, etc.) is an important external factor in implementation. The next important factor is the curriculum and its implementation, and this is the external factor we focus on in this study. We want to investigate the importance of the implementation of Physical Education, the annual curriculum, structured preparation and other forms of implementation of the Physical Education (school in nature and sports days) in schools for aerobic performance in the first three years of primary school.

Methods

A sample of participants

The study sample includes two elementary schools that are located in similar geographic settings (lake, mountains, proximity to forests and meadows, proximity and variety of safe trails, etc.) but use different methods for planning and implementing physical education as a subject. The first is a Slovenian elementary school where 105 hours of physical education and 5 sports days are systematically planned each year and included in the annual curriculum; the second is an Austrian elementary school where 105 hours of physical education are planned in the first and second grades and 70 hours of physical education are planned in the third grade, and no sports days are planned in any grade, and again there is a loose annual plan for physical education without preparation of individual sports lessons. Only healthy students from both elementary

schools were included in the further study at the end of the first three years (i.e., 66 third grade students, 33 from Slovenia and 33 from Austria).

A sample of variables

We included the “beep test” (Leger and Lampert, 1982) in the sample of variables. The “beep test” is a standardized test for measuring aerobic power. From the partial values obtained, the maximum oxygen uptake can be determined in the tables for each age.

The organization and process of data collection

All participating students took the test voluntarily. The administration of the test and the method of motivation were the same for all students. We administered the test at approximately the same time (morning time, April 2022). Endurance is influenced by many factors that we wanted to mitigate as much as possible (daily well-being, prolonged illness, individual participation in endurance activities during leisure time, etc.). Only healthy students were included in the sample. By increasing the sample size, we aimed to reduce individual influences on the outcome. Students were required to run a distance of 20 meters as many times as possible, taking into account the running pace, which increased by 0.5 km/h every minute at an initial speed of 8.5 km/h. Results were recorded as the sum of all partial distances the student could still cover at the given speed.

Methods of data processing

The data obtained from the “beep test” were processed using the statistical program SPSS 21 (Statistical Package for The Social Science). For the comparison between Slovenian and Austrian students, due to the abnormally distributed data, the alternative nonparametric Mann Whitney U test was used to detect statistically significant differences between students. Statistical significance was tested at the 5 percent risk level.

Results

The results of our investigation are presented in a table and a figure. In figure 1 we present a comparison between Slovenian and Austrian students in terms of the average sublevel achieved, while the table shows whether the perceived differences are statistically significant.

Figure 1 shows that Austrian students passed an average of 26.7 sublevels of the beep test, while Slovenian students passed 33.4 sublevels. Using the Kolmogorov-Smirn test, we found that the distribution curves of the results for both the Austrian and Slovenian students did not conform to the normal distribution. Therefore, we used nonparametric tests below to measure the differences between the groups of students.

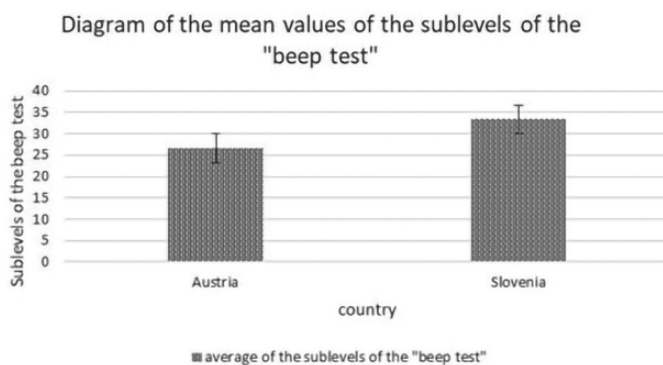


Figure 1: Diagram of differences between Slovenian and Austrian students in the sublevels of the beep test. (Source: Author).

Table 1: Ranks and Test Statistics

Beep test	Beep test	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Sig.
Sublevels of beep test	Austria	33	28,3	934,0	373,0	934,0	0,028*
	Slovenia	33	38,7	1277,0			
	Total	66					

N – number of participants, * $p < 0.05$

Table 1 shows that Slovenian students differ statistically significantly in the number of sublevels of the beep test passed ($U = 373$, $p = 0.028$). The analysis of the results of the comparison schools shows statistically significant differences in the aerobic performance test. In the following we will try to find the reasons for this and make some suggestions.

Discussion

We have based the study on three foundations, first, the importance of developing endurance in the first triad of elementary school, second, the importance of good curricular starting points (core competencies and a concept-based approach), and third, the importance of writing precise and structured lesson plan documents.

There are many factors that influence endurance, the most common of which include obesity (Matejek et al., 2014), one's activity level, heredity, biological basis, and daily form (Škof, 2016; Ušaj, 2003). In addition to physical performance, the effects of endurance affect various cognitive functions that are indispensable in the educational system and consequently influence student performance. Aerobic exercise improves blood flow to the brain and increases the concentration of the neurotrophin BDNF for neuron growth (Pencea et al., 2001). Neural networks are also associated with solving other cognitive problems (Singh et al., 2019), which consequently means that students learn new

cognitive concepts more easily and quickly. Starc et al. (2020) note that the decline in student endurance after returning to school is due to various interventions during an outbreak of coronavirus disease, suggesting a resulting decline in cognitive performance and consequently academic success. Resilience is thus an important functional skill, and it makes sense to include it in the general curriculum of educational systems.

A comparison of educational systems (Gracar, 2015) and especially of curricular starting points between Austria and Slovenia shows that Austrian starting points are more comprehensive, less specific and more general. In particular, the analysis of lesson plan documents (Kovač et al., 2011; Jahresplanung, 2021) of annual training preparations and preparations for individual lessons shows that Slovenian annual training preparations for the subject of physical education are more structured, more weekly hours are devoted to them, and they have additionally defined sports days and school-based character.

The results of our study show that it makes sense to structure curricula better and give teachers fewer choices. Compared to the Austrian children, the Slovenian children passed almost 7 more sublevels in the placement test (Figure 1). Because of the scatter of the data, we used the nonparametric Mann Whitney U test, which showed that the differences were statistically significant (Table 1). We adjusted for age and external conditions, selected schools that were as similar in size as possible, and attempted to limit any factors that would make it financially or organizationally impossible to conduct the exercise.

Conclusions

We found differences between the groups. We believe that the openness and less structured nature of the curriculum allows the teacher to work more flexibly for the students and him/herself. On the other hand, we find that greater structure can mean more reliable and consistent delivery of endurance activities.

The limitations of the study lie primarily in the number of students selected and, relatedly, teachers, who may be an important factor in the frequency and intensity of instruction. By determining 24-hour intensity, we would obtain more detailed data on extracurricular activities than by subjectively assessing the frequency and intensity of instruction. By increasing the sample size of comparable schools from several countries with different curriculum structure and openness, with direct measurement of additional physical activity, and with different mechanisms for evaluating teachers' work, our conclusions would be more reliable.

References

BURFORD, E.-M., ELLEGAST, R., WEBER, B., BREHMEN, M., GRONEBERG, D., SINN-BEHRENDT, A. and BRUDER, R., 2017. The comparative analysis of postural and biomechanical parameters of preschool teachers pre-

- and post-intervention within the ErgoKiTa study. *Ergonomics*, vol. 60, no. 12, pp. 1718–1729.
- ČECHO, R., ŠVIHROVÁ, V., ČECHO, D., NOVÁK, M. and HUDEČKOVÁ, H., 2019. Exposure to mental load and psychosocial risks in kindergarten teachers. *Zdravstveno varstvo*, vol. 58, no. 3, pp. 120–128.
- EUROPEAN AGENCY FOR SAFETY AND HEALTH AT WORK, n. d. *Work ability index* [online]. [viewed 13 December 2019]. Available from: <https://healthy-workplaces.eu/previous/all-ages-2016/en/tools-and-publications/practical-tools/work-ability-index>
- GRACAR, M. (2015). *Primerjava izobraževalnih sistemov Slovenije in Avstrije*. Univerza v Ljubljani, Fakulteta za družbene vede.
- HOWIE, E.K., SCHATZ, J. and PATE, R.R. (2015). Acute Effects of Classroom Exercise Breaks on Executive Function and Math Performance: A Dose-Response Study. *Research Quarterly for Exercise and Sport*, vol. 86, pp. 217–224, doi: 10.1080/02701367.2015.1039892.
- INSEL, P., WALTON, R. and FAHEY, T. (2017). *Fit & Well: Core Concepts and Labs in Physical Fitness and Wellness*. (12th ed.). McGraw-Hill.
- KOVAČ, M., MARKUN PUHAN, N., LORENCI, B., NOVAK, L., PLANINŠEC, J., HRASTAR, I., PLETERŠEK, K., ... MUHA, V. (2011). Učni načrt. Program osnovna šola. Športna vzgoja [online]. [viewed 10 May 2022]. Available from: https://www.gov.si/assets/ministrstva/MIZS/Dokumenti/Osnovna-sola/Ucni-nacrti/obvezni/UN_sportna_vzgoja.pdf
- LANG, J. J., TREMBLAY, M. S., LÉGER, L., OLDS, T. and TOMKINSON, G. R. (2018). International variability in 20 m shuttle run performance in children and youth: who are the fittest from a 50-country comparison? A systematic literature review with pooling of aggregate results. *British journal of sports medicine*, vol. 52, no. 4, pp. 276. <https://doi.org/10.1136/bjsports-2016-096224>.
- MATEJEK, Č., PLANINŠEC, J., FOŠNARIČ, S. in PIŠOT, R. (2014). Relations of weight status and physical fitness of children in Slovenia. *Slovenian Journal of Public Health*, vol. 53, no. 1, pp. 11–16.
- NEVILL, A.M., RAMSBOTTOM, R., SANDERCOCK, G., BOCACHICA-GONZÁLEZ, C.E., RAMÍREZ-VÉLEZ, R. and TOMKINSON, G. (2021). Developing a New Curvilinear Allometric Model to Improve the Fit and Validity of the 20-m Shuttle Run Test as a Predictor of Cardiorespiratory Fitness in Adults and Youth. *Sports Medicine*, vol. 51, pp. 1581–1589. <https://doi.org/10.1007/s40279-020-01346-0>
- PATEL, H., et al. (2017). Aerobic vs anaerobic exercise training effects on the cardiovascular system. *World journal of cardiology*, vol. 9, no. 2, pp. 134–138.
- PENCEA, V., BINGAMAN, K.D., WIEGAND, S.J., and LUSKIN, M.B. (2001). Infusion of Brain-Derived Neurotrophic Factor into the Lateral Ventricle

- cle of the Adult Rat Leads to New Neurons in the Parenchyma of the Striatum, Septum, Thalamus, and Hypothalamus. *J. Neurosci.* vol. 21, pp. 6706–6717, doi: 10.1523/jneurosci.21-17-06706.2001.
- RETAR, I. (2019). *Zgodnje gibalno učenje in poučevanje*. Koper: Založba Univerze na Primorskem.
- RUIZ, J. R., CASTRO-PIÑERO, J., ESPAÑA-ROMERO, V., ARTERO, E. G., ORTEGA, F. B., CUENCA, M. M., JIMENEZ-PAVÓN, D., CHILLÓN, P., GIRELA-REJÓN, M. J., MORA, J., GUTIÉRREZ, A., SUNI, J., SJÖSTRÖM, M. and CASTILLO, M. J. (2011). Field-based fitness assessment in young people: the ALPHA health-related fitness test battery for children and adolescents. *British journal of sports medicine*, vol. 45, no. 6, pp. 518–524. <https://doi.org/10.1136/bjism.2010.075341>
- SINGH, A.S.; SALIASI, E.; VAN DEN BERG, V.; UIJTDEWILLIGEN, L.; DE GROOT, R.H.M.; JOLLES, J.; ANDERSEN, L.B.; BAILEY, R.; CHANG, Y.K.; DIAMOND, A.; et al. Effects of Physical Activity Interventions on Cognitive and Academic Performance in Children and Adolescents: A Novel Combination of a Systematic Review and Recommendations from an Expert Panel. *Br. J. Sports Med.* 2019, doi: 10.1136/bjsports-2017-098136.
- STARC, G., STREL, J., KOVAČ, M., LESKOŠEK, B., SORIĆ, M. and JURAK, G. (2020). *Slofit 2016 - Letno poročilo o telesnem in gibalnem razvoju otrok in mladine slovenskih osnovnih in srednjih šol v šolskem letu 2019/20*. Ljubljana: Fakulteta za šport, Inštitut za kineziologijo.
- ŠKOF, B. (2010). *Spravimo se v gibanje za zdravje in srečo gre. Kako do boljše telesne zmogljivosti slovenske mladine?* Ljubljana: Fakulteta za šport, Inštitut za šport.
- ŠKOF, B. (2016). *Šport po meri otrok in mladostnikov*. Univerza v Ljubljani, Fakulteta za šport.
- UŠAJ, A. (2003). *Kratek pregled osnov športnega treniranja*. Ljubljana: Fakulteta za šport, Inštitut za šport.
- UŠAJ, A. (2014). Vzdržljivost pri teku. *Šport*, vol. 3–4, pp. 153–166.

Oral hygiene and the use of fluoride toothpastes in children and adolescents in Slovenia in 2019

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Abstract

Introduction: We present the results of the »National Survey on Oral Health of Children and Adolescents in Slovenia in 2019«, which established for the first time at the national level, the level of oral health care among children and adolescents. The aim of our study was to assess the state of oral health of children and adolescents and provide recommendations for its promotion. We report in more detail the results and findings related to oral hygiene and fluoride use. **Methods:** The target population were children and adolescents aged 0–17 years. The sample, representative for gender and age, included 3,200 children and adolescents (1% of this population in Slovenia). The survey was conducted using the EGOHID questionnaire. Data were weighted by gender and age. The distributions of proportions between different groups (by gender or age) and comparisons were analysed with the chi-square test and the CCP test to compare proportions between different groups. **Results:** Only 62% of children aged 0–5 regularly brushed their teeth (or were assisted by parents). The proportion of children who brushed their teeth regularly increased slightly after the age of 5, with 80% of children brushing their teeth regularly. On average, 20% of children/adolescents did not brush their teeth regularly between the ages of 6–10 and 11–17. Among adolescents aged 15–17, 91% of girls and only 66% of boys regularly brushed their teeth (hi-square test = 17.4, $p < 0.001$; $p < 0.001$). After the age of 4, the proportion of children whose parents helped clean their teeth decreased sharply, with 81% of 5-year-olds, 71% of 6-year-olds and 62% of 7-year-olds being helped. Only 30% of children before the age of 1 used fluoride-containing toothpaste. 66% of children/adolescents, aged 3–13, were expected to use fluoride-containing toothpaste. After the age of 14, the proportion of adolescents who did not know if their toothpaste contained fluoride increased, and as many as 33% of adolescents stated that they did not use toothpaste that

contained fluoride. 47% of parents believed that daily cleaning of teeth with fluoride-containing toothpaste was good for the child's teeth, and 13% thought that it was harmful. As many as 20% of parents of children aged 0–5 believed that fluoride-containing toothpaste was harmful to their teeth, compared to 9% of parents of children aged 6–10. *Discussion and conclusions:* Controlled cleaning of teeth with fluoride-containing toothpaste at least twice a day is recommended as an effective measure to prevent dental and oral diseases. It is recommended that children start brushing their teeth as soon as the first tooth erupts into the oral cavity and help them until they develop the necessary motor skills. Findings and recommendations for improving oral health represent a step towards reducing the burden of dental and oral diseases and costs in the (dental) health care system.

Keywords: oral health, children, adolescents, oral hygiene, fluorides

Introduction

Oral health is an integral part of general health and has a significant impact on the quality of life of the individual and society. Oral health, like other aspects of health, is determined by individual, social and physical environment (WHO, 2016). With the aim of transforming and modernizing the existing system of oral health and dental care indicators, a project group has prepared a selection of 40 indicators for monitoring oral health as part of the European Global Oral Health Indicators Development (EGOHID) project (Bourgeois et al., 2005; Bourgeois and Llundra, 2005; Bourgeois et al., 2008a).

In Slovenia, we also follow the trend of establishing a system for monitoring oral health indicators. In this paper, we focus on the “National Survey on Oral Health of Children and Adolescents in Slovenia in 2019”, with which we determined for the first time at the national level how parents/guardians of children/adolescents, and adolescents take care of (their) oral health, and how they assess (their) oral health. The aim of our study was to assess the state of oral health of children and adolescents and provide recommendations for promoting oral health. We report in more detail the results and findings related to oral hygiene and fluoride use.

Methods

When conducting the study, we followed the recommended international methodology for reporting on oral health (Bourgeois et al., 2008a; Bourgeois et al., 2008b; WHO, 2013).

Research design

We conducted a survey on the oral health of children and adolescents at the national level for the first time. It was designed as a cross-sectional epidemiological survey of the Health Interview Survey (HIS) type.

Observers

The target population of the »National Survey on Oral Health of Children and Adolescents in Slovenia in 2019« were children and adolescents under the age of 18 on February 13, 2019, who lived as members of private households. The sample, representative for gender and age, was prepared by the Statistical Office of the Republic of Slovenia (SURS) from its databases based on simple random sampling. The sampling frame was the Central Population Register of Slovenia. The sample included approximately 3,200 children and adolescents, which accounts for 1% of this population in Slovenia.

Research tool

The survey was conducted using the EGOHID questionnaire on the oral health of children and adolescents. Questionnaires for children and adolescents differed from each other according to the requirements and age characteristics of the population (0–5 years, 6–10 years, 11–17 years). They contained 33–37 closed and/or open-ended questions. We created the online survey questionnaires using the online tool 1KA (2019). They could only be accessed by using the personalized password that the invitees received in the notification letter.

Research procedure

The set of indicators was prepared in accordance with the EGOHID methodology (EC, 2004; Bourgeois et al., 2008a). In 2018, we conducted a pilot verification of the international methodology for monitoring global oral health indicators in Slovenia (Šket, 2015). In January 2019, the SURS prepared a sample of 3,200 children and adolescents. The observation period took place from February 13 to March 30, 2019. Respondents were sent notification letters by mail with the option of completing an anonymous questionnaire online using a personalized password. We also sent them a reminder by post.

Observed outcomes and explanatory factors

In our study, we examined the frequency of teeth cleaning since the eruption of the first tooth. In the analysis, we combined the categories of brushing your teeth twice or several times a day and the categories once a day, several times a week, once a week and never, since regular teeth brushing means brushing your teeth at least twice a day. We were interested in whether parents/guardians help or have helped children in brushing their teeth. The question was answered by those parents/guardians whose children brush their teeth, or where they were assisted. Additionally, we asked whether children/adolescents use toothpaste, and if they do, whether it contains fluoride.

Other observed outcomes are presented in more detail in the scientific monograph (Artnik et al., 2020).

The interpretation of the results was based on the number and proportions of people in the selected categories, according to demographic variables (gender, age, education of parents/guardians, living environment) or other variables that were determined according to the research needs or for planning further measures.

Methods of analysis

The data obtained from the study were weighted by gender and age, considering one-year age groups. The analysis of sample and population weighted data was performed in the computer programs IBM SPSS Statistics for Windows, version 21.0 (2020) and R program, version 3.6.0 (n. d.).

The distributions of proportions between different groups (by gender or age) and comparisons were tested using the chi-square test and the CCP test (Column Comparison Proportion test) to compare proportions between different groups. In both cases, we used a 95% confidence interval in order to be able to assess the studied situation (Benjamini and Hochberg, 1995; IBM, 2017).

Results

Among the 3,200 selected persons, 3,164 were suitable (these persons could be reached at the addresses that were accessible to us). The questionnaire was completed by 1,406 parents or adolescents, which represented a response rate of 44%, namely in the age group 0–5 years 43% (469 children), in the age group 6–10 years 46% (465 children) and in the age group 11–17 years 45% (472 adolescents).

Frequency of teeth cleaning

We found out that only 62% of children aged 0–5 brushed their teeth regularly (or their parents helped them). The proportion of children who brushed their teeth regularly is the smallest among children under the age of 1; parents regularly brushed the teeth of only 30% of children up to the age of 1. Among children aged 1–4 years, the proportion increased to 65% (Figure 1).

The proportion of children who brushed their teeth regularly increased slightly after the age of 5, namely 80% of children brushed their teeth regularly. On average, 20% of children/adolescents did not brush their teeth regularly between the ages of 6–10 and 11–17.

For children aged 0–10 years who brushed their teeth regularly, we noted that the differences in the proportion between boys and girls were not statistically significant. Among adolescents aged 11–17, 86% of girls and 74% of boys brushed their teeth regularly; differences in the proportion between genders were statistically significant (chi-square test = 9.517, $p = 0.002$; CCP test, $p = 0.02$). The biggest (statistically significant) differences were seen among adoles-

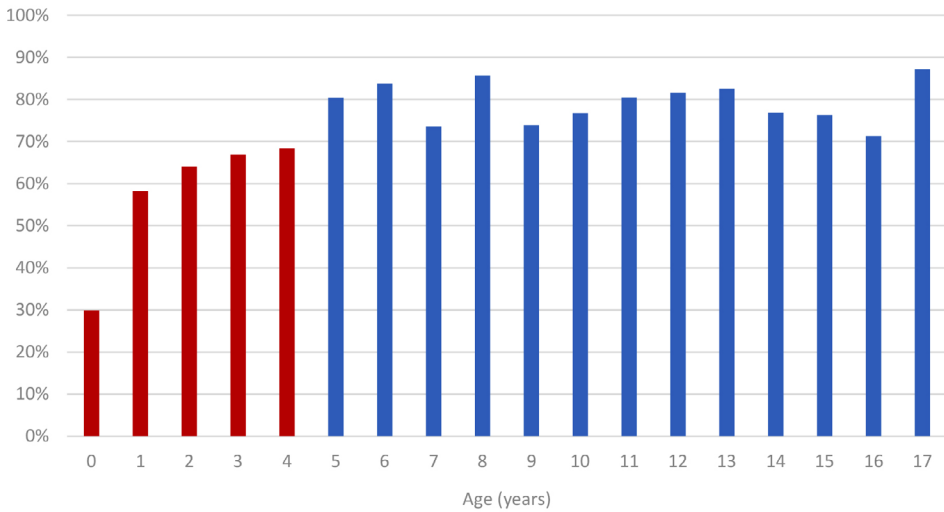


Figure 1: Proportion of children and adolescents who brush their teeth/get their teeth brushed regularly (at least twice a day), at different ages.

cents aged 15–17 years, among whom 91% of girls and only 66% of boys regularly brushed their teeth (chi-square test = 17.4, $p < 0.001$; $p < 0.001$).

The results showed that the education of the parents had no effect on whether children aged 0–5 brushed their teeth more regularly. The proportion of children who brushed their teeth or had their teeth brushed regularly and whose parents had at least a higher education increased in the age group of children 6–10 years, compared to children aged 0–5 years; these proportion differences were statistically significant (chi-square test = 43.855, $p < 0.001$; CCP test, $p < 0.001$).

In a rural living environment, there was a lower proportion of children/adolescents who regularly brushed their teeth, compared to children and adolescents from urban or suburban environments. The differences were most noticeable in children aged 0–5 years; 55% of children in rural areas cleaned their teeth regularly, 66% in urban areas and 71% in suburban areas.

Parents' help in brushing their children's teeth

The results showed that parents of most children (97%) aged 0–4 years helped with brushing their teeth (Figure 2).

This proportion drops sharply after 4 years of age, when parents helped 81% of 5-year-olds, 71% of 6-year-olds and 62% of 7-year-olds. The sum of the yellow and red coloured columns in Figure 2 shows the proportion of children in different age groups whose parents did not (anymore) help with brushing their teeth. The results showed that parents of 30% of 6-year-olds and 40% of 7-year-olds no longer helped with brushing their teeth. Parents' help in brushing their children's teeth drops sharply between the ages of 7 and 10.

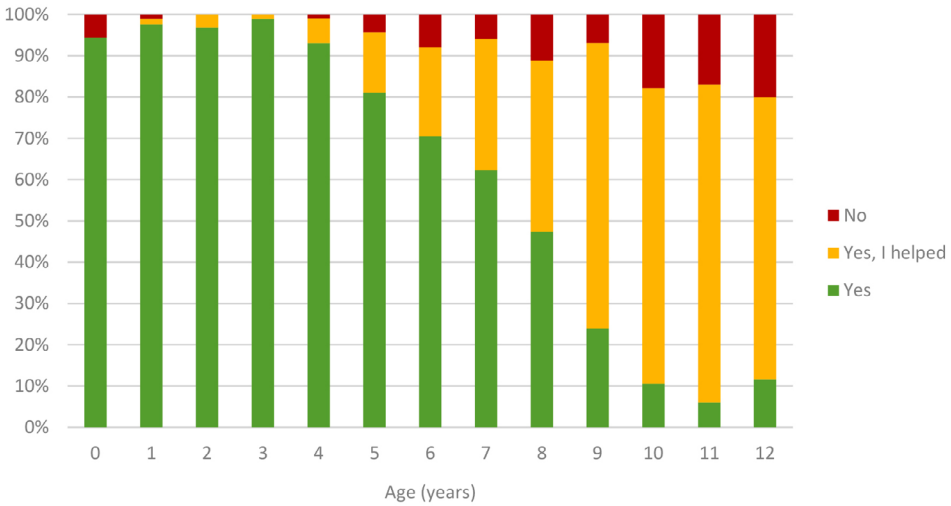


Figure 2: Proportion of children/adolescents according to the help of parents/guardians in cleaning teeth at different ages.

Fluoride-containing toothpaste use

In the study we found that among two-year-old children, approximately every tenth child does not use (any) toothpaste, but after the age of 3, almost all children use it (Figure 3). Further, the analysis showed that only 30% of children before the age of 1, used fluoride-containing toothpaste.

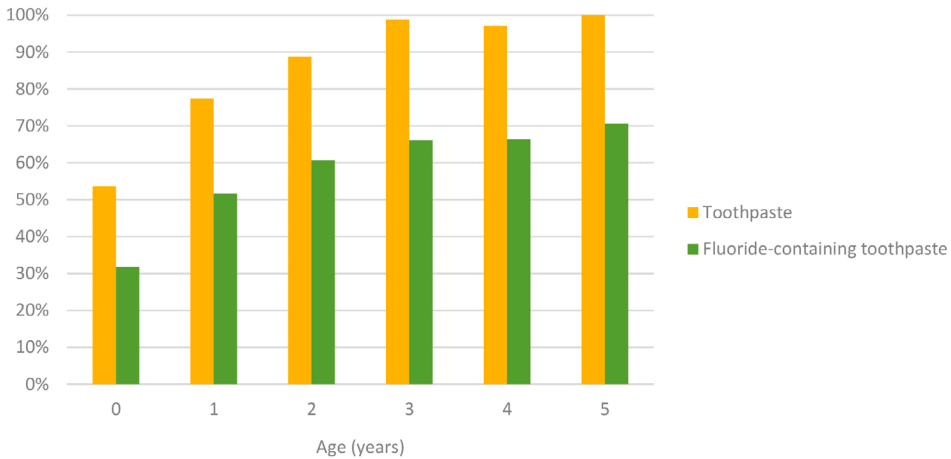


Figure 3: Proportion of children using (any) toothpaste and proportion of children using fluoride-containing toothpaste at different ages.

Children/adolescents aged 3–13 years were most likely to use fluoride-containing toothpaste. 66% of children/adolescents, aged 3–13, were expected to use fluoride-containing toothpaste, 18% of children/adolescents indicated that they did not use fluoride-containing toothpaste, and 17% of children/adoles-

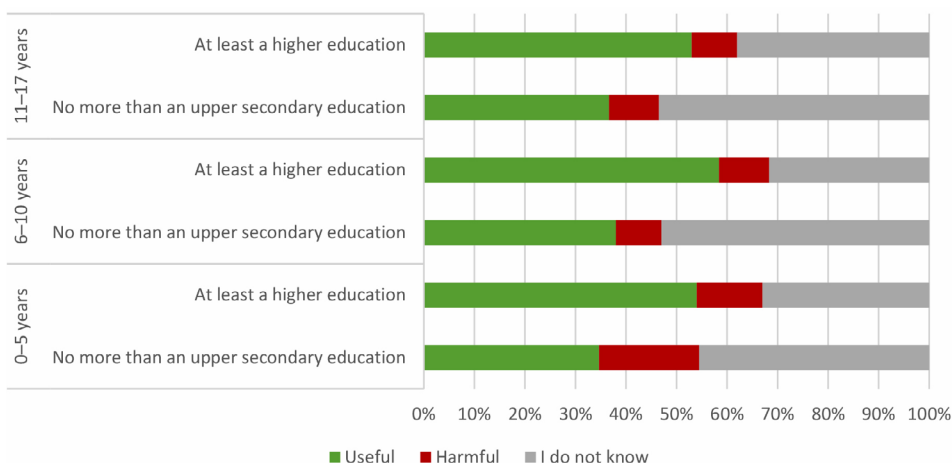


Figure 4: Proportion of parents/guardians in different age groups of children/according to education and opinion on the usefulness/harmfulness of daily cleaning of teeth with fluoride-containing toothpaste.

cents did not know whether they used fluoride-containing toothpaste. After the age of 14, the proportion of adolescents who did not know if their toothpaste contains fluoride increased, and as many as 33% of adolescents stated that they did not use toothpaste that contains fluoride.

Among parents who reported that their child used fluoride-containing toothpaste, 47% believed that fluoride-containing toothpaste was beneficial for the child's teeth, 41% of parents could not decide whether brushing teeth with fluoride toothpaste was beneficial or harmful, and 13% of them believed that brushing teeth with fluoride-containing toothpaste was harmful for the child's teeth (Figure 4).

Among parents with at least a higher education, 56% believed that using toothpaste containing fluoride was beneficial for the child's teeth; compared to parents with no more than an upper secondary education, among whom only 36% thought so (Figure 4); the differences in proportions were statistically significant (chi-square test = 32.152, $p < 0.001$; CCP test, $p < 0.001$). There was a difference between parents with no more than an upper secondary education who believed that fluoride-containing toothpaste was harmful to the teeth, depending on the age group of the children. As many as 20% of parents of children aged 0-5 years believed that fluoride-containing toothpaste was harmful to their teeth, compared to 9% of parents of children aged 6-10 years (Figure 4); the difference was statistically significant (chi-square test = 6.690, $p = 0.035$; CCP test, $p = 0.031$). There were no differences between the proportions of parents of children aged 0-5 and 6-10 years with at least a higher education who believed that fluoride-containing toothpaste was harmful for the child's teeth.

Discussion

The findings of our study point to insufficient teeth cleaning, inadequate parents' help in brushing their children's teeth, and ignorance of the benefits of using fluoride toothpaste.

Frequency of teeth cleaning

The most common method of removing plaque from the tooth surface is brushing with a toothbrush. Systematic review of the relationship between age and the beginning of tooth cleaning and the development of caries has not (yet) been done, but there are many observational studies that report this (Verrrips et al., 1994; Hinds and Gregory, 1995; Vanobbergen et al., 2001; Wigen et al., 2018).

The results of a study conducted in Slovenia in 2018 (Jeriček-Klanšček et al., 2019) showed that 70% of young people brush their teeth regularly. There were significant differences between genders (girls brushed teeth more often). The proportion of those who regularly brushed their teeth was highest among 17-year-old girls (81%) and lowest among 15-year-old boys (57%). The results of our study, carried out in 2019, show similar, even slightly higher proportions of young people of both genders who brush their teeth regularly.

Parents' help in brushing their children's teeth

Children cannot brush their teeth without help and should be assisted until motor and mental functions allow them to adequately brush their teeth alone. Since children's coordination is different, there is no uniformly recommended age as to when children should be assisted with toothbrushing. However, it is recommended to assist with toothbrushing at least until the child is about 6 or 7 years old (Oral Health Foundation, n. d.; WebMD, 2018; BDA, 2020; CDC, 2022), as the first permanent teeth erupt at this age.

Fluoride-containing toothpaste use

It is possible that the data on the fluoride content in toothpaste obtained from parents and adolescents (who had the possibility to complete the questionnaire themselves) were not reliable and that they did not know whether children/adolescents were using fluoride-containing toothpaste. The European Academy of Paediatric Dentistry (Toumba et al., 2019) and the American Academy of Pediatric Dentistry (AAPD, 2016) recommends brushing teeth with fluoride toothpaste at least twice a day. At the same time, we should pay attention to the appropriate concentration of fluorides according to the age of the child and the amount of toothpaste children use daily when brushing their teeth.

Conclusions

The results of the »National Survey on Oral Health of Children and Adolescents in Slovenia in 2019« represent a step towards reducing the burden of denr

tal and oral diseases and costs in the (dental) health care system. An important challenge for the future is continuous monitoring of oral health and the dental health care system in Slovenia with oral health indicators according to international recommendations, which will make it easier to plan suitable and effective programs for improving oral health. We should encourage activities to improve oral health and strengthen awareness of the importance of oral health in an individual's life. Oral health is an important part of general health, which has been proven to contribute to a better quality of life.

References

- 1KA. Aplikacija za spletno anketiranje. En klik spletne ankete, 2019 [online]. [viewed 16 June 2022]. Available from: <https://www.1ka.si/>
- AMERICAN ACADEMY OF PEDIATRIC DENTISTRY (AAPD), 2016. *Oral Health Policies & Recommendations (The Reference Manual of Pediatric Dentistry). Policy on early childhood caries (ECC): classifications, consequences, and preventive strategies* [online]. [viewed 21 June 2022]. Available from: https://www.aapd.org/media/policies_guidelines/p_eccclassifications.pdf
- ARTNIK, B., RANFL, M., BLATNIK, J., MAGAJNA, A. and ROSTOHAR, A., 2020. *Ustno zdravje otrok in mladostnikov, 2019: nacionalna raziskava o ustnem zdravju otrok in mladostnikov v Sloveniji leta 2019*. Elektronska izd. Ljubljana. [online]. [viewed 28 June 2022]. Available from: https://www.nijz.si/sites/www.nijz.si/files/publikacije-datoteke/publikacija_otroci_ustno_zdravje.pdf
- BENJAMINI, Y. and HOCHBERG, Y., 1995. Controlling the False Discovery Rate: A Practical and Powerful Approach to Multiple Testing. *Journal of the Royal Statistical Society. Series B (Methodological)*, vol. 57, no. 1, pp. 289–300.
- BOURGEOIS, D. M. and LLODRA, J. C., 2005. Chapter 1. Health Surveillance in Europe: European Global Oral Health Indicators Development Project. 2003 report proceedings. In: Bourgeois, D. M., ed. *Health surveillance in Europe. European Global Oral Health Indicators Development Project. Final report 2003–2005*. Lyon: Community Action Programme on Health Monitoring, European Commission, Health and Consumer Protection Directorate-General. [viewed 19 June 2022]. Available from: https://ec.europa.eu/health/ph_projects/2002/monitoring/fp_monitoring_2002_frep_o3b_en.pdf
- BOURGEOIS, D. M., LLODRA, J. C., CHRISTENSEN, L. B., PITTS, N. B., OTTOLENGHI, L. and SENKOLA, E., 2008b. *Health surveillance in Europe. Oral health interviews and clinical surveys: guidelines*. Lyon: University Lyon. [viewed 21 June 2022]. Available from: https://ec.europa.eu/health/ph_projects/2005/action1/docs/action1_2005_frep_14_a5_en.pdf

- BOURGEOIS, D. M., LLODRA, J. C., NORBLAD, A. and PITTS, N. B., 2005. Chapter 5, A selection of essential oral health indicators. Recommended by European Global Oral Health Indicators Development Project. In: Bourgeois, D. M., ed. *Health surveillance in Europe. European Global Oral Health Indicators Development Project. Final report 2003–2005*. Lyon: Community Action Programme on Health Monitoring, European Commission, Health and Consumer Protection Directorate-General. [viewed 19 June 2022]. Available from: https://ec.europa.eu/health/ph_projects/2002/monitoring/fp_monitoring_2002_frep_o3b_en.pdf
- BOURGEOIS, D. M., LLODRA, J. C., NORDBLAD, A. and PITTS, N. B., 2008a. Report of the EGOHID I Project. Selecting a coherent set of indicators for monitoring and evaluating oral health in Europe: criteria, methods and results from the EGOHID I project. *Community dental health*, vol. 25, no. 1, pp. 4–10.
- BRITISH DENTAL ASSOCIATION (BDA), 2020. *Brushing: top tips for your patients* [online]. [viewed 21 June 2022]. Available from: <https://bda.org/about-the-bda/campaigns/oralhealth/Pages/brushing.aspx>
- CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC), 2022. *Basics of oral health. Children's oral health. What parents and caregivers can do* [online]. [viewed 29 June 2022]. Available from: <https://www.cdc.gov/oralhealth/basics/childrens-oral-health/index.html>
- EUROPEAN COMMISSION (EC), 2004. *Health and Consumer Protection Directorate-General. Selecting essential oral health indicators in Europe: Report of the Consensus Workshop* [online]. [viewed 18 June 2022]. Available from: http://ec.europa.eu/health/ph_projects/2002/monitoring/fp_monfitoring_2002_a3_frep_o3_en.pdf
- FDI – WORLD DENTAL FEDERATION, 2016. *About oral health. FDI's definition of oral health* [online]. [viewed 11 July 2022]. Available from: <https://www.fdiworlddental.org/fdis-definition-oral-health>
- HINDS, K. and GREGORY, J. R., 1995. National diet and nutrition survey: children aged 1.5 to 4.5 years. Volume 2: Report of the dental survey. London: HMSO.
- INTERNATIONAL BUSINESS MACHINES CORPORATION (IBM), 2017. IBM SPSS Statistics Algorithms. Copyright IBM Corporation 1989 [online]. [viewed 16 June 2022]. Available from: ftp://public.dhe.ibm.com/software/analytics/spss/documentation/statistics/25.0/en/client/Manuals/IBM_SPSS_Statistics_Algorithms.pdf
- INTERNATIONAL BUSINESS MACHINES CORPORATION (IBM), 2020. SPSS Statistics 21.0 available for download [online]. [viewed 19 July 2022]. Available from: <https://www.ibm.com/support/pages/spss-statistics-210-available-download>
- JERIČEK-KLANŠČEK, H., ROŠKAR, M., DREV, A., PUCELJ, V., KO-PRIVNIKAR, H., ZUPANIČ, T., KOROŠEC, A., GOBEC, M. and

- PRELEC POLJANŠEK, P., 2019. Z zdravjem povezana vedenja v šolskem obdobju med mladostniki v Sloveniji. Izsledki mednarodne raziskave HBSC, 2018. Ljubljana: Nacionalni inštitut za javno zdravje.
- ORAL HEALTH FOUNDATION, n. d. *Better oral health for all* [online]. [viewed 21 June 2022]. Available from: <https://www.dentalhealth.org/childrens-teeth>
- ŠKET, T., 2015. *Preverjanje mednarodne metodologije za spremljanje globalnih kazalnikov ustnega zdravja v Sloveniji*. Ljubljana: Medicinska fakulteta.
- THE R PROJECT FOR STATISTICAL COMPUTING, n. d. R version 3.6.0 [online]. [viewed 16 June 2022]. Available from: <https://www.r-project.org/>
- TOUMBA, K. J., TWETMAN, S., SPLIETH, C., PARNELL, C., VAN LOVEREN, C. and LYGIDAKIS, N. A., 2019. Guidelines on the use of fluoride for caries prevention in children: an updated EAPD policy document. *European archives of paediatric dentistry: official journal of the European Academy of Paediatric Dentistry*, vol. 20, no. 6, pp. 507–516.
- VANOBERGEN, J., MARTENS, L., LESAFFRE, E., BOGAERTS, K. and DECLERCK, D., 2001. Assessing risk indicators for dental caries in the primary dentition. *Community dentistry and oral epidemiology*, vol. 29, no. 6, pp. 424–434.
- VERRIPS, G. H., KALSBECK, H., VAN WOERKUM, C. M., KOELEN, M. and KOK-WEIMAR, T. L., 1994. Correlates of toothbrushing in preschool children by their parents in four ethnic groups in The Netherlands. *Community dental health*, vol. 11, no. 4, pp. 233–239.
- WEBMD, 2018. *Brushing and flossing children's teeth. When should children brush and floss on their own?* [online]. [viewed 24 June 2022]. Available from: <https://www.webmd.com/oral-health/guide/brushing-flossing-child-teeth#2>
- WIGEN, T. I., BAUMGARTNER, C. S. and WANG, N. J., 2018. Identification of caries risk in 2-year-olds. *Community dentistry and oral epidemiology*, vol. 46, no. 3, pp. 297–302.
- WORLD HEALTH ORGANIZATION (WHO), 2013. *Oral Health Surveys. Basic Methods*. 5. edition, Geneva: World Health Organization.

Amount and intensity of physical activity of a group of gymnasts

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Abstract

Introduction: Physical activity (PA) has many health benefits for children and adolescents and can contribute to adequate body mass, increase bone density, prevent as chronic noncommunicable diseases and improve cognitive skills. Accelerometers are valid and useful devices for assessing the intensity and volume of PA in children and adolescents. Therefore, accelerometry has become one of the most objective methods to measure PA in children and adolescents. The aim of our study was to investigate whether our sample of gymnasts achieved the daily recommendations of PA. We hypothesized that there would be differences in mean of moderate to vigorous physical activity (MVPA) between weekdays and weekends. We also hypothesized that our sample would be less sedentary than their peers, which has been found in several studies. *Methods:* Twenty-nine female gymnasts (Salto club) participated in our study, from which we obtained 25 useful data. The participants were aged between 8 and 16 years (12.26 ± 2.21 years; body height 152.08 ± 11.33 ; body mass 43.74 ± 8.69 ; BMI 18.70 ± 1.59). Participants were measured with an accelerometer (GT3X+, ActiGraph, USA) for 10 consecutive days between 3.10.2020 and 12.10.2020 (from Saturday to Monday). The variables obtained on the average amount and intensity of PA and sedentary time, were used for further analysis. *Results:* By analyzing the obtained results, we found that the participants achieved the daily recommendations of amount and intensity of PA during the week and at the weekend. On average, they participated in MVPA for 205.22 ± 62.19 minutes, which is equivalent to 3.42 ± 1.04 hours per day. They spent 156.62 ± 42.22 minutes at moderate intensity PA, while they spent 30.03 ± 15.35 minutes at vigorous PA. The dependent t-test showed that the participants spent statistically significantly more time in MVPA during the week than at weekends ($t(24) = 6.57$; $p < 0.001$). In addition, the sample of gymnasts tended to spend more than 9 hours

per day in physical inactivity (sedentariness) during the week days and at the weekend, but the analysis did not show statistical significance ($p = 0.07$). *Discussion and conclusions:* The results of the present study show that the participants achieved daily recommendations for the amount and intensity of PA. In addition, sample of gymnasts tended to spend more than 9 hours sedentary, both during the week and at weekends. PA, especially gymnastics can help increase the recommended daily amount of PA and thus might reduce the consequences of a sedentarism.

Keywords: accelerometer ActiGraph GT3X+, children and adolescents, sedentarism

Introduction

Nowadays, children and adolescents are increasingly inactive due to modern lifestyle, that forces them to spend most of the day sedentary. At every turn, they use various technologies instead being physically active in their everyday, such as school time, homework and, unfortunately, leisure time. Physical activity (PA) has many health benefits for children and adolescents and can contribute to adequate body mass, increase bone density, prevent chronic non-communicable diseases and improve cognitive skills (Cooper et al., 2015; Duncan et al., 2018; Pfitzner et al., 2013).

WHO guidelines on PA and sedentary behavior (2020) suggest for children and adolescents (age 5–17 years) to be at least an average of 60 minutes per day of moderate- to vigorous-intensity (MVPA), mostly aerobic physical activity. Therefore, PA for children in adolescents should include at least 3 days a week as well as activities that strengthen muscles and bones. In addition, WHO recommends limiting the amount of time spent sedentary, especially in front of screens (e.g. TV, computers, video games etc.). Several studies have reported that most children and adolescents are not sufficiently active and that activity levels decrease with age in childhood (Chung et al., 2012; Cooper et al., 2015; Guthold et al., 2010; Nader et al., 2008). A study that examined PA of European children aged 2–11 years concluded that only 2–15 % of girls achieved the minimum MVPA recommendation (Konstabel et al., 2014a). Similarly, a study by Hallal et al. (2012) and Guthold et al. (2010), conducted on a sample of 13 to 15 year old youth, found that only 20 % (boys and girls) and 15.4 % (girls), respectively, met the 60-minute MVPA recommendation. Some studies that found that more than 95 % of 9-year-old and 82 % and 65 % of 15-year-old adolescents were sufficiently active, respectively, due to the use of age-specific intensity thresholds (Guthold et al., 2010).

Assessing PA of children and adolescents is key for monitoring their health status as well as to determining the effectiveness of exercise interventions (Duncan et al., 2020; Duncan et al., 2018). Within the last decades, researchers have begun to use different methods to assess adequate daily PA. As a results, accelerometry has become one of the most objective methods for measuring PA in children and adolescents (Borghese et al., 2017; Duncan et al.,

2020; Freedson, Pober & Janz, 2005; Toftager et al., 2013). The devices are more reliable and valid methods for assessing the frequency, duration and intensity of PA in children and adolescents (Borghese et al., 2017; Duncan et al., 2020; Duncan et al., 2018; Toftager et al., 2013), instead of alternative methods such as self-reports (Duncan et al., 2020; Freedson et al., 2005; Huber et al., 2019).

Studies conducted on children and adolescents suggest different wearing duration for the accelerometer: a) at least 3 days (Cooper et al., 2015; Fairclough et al., 2012; Konstabel et al., 2014), b) some of them suggest at least 4 days (Hallal et al., 2012; Nader et al., 2008; Pfitzner, Gorzelniak, Heinrich, von Berg, et al., 2013), c) 5 days (Volmut et al., 2021) or even 7 days (Borghese et al., 2017; Chung, A. E., Cockrell Skinner, A., Steiner, M. J., Perrin, 2012; Fairclough et al., 2012; Guthold et al., 2010; Mâsse et al., 2005; McLellan et al., 2020; Nader et al., 2008; Pfitzner, Gorzelniak, Heinrich, von Berg, et al., 2013; Riddoch et al., 2007; Toftager et al., 2013) The duration of wearing the device during the day is also important to obtain valid data of PA and sedentary. Most studies conducted recommended at least 8 hours of valid recording time per day (Cooper et al., 2015; Konstabel et al., 2014) to avoid loss of data from participants who used minimum of 10 hours per day (Borghese et al., 2017; Fairclough et al., 2012; Hallal et al., 2012; McLellan et al., 2020; Pfitzner et al., 2013; Riddoch et al., 2007).

Despite the difference in waking wear time per day and wearing period (the number of days), some study used calculation only per weekday during specific period of the day (before school, during school, after school, early evening and evening) (Catellier et al., 2005; Fairclough et al., 2012; Konstabel et al., 2014a; McLellan et al., 2020), the other studies compare differences between weekday and weekend day (Borghese et al., 2017; Catellier et al., 2005; Konstabel et al., 2014; McLellan et al., 2020; Nader et al., 2008; Pfitzner et al., 2013; Toftager et al., 2013; Volmut et al., 2021).

The aim of our study was to investigate whether our sample of gymnasts achieves the daily recommendations of PA. We hypothesized that there would be differences in mean of MVPA between weekdays and weekends. We also hypothesized that our sample would be less more active and less sedentary than their peers, which has already been found in several studies.

Methods

Participants

The sample consisted of twenty-nine female gymnasts (Salto Club from the coastal region), from whom we obtained 25 useful data. The participants were aged between 8 and 16 years (12.26 ± 2.21 years; body height 152.08 ± 11.33 ; body weight 43.74 ± 8.69 ; BMI 18.70 ± 1.59). Prior to the experiment, we presented the study to the coaches and the parents or legal guardians of the participants. The parents or legal guardians of all participants gave written informed consent to participate in the study. The study was conducted in accordance with the Dec-

laration of Helsinki and the experiment was approved by the National Medical Ethics Committee for Research on Children and Adolescents, obtained 23th of January 2018, (approval no: 0120-631/2017/2).

Study design

Participants were instructed by the researchers to wear an accelerometer (GT3X+, ActiGraph, USA) concurrently around their waist for 10 consecutive days between 3.10.2020 and 12.10.2020 (from Saturday to Monday). We instructed parents and gymnasts to put the device on immediately after waking up and asked them to remove the device only for aquatic activities, showering/bathing and sleeping. After the devices were returned, the data were downloaded in 30-s epoch lengths using ActiLife (Version 6.13.4; 2009-2015 ActiGraph LLC) and saved in raw format as GT3X files. Inclusion criteria for data validation were based on equal wearing time of participants putting the device on soon after waking up and to take off before going to bed. A compliant recording requires at least 10 hours of awake wear time per day, including at least 5 valid weekdays and at least 2 valid weekend days.

Statistical analysis

Statistical analysis was conducted with IBM SPSS Statistic 26 (IBM, New York, USA). We calculated descriptive statistics (mean value \pm standard deviation, minimum and maximum value) for all descriptive parameters of the participants. The normality of the data distribution was checked with Shapiro-Wilk test. Differences between groups were assessed with the dependent-samples t-test. Hedges g effect sizes (ES) were calculated and interpreted as suggested suggestions by Rhea where: < 0.25 = trivial; $0.25-0.50$ = small; $0.51-1.0$ = moderate and > 1.0 = large (Rhea, 2004). The threshold for statistical significance was set at $p < 0.05$.

Results

From twenty-nine participants, we obtained 25 useful data from our sample. Descriptive statistic regarding participants are presented in Table 1.

Table 1: Descriptive statistic of participant's parameters.

	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
N (25)				
Age/years	12.26	2.21	8.11	16.40
BH/cm	152.08	11.33	127.00	171.00
BW/kg	43.74	8.69	24.40	57.00
BMI/kg m ⁻²	18.70	1.59	14.90	22.30

SD–standard deviation; *Min*–minimum; *Max*–maximum; *BH*–body height; *BW*–body weight; *BMI*–body mass index

Table 2 presents descriptive statistic on participants' physical activity phenotypes.

Table 2: Descriptive statistic of PA phenotypes for 7 days.

	Mean	SD	Min	Max
N (25)				
Sedentary/min	608.14	75.93	480.95	759.17
Light/min	80.74	14.47	53.10	105.00
Moderate/min	156.62	22.40	120.55	207.90
Vigorous/min	30.03	8.17	14.67	50.33
Very V/min	18.57	10.97	5.57	49.98
MVPA/min	205.22	32.79	144.64	278.38
Overall PA/cpm	1316.50	387.39	683.21	2329.84

SD–standard deviation; Min–minimum; Max–maximum; V–vigorous; PA–physical activity; MVPA–moderate to vigorous PA

Table 3 summarises the differences between the recommendations on PA and sedentary behaviour between weekdays and weekend days. The dependent t-test showed that participants spent statistically significantly more time in MVPA during the week than on weekends ($p < 0.001$; $ES = 1.06$), but the differences in sedentary time were not statistically significant ($ES = 0.35$).

Table 3: Differences between week and weekends in MVPA and sedentary.

Outcomes	Week		Weekends		p	ES
	Mean	SD	Mean	SD		
N (25)						
MVPA/min	217.49	27.59	172.11	52.87	0.000**	1.06
SED/min	613.95	82.57	584.51	84.91	0.065	0.35

SD–standard deviation; ES–effect size (Hedges); MVPA–moderate to vigorous physical activity; SED–sedentary; * $p < 0.05$; ** $p < 0.001$

Discussion

The purpose of the present study was to find out whether young gymnasts achieve the daily physical activity (PA) recommendation and how long they spend in the individual PA phenotype. We hypothesized that there would be differences in mean of moderate to vigorous physical activity (MVPA) between weekdays and weekends. We also hypothesized that our sample would be less sedentary than their peers, which has been found in several studies.

In addition, there are a few studies conducted on children and adolescents that have found differences between weekdays and weekends in MVPA and sedentary. According to our analysis, our participants spent an average of 217.49 minutes in MVPA on weekdays and 172.11 minutes on weekends, which is a statistically significant difference ($p < 0.001$). Trost et al. (2000) found significant

differences between weekdays and weekend for girls. In the youngest age group, girls had significantly greater MVPA scores at weekend. In studies that looked at the different phenotypes of PA on weekdays and weekends, gender differences were found (McLellan et al., 2020; Pfitzner, Gorzelniak, Heinrich, von Berg, et al., 2013). Another survey by Pfitzner et al. (2013) did not detect statistically significant differences between weekdays and weekend days in boys and of borderline significance in girls. Another study have shown that MVPA decreases with age on both weekdays and weekend days (Nader et al., 2008). Unfortunately, due to the difference in downloaded and processed accelerometer data, we cannot compare our results with those of other studies that have found differences between weekdays and weekends. Different methods resulted from the different wearing period, ranging from 5 (Volmut et al., 2021) to 7 days (Borghese et al., 2017; Evenson et al., 2008; Konstabel et al., 2014; McLellan et al., 2020; Nader et al., 2008; Pfitzner et al., 2013; Toftager et al., 2013) and the varying compliant recording, ranging from at least 2 weekdays and 1 weekend day (Volmut et al., 2021), to 3 weekdays and at least 1 weekend day (Konstabel et al., 2014; McLellan et al., 2020), with some studies even recommending 5 weekdays and 2 weekend days (Nader et al., 2008; Toftager et al., 2013) of at least 10 hours of awake wearing time per day (Borghese et al., 2017; Konstabel et al., 2014; McLellan et al., 2020). In our study, we used 10 consecutive days of wearing with the required compliant recording as in the studies by Nader et al. (2008) and Toftager et al. (2013) and we used date of at least 10 hours. Second, in methodology, various studies refer to different data collection at a sampling rate of 30 Hz (Pfitzner, Gorzelniak, Heinrich, von Berg, et al., 2013) as we have used, or even of 80 Hz (Borghese et al., 2017; McLellan et al., 2020) and downloaded in different epoch lengths from 5-s (McLellan et al., 2020), to 30-s (Evenson et al., 2008; Toftager et al., 2013) or even 60-s (Borghese et al., 2017; Konstabel et al., 2014; Pfitzner et al., 2013; Volmut et al., 2021), which is the most commonly used epoch.

Our sample of gymnasts engage in training activities every day during the weekdays and also one day at the weekend (Saturday). Unfortunately, they still tend to spend more than 9 hours sedentary. The results regarding sedentary time showed no statistically significant differences between weekdays and weekend ($p = 0.065$). To our knowledge, some studies have obtained similar results showing that children and adolescents spend about 8 hours sedentary (Borghese et al., 2017; McLellan et al., 2020) or even 10 hours (Pfitzner, Gorzelniak, Heinrich, von Berg, et al., 2013), which increases with age (Cooper et al., 2015; Nader et al., 2008; Toftager et al., 2013). A study conducted on children and adolescents from different countries around the world found that children spend 3 or more hours sedentary, excluding time spent sitting at school and doing homework (Guthold et al., 2010).

Conclusions

Our findings suggest that gymnasts who are training almost every day (except on Sunday) were more physically active and achieve WHO' recommenda-

tion of PA and were less sedentary during weekdays in comparison with weekend days. Nevertheless, they spent more than 9 hours in sedentary, which is worrying. These observations highlight the importance of gymnastic training, which can help increase the recommended daily amount of PA while minimizing negative consequences of a sedentariness.

References

- Borghese, M. M., Tremblay, M. S., LeBlanc, A. G., Leduc, G., Boyer, C., & Chaput, J. P. (2017). Comparison of ActiGraph GT3X+ and Actical accelerometer data in 9–11-year-old Canadian children. *Journal of Sports Sciences*, 35(6), 517–524. <https://doi.org/10.1080/02640414.2016.1175653>
- Catellier, D. J., Hannan, P. J., Murray, D. M., Addy, C. L., Conway, T. L., Yang, S., & Rice, J. C. (2005). Imputation of Missing Data When MEasuring Physical Activity by Accelerometry. *NIH Public Access*, 37(11 Suppl), S555–S562.
- Chung, A. E., Cockrell Skinner, A., Steiner, M. J., Perrin, E. M. (2012). Physical Activity and BMI in a Nationally Representative Sample of Children and Adolescents. *Clin Pediatr (Phila)*, 51(2), 122–129. <https://doi.org/10.1177/0009922811417291>
- Cooper, A. R., Goodman, A., Page, A. S., Sherar, L. B., Esliger, D. W., van Sluijs, E. M. F., Andersen, L. B., Anderssen, S., Cardon, G., Davey, R., Froberg, K., Hallal, P., Janz, K. F., Kordas, K., Kreimler, S., Pate, R. R., Puder, J. J., Reilly, J. J., Salmon, J., ... Ekelund, U. (2015). Objectively measured physical activity and sedentary time in youth: The International children's accelerometry database (ICAD). *International Journal of Behavioral Nutrition and Physical Activity*, 12(1), 1–10. <https://doi.org/10.1186/s12966-015-0274-5>
- Duncan, M. J., Eyre, E. L. J., Cox, V., Roscoe, C. M. P., Faghy, M. A., Tallis, J., & Dobell, A. (2020). Cross-validation of Actigraph derived accelerometer cut-points for assessment of sedentary behaviour and physical activity in children aged 8-11 years. *Acta Paediatrica, International Journal of Paediatrics*, 109(9), 1825–1830. <https://doi.org/10.1111/apa.15189>
- Duncan, S., Stewart, T., Schneller, M. B., Godbole, S., Cain, K., & Kerr, J. (2018). Convergent validity of ActiGraph and Actical accelerometers for estimating physical activity in adults. *PLoS ONE*, 13(6), 1–13. <https://doi.org/10.1371/journal.pone.0198587>
- Evenson, K. R., Catellier, D. J., Gill, K., Ondrak, K. S., & McMurray, R. G. (2008). Calibration of two objective measures of physical activity for children. *Journal of Sports Sciences*, 26(14), 1557–1565. <https://doi.org/10.1080/02640410802334196>
- Fairclough, S. J., Beighle, A., Erwin, H., & Ridgers, N. D. (2012). School day segmented physical activity patterns of high and low active children. *BMC Public Health*, 12(1). <https://doi.org/10.1186/1471-2458-12-406>

- Freedson, P., Pober, D., & Janz, K. F. (2005). Calibration of accelerometer output for children. *Medicine and Science in Sports and Exercise*, 37(11 SUPPL.), 523–530. <https://doi.org/10.1249/01.mss.0000185658.28284.ba>
- Guthold, R., Cowan, M. J., Autenrieth, C. S., Kann, L., & Riley, L. M. (2010). Physical Activity and Sedentary Behavior Among Schoolchildren: A 34-Country Comparison. *Journal of Pediatrics*, 157(1), 43–49.e1. <https://doi.org/10.1016/j.jpeds.2010.01.019>
- Hallal, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., Ekelund, U., Alkandari, J. R., Bauman, A. E., Blair, S. N., Brownson, R. C., Craig, C. L., Goenka, S., Heath, G. W., Inoue, S., Kahlmeier, S., Katzmarzyk, P. T., Kohl, H. W., Lambert, E. V., Lee, I. M., ... Wells, J. C. (2012). Global physical activity levels: Surveillance progress, pitfalls, and prospects. *The Lancet*, 380(9838), 247–257. [https://doi.org/10.1016/S0140-6736\(12\)60646-1](https://doi.org/10.1016/S0140-6736(12)60646-1)
- Huber, D. L., Thomas, D. G., Danduran, M., Meier, T. B., McCrea, M. A., & Nelson, L. D. (2019). Quantifying activity levels after sport-related concussion using actigraph and mobile (mHealth) technologies. *Journal of Athletic Training*, 54(9), 929–938. <https://doi.org/10.4085/1062-6050-93-18>
- Konstabel, K., Veidebaum, T., Verbestel, V., Moreno, L. A., Bammann, K., Tornaritis, M., Eiben, G., Molnár, D., Siani, A., Sprengeler, O., Wirsik, N., Ahrens, W., & Pitsiladis, Y. (2014a). Objectively measured physical activity in European children: the IDEFICS study. *International Journal of Obesity*, 38, 135–143. <https://doi.org/10.1038/ijo.2014.144>
- Konstabel, K., Veidebaum, T., Verbestel, V., Moreno, L. A., Bammann, K., Tornaritis, M., Eiben, G., Molnár, D., Siani, A., Sprengeler, O., Wirsik, N., Ahrens, W., & Pitsiladis, Y. (2014b). Objectively measured physical activity in European children: The IDEFICS study. *International Journal of Obesity*, 38, S135–S143. <https://doi.org/10.1038/ijo.2014.144>
- Mâsse, L. C., Fuemmeler, B. F., Anderson, C. B., Matthews, C. E., Trost, S. G., Catellier, D. J., & Treuth, M. (2005). Accelerometer data reduction: A comparison of four reduction algorithms on select outcome variables. *Medicine and Science in Sports and Exercise*, 37(11 SUPPL.). <https://doi.org/10.1249/01.mss.0000185674.09066.8a>
- McLellan, G., Arthur, R., Donnelly, S., & Buchan, D. S. (2020). Segmented sedentary time and physical activity patterns throughout the week from wrist-worn ActiGraph GT3X+ accelerometers among children 7–12 years old. *Journal of Sport and Health Science*, 9(2), 179–188. <https://doi.org/10.1016/j.jshs.2019.02.005>
- Nader, P. R., Bradley, R. H., Houts, R. M., McRitchie, S. L., & O'Brien, M. (2008). Moderate-to-vigorous physical activity from ages 9 to 15 years. *JAMA - Journal of the American Medical Association*, 300(3), 295–305. <https://doi.org/10.1001/jama.300.3.295>
- Pfitzner, R., Gorzelniak, L., Heinrich, J., Von Berg, A., Klü Mper, C., Bauer, C. P., Koletzko, S., Berdel, D., Horsch, A., & Schulz, H. (2013). Physical Activ-

- ity in German Adolescents Measured by Accelerometry and Activity Diary: Introducing a Comprehensive Approach for Data Management and Preliminary Results. *POLSoNe*, 8(6), e65192. <https://doi.org/10.1371/journal.pone.0065192>
- Pfitzner, R., Gorzelniak, L., Heinrich, J., von Berg, A., Klümper, C., Bauer, C. P., Koletzko, S., Berdel, D., Horsch, A., & Schulz, H. (2013). Physical Activity in German Adolescents Measured by Accelerometry and Activity Diary: Introducing a Comprehensive Approach for Data Management and Preliminary Results. *PLoS ONE*, 8(6). <https://doi.org/10.1371/journal.pone.0065192>
- Rhea, M. (2004). Determining the magnitude of treatment effects in strength training research through the use of the effect size. *Journal of Strength and Conditioning Research*, 18(4), 918–920.
- Riddoch, C. J., Mattocks, C., Deere, K., Sounders, J., Kirkby, J., Tilling, K., Leary, S. D., Blair, S. N., & Ness, A. R. (2007). Objective measurement of levels and patterns of physical activity. *Archives of Disease in Childhood*, 92(11), 963–969. <https://doi.org/10.1136/adc.2006.112136>
- Toftager, M., Lund Kristensen, P., Oliver, M., Duncan, S., Christiansen, L. B., Boyle, E., Brønd, J. C., & Troelsen, J. (2013). Accelerometer data reduction in adolescents: effects on sample retention and bias. *International Journal of Behavioral Nutrition and Physical Activity*, 10(1). <http://www.ijbnpa.org/content/10/1/140>
- Trost, S. G., Pate, R. R., Freedson, P. S., Sallis, J. F., & Taylor, W. C. (2000). Using objective physical activity measures with youth: How many days of monitoring are needed? *Medicine and Science in Sports and Exercise*, 32(2), 426–431. <https://doi.org/10.1097/00005768-200002000-00025>
- Volmut, T., Pišot, R., Planinšec, J., & Šimunič, B. (2021). Physical Activity Drops During Summer Holidays for 6- to 9-Year-Old Children. *Frontiers in Public Health*, 8(January), 1–7. <https://doi.org/10.3389/fpubh.2020.631141>

Elementary school projects as a possibility of improving pupils' eating habits

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Abstract

Introduction: At the Stane Žagar primary school in Kranj, there are two projects taking place we had focused on, defining their role on education about nutrition. Projekt 2° Zelene strehe and Tradicionalni slovenski zajtrk. The first provides an additional space for high quality learning environment. Pupils need to take care of the green roof and plants, which helps them to learn about responsibility. The latter provides them knowledge not only about importance of breakfast consumption, but also about locally produced food, beekeeping and local farming. It consists of bread, milk, butter, honey and an apple or other fresh or dried fruit without any added sugars. *Methods:* In spring 2021 we conducted a survey. There were 59 pupils in the sample from three 7th grade classes. The purpose was to determine what their eating habits are like. Based on those we inferred what their knowledge is on nutrition. We conducted a quiz on Kahoot platform, there were 10 questions regarding the content we presented. We used an OPKP programme to calculate nutritional and energy values of traditional Slovenian breakfast. *Results:* On average, this breakfast provides 1604 kJ (382 kcal), which is 16 % of daily energy requirements for pupils in age group 13–14 years. 10 % of the breakfast is composed of protein, 26 % of fats and 64 % of carbohydrates. Results of the questionnaire have shown that less than half of pupils eat breakfast daily. The frequency of wholegrains and legumes consumption is also low. Pupils mostly consume one or two sorts of fruit per day (68 %), but 17 % of them don't include fruits in their diet every day. 47 % of pupils eat vegetables every day, mostly one or two sorts per day. Females consume more wholegrain product (36 %) than males (27 %). Most pupils, 67 females and 74 % males, drink water. 76 % of pupils have between 3 and meals per day. We used quiz on Kahoot platform to evaluate their knowledge on guidelines for balanced nutrition. The most pupils expressed their opinion on the issue of 'What is in the lowest

layer of the nutrition pyramid scheme? as we have presented the new nutrition pyramid scheme, which they have not met yet. *Discussion and conclusions:* Some edible plants are grown on the green roof, mostly berries. In plant-based foods there are bioactive compounds. They not only have antioxidant properties but also play a role in lowering risk for some noncommunicable diseases. Both projects carry a great potential in educating pupils and improving their eating habits. We suggest upgrading the projects with interactive contents, thus pupils would be more effectively presented the purpose of balanced nutrition. Questionnaire results show pupils' eating habits are not suitable, hence we inferred their knowledge on nutrition is insufficient. Implementing such projects might be beneficial for their knowledge. By upgrading the projects, additional information would be provided and changes in eating habits would be encouraged.

Keywords: Eating habits, traditional Slovenian breakfast, green roof, plant foods, antioxidants

Introduction

Balanced diet is very important for pupils. Guidelines for balanced diet suggest having regular and evenly distributed meals throughout a day. Consequently consumption of meals is more frequent and quantity of foods consumed is smaller. This is thought to be beneficial for blood fatty acids and blood glucose levels, which reflects in improved abilities of pupils during lessons. Pupils should have breakfast at home and it should consist of whole-grain foods, such as whole grain bread, cereals or porridge. Blood glucose levels elevation is slower, which contributes to improved pupils' abilities during lessons (Gabrijelčič, Pograjc, Gregorič, Adamič and Čampa, 2005).

Daily intake of protein for children and adolescents is 0,9 – 1g/kg or 10–15 % of daily energy intake (DEI). Sources of protein are lean meat, fish, eggs, milk and dairy products, legumes and nuts. Pupils' energy intake from fats should cover 30–35 % of DEI. Fats are further divided into groups: monounsaturated fatty acids, polyunsaturated fatty acids and saturated fatty acids. Unsaturated fatty acids altogether are recommended to cover 20 % of DEI. Monounsaturated fatty acids are recommended to cover 10–13 % of DEI, polyunsaturated fatty acids 7–10 %. Omega-6 and omega-3 fatty acids are in the group of polyunsaturated fatty acids, former should cover 2,5 % of DEI and latter 0,5 %. Carbohydrates are recommended to cover over 50 % of DEI. However, pupils have to choose carefully. Sugars belong in the group of carbohydrates as well, and yet they should be limited up to 10 % of DEI. Complex carbohydrates are recommended, such as whole-grain foods which also contain dietary fibre (Gabrijelčič et al., 2005).

Since meals in school represent only one part of pupils' diet, they need additional knowledge to be able to choose and prepare balanced meals at home as well. They could get some additional knowledge about nutrition from projects,

which take place in elementary school. In this article, we have highlighted two projects, which take place in Elementary school of Stane Žagar Kranj. First project is *Traditional slovenian breakfast* (Tradicionalni slovenski zajtrk) and the second is *Project 2° Green roof* (Projekt 2° Zelene strehe) (Ministrstvo za kmetijstvo, gozdarstvo in prehrano, 2018).

Traditional slovenian breakfast takes place every year in november and is composed of locally produced foods. It is the same every year, there are bread, milk, butter, honey and an apple. Bread must be made in Slovenia, whereas other foods must be produced and processed in Slovenia (Ministrstvo za kmetijstvo, gozdarstvo in prehrano, 2018). Project 2° Green roof has started in 2020, therefore it is new to school (Eko sklad, 2020). There are many edible plants planted there, including strawberries, raspberries, grapes, aronia and some herbs. The roof is surrounded by a fence and is safe to walk on. There are two separate spaces on the roof, purposely built as outdoor classrooms (Kandus and Skubic, 2020).

Berries planted on the green roof are rich in antioxidants, some vitamins and minerals. Their energy value is low, however their nutritional value is high (Mikulič-Petkovšek, Koron, Zorenc in Veberič, 2017). Berries also contain some dietary fibre. The most abundant antioxidants in berries are vitamin C, flavonoids and anthocyanins (Burton-Freeman, Sandhu in Edirisinghe, 2016).

Methods

In spring 2021 we conducted a survey. There were 59 pupils from three 7th grade classes in the sample. 36 (61%) were female and 23 (39%) were male. 35 (59%) of pupils were 12 years old at the time of conducting our survey, 22 (37%) were 13 years old and two (3%) were 15 years old. We handed out the surveys and consensus in a paper form to pupils. Parents had to sign the consensus. The survey had 30 questions, the majority referring to eating habits. Some questions also referred to habits during the covid pandemic, exercise and their own opinion of their body mass. Most of them were closed or multiple choice questions. One was an open question. The purpose was to determine what their eating habits are like. Based on their answers we inferred what their knowledge is on nutrition. Pupils had about one week to complete the survey and return it. We collected them on the same day we gave short lectures about balanced nutrition.

We prepared a 45 minutes long lecture based on nutritional guidelines for educational institutions and general guidelines. We divided our lecture into two parts. 30 minutes of lecture and 15 minutes for discussion and the quiz. Lecture covered the topics of: number and frequency of meals in a day; guidelines for choosing carbohydrates, protein and fats; choosing drinks; how to prepare a meal based on macronutrient guidelines. We prepared the quiz on the Kahoot platform, there were 10 questions referring to balanced diet and exercise. All of them were multiple choice questions.

We used an OPKP programme to calculate nutritional and energy values of traditional Slovenian breakfast. We processed the results from the survey with an Excel Microsoft Office 365 programme.

Results

Traditional slovenian breakfast

Traditional slovenian breakfast is composed of bread, milk, honey, butter and an apple (Ministrstvo za kmetijstvo, gozdarstvo in prehrano, 2018). As dietitians we suggest consumption of whole grain bread from locally produced grains, such as wheat whole grain bread or whole grain bread with different seeds. An advantage of whole-grain bread is, that it has more dietary fibre compared to white bread and thus more minerals, vitamins and micronutrients (Prehrana.si, n. d.e). Honey should be consumed carefully, since it has high energy density. We suggest consuming no more than two tea spoons of honey per day, considering children don't consume any sugars with other sweet foods (Prehrana.si, n. d.c). Milk has high nutrient and low energy density, it is a source of quality protein. We need to introduce pupils to low-fat dairy products, because fatty acids in dairy products are mostly saturated. As children start elementary school, we suggest they consume only semi-skimmed milk. Substitution of milk for fermented dairy products, such as yoghurt, is also encouraged, since it contains more probiotic bacteria and is easier to digest (Prehrana.si, n. d.d). A fruit included in the breakfast should be fresh and locally produced. Another choice is dried fruit without added sugars (Pravilnik o izvajanju projekta Tradicionalni slovenski zajtrk, 2020).

Table 1: Foods in an average traditional slovenian breakfast and their energy values.

<i>Food</i>	<i>Whole grain bread</i>	<i>Milk, semi-skimmed</i>	<i>Butter</i>	<i>Honey</i>	<i>Apple</i>	<i>Altogether</i>
Quantity (g)	50	200	15	20	111	397
Energy value (kcal)	100	75	74	67	67	382
Energy value (kJ)	420	315	310	281	281	1604

DEI for pupils in age group 13–14 years is 10080 kJ (2400 kcal) (Nacionalni inštitut za javno zdravje, 2020). An average traditional slovenian breakfast has 1604 kJ (Table 1) and represents 16% of DEI in an above mentioned age group. Figure 1 shows that 10% of energy value of traditional slovenian breakfast is obtained from protein, 26% from fats and 64% from carbohydrates (OPKP, 2021).

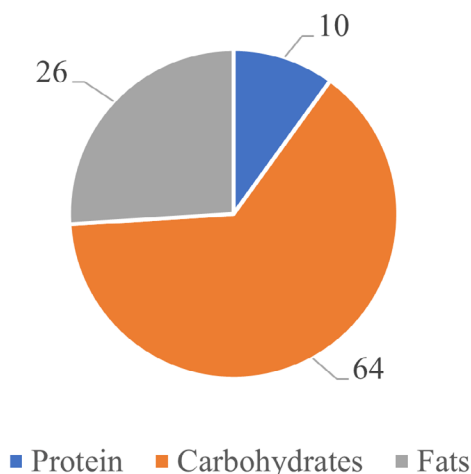


Figure 1: Energy (%) from macronutrients in an average traditional Slovenian breakfast.

Survey results

We conducted a survey in three 7th grade classes. 59 pupils completed it, 36 (61%) were female and 23 (39%) were male. 35 (59%) pupils were 12 years old, 22 (37%) were 13 years old and two (3%) were 15 years old. They had to complete 30 questions. 29 questions were closed or multiple choice questions, one question was an open one.

Sorts of fruits and vegetables consumed: the majority of male pupils, 11 (48%), consume 2 different sorts of fruit every day, five (22%) consume one sort of fruit, three (13%) three sorts of fruit or more every day and four (17%) do not consume fruit every day. The results were similar for female pupils, 14 (39%) of them have two different sorts of fruit every day, ten (28%) have one sort of fruit, six (17%) have three different sorts of fruit every day or more and six (17%) do not have fruit every day. 13 (22%) pupils consume one sort of vegetables, 19 (32%) consume two sorts, eight (14%) consume three sorts and 13 (22%) consume four sorts of vegetables or more every day. Six (10%) of pupils do not consume vegetables daily.

Frequency of fruits and vegetables consumed: 31 (53%) pupils consume fruit every day, 21 (36%) consume pupils consume it three to five times per week, five (8%) once per week and two (3%) pupils never consume fruit. 28 (47%) of pupils consume vegetables every day, 23 (39%) consume it three to five times per week and six (10%) one per week. Two (3%) never consume vegetables.

Bread, pasta and flour: 58 (98%) pupils answered the question, what kind of bread, pasta and flour they use more often to prepare their meals; white or wholegrain. The results have showed that more pupils use white bread, pasta and flour, 16 (73%) male pupils and 23 (64%) female pupils. Only six (27%) male pupils and 13 (36%) female pupils use whole grain bread, pasta and flour.

The majority of pupils consume whole grain foods, such as porridge, cereals or semolina once per week, those are 19 (32 %). Only three (5%) consume those foods daily, 14 (24%) three to five times per week, 18 (31%) one to three times per month and five (8%) never consume those foods.

Drinks they consume at least once or twice every week: 57 (97%) pupils drink water, 21 (91%) male and 36 (100%) female. 19 (83%) males and 19 (53%) females drink fruit juice. Ten (43%) males and 16 (44%) females drink unsweetened tea. Five (22%) males and five (14%) females drink energy drinks. 13 (57%) males and three (14%) females drink soda.

Drink consumed the most: Water is a drink pupils consume most often, 17 (74%) males and 24 (67%) females. Fruit juice follows on second place with five (22%) males and seven (19%) females.

Meals and breakfast: 58 (98%) pupils answered a question, what is the average number of meals, they have every day. The majority, 45 (76%) pupils, have three to five meals per day. Three (5%) have more than six meals and ten (17%) have less than three meals every day. 22 (37%) pupils have breakfast every day, 13 (22%) three to five times per week and 24 (41%) once per week or less.

Self opinion of body mass: we did not ask pupils to reveal us their body mass only to express their self opinion of their body mass. They were given three choices: body mass is normal / too high / too low. 17 (74%) males and 27 (75%) females stated their body mass is normal. Four (17%) males and six (17%) females stated it is too high and two (9%) males and three (8%) females stated it is too low.

Exercise and screentime during the pandemic in 2020 and first quarter of 2021 compared to exercise and screentime before the pandemic: 25 (42%) pupils exercised the same and 19 (32%) exercised more. The minority of them exercised less, those were 15 (25%). However, there were 42 (71%) pupils who answered they have had more screentime during the pandemic. 16 (27%) pupils have had the same screentime and one (2%) has had less.

Table 2: Answers to some other questions (n).

Question	Daily	3-5 times per week	Once per week	1-3 times per month	Never
How often do you eat breakfast?	22	13	8	3	13
How often do you eat dairy products (milk, yoghurt, cottage cheese, kefir)?	21	26	4	7	1
How often do you help to prepare meals?	12	20	17	5	4
How often do you use fats, such as butter, whipping cream, sour cream or pork fat for preparing your meals?	4	26	17	10	2

Question	Daily	3-5 times per week	Once per week	1-3 times per month	Never
How often do you add salt in your meals (soup, sauce, potatoes)?	11	12	17	6	13
How often do you eat fried food?	0	10	21	27	0
How often do you eat eggs?	4	18	27	8	2
How often do you eat fast food?	0	2	14	35	7
How often do you eat snacks, such as flips, chips, crackers, pretzel sticks or salted peanuts?	1	18	27	12	1
How often do you eat sweets or desserts?	3	19	27	7	3
How often do you eat nuts (hazelnuts, almonds, peanuts, walnuts)?	3	11	20	19	6
How often do you eat processed meat foods, such as pate, hot-dogs or meat cheese?	3	8	28	17	2
How often do you eat legumes, such as peas, beans or chickpeas?	0	9	17	19	14
How often do you eat toast instead of bread?	4	10	24	18	3

Lecture

We had given a short lecture in all three 7th grade classes. We included basic information on topics of: guidelines for balanced nutrition; macronutrients; the food pyramid; how to build a balanced and healthy plate; importance of having breakfast every day; healthy food preparation methods; limited usage of salt. A lecture lasted for 30–35 minutes. After the lecture we carried out a short quiz to evaluate their knowledge on guidelines for balanced nutrition, we prepared earlier on Kahoot platform. Since not all of the pupils had owned a smartphone, we had a group discussion about the questions on Kahoot. The majority of questions were referring to our lecture. They mostly answered the questions correctly, however they did not express their opinions often to build a discussion. The most pupils expressed their opinion on the issue of ‘*What is in the lowest layer of the nutrition pyramid scheme?*’ as we have presented the new nutrition pyramid scheme, which they have not met yet.

Discussion

The project Traditional slovenian breakfast is educating pupils about the advantages of locally produced food. Local food is more mature and ripe at time of harvesting, thus it is more rich in micronutrients and has a higher nutrition-

al value. Flavour of fruits, vegetables and other foods is more rich, traditional (Ministrstvo za kmetijstvo, gozdarstvo in prehrano, 2018).

Anthocyanins are a subgroup of flavonoids and can be found in berries, aronia and grapes (Tsuda, 2011; Ramos, 2014). Some researches on animals imply they may have a role in obesity management (Tsuda, 2011); adipose cells function improvement; improved metabolism of triacylglycerides; and they might reduce the risk of developing metabolic syndrome and obesity (Ramos, 2014). Researches on humans have alighted the role of anthocyanins in management of type 2 diabetes and in prevention of cardiovascular diseases (Tsuda, 2011; Ramos, 2014).

It has been proven that vitamin C has antioxidative properties, however taking vitamin C in dietary supplements does not lower risk for diseases, such as stroke or cancer. However, it has shown beneficial effects in women who were pregnant and smoking, they had lower risk for an early birth (Higdon, Drake, Angelo and Delage, 2018). Less ripe fruits contain more acids, including vitamin C, their content decreases with ripening (Mikulič-Petkovšek, Koron, Zorenc and Veberič, 2017). Vitamin C is important in a process of restoring other antioxidants, such as vitamin E. It protects leukocytes from being damaged by oxidation. Recommended daily allowance differs among different age groups. For children it is lower, for adults higher (Higdon, Drake, Angelo, et al., 2018).

The most energy consumed with berries comes from sugars, both glucose and fructose (Burton-Freeman, Sandhu and Edirisinghe, 2016), thus consumption of fruits (150–250g per day) should be lower than of vegetables (250–400g per day) (Hlastan Ribič, 2009).

Conclusions

Traditional slovenian breakfast is suitable for pupils in both macronutrient composition and energy intake. Eventhough it exceeds the guidelines for energy intake with snack (16% instead of 10–15%), we concluded pupils need energy for concentration during classes and physical education. For the same reasons we support breakfast being more abundant in carbohydrates and poor in fats as the guidelines instruct. Lower content of fats is beneficial from the view of type of fatty acids, since it contains mostly saturated fatty acids from butter and milk. We propose substitution of part of butter with walnuts, thus children would consume unsaturated fatty acids as well. We would like to emphasize it is also important that pupils receive detailed instructions how much of each food they can consume, e.g. one tea spoon of honey.

The two projects are very different, but we found a connection. The connection is local food production. Looking from this perspective, those projects complement each other. The project Traditional slovenian breakfast is educating pupils why local food production is more environment friendly and why locally produced food has higher nutritional value, among other topics. Project 2°

Green roof allows the pupils to actually take care of plants grown on the green roof, thus in a way they are producing local food as well.

Thus we conducted, both projects carry a great potential in educating pupils and improving their eating habits, if there are certain additions made to them. Examples are our lecture we gave in three classes and a quiz. We suggest upgrading the projects with more interactive contents, such as different didactic games, lectures, quizzes and other different didactic methods, thus pupils would be more effectively presented the purpose of balanced nutrition. School and local producers or farmers could cooperate and organize workshops together. Workshops could be held on school's green roof, where pupils could also meet the local producers or farmers and learn more about their work and food. Thus pupils could learn more about different crops and foods they might not have met with yet. Questionnaire results show pupils' eating habits are not suitable, hence we inferred their knowledge on nutrition is insufficient. Interactive contents would help them recognize new healthier methods of food preparation, more knowledge on building a healthy balanced plate and understanding the importance of drinking water instead of juice or soda, importance of reducing salt in the diet and importance of eating fruit and vegetables. Implementing such projects might be beneficial for their knowledge. By upgrading the projects, additional information would be provided and changes in eating habits would be encouraged.

References

- BURTON-FREEMAN, B. M., SANDHU, A. K. and EDIRISINGHE, I., 2016. Red raspberries and their bioactive polyphenols: cardiometabolic and neuronal health links [online]. *Advances in nutrition*, vol.7, no. 1, pp. 44–65. [viewed 6 May 2021]. Available from: <http://dx.doi.org/10.3945/an.115.009639>
- EKO SKLAD, 2020. *Zelena streha na OŠ Staneta Žagarja v Kranju* [online]. [viewed 27 May 2021]. Available from: <https://www.ekosklad.si/nev-ladne-organizacije/novica/zelena-streha-na-o-staneta-agarja-v-kranju>
- GABRIJELČIČ, M., POGRAJC, L., GREGORIČ, M., ADAMIČ, M. and ČAMPA, A., 2005. *Smernice zdravega prehranjevanja v vzgojno-izobraževalnih ustanovah (od prvega leta dalje)* [online]. Ljubljana: Ministrstvo za zdravje, 80. [viewed 6 May 2021]. Available from: http://solskilonec.si/wp-content/uploads/2014/10/Smernice_zdrave_prehrane_MZ-2005-1.pdf
- HIGDON, J., DRAKE, V. J., ANGELO, G. and DELAGE, B., 2018. *Vitamin C* [online]. [viewed 6 May 2021]. Available from: <https://lpi.oregonstate.edu/mic/vitamins/vitamin-C>
- HLASTAN RIBIČ, C., 2009. *Zdrav krožnik: priporočila za zdravo prehranjevanje* [online]. Ljubljana: Inštitut za varovanje zdravja. [viewed 10 June 2021]. Available from: http://cindi-slovenija.net/images/stories/trgovina/zlozenke/Cindi_ZdravKroznik_preview.pdf

- KANDUS, B. and SKUBIC, V., 2020. *Zelene strehe v Kranju – pregled potenciala za ozelenitev ravnih streh v Mestni občini Kranj in predlogi za ozelenitev 12-ih objektov*. Ljubljana: prostoRož, 87.
- MIKULIČ-PETKOVŠEK, M., KORON, D., ZORENC, Z. and VEBERIČ, R., 2017. Do optimally ripe blackberries contain the highest levels of metabolites [online]? *Food chemistry*, vol. 215, pp. 41–49. [viewed 22 May 2021]. Available from: <http://dx.doi.org/10.1016/j.foodchem.2016.07.144>
- MINISTRSTVO ZA KMETIJSTVO, GOZDARSTVO IN PREHRANO (MKGP), 2018. *Dan slovenske hrane in tradicionalni slovenski zajtrk* [online]. [viewed 29 April 2021]. Available from: <https://www.nasasuperhrana.si/clanek/dan-slovenske-hrane-in-tradicionalni-slovenski-zajtrk-2/>
- NACIONALNI INŠTITUT ZA JAVNO ZDRAVJE (NIJZ), 2020. *Referenčne vrednosti za energijski vnos ter vnos hranil* [online]. [viewed 30 April 2021]. Available from: https://www.nijz.si/sites/www.nijz.si/files/uploaded/referencne_vrednosti_2020_3_2.pdf
- ODPRTA PLATFORMA ZA KLINIČNO PREHRANO (OPKP), 2021. [computer program]. [viewed 29 April 2021]. Available from: <https://www.opkp.si/>
- Pravilnik o izvajanju projekta Tradicionalni slovenski zajtrk*, 2020. Official gazette of the Republic of Slovenia [online], no. 128/2020, 2287. article. [viewed 10 May 2021]. Available from: [https://www.uradni-list.si/glasilo-uradni-list-rs/vsebina/2020-01-2287/pravilnik-o-izvajanju-projekta-tradicionalni-slovenski-zajtrk/#\(vsebina\)](https://www.uradni-list.si/glasilo-uradni-list-rs/vsebina/2020-01-2287/pravilnik-o-izvajanju-projekta-tradicionalni-slovenski-zajtrk/#(vsebina))
- PREHRANA.SI, b. d.c. *Med* [online]. [viewed 30 April 2021]. Available from: <https://prehrana.si/zivila/druga-zivila/med>
- PREHRANA.SI, b. d.d. *Mleko in mlečni izdelki* [online]. [viewed 30 April 2021]. Available from: <https://prehrana.si/zivila/mleko-in-mlecni-izdelki>
- PREHRANA.SI., b. d.e. *Polnozrnata žita* [online]. [viewed 30 April 2021]. Available from: <https://www.prehrana.si/clanek/408-polnozrnata-zita>
- RAMOS, P., HERRERA, R. and MOYA-LEON, M. A., 2014. Handbook of anthocyanins. In: WARNER, L. M., ur. *Anthocyanins: food sources and benefits to consumer's health* [online]. New York: Nova Science publishers Inc. [viewed 20 May 2021]. Available from: https://www.researchgate.net/publication/270571083_Handbook_of_Anthocyanins_Anthocyanins_Food_sources_and_benefits_to_consumers_health
- TSUDA, T., 2011. Dietary anthocyanin-rich plants: biochemical basis and recent progress in health benefits studies [online]. *Molecular nutrition and food research*, vol. 56, no. 1, pp. 159–170. [viewed 19 May 2021]. <http://dx.doi.org/10.1002/mnfr.201100526>

Growing up in a family with alcohol addiction and the importance of strengthening protective factors to maintain the health of a child

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Abstract

Despite its mass presence in Slovenian culture, alcohol addiction is still a gray area of research, as evidenced by how difficult it is to trace data on the prevalence of this disease. In addition to the already established measures to treat addiction in individuals, there is still a lack of awareness of the impact of special circumstances in which children of addicted parents grow up and in the treatment and support of relatives from such families. Alcohol addiction not only affects the occurrence of many harmful consequences for the individual who drinks, but also for all members of his family, especially children. The chaotic and unstable family environment, characterized by alcohol addiction, represents a wide range of risk factors for the child's psychosocial and physical well-being. The presence of addiction in the family and thus the special circumstances of growing up poses many challenges to the child, which require him to develop various mechanisms of survival and often neglect to meet their own needs at the expense of meeting the needs of the parents. An additional challenge for a child is the stigmatizing environment outside the family, which further limits the child's ability to experience a safe environment. These circumstances can affect many outcomes that pose a risk to a child's mental and physical health, such as depressive and anxiety states, externalizing and internalizing problems, interpersonal problems, risky behaviours, poor physical health, and so on. The purpose of this paper is to present in more detail the risk factors and possibilities of action to strengthen protective factors in various areas of work, which could reduce the negative health outcomes of children and adolescents coming from families with alcohol addiction. Approaching this need is possible by early psychosocial treatment of the child, raising awareness of the community about the problem of alcohol and raising awareness of children and adolescents about diseases such as addiction. It is also important to strengthen and promote sources

of assistance, such as providing a safe space for the child, by enabling support from the environment outside the family (school environment, NGOs, local community).

Keywords: alcohol addiction, children from families affected by alcohol addiction, psychosocial consequences, protective factors

Introduction

Alcohol addiction is a disease that causes an irresistible craving for alcohol, despite the fact that it harms both the individual and his loved ones. It makes it hard for an individual to function on a daily basis and fulfill various roles, such as the role of a partner, parent, employee, etc. (Perko, 2011). Addiction requires the attention of all family members, which makes it a family disease (Goeke, 2017). The consequences affect partners and children, which means that dealing with an individual's addiction makes it crucial to also deal with all close relatives involved. Children are the ones who are often overlooked in this regard. There is a lack of knowledge in fields where working with children from such families is required and, at the same time, accessible sources of help. In addition, the cloud of stigma that overshadows such families makes it harder for relatives to seek help or support in case of exposure to alcohol addiction (Black, 1992; Haverfield and Theiss, 2015). Children from such families are faced with the difficulties of dealing with special circumstances and everyday stress, which poses a serious threat to the children's mental and physical health.

Risk and protective factors

Circumstances of growing up in a family affected by alcohol addiction

Alcoholism dictates special circumstances that require adaptive functioning in the family. Each member assumes a role that is necessary for the psychological survival of the family dynamic and, simultaneously, for their own survival. The atmosphere in such families is extremely chaotic, unpredictable, and inconsistent (Nodar, 2012). All the members are on the lookout for whether the parent will come home drunk, and whether an argument or a fight will follow. Children are constantly exposed to stressors and deprived of a sense of security, which is the basis of the normative development (Poljšak Škraban, 2007; Huse song et al., 2008). Violence is also often present, as both addiction and the influence of alcohol reduce the ability to control aggressive impulses (Hall, 1994; Zuckerman, 2005; Kordič, 2007). In a small study conducted in Slovenia, two out of three adult children from families affected by alcohol addiction reported the presence of violence at home (Henigsmann, 2015).

Compared to an optimal family dynamic, communication within alcohol-affected families differs significantly. If the optimal environment is usually characterized by consistent, clear, specific, and constructively-oriented com-

munication, families affected by alcohol addiction are usually characterized by the exact opposite, namely, unclear, inconsistent, and often deficient communication, which is often negative, offensive, and lacks the expression of warmth and sensibility (Sheridan and Green, 1993; Johnson and Stone, 2009).

A non-alcoholic parent is usually so occupied with their partner's alcohol addiction that they are unable to consistently meet or respond to their child's needs (Haverfield and Theiss, 2014). Therefore, these children are often left to fend for themselves, for which they develop various strategies, including defense mechanisms such as denial and repression (Black, 1992). In these families, a common phenomenon called the parentification of the child occurs, which means that a child takes care of the alcoholic parent, instead of the adult being the one meeting their child's basic needs (Pasternak and Schier, 2012).

Black (1992) defines two basic rules that are usually formed in families affected by alcohol addiction: "don't trust" and "don't tell". When the child in the family is not raised in a safe environment and lacks a secure attachment to their parents, they consequently also have difficulties trusting other adults. Alcohol addiction at home is kept as a family secret, which is often a result of the stigma present outside the family unit (Haverfield and Theiss, 2015).

Stigma

The presence of stigmatization of alcohol addiction plays an important role in experiencing and dealing with the circumstances of addiction in the family. Despite the fact that drinking alcohol is socially acceptable in Slovenia, it is also common that an individual who becomes addicted to alcohol is suddenly pushed to the edge of society. Some research has shown that most people believe that the person who becomes addicted has only themselves to blame for their problems, since addiction is often attributed to character traits. As a result, addicted individuals are more often socially distanced than those with other mental illnesses (Haverfield and Theiss, 2015).

The stigma influences not only the individual who is addicted, but also their family members (WHO, 2014 in: Haverfield and Theiss, 2015). The fact that members avoid talking about addiction within the family strengthens stigmatization. This makes the topic a taboo, which further encourages children to keep family alcoholism a secret. The more severe the form of alcoholism, the greater the need to hide everything that happens at home (Haverfield and Theiss, 2015). At the same time, children often experience feelings of shame, guilt, anger, and loneliness, which, due to the stigma, keeps them from sharing their situation with others (Black, 1992; Pasternak and Schier, 2012). This contributes to more negative outcomes of growing up in family affected by alcohol addiction.

Psychosocial and health consequences of growing up in family affected by alcohol addiction

Children from families affected by alcohol addiction form a very heterogeneous group. The outcomes of growing up in such families differ from one another, just like the families and personal characteristics are also different. What they do have in common is that these children grow up in circumstances that prematurely put them in survival mode, so they can cope with challenges of their parents' addiction (Goeke, 2017). This can have a negative impact on various levels of performance. Research has shown that these children more often show signs of internalization and excessive inhibition or, on the other hand, problems of externalization and excessive rebellion (Omkarappa and Rentala, 2019; Redlin and Borchardt, 2019). As they grow older, the outcomes are shown to become more complex and more diverse. Children of alcoholics are more likely to experience periods of depression and anxiety, problems with alcohol and other drugs, and abusive relationships (Goeke, 2017; Omkarappa and Rentala, 2019). Because they are often victims of cumulative trauma, they can also develop post-traumatic stress syndrome or complex post-traumatic stress disorder (Harter and Vanecek, 2000; Rzeszutek et al., 2021).

Insecure attachment to a parent during childhood, usually more common in families affected by alcohol addiction, is reflected in a pronounced fear of rejection or abandonment (Henigsmann, 2015). In a chaotic environment, in which anything can happen, they do not have optimal opportunities for the adequate development of a healthy self-image, which is later evident in their difficulties in establishing and maintaining interpersonal relationships (Firestone and Firestone, 2005). Additional problems in relationships are reflected by marked mistrust and fear of relationships (Kerig, 2003; Henigsmann, 2015). When violence is also present, there is a greater likelihood that children from these families will experience fear of relationships, along with more severe depressive and anxious feelings when actually in a relationship. (Kerig, 2003).

In addition to psychosocial consequences, medical ones can also occur. Children and adolescents who have experienced cumulative stress and trauma are more likely to suffer from autoimmune diseases, ischemic heart disease, and various inflammatory diseases (Dube et al., 2009). Some research has shown that growing up in a family affected by alcohol addiction affects a greater possibility of developing hypertension, diabetes, insomnia, gastrointestinal diseases, cancer, and other diseases (Goeke, 2017). Risky behaviors related to health (smoking, drinking alcohol, illegal drugs, higher body weight index, and little physical activity) are more common among children of alcoholics (Serec et al., 2012; Fuller-Thomson et al., 2013).

On the other hand, research also reports on the possibility that children come out of these circumstances resilient, which means that they develop more appropriate coping mechanisms for dealing with everyday stressors (Park and Schepp, 2015). In this case, even if they are growing up in a destructive environment, these children know how to draw positives from it. Walker and Lee (1998) claim that those who are more socially competent and mature have more chances to become resilient.

Protective factors and encouragement of resilience

Protective factors are an important counterbalance to the risk factors faced by children from families affected by alcohol addiction. The main goal of reducing the probability of negative outcomes is to strengthen intrapersonal and interpersonal (family, community) protective factors that affect children. These factors can reduce the power of risks that are sometimes unavoidable for these children (Goeke, 2017).

Working on protective factors also strengthens resilience, which is known as something that enables the regulation of the negative effects of stress. It also holds the ability to achieve positive outcomes despite living in a harmful environment, especially by reducing threats regarding mental and physical health (Park and Schepp, 2015; Redlin and Borchardt, 2019). A resilient individual will also handle potential discrimination, shame and condemnation better, and at the same time, will be able to take on the responsibility that the parent is unable to (Redlin and Borchardt, 2019).

There are many possible protective factors. Having a secure and stable home provided by the non-alcoholic parent, despite parental alcoholism, is one of them. Regardless of the chaotic circumstances, the non-alcoholic parent manages to consistently meet the child's needs and maintain a balance within the family (Hussong et al., 2008; Goeke, 2017). Siblings also play a very important role, where a healthy relationship and support make it easier for a child to withstand the conditions at home (Edenber and Foroud, 2013; Goeke, 2017). Engagement in a quality relationship with an adult, such as a teacher, counselor, grandparent, uncle/aunt, neighbor, etc., outside the primary family also provides an effective contribution. (Larson and Thayne, 1998). The child seeking help and confiding in someone, thus realizing that they are not alone, is also an important protective indicator (Haverfield and Theiss, 2014; Goeke, 2017). An important role is also held by all the other positive relationships and experiences that the child acquires outside the family, which can be encouraged with extracurricular activities (sports, creativity, scouting) that offer children a retreat and an extra purpose in life (Larson and Thayne, 1998; Goeke, 2017).

A person's individual development is often shaped by interactions they have in their environment (Bronfenbrenner, 1989 v: Rodgers, 2009). The local community also plays an important role in strengthening the protective factors by representing the child's close environment outside the family unit; that includes the neighborhood, schools, primary health center, or more generally important people with whom the child comes into contact on a daily basis. This environment also has the power to both strengthen and weaken the effects of the stigma of parental alcohol addiction. The discussion and internalization of knowledge about alcohol addiction as a disease, which expands to the wider local community (school, primary health service, social service, non-governmental organizations), is therefore a very important step towards the stigma losing its power and towards a community in which children can feel more

accepted. An important factor are also the sources of help that let a child know that a safe environment is available when they need it.

Sources of help

In Slovenia, there are relatively few programs dedicated to the treatment of children from families affected by alcohol addiction. They are mostly based in the Central Slovenia region, which makes them less approachable for children who live in other parts of Slovenia. General support is available in different regions from Al-Anon, which is intended for close relatives of a person who has alcohol addiction, and Ala-Teen, which is intended for teenagers from families affected by alcohol addiction (Društvo Al-Anon, n.d.). Few NGOs also offer support to all family members who are recovering from their parents' or partners' addiction.

Knowledge about the disease is one of the key factors of understanding what is happening in a family affected by alcohol addiction and a step toward a more constructive way of coping with parental alcohol addiction. It is crucial for children from such families to get as much information as they can about alcohol addiction. Information is available at the Slovenian Association for Helping Children of Alcoholics, which is a part of the international NACOA network (NACOA Slovenija, n.d.). Information about addiction and its impact on children is also a welcome contribution for workers in different work fields, such as primary health, social service, and education, which often encounter children from affected families. Knowing the specifics about a child's environment helps them take the so-called "person-in environment" approach (Goeke, 2017).

Due to the frequent experience of stigma, anonymity is often more important for children seeking support, which is why the various online or telephone counseling services that provide this also fare better (Haverfield and Theiss, 2014). In Slovenia, they have online counseling services, such as 'To Sem jaz', and a telephone for children and adolescents - the 'TOM telephone', which is intended for children in need of emotional or informational support.

Conclusions

Children from families affected by alcohol addiction are daily exposed to the insecure, inconsistent environment, stressors, and harmful factors that threaten their health. However, there is a fine line between their vulnerability and resilience. This line is largely determined by the power ratio between risk factors and protective factors. Although these children cannot avoid certain risk factors, strengthening protective factors can reduce the possibility of negative outcomes.

The environment outside the family also plays an important role in establishing a supportive environment for children who deal with unstable family circumstances. The ecological systems that come into daily contact with

these children (educational, primary health, social services) are the ones that must be equipped with knowledge about the problem of alcohol addiction, carry the recognition of it as a mental disease, and be aware of the specific circumstances in which children from such families grow up in. Additional awareness that children from families affected by alcohol addiction form a heterogeneous group and that there is a need of an individual approach is most welcome. In this case, the “person-in-environment” approach is encouraged, which puts the understanding of the person in a wider context of their environment and the influences that has on them. People working in the field of primary health, social services, and education should have enough information about the sources of help for children from families affected by alcohol addiction, to which these children can turn to when in need for specific support.

Support for these children can be provided by any individual, who is able to support one or more family members from these families, in various ways (emotional, informational, instrumental support). A good start would be helping reduce the stigma around alcohol addiction or even becoming a positive influence by providing consistent and reliable relationships for children from affected families.

References

- BLACK, C., 1992. Effects of family alcoholism. In: Saitoh, S., Steinglassm, P. and Schuckit, M.A., ed. *Alcoholism and the Family*. New York: Brunner/Mazel.
- Društvo Al-anon*, n.d. *Družinske skupine Al-Anon in Alateen* [online]. [viewed 16 June 2022]. Available from: <https://www.al-anon.si/>
- DUBE, S.R., FAIRWEATHER, D., PEARSON, W.S., FELITTI, V.J., ANDA, R.F. and CROFT, J.B., 2009. Cumulative childhood stress and autoimmune diseases in adults [online]. *Psychosom Med*, vol. 71, no. 2, pp. 243–50. [viewed 8 July 2022]. Available from: <http://dx.doi.org/10.1097/PSY.0b013e3181907888>
- EDENBER, H.J., and FOROUD, T., 2013. Genetics and alcoholism. *Nature Reviews Gastroenterology & Hepatology*, vol. 10, no. 8, pp. 487–494.
- FIRESTONE, R.W., FIRESTONE, L.A. and CATLETT, J., 2005. *Sex and Love in intimate relationships*. Washington: American Psychological Association.
- FULLER-THOMSON, E., KATZ, B.R., PHAN, V.T., LIDDYCOAT, J. P. M. and BRENNENSTUHL S., 2013. The long arm of parental addictions: the association with adult children’s depression in a population-based study [online]. *Psychiatry Res.*, vol. 210, no. 1, pp. 95–101. [viewed 8 July 2022]. Available from: <http://dx.doi.org/10.1016/j.psychres.2013.02.024>
- GOEKE, J., 2017. *Identifying Protective Factors for Adult Children of Alcoholics* [online]. [viewed 27 June 2022]. Available from: https://sophia.stkate.edu/msw_papers/748

- HALL, C.W., BOLEN, L.M. and WEBSTER, R.E., 1994. Adjustment Issues With Adult Children of Alcoholics. *Journal of Clinical Psychology*, vol. 50, no. 5, pp. 786–792.
- HARTER, S.L. and VANECEK, R.J., 2000. Cognitive assumptions and long-term distress in survivors of childhood abuse, parental alcoholism, and dysfunctional family environments. *Cognitive Therapy & Research*, vol. 24, no. 4, pp. 445–472.
- HAVERFIELD, M.C. and THEISS, J.A., 2014. A theme analysis of experiences reported by adult children of alcoholics in online support forums. *Journal of Family Studies*, vol. 20, no. 2, pp. 166–184.
- HAVERFIELD, M.C. and THEISS, J.A., 2015. Parent's alcoholism severity and family topic avoidance about alcohol as predictors of perceived stigma among adult children of alcoholics: Implications for emotional and psychological resilience [online]. *Health Communication*, vol. 31, no. 5, pp. 606–616. [viewed 10 July 2022]. Available from: <http://dx.doi.org/10.1080/10410236.2014.981665>
- HENIGSMAN, K., 2015. *Partnerski odnosi v družinah z alkoholizmom*: master's thesis. Ljubljana: University of Ljubljana, Faculty of Arts, Department of psychology.
- HUSSONG, A.M., BAUER, D.J., HUANG, W., CHASSIN, L., SHER, K.J. and ZUCKER, R.A., 2008. Characterizing the Life Stressors of Children of Alcoholic Parents, *Journal of Family Psychology*, vol. 22, no. 6, pp. 819–832.
- JOHNSON, P. and STONE, R., 2009. Parental Alcoholism and Family Functioning: Effects on Differentiation Levels of Young Adults. *Alcoholism Treatment Quarterly*, vol. 27, no. 1, pp. 3–18.
- KERIG, P.K., 2003. In Search of Protective Processes for Children Exposed to Interparental Violence. *Journal of Emotional Abuse*, vol. 3, no. 3/4, pp. 149–181.
- KORDIČ, B., 2007. Etiologija, dinamika in posledice nasilja v družini. *Socialna pedagogika*, vol. 11, no. 4, pp. 429–452.
- LARSON, J.H. and THAYNE, T.R., 1998. Marital Attitudes and Personal Readiness for Marriage of Young Adult Children of Alcoholics. *Alcoholism Treatment Quarterly*, vol. 16, no. 4, pp. 59–73.
- NACOA Slovenija, n.d. *O nas* [online]. [viewed 16 June 2022]. Available from: <https://nacoa.si/>
- NODAR, M., 2012. Chaotic Environments and Adult Children of Alcoholics. *The professional Counselor*, vol. 2, no. 1, pp. 43–47.
- OMKARAPPA, D.B. and RENTALA, S., 2019. Anxiety, depression, self-esteem among children of alcoholic and nonalcoholic parents. *Journal of Family Medicine and Primary Care*, vol. 8, no. 2, pp. 604–609.

- PARK, S. and SCHEPP, K.G., 2015. A Systematic review of research on children of alcoholics: Their inherent resilience and vulnerability. *Journal of Child & Family Studies*, vol. 24, no. 5, pp. 1222–1231.
- PASTERNAK, A. and SCHIER, K., 2012. The role reversal in the families of Adult Children of Alcoholics. *Psychiatry and Psychotherapy*, vol. 3, pp. 51–57.
- PERKO, A., 2011. *Otroci alkoholikov in tiranov*. Ljubljana: Buča in Zavod Mitikas.
- POLJŠAK ŠKRABAN, O., 2007. Pojmovanja “normalnosti” procesov v družini; funkcionalnost in kompetentnost družinskega sistema, *Socialna pedagogika*, vol. 11, no. 2, pp. 189–212.
- REDLIN, S. and BORCHARDT, J., 2019. A comparison of resiliency in adult children of alcoholics versus adult children of non-alcoholics [online]. *Modern Psychological Studies*, vol. 24, no. 1, article 9. [viewed 19 June 2022]. Available from: <https://scholar.utc.edu/mps/vol24/iss1/9>
- RODGERS, B.E., 2009. *An Ecological Approach to Understanding the Stigma Associated with Receiving Mental Health Services: The Role of Social Proximity*: doctoral thesis [online]. Virginia: Faculty of Virginia Polytechnic Institute and State University. [viewed 18 July 2022]. Available from: <https://vtechworks.lib.vt.edu/handle/10919/29982>
- RZESZUTEK, M., LIS-TURLEJSKA, M., PIĘTA, M., VAN HOY, A., ZAWISTOWSKA, M., DRABAREK, K., KOZŁOWSKA, W., SZYSZKA, M., and FRĄC, D., 2021. Profiles of Posttraumatic Stress Disorder (PTSD), Complex Posttraumatic Stress Disorder (CPTSD), and Subjective Well-Being in a Sample of Adult Children of Alcoholics [online]. *Psychological Trauma: Theory, Research, Practice, and Policy*. [viewed 22 June 2022]. Available from: <http://dx.doi.org/10.1037/tra0001211>
- SEREC, M., ŠVAB, I., KOLŠEK, M., ŠVAB, V., MOESGEN, D. and KLEIN, M., 2012. Health-related lifestyle, physical and mental health in children of alcoholic parents [online]. *Drug and alcohol review*, vol. 31, no. 7, pp. 861–870. [viewed 4 July 2022]. Available from: <https://doi.org/10.1111/j.1465-3362.2012.00424.x>
- SHERIDAN, M. J. and GREEN, R. G., 1993. Family Dynamics and Individual Characteristics of Adult Children of Alcoholics. *Journal of Social Service Research*, vol. 17, no. 1-2, pp. 73–97.
- WALKER, J.P. and LEE, R. E., 1998. Uncovering strengths of children of alcoholic parents. *Contemporary Family Therapy*, vol. 20, pp. 521–538.
- ZUCKERMAN, M., 2005. *Psychobiology of Personality*. New York: Cambridge University Press.

Movement and hardware content selection for exergame development

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Abstract

Introduction: A trend of spending leisure time in front of various screens is widespread among children and adolescents. Prolonged sitting, low level of local muscular endurance, and playing video games are some of the risk factors for low back pain among children and adolescents. In order to motivate children to be regularly active, exercise video games (exergames) have appeared on the market. The aim of this paper is to review the literature on movement content to increase spine stability and hardware options for effective motion tracking. In order to determine the game content more accurately, the second aim was to evaluate the correlation between maximum trunk strength (in the lateral and frontal planes) and the performance of the lumbar stability test. *Methods:* We focused on Pubmed database, where we searched for articles published since 2010. The correlation study included 9 subjects (age $20,4 \pm 6,1$, height $178,8 \pm 6,1$ cm, weight $70,8 \pm 13,5$ kg) who were physically active 3 times per week. We used Spearman coefficient for correlation analysis. *Results:* 40 articles were included in the analysis. Maximal trunk strength in sagittal and frontal planes did not significantly correlate with total CoP area ($r < 0,10$, $p > 0,79$). In general, researchers agreed that a successful preventive-curative approach to manage low back pain consists of several phases. In reviewing the hardware, the researchers stressed the importance of motion tracking with marker-less sensors, as their validity in performing simple movements is comparable to the gold standard.

Key words: physical activity, exergames, sedentary behaviour, low back pain, children

Introduction

A sedentary lifestyle and physical inactivity are well-known trends in developed countries. In 2011, a study including nearly 300,000 participants from 76 different countries showed that 1 out of 5 people did not meet the minimum level of physical activity (Dumith et al., 2011). Just four years later, in 2015, the World Health Organisation revealed that about one third of the world's population aged 15 years or less did not meet the minimum requirements of 1 hour of moderate to high intensity physical activity per day (WHO, 2020). The SARS-CoV-2 virus, responsible for COVID-19 disease, spread worldwide in 2020, causing a global pandemic. The population that has been particularly affected by the pandemic are children and adolescents. Reduction in physical activity during the pandemic could have adverse effects, as regular physical activity prevents the occurrence of several diseases such as obesity, cardiovascular disease and lower back pain (LBP) (Rubin, 2007).

LBP is a global health problem experienced by 50-80% of adults (Rubin, 2007). In approximately 20% of the population, pain develops into chronic LBP (Maher, etc., 2017). Unfortunately, LBP often starts in childhood and the prevalence in adolescents is similar to that in adults (Leboeuf-Yde and Kyvik, 1998). The trunk plays an important role in both elite sport and everyday life. The effectiveness of multi-joint movements depends on the efficiency of force transfer between the body segments. Kicking, throwing and lifting are examples of multi-joint movements in which an adequate level of stability of the spine is essential for the transfer of energy from the trunk to the arms or legs. Stability is the ability to control the joint position and depends on the effective interaction of the passive, active and nervous system (Panjabi, 1992). Exercise is an important factor in maintaining a healthy lifestyle and is important for treating several diseases, including LBP (Hurley et al., 2011). Several studies have shown improved muscle strength, local endurance and patterns of muscle activation after exercise intervention (Magnusson et al., 1996; Pedersen et al., 2004; Kocjan and Sarabon, 2020). For the treatment of LBP, exercise has been shown to be more effective than non-exercise-based interventions (Searle et al., 2015). Due to multifactorial nature of LBP the training content should include exercises that improve coordination, aerobic capacity, strength and local endurance (Owen et al., 2020; Gordon and Bloxham, 2016).

Video games with moving content (exergames) represent one way to improve movement activity among children and adolescents. Studies have shown the impact of playing such games on psychological abilities, physical activity in overweight people (Höchsmann et al., 2016; Andrade and Correia, 2019) and balance performance in older adults (Fang et al., 2020). Exergame systems such as Xbox and Kinect are becoming increasingly popular where a new type of entertainment could promote physical activity (Sween et al., 2014).

The aim of this paper is to review scientific literature on the field of motion tracking technology and exercise protocols to reduce the risk of LBP. The

second aim is to evaluate the relationship between maximum trunk strength and the performance of the stability test.

Methods

Subjects: The literature review included subjects between 10 and 65 years of age. The relationship study involved 9 subjects (20.4 ± 6.1 years, 178.8 ± 6.1 centimeters, 70.8 ± 13.5 kilograms). Subjects with LBP and/or musculoskeletal disorders were excluded from the study. Before the study all subjects signed the informed consent.

Article selection process: The review was carried out in the PubMed database. We focused on articles published since 2010. The search key relating to the hardware contained the following keywords: (“*motion*” OR “*movement*” OR “*exercise*”) AND (“*capture*” OR “*video analysis*” OR “*tracking*”) AND (“*system*” OR “*technology*”). The search key related to movement therapy contained the following keywords: (“*low back pain*”) AND (“*exercise*” OR “*training*” OR “*kinesiotherapy*”) AND (“*program*” OR “*intervention*”).

Trunk strength and stability assessment: Postural control was evaluated with unstable sitting test, where we measured the center of pressure (CoP) area. Participants sat on an unstable hemi-sphere (radius = 22 cm; height = 18 cm) with arms crossed over their chest and their feet rested on a surface that was a part of the hemi-sphere. The hemi-sphere was placed on the force plate (Kistler, 9286B, Switzerland). Subjects performed 3 repetitions of 30 seconds with an intermediate 30 second break.

Maximal trunk strength was measured with multi-functional dynamometer (S2P d.o.o., Ljubljana, Slovenia). Each subject performed 3 maximal isometric contractions in direction of trunk extension and lateral flexion to the right.

Statistical analysis: Maximal force was evaluated as the peak value within one second time interval. An average of three repetitions was included into the further statistical analysis. The normality of the data distribution was verified with Shapiro–Wilk tests. Spearman coefficient was used to analyse the correlation between the variables. The level of statistical significance was set to $p < 0.05$. Statistical analyses were done in SPSS (SPSS statistics 19, IBM, New York, USA).

Results

The final review included 15 (hardware) and 25 (movement therapy) articles (Figure 1). Overall, the researchers agree that a successful LBP program consists of several phases (McGill, 2007). It seems that local muscle endurance plays a key role in LBP prevention and is superior to maximal strength. Our study did not show a significant association between the maximal strength in sagittal plane, frontal plane (Figure 2) and the CoP area ($\rho = 0.100$; $p = 0.789$, $\rho = 0.033$; $p = 0.932$, respectively).

Regarding the motion tracking sensor, Microsoft Kinect V2 is an affordable, valid and reliable tool and it provides a solution which tracks gross body movements.

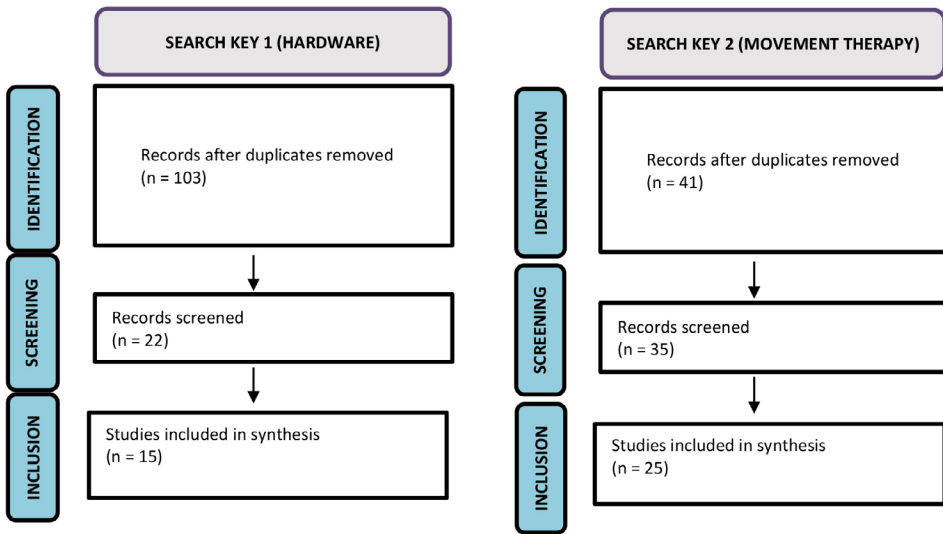


Figure 1: Diagram of selecting systematic reviews for the study

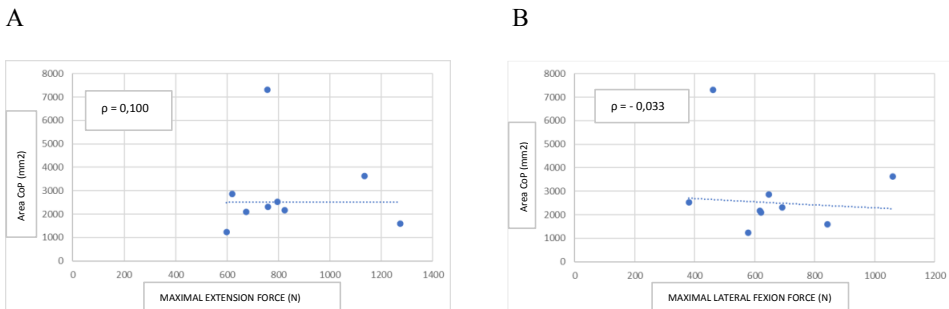


Figure 2: Relationship between trunk strength (sagittal plane (A), frontal plane (B)) and the center of pressure area during unstable sitting on a wobble board

Discussion

The literature review of managing LBP with movement therapy highlights the importance of a multi-stage approach, with education and the development of local muscle endurance at the forefront. Motion capture sensors without markers are an easy and affordable alternative to more expensive and complex systems.

The most important factor in the development of an exergame is the need to make the game attractive to players and at the same time effective as an exercise. The introductory part of the treatment program consists of a patient's education, where she/he learns functional anatomy (Figure 3), harmful movements, protective techniques during handling loads and relieving positions. In the second part, patients learn to perform movements in lumbar spine and in hip joint. The aim of the third part is to learn the mechanism for increasing spine stability. In the fourth part, patients improve key motor abilities that increase spine stability. The fifth part represents the integration of the earlier parts, with great emphasis on improving neuromuscular coordination in conditions of instability.



Figure 3: Animation of functional anatomy in the educational part of a novel exergame

All parts of the exercise program aim to improve the stability of the spine which is influenced by three systems. The most important role of the passive system is to limit the extreme ranges of motion. The sitting position usually increases lumbar spine flexion and stretches the passive tissues at the back of the vertebrae. Prolonged sitting caused by the pandemic is a risk factor for the de-

velopment of LBP (Gupta et al., 2015). In the education part of the exergame, we inform the patient of the correct sitting postures and load handling techniques.

Trunk movements cannot be performed without the presence of the active system. The stability is first provided by deep trunk muscles, while the superficial muscles are primarily engaged during large movements of the spine. Several studies have shown changes in muscle activation of trunk muscles in people with LBP compared to healthy subjects (Cholewicki et al., 2005; Carpes et al., 2008). There are little prospective studies regarding the effect of maximal trunk strength on the incidence of LBP and their findings are contradictory (Lee et al., 1999; Cho et al., 2014). Literature highlights that the maximum hip strength is superior to the maximum trunk strength for LBP prevention (Coyle et al., 2021; Alsufiany et al., 2020). Furthermore, decreased local endurance of trunk muscles and impaired trunk strength ratio in sagittal plane represents a risk factor for future LBP (Biering-Sorensen, 1984; Lee et al., 1999). The latter suggests that local muscle endurance has a significant impact on the spine health which is in line with recent studies (Pilz et al. 2020). In addition, the exergame content regarding the volume/intensity of trunk flexors and extensors should be well balanced. Isolated maximal trunk strength and endurance of trunk muscles (assessed by the Biering-Sorensen test) are not significantly correlated (Conway et al., 2016). The latter indicates the importance of pelvic muscles in controlling the pelvic position and consequently the lumbar region of the spine. In a novel exergame it will be important to include exercises to strengthen the entire kinetic chain and not just individual muscle groups. The third subsystem, the nervous system, controls muscle activity. In cases where perturbations affect the spine, the human body automatically ensures spine stability. Reflex postural adjustments are the reactions of trunk muscles, which are important to maintain the correct position of vertebrae during unexpected trunk loading (Santos et al., 2010; Cholewicki et al., 2005). Koch and Hansel (2019) found out significant difference between healthy participants and LBP patients in the CoP sway during upright standing in situations with higher postural demands. This indicates that exercises should be performed in conditions of instability.

In order to successfully carry out an exercise intervention by playing an exergame, it is essential that information received by the therapist/coach from the device is valid and reliable. The current gold standard for non-invasive motion capture is radiography, which measures bone movement via X-rays (Kessler et al., 2019). Systems that track human motion with markers placed on specific anatomical locations are the best approximation to the gold standard. Movement tracking based on markers is risky due to errors in the setting of markers, and their installation is time-consuming, which is an important obstacle in clinical or sporting environments (Gorton and Hebert 2009; Whittle, 1996). On the other hand, systems without markers such as Microsoft Kinect, Intel Realsense and StereoLabs Zed have been developed, which are supposed to accurately detect body segments during movement. Investigators performed

validation studies mainly in the field of walking and body posture, while fewer studies have assessed accuracy during more complex multi-joint movements (Ma et al., 2018). Although the time-spatial variables of motion capture systems without markers appear to be equivalent to systems with markers, the movement accuracy of some joints is not good enough (Wade et al., 2022). After we reviewed several possibilities, we decided to use Kinect V2 sensor to track movement in our exergame. The Kinect V2 proved to be a valid and reliable sensor for motion tracking in an exergame (Ma et al., 2018).

Our study has some limitations. Since the stability is influenced by several factors, the interpretation of results based on one test is questionable. In addition, the sample of subjects in the correlation study does not allow generalisation to the general population.

Conclusion

The COVID-19 pandemic and a sedentary lifestyle have caused a decrease in regular physical activity in children and adolescents, which increases the risk of LBP. Since children and adolescents spend several hours in front of various screens, a well-designed exergame represents a new motivational approach to regular physical activity. The content of a novel exergame should improve patients' education and local muscle endurance, and gross body movements should be tracked by a reliable markerless system (Microsoft Kinect V2).

References

- ALSUFIANI, M. B., LOHMAN, E. B., DAHER, N. S., GANG, G. R., SHALLAN, A. I. and JABER, H. M., 2020. Non-specific chronic low back pain and physical activity: A comparison of postural control and hip muscle isometric strength: A cross-sectional study. *Medicine*, 99(5).
- BIERING-SØRENSEN F., 1984. Physical measurements as risk indicators for low-back trouble over a oneyear period. *Spine (Phila Pa 1976)*, 9(2), 106–119.
- CARPES, F.P., REINEHR, F.B. and MOTA, C.B. 2008. Effects of a program for trunk strength and stability on pain, low back and pelvis kinematics, and body balance: a pilot study. *J Body Mov Ther*, 12(1), 22–30.
- CHO KH, BEOM JW, LEE TS, LIM JH, LEE TH and YUK JH, 2014. Trunk muscles strength as a risk factor for nonspecific low back pain: a pilot study. *Ann Rehabil Med*, 38(2), 234–240.
- CHOLEWICKI, J., SILFIES, S.P., SHAH, R.A., GREENE, H.S., REEVES, N.P., ALVI, K. and GOLDBERG, B. 2005. Delayed trunk muscle reflex responses increase the risk of low back injuries. *Spine (Phila Pa 1976)*, 30(23), 2614–2620.
- CONWAY R, BEHENNAH J, FISHER J, OSBORNE N and STEELE J, 2016. Associations between Trunk Extension Endurance and Isolated Lumbar

- Extension Strength in Both Asymptomatic Participants and Those with Chronic Low Back Pain. *Healthcare (Basel)*, 19(3), 70.
- COYLE, P. C., KNOX, P. J., POHLIG, R. T., PUGLIESE, J. M., SIONS, J. M. and HICKS, G. E., 2021. Hip Range of Motion and Strength Predict 12-Month Physical Function Outcomes in Older Adults With Chronic Low Back Pain: The Delaware Spine Studies. *ACR Open Rheumatology*, 3(12), 850–859.
- DUMITH, S. C., HALLAL, P. C., REIS, R. S. and KOHL, H. W., 2011. World-wide prevalence of physical inactivity and its association with human development index in 76 countries. *Preventive medicine*, 53(1-2), 24–28.
- FANG, Q., GHANOUNI, P., ANDERSON, S.E., TOUCHETT, H., SHIRLEY, R., FANG, F. and FANG, C., 2020. Effects of Exergaming on Balance of Healthy Older Adults: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Games Health J*, 9(1), 11–23.
- GORDON, R. IN BLOXHAM, S., 2016. A Systematic Review of the Effects of Exercise and Physical Activity on Non-Specific Chronic Low Back Pain. *Healthcare (Basel)*, 4 (2), 22.
- GORTON, G.E., HEBERT, D.A. and GANNOTTI, M.E. 2009. Assessment of the kinematic variability among 12 motion analysis laboratories. *Gait & Posture*, 29, 398–402.
- GUPTA, N., CHRISTIANSEN, C. S., HALLMAN, D. M., KORSHØJ, M., CARNEIRO, I. G. and HOLTERMANN, A., 2015. Is objectively measured sitting time associated with low back pain? A cross-sectional investigation in the NOMAD study. *PloS one*, 10 (3).
- HÖCHSMANN, C., SCHÜPBACH, M. IN SCHMIDT-TRUCKSÄSS, A., 2016. Effects of Exergaming on Physical Activity in Overweight Individuals. *Sports Med*, 46 (6).
- HURLEY, B.F., HANSON, E.D. and SHEAFF, A.K., 2011. Strength training as a countermeasure to aging muscle and chronic disease. *Sports Medicine*, 41 (4).
- KESSLER, S.E., RAINBOW, M.J., LICHTWARK, G.A., CRESSWELL, A.G., D'ANDREA, S.E., KONOW, N. IN KELLY, L.A., 2019. A direct comparison of biplanar videoradiography and optical motion capture for foot and ankle kinematics. *Frontiers in Bioengineering and Biotechnology* 7, 199.
- KOCJAN, A. and SARABON, N., 2020. The Effect of Unicycle Riding Course on Trunk Strength and Trunk Stability Functions in Children. *J Strength Cond Res*, 34(12), 3560–3568.
- LEBOEUF-YDE, C. and KYVIK, K.O., 1998. At what age does low back pain become a common problem? A study of 29,424 individuals aged 12–41 years. *Spine (Phila Pa 1976)*, 23(2), 228–234.

- LEE, J.H., HOSHINO, Y., NAKAMURA, K., KARIYA, Y., SAITA, K. and ITO, K., 1999. Trunk muscle weakness as a risk factor for low back pain. A 5-year prospective study. *Spine (Phila Pa 1976)*, 24 (1), 54–57.
- MA M, PROFFITT R and SKUBIC M., 2018. Validation of a Kinect V2 based rehabilitation game. *PLoS One*, 24, 13(8).
- MAGNUSSON, M.L., ALEKSIEV, A., WILDER, D.G., POPE, M.H., SPRATT, K, LEE, S.H., GOEL, V.K., and WEINSTEIN, J.N.. 1996. Unexpected load and asymmetric posture as etiologic factors in low back pain. *Eur Spine J*, 5 (1), 23–35.
- MCGILL, S.M., 2007. *Low Back Disorders: Evidence-Based Prevention and Rehabilitation*. Champaign, IL: Human Kinetics
- OWEN, P. J., MILLER, C. T., MUNDELL, N. L., VERSWIJVEREN, S., TAGLIAFERRI, S. D., BRISBY, H., BOWE, S. J. and BELAVY, D. L., 2020. Which specific modes of exercise training are most effective for treating low back pain? Network meta-analysis. *British journal of sports medicine*, 54 (21), 1279–1287.
- PANJABI, M.M., 1992. The stabilizing system of the spine. Part I. Function, dysfunction, adaptation, and enhancement. *J Spinal Disord*, 5 (4), 383–389.
- PEDERSEN, M. T., ESSENDROP, M., SKOTTE, J. H., JØRGENSEN, K. and FALLENTIN, N., 2004. Training can modify back muscle response to sudden trunk loading. *European spine journal*, 13 (6), 548–552.
- PILZ, B., VASCONCELOS, R. A., TEIXEIRA, P. P., MELLO, W., OLIVEIRA, I. O., ANANIAS, J. and GROSSI, D. B., 2020. Comparison of Hip and Lumbopelvic Performance Between Chronic Low Back Pain Patients Suited for the Functional Optimization Approach and Healthy Controls. *Spine*, 45(1), 37–44.
- RUBIN, D. I., 2007. Epidemiology and risk factors for spine pain. *Neurologic clinics*, 2 (2), 353–371.
- SANTOS, M. J., KANEKAR, N. and ARUIN, A. S., 2010. The role of anticipatory postural adjustments in compensatory control of posture: 2. Biomechanical analysis. *Journal of electromyography and kinesiology*, 20 (3), 398–405.
- SEARLE, A., SPINK, M., HO, A. and CHUTER, V., 2015. Exercise interventions for the treatment of chronic low back pain: a systematic review and meta-analysis of randomised controlled trials. *Clin Rehabil*, 29 (12), 1155–1167.
- SWEEN, J., WALLINGTON, S. F., SHEPPARD, V., TAYLOR, T., LLANOS, A. A., and ADAMS-CAMPBELL, L. L., 2014. “The role of exergaming in improving physical activity: a review. *Journal of physical activity & health*, 11 (4), 864–870.

- WADE, L., NEEDHAM, L., MCGUIGAN, P. and BILZON, J., 2022. Applications and limitations of current markerless motion capture methods for clinical gait biomechanics. *Peer J*, 10.
- WHITTLE, M.W., 1996. Clinical gait analysis: a review. *Human Movement Science*, 15, 369–387.
- WORLD HEALTH ORGANIZATION. *Physical inactivity: a global public health problem*, 2020.

Nutrition for healthy term infants and the role of gut microbiota

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Abstract

Introduction: Nutrition in the first year of life plays an important role in the child's development, directly through the intake of nutrients, as well as indirectly by influencing the composition of the gut microbiota. Improper diet already at the very beginning can significantly affect the onset of metabolic and other chronic diseases in children and adolescents. Moreover, this period is crucial also for the development of taste and eating habits. *Methods:* A narrative review of the literature in the world databases and currently valid guidelines in the Republic of Slovenia was made. The analysis included studies examining the impact of diet and gut microbiota on health in the first years of life.

Results: The presence of microorganisms in the placenta and meconium indicates the first contact of the digestive tract with the microbiota already during pregnancy. Extensive colonization occurs during birth and in the first months of life, while the development and maturation of the microbiota is strongly influenced by the factors such as gestational age, mode of delivery, diet, environment, and antibiotic treatment. The composition of the gut microbiota in the first year of life is very uniform and individually specific and develops toward an adult-like structure between the age of three and five. Among the important factors influencing the composition of the gut microbiota is also the introduction of complementary foods (CFs). Current guidelines recommend that CFs should be introduced gradually after the age of six months. The introduction of CFs before the age of 17 weeks can lead to obesity, respiratory disorders and eczema in later childhood. With the later introduction of CFs (five to seven months), there is a risk that the energy value of nutrients in breast milk or infant formula is no longer sufficient for the baby's rapid development. *Discussion and conclusion:* Diet and its indirect influence on the composition and abundance of the gut microbiota are one of the most important factors influencing

metabolism, resistance to infections and development of the immune system. Thus, by choosing an appropriate diet in the early childhood, we can significantly contribute to health later in life.

Keywords: infants, nutrition, gut microbiota, health

Introduction

An increasing amount of scientific evidence shows the importance of diet during early infancy. Fetal development and infancy are life stages that are characterized by rapid growth, development and maturation of organs and systems. Variation in the quality or quantity of nutrients consumed by mothers during pregnancy, or infants during the first year of life, can exert permanent and powerful effects upon developing tissues. These effects are termed 'metabolic programming' and represent an important risk factor for non-communicable diseases of adulthood (Langley-Evans, 2015). Thus, diet in early infancy has a key role on growth pattern and development but is also important for the generation of lifelong flavour preferences and dietary habits that will influence mid- and long-term health (D'Auria et al., 2020). For instance, evolutionary driven preferences for sweet and salty tastes can be modified by repeated early exposure to the taste of some vegetables which enhances liking for those vegetables with effects persisting up to 6 years later (Fewtrell et al., 2017).

Nutrition of infants is divided in three periods: exclusive dairy diet (breast milk or infant formula), introduction of complementary foods (CFs) and transition to modified family diet. Exclusive breast-feeding (EBF) as defined by the World Health Organization (WHO) means that the infant receives only breast milk and no other liquids or solids except for drops or syrups consisting of vitamins, mineral supplements, or medicines (World Health Assembly, 2002). The term complementary feeding (CF) describes a period in which there is a gradual reduction of frequency and volume of breast milk or formula together with the introduction of CFs. This period is important in the transition of the infant from milk feeding to family foods and is necessary for both nutritional and developmental reasons (Dipasquale & Romano, 2020). Available literature data show increasing interest and concerns about the impact of CF timing and modality on the onset of later non-communicable disorders, such as overweight and obesity, allergic diseases, celiac disease, or diabetes (Dipasquale & Romano, 2020). Moreover, nutrition early in life was recognized as a strong determinant of the children gut microbiome assembly and maturation (Lim et al., 2016). This highly modifiable and adaptive system of bacteria, viruses, fungi, protists and other microorganisms reversely affects the host in multiple complex ways (Subramanian et al., 2015). Various epidemiological studies have shown a correlation between factors disrupting the gut microbiota during childhood on the one hand and immune and metabolic disorders in adulthood on the other.

The aim of our study was to present the currently valid guidelines on nutrition for healthy term infants and to review the recent articles regarding the influence of nutrition on gut microbiota and development of diseases later in life.

Methods

A narrative review of scientific and professional literature was performed using the world databases such as PubMed and websites of professional organizations. The keywords used in the search were: infants, nutrition, breast-feeding, complementary feeding, recommendations, gut microbiota, health, and their combinations. Inclusion criteria were English language articles published after 2000, with available full text and the appropriate content. Altogether 30 articles are presented in this narrative review.

Results and discussion

Breastfeeding or formula feeding

Human milk not only provides the perfectly adapted nutritional supply for the infant but also plays a crucial role in promoting healthy growth and development (Mosca & Gianni, 2017). The WHO recommends that infants are exclusively breastfed up to the completion of 6 months, with breastfeeding continuing to be an important part of the diet until the infant is at least 2 years old (World Health Assembly, 2002). EBF by a healthy mother can meet the nutrient requirements of healthy-term infants for most nutrients for approximately 6 months, although the lack of evidence from randomized clinical trials suggests that it is not certain whether this applies to all mothers and infants. Some infants may require additional energy or iron before 6 months (Fewtrell et al., 2017). Advances in research have clearly indicated several short and long-term health benefits associated with breastfeeding (Mosca & Gianni, 2017). A systematic review published in 2016 indicates a strong protective effect of EBF during the first 6 months against infectious diseases, with an 88% reduction of mortality in comparison to infants that have never been breastfed (Victora et al., 2016). Compelling evidence indicates a major protective role of breastfeeding with regard to the risk of gastrointestinal (GI) and respiratory infections, including hospitalization due to these diseases (B. L. Horta et al., 2013). Among the long-term health outcomes, longer exposure to breastfeeding is associated with 35% reduction of the risk of developing diabetes type II (B. L. Horta et al., 2015a). Breastfeeding seems to exert a protective effect against obesity development in later life, while formula feeding seems to favour high weight gain (B. Horta et al., 2013). Furthermore, consistent evidence indicates that breastfeeding is associated with positive cognitive outcome. Specifically, the intelligence quotient in ever breastfed infants has been reported to be 3.4 points higher than that of never breastfed infants (B. L. Horta et al., 2015b).

Complementary feeding

According to the WHO definition, the introduction of CFs is needed to ensure optimal energy and nutrient intake when “breast milk alone is no longer sufficient to meet the nutritional requirements in terms of energy and nutrients of infants” (World Health Assembly, 2002). Based on the available evidence, current guidelines recommend that CFs (solids and liquids other than breast milk or infant formula) should not be introduced before 4 months (17 weeks) but should not be delayed beyond 6 months (26 weeks). GI and renal functions are sufficiently mature by approximately 4 months to enable term infants to process CFs, and by 4 to 6 months they will have attained the necessary motor skills to cope safely with CFs (Fewtrell et al., 2017). The introduction of CF is this time frame is also regarded as the most appropriate in terms of health outcomes. Conversely, the introduction before the age of 17 weeks is associated with greater risk of obesity and adoption of unhealthy eating habits (D’Auria et al., 2020). There may also be an increased risk of allergy if solids are introduced before 3 to 4 months. There is, however, no evidence that delaying the introduction of allergenic foods beyond 4 months reduces the risk of allergy, either for infants in the general population or for those with a family history of atopy (Fewtrell et al., 2017).

Infant’s gut microbiota

Until recently, it was widely believed that the microbial colonization of the GI tract begins during and immediately after birth. However, the detection of bacteria in placental tissue and meconium suggests the first contact of the GI tract with the microbiota already during pregnancy (Aagaard et al., 2014). More extensive colonization of the GI tract then occurs during and after birth, while development and maturation of the microbiota are strongly influenced by various factors such as gestational age, mode of delivery (vaginal birth vs. birth by caesarean section), nutrition (breast milk vs. milk formula), environment, and antibiotic treatment (Zhuang et al., 2019). Among these factors, vaginal delivery and breastfeeding were found to positively modulate the composition of the gut microbiota, while both contribute to an enrichment of beneficial bacterial strains such as *Bifidobacterium* (Martin et al., 2016). Moreover, higher abundance of potentially pathogenic and proinflammatory *Klebsiella* and *Enterococcus* in infants born with caesarean section may imply a higher risk of immunological disorders and risk of infections (Reyman et al., 2019). In addition, pregnancy outcome and child development may also be influenced by the microbial compounds and metabolites of the maternal microbiota (Romano-Keeler & Weitkamp, 2015). The gut microbiota of the newborn is therefore characterized by a high inter-individual diversity, which is generally low in the first year of life, changes very rapidly and is shaped toward an adult-like between the age of 3 and 5 (Koenig et al., 2011).

Effects of nutrition on infant's microbiota

Breast milk is widely accepted as the nutritional gold standard for infants, with recommended EBF for the first 6 months (World Health Assembly, 2002). In addition to the essential nutrients, the breast milk contains complex microbial community, that is not aleatory assembled (Drago et al., 2017). As shown by Biagi et al. (2018), different types of microbial communities in milk are associated with features in the infant's gut and mouth ecosystems, such as high relative abundance of the most important probiotic group of bifidobacteria. Additionally to the intrinsic health-promoting effects of milk itself, feeding directly from the breast can contribute to the preterm infant's microbiome assembly (Biagi et al., 2018). However, the breastmilk composition is adjusted to the needs of the new-born and is changing over time e.g., colostrum is rich in human milk oligosaccharides (HMOs), while mature milk contains greater amounts of proteins (Bode, 2012). HMOs represent one of the most abundant bioactive molecules in human milk known to stimulate the growth and colonization of beneficial gut microbiota species and suppress the growth of opportunistic pathogenic species (Newburg et al., 2005). While the gut microbiota of breastfed infants is characterized by the higher counts of bifidobacteria and lactobacilli and lower levels of potential pathogens, the gut microbiota of formula-fed infants is associated with a more diverse gut microbiota that is dominated by *Staphylococcus*, *Enterococcus*, *Bacteroides*, *Clostridium*, enterobacteria, and the genus *Atopobium* (Martin et al., 2016). It was also shown that breast milk in the case of EBF infants may provide the gut microbiome with a greater plasticity that eases the transition into CF (Thompson et al., 2015). The last induces the development of a mature microbiota with genes responsible for complex carbohydrate, starch, and xenobiotic degradation as well as vitamin production (Koenig et al., 2011). Although the introduction of solid foods is a major event in the first year of life, it is little known to what extent the choice of specific foods or the diversity of introduced foods influence microbial community diversity, structure, and taxonomy in the gut (Homann et al., 2021). Mainly the introduction of solid foods has been associated with changes in phyla abundances, especially an increase in *Bacteroidetes* (Koenig et al., 2011). However, some study results suggest that the introduction of solid food does not appear to result in a profound shift in microbial community structure as long as breastfeeding is continued (Galazzo et al., 2020).

The role of gut microbiota in infant's health

Gut microbiota was recognized as an important determinant of the GI, immune and central nervous system (CNS) development. Therefore, an early life as a critical period for microbial colonization can affect not only the infant's health but is also profound for wellbeing further in life (Yao et al., 2021). While an early life is a period of fast brain development, the gut microbiota metabolites (e.g., short-chain fatty acids and lipopolysaccharides) are one of the most important components that pass directly through epithelial cells and can reg-

ulate the development of the brain and CNS. Therefore, the disturbances in the assembly and maturation of the gut microbiota may impact development of motor, social, and cognitive function (Diaz Heijtz, 2016). Furthermore, after birth infant microbiota shape innate and acquired immunity and may have a profound impact on the structure and function of the immune system e.g. (i) low diversity and bacterial density may cause an impaired stimulation of secretory IgA that can result in a reduced mucosal barrier function; (ii) bacterial diversity was inversely associated with allergic sensitization; fecal microbiota transplant from normal weight infant to germfree mice showed greater villus height and crypt depth, as well as higher proliferating cells in the ileum than recipients of low-weight infant microbiota (Ximenez & Torres, 2017). Based on the data supporting the correlation between microbiota colonization and disease onset, there is also a great overall impact on long-term health. However, the specific influencing factors and mechanisms need to be further explored.

Conclusions

Nutrition in the first years of life is one of the most important factors that can significantly affect the wellbeing, development and health of the child. The first years of children's life are also recognized as an important factor in the development of a healthy gut microbiota. Based on this literature review the protective role of breastmilk against numerous diseases such as diabetes and obesity, was noted. Moreover, there are different microbial colonization patterns of the gut between breastfed and formula-fed infants, with the latter achieving an early divergence toward an adult-like microbiota composition. However, findings support the current WHO recommendation for exclusive breastfeeding during the first 6 months with continued breastfeeding until at least 12 months. To sum up, while the infants gut microbiota effects both infant health and long-term health, it is important to follow the nutritional guidelines in order to establish its favourable composition.

References

- AAGAARD, K., MA, J., ANTONY, K. M., GANU, R., PETROSINO, J., & VERSALOVIC, J. (2014). The placenta harbors a unique microbiome. *Science Translational Medicine*, 6(237), 237ra65. <https://doi.org/10.1126/scitranslmed.3008599>
- BIAGI, E., ACETI, A., QUERCIA, S., BEGHETTI, I., RAMPPELLI, S., TURRONI, S., SOVERINI, M., ZAMBRINI, A. V., FALDELLA, G., CANDELA, M., CORVAGLIA, L., & BRIGIDI, P. (2018). Microbial Community Dynamics in Mother's Milk and Infant's Mouth and Gut in Moderately Preterm Infants. *Frontiers in Microbiology*, 9. <https://www.frontiersin.org/articles/10.3389/fmicb.2018.02512>
- BODE, L. (2012). Human milk oligosaccharides: Every baby needs a sugar mama. *Glycobiology*, 22(9), 1147–1162. <https://doi.org/10.1093/glycob/cws074>

- D'AURIA, E., BORSANI, B., PENDEZZA, E., BOSETTI, A., PARADISO, L., ZUCCOTTI, G. V., & VERDUCI, E. (2020). Complementary Feeding: Pitfalls for Health Outcomes. *International Journal of Environmental Research and Public Health*, 17(21), E7931. <https://doi.org/10.3390/ijerph17217931>
- DIAZ HEIJTZ, R. (2016). Fetal, neonatal, and infant microbiome: Perturbations and subsequent effects on brain development and behavior. *Seminars in Fetal & Neonatal Medicine*, 21(6), 410–417. <https://doi.org/10.1016/j.siny.2016.04.012>
- DIPASQUALE, V., & ROMANO, C. (2020). Complementary feeding: New styles versus old myths. *Minerva Medica*, 111(2), 141–152. <https://doi.org/10.23736/S0026-4806.19.06320-1>
- DRAGO, L., TOSCANO, M., DE GRANDI, R., GROSSI, E., PADOVANI, E. M., & PERONI, D. G. (2017). Microbiota network and mathematic microbe mutualism in colostrum and mature milk collected in two different geographic areas: Italy versus Burundi. *The ISME Journal*, 11(4), 875–884. <https://doi.org/10.1038/ismej.2016.183>
- DU TOIT, G., ROBERTS, G., SAYRE, P. H., BAHNSON, H. T., RADULOVIC, S., SANTOS, A. F., BROUGH, H. A., PHIPPARD, D., BASTING, M., FEENEY, M., TURCANU, V., SEVER, M. L., GOMEZ LORENZO, M., PLAUT, M., & LACK, G. (2015). Randomized Trial of Peanut Consumption in Infants at Risk for Peanut Allergy. *New England Journal of Medicine*, 372(9), 803–813. <https://doi.org/10.1056/NEJMoa1414850>
- FEWTRELL, M., BRONSKY, J., CAMPOY, C., DOMELLÖF, M., EMBLETON, N., FIDLER MIS, N., HOJSAK, I., HULST, J. M., INDRIO, F., LAPILLONNE, A., & MOLGAARD, C. (2017). Complementary Feeding: A Position Paper by the European Society for Paediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN) Committee on Nutrition. *Journal of Pediatric Gastroenterology and Nutrition*, 64(1), 119–132. <https://doi.org/10.1097/MPG.0000000000001454>
- GALAZZO, G., BEST, N. VAN, BERVOETS, L., DAPAAH, I. O., SAVELKOUL, P. H., HORNEF, M. W., HUTTON, E. K., MORRISON, K., HOLLOWAY, A. C., MCDONALD, H., RATCLIFFE, E. M., STEARNS, J. C., SCHERTZER, J. D., SURETTE, M. G., THABANE, L., MOMMERS, M., LAU, S., HAMELMANN, E., & PENDERS, J. (2020). Development of the Microbiota and Associations With Birth Mode, Diet, and Atopic Disorders in a Longitudinal Analysis of Stool Samples, Collected From Infancy Through Early Childhood. *Gastroenterology*, 158(6), 1584–1596. <https://doi.org/10.1053/j.gastro.2020.01.024>
- HOMANN, C.-M., ROSSEL, C. A. J., DIZZELL, S., BERVOETS, L., SIMIONI, J., LI, J., GUNN, E., SURETTE, M. G., DE SOUZA, R. J., MOMMERS, M., HUTTON, E. K., MORRISON, K. M., PENDERS, J., VAN BEST, N., & STEARNS, J. C. (2021). Infants' First Solid Foods: Impact on Gut Mi-

- crobiota Development in Two Intercontinental Cohorts. *Nutrients*, 13(8), 2639. <https://doi.org/10.3390/nu13082639>
- HORTA, B., CESAR, V., & ORGANIZATION, W. H. (2013). *Long-term effects of breastfeeding: A systematic review*. World Health Organization. <https://apps.who.int/iris/handle/10665/79198>
- HORTA, B. L., LORET DE MOLA, C., & VICTORA, C. G. (2015a). Long-term consequences of breastfeeding on cholesterol, obesity, systolic blood pressure and type 2 diabetes: A systematic review and meta-analysis. *Acta Paediatrica*, 104(S467), 30–37. <https://doi.org/10.1111/apa.13133>
- HORTA, B. L., LORET DE MOLA, C., & VICTORA, C. G. (2015b). Breastfeeding and intelligence: A systematic review and meta-analysis. *Acta Paediatrica (Oslo, Norway: 1992)*, 104(467), 14–19. <https://doi.org/10.1111/apa.13139>
- HORTA, B. L., VICTORA, C. G., & ORGANIZATION, W. H. (2013). *Short-term effects of breastfeeding: A systematic review on the benefits of breastfeeding on diarrhoea and pneumonia mortality*. World Health Organization. <https://apps.who.int/iris/handle/10665/95585>
- KOENIG, J. E., SPOR, A., SCALFONE, N., FRICKER, A. D., STOMBAUGH, J., KNIGHT, R., ANGENENT, L. T., & LEY, R. E. (2011). Succession of microbial consortia in the developing infant gut microbiome. *Proceedings of the National Academy of Sciences of the United States of America*, 108(Suppl 1), 4578–4585. <https://doi.org/10.1073/pnas.1000081107>
- LANGLEY-EVANS, S. C. (2015). Nutrition in early life and the programming of adult disease: A review. *Journal of Human Nutrition and Dietetics: The Official Journal of the British Dietetic Association*, 28 Suppl 1, 1–14. <https://doi.org/10.1111/jhn.12212>
- LIM, E. S., WANG, D., & HOLTZ, L. R. (2016). The Bacterial Microbiome and Virome Milestones of Infant Development. *Trends in Microbiology*, 24(10), 801–810. <https://doi.org/10.1016/j.tim.2016.06.001>
- MARTIN, R., MAKINO, H., YAVUZ, A. C., BEN-AMOR, K., ROELOFS, M., ISHIKAWA, E., KUBOTA, H., SWINKELS, S., SAKAI, T., OISHI, K., KUSHIRO, A., & KNOL, J. (2016). Early-Life Events, Including Mode of Delivery and Type of Feeding, Siblings and Gender, Shape the Developing Gut Microbiota. *PLOS ONE*, 11(6), e0158498. <https://doi.org/10.1371/journal.pone.0158498>
- MOSCA, F., & GIANNÌ, M. L. (2017). Human milk: Composition and health benefits. *La Pediatria Medica E Chirurgica: Medical and Surgical Pediatrics*, 39(2), 155. <https://doi.org/10.4081/pmc.2017.155>
- NEWBURG, D. S., RUIZ-PALACIOS, G. M., & MORROW, A. L. (2005). Human milk glycans protect infants against enteric pathogens. *Annual Review of Nutrition*, 25, 37–58. <https://doi.org/10.1146/annurev.nutr.25.050304.092553>

- REYMAN, M., VAN HOUTEN, M. A., VAN BAARLE, D., BOSCH, A. A. T. M., MAN, W. H., CHU, M. L. J. N., ARP, K., WATSON, R. L., SANDERS, E. A. M., FUENTES, S., & BOGAERT, D. (2019). Impact of delivery mode-associated gut microbiota dynamics on health in the first year of life. *Nature Communications*, *10*(1), 4997. <https://doi.org/10.1038/s41467-019-13014-7>
- ROMANO-KEELER, J., & WEITKAMP, J.-H. (2015). Maternal influences on fetal microbial colonization and immune development. *Pediatric Research*, *77*(1–2), 189–195. <https://doi.org/10.1038/pr.2014.163>
- SUBRAMANIAN, S., BLANTON, L. V., FRESE, S. A., CHARBONNEAU, M., MILLS, D. A., & GORDON, J. I. (2015). Cultivating healthy growth and nutrition through the gut microbiota. *Cell*, *161*(1), 36–48. <https://doi.org/10.1016/j.cell.2015.03.013>
- THOMPSON, A. L., MONTEAGUDO-MERA, A., CADENAS, M. B., LAMPL, M. L., & AZCARATE-PERIL, M. A. (2015). Milk- and solid-feeding practices and daycare attendance are associated with differences in bacterial diversity, predominant communities, and metabolic and immune function of the infant gut microbiome. *Frontiers in Cellular and Infection Microbiology*, *5*, 3. <https://doi.org/10.3389/fcimb.2015.00003>
- VICTORA, C. G., BAHL, R., BARROS, A. J. D., FRANÇA, G. V. A., HORTON, S., KRASEVEC, J., MURCH, S., SANKAR, M. J., WALKER, N., ROLLINS, N. C., & LANCET BREASTFEEDING SERIES GROUP. (2016). Breastfeeding in the 21st century: Epidemiology, mechanisms, and life-long effect. *Lancet (London, England)*, *387*(10017), 475–490. [https://doi.org/10.1016/S0140-6736\(15\)01024-7](https://doi.org/10.1016/S0140-6736(15)01024-7)
- WORLD HEALTH ASSEMBLY, 55. (2002). *Infant and young child nutrition (WHA55.25)*. World Health Organization. <https://apps.who.int/iris/handle/10665/78542>
- XIMENEZ, C., & TORRES, J. (2017). Development of Microbiota in Infants and its Role in Maturation of Gut Mucosa and Immune System. *Archives of Medical Research*, *48*(8), 666–680. <https://doi.org/10.1016/j.arcmed.2017.11.007>
- YAO, Y., CAI, X., YE, Y., WANG, F., CHEN, F., & ZHENG, C. (2021). The Role of Microbiota in Infant Health: From Early Life to Adulthood. *Frontiers in Immunology*, *12*. <https://www.frontiersin.org/articles/10.3389/fimmu.2021.708472>
- ZHUANG, L., CHEN, H., ZHANG, S., ZHUANG, J., LI, Q., & FENG, Z. (2019). Intestinal Microbiota in Early Life and Its Implications on Childhood Health. *Genomics, Proteomics & Bioinformatics*, *17*(1), 13–25. <https://doi.org/10.1016/j.gpb.2018.10.002>

Parent awareness about the onset of febrile seizures and fever

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Abstract

Introduction: Many parents believe that a body temperature of 39.0°C is harmful, puts their child at risk, and must be reduced immediately. But fever is merely a symptom, not a disease. In fact, it is essential for a child to successfully recover from their disease. Febrile seizures, which are the most common type of convulsions among children, often raise concern among parents since they resemble epileptic seizures. It is important to raise awareness among parents about the different stages of fever, the positive and negative effects of fever, and the methods used to reduce fever. This knowledge is the key to the successful prevention and treatment of febrile seizures. Aim of the research was to determine the level of parents' awareness, knowledge, and reactions to febrile seizures. *Methods:* We conducted a quantitative empirical study based on data collection. The data was acquired by means of a questionnaire, which was drawn up following a literature review. The research sample included 50 randomly selected parents. *Results:* Upon analyzing the results, we found that parents are relatively well acquainted with the occurrence of fever. Most are familiar with the different methods of reducing fever, but more than half of them start reducing it too early, which ultimately prevents the body from fending off the disease on its own. Our study focused on parents' familiarity with febrile seizures. The results indicate that only 10 % of parents participating in the study would turn their child on the side during a febrile seizure, and that only a small percentage would administer oral medications to their child during a febrile seizure. Based on the data acquired, we conclude that parents are well acquainted with the symptoms of febrile seizures and that they would immediately recognize its onset. Raising concern is the finding that 54 % of parents participating in the study claim that the outpatient department for children and schoolchildren failed to provide any information on febrile seizures. *Discussion and conclusion:* Fever and

its effects can be a source of anxiety for parents their entire childhood. Much of the available information on fever is non-fact-checked and incomplete, which may stir confusion among parents. Such information should be provided to parents by healthcare professionals, who are also professionally trained in health care education. Parents mostly trust healthcare professionals and are quick to rely on their guidance. In-depth knowledge and awareness can facilitate encounters with febrile seizures for parents, since it makes it easier for them to recognize the onset of the condition and reassures them such convulsions are not life-threatening. Healthcare professionals should be the most reliable source of information for parents; however, it is vital that healthcare professionals are able to provide the key information and choose the most suitable method of passing it on.

Keywords: fever, febrile seizures, parents

Introduction

The average (normal) body temperatures for children vary, depending on many factors, including the child's age, daily activity levels and given the time of the day. Infants tend to have higher temperatures than older children. In addition, fever is an important part of the body's defense against infection and viral disease. Thus most mild fevers do have a beneficial effect, it might happen that a child with a fever may become more uncomfortable as the temperature rises and it can make children feel foggy and tired (American Academy of Pediatrics, 2015). Moreover, increased body temperature is a symptom, certainly not a disease. It actually stimulates the body's immune and protective response, and at the same time it is an important part of the body's defence against infection or disease (Herlihy, D'Acremont, Burgess in Hamer, 2016). Like other forms of inflammation or infection, a fever enhances the innate immune defence and is beneficial for the organism as it strengthens the inflammatory response and the functioning of the overall immune system. In addition, it also reduces the formation of toxic substances and it plays a significant role in certain infections by inhibiting the production of certain microorganisms. It also supports the immune system's attempt to gain advantage over infectious agents, such as viruses and bacteria, it helps the immune cells to work better and makes the body less favourable as a host for replicating viruses and bacteria that are temperature sensitive. Also, it increases the rise of antibiotic resistance and improves the binding of iron into cells which inhibits the growth of bacteria (Strgar, 2019). It is not recommended to immediately or suddenly lower the elevated body temperature as a sudden and extreme change in temperature can have a negative effect on the course of the disease. Children with a healthy heart and a stable blood flow can easily tolerate even extreme temperatures as high as 40 °C. Adults should start to bring a child's fever down when their body temperature exceeds 38,5 °C. When there is a child, who is subject to febrile seizures (febrile convulsions), we should start lowering his elevated body

temperature already between 37.5 °C and 38 °C (Nase, 2016). Immediate action is needed in the case of a child having an epileptic seizure, when a child is in the shock-like state, after a surgery and if a child has a weakened heart. If the core temperature continues to rise dramatically, it can harm and thus deteriorate our cells (Pedriatrična klinika Ljubljana, b. d.).

Young children between the ages of about 6 months and 6 years old are the most likely to experience febrile seizures, caused by elevated body temperature. The latter are most commonly observed in children between 14 and 18 months of age. The phenomenon of febrile seizures continues building up in the first few hours (American Academy of Pediatrics, 2017). Febrile seizures or convulsions are the most common form of cramps that occur in young children, affecting 2-5 % of them. They take place when fever is not lowered properly. These incidents may frighten parents as they are very similar to epileptic seizures (Capovilla, 2009). The fact is that febrile seizures might be life threatening for a child. Febrile seizures are particularly dangerous for children who suffer from associated cardiovascular diseases, given that elevated body temperature makes the heart beat faster (National Institute of Neurological Disorders and Stroke, 2020). In many situations, parents are the ones who are the first to see their child suffer from febrile seizures and at a time like this, knowledge is essential to help identify the first signs when febrile seizures occur and appropriate care needs to be given as soon as possible (National collaborating centre for women's and children's health, 2019). It often happens that parents' action is inadequate and useless as they are overwhelmed with emotions, worry and fear when they see, for the first time, their own child having a febrile convulsion. A lot of parents often state that it was the worst day ever to see their child completely unresponsive. The healthcare team is the one responsible for providing all relevant information to the parents of a child in a situation like this and at the same time offer them knowledge, practices and first aid measures regarding febrile convulsions. Immediate medical attention, further hospital treatment and medical observation are often necessary (Cantrell, 2011). When febrile seizures begin, there is nothing you can do to make the seizure stop. The most important thing, in a situation like this, is to stay calm and focused and to protect your child from possible bumps, falls and other injuries that might occur during a seizure (Victorio, 2020). The objective of the herewith research was to describe febrile seizures and the occurrence of fever and above all, to determine the level of parents' awareness with respect to febrile seizures. In addition, we were interested in finding out how parents deal with the child's fever and febrile seizures. Finally, we also wanted to know what information sources most contributed to their knowledge and about the quality of the information in their possession.

Methods

For the purpose of this research we decided to conduct a quantitative empirical study based on data collection. The data was acquired by means of a ques-

tionnaire, which was drawn up following a literature review and adopted accordingly to the needs of our research (Miklič, 2010). In order to carry out the survey, we contacted the head nurse of the pediatric clinic and she then invited us to an interview. Before conducting the interview, we had to obtain the consent from the Pediatric Division at the Community Medical Center Ilirska Bistrica. After being given all the necessary consents, we handed over the questionnaire, containing all the survey questions, to the medical team working at the children's department of pediatric medicine. The questionnaires were then distributed to parents during the children's preventive and curative examinations or treatment. For the purpose of theory elaboration, a descriptive method of work was adopted in order to perform a systematic domestic and foreign literature review. The data we were able to obtain from the questionnaire above mentioned were further processed with the help of the following computer tools: Microsoft Office Excell and Microsoft Office Word and the 1KA Application. The research sample included 50 randomly selected parents. Non-random sampling was the sampling technique used in order to make the sample selection based on factors other than just random chance. 16 % (8) of men and 84 % (42) of women took part in the survey as interviewees or survey respondents.

Results

Upon analyzing the results of the above mentioned questionnaire, we found that parents are relatively well acquainted with the occurrence of fever in a child. Moreover, it was discovered that there is only one parent (2 %) who lowers the fever incorrectly. Most are familiar with the different methods of reducing fever, but only 15 (30 %) of them use them in the most suitable or appropriate combination. For the treatment of fever in children, 26 (52 %) of parents participating in the study would administer rectal suppositories and syrup as fever reducers for children. Only 14 % of parents taking part in the survey in question would break their child's elevated body temperature safely with a lukewarm bath or shower and cold compresses or tepid sponging.

Furthermore, it was also established that more than half of them (50 %) start reducing fever too early, which ultimately prevents the body from fending off the disease on its own. In order to break the fever, many parents (22 %) decide to lower the child's elevated body temperature when it exceeds 38,0 °C. More than a quarter (28 %) of all surveyed parents know when it is best to start taking a fever down. Table 1 shows the parents' responses as far as the right time to start taking a child's fever down is concerned.

Table 1: The beginning of bringing a child's fever down

Body temperature (°C)	Number	Share/Percentage
I do not bring body temperature down	0	0
36,0–37,5	0	0

Body temperature (°C)	Number	Share/Percentage
37,5–38,0	25	50
38,0–38,5	11	22
Above 38,5	14	28
Total	50	100

By raising a question of how parents should respond to a child having febrile seizures, we wanted to establish the level of their awareness when it comes to taking action when the above phenomenon occurs. Multiple replies were possible. The answers we got from the parents are shown in table 1. The fact is that 32 parents (64 %) would call for a medical emergency in the event of febrile seizures. Only 5 parents (10 %) would do the right thing and thus turn their child on the side during a febrile seizure and only 3 (6 %) parents would let febrile seizures to stop themselves. Poorly informed parents (14 %) would administer oral medications to their child as soon as a febrile seizure takes place. 14 parents (28 %) would handle the situation in an improper way by trying to bring a child's fever with tepid sponging.

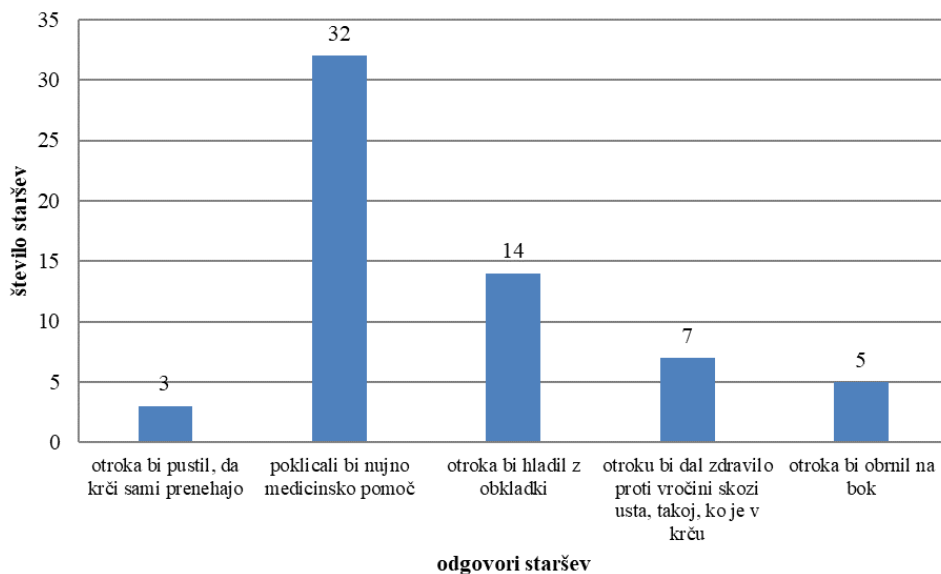


Figure 1: Measures taken in the event of a febrile seizure

Discussion

In the herewith research, a special focus was placed on knowledge and awareness regarding febrile seizures. Among parents, participating in the study, 10 % are the ones who have experienced their child having febrile seizure on one occasion, which was more than expected considering such a small case sample. From the data we had collected, we found that the majority of parents (64 %)

would in the event of febrile seizures – immediately call for emergency medical assistance, which is particularly necessary if febrile seizures occur for the first time (Neubauer, 2002). The results indicated that only 10 % of parents participating in the study would turn their child on the side during a febrile seizure, and this piece of information was not expected at all. In addition, we were also surprised to learn that 14 % of parents participating in the survey would administer oral medications to their child, in the child's mouth, during a febrile seizure. Such a conclusion suggests that 14 % of parents, taking part in the study in question, have no idea whatsoever what in fact a febrile seizure looks like and what happens during this phenomenon. Only 6 % of parents are not afraid if they found themselves in front of febrile seizures as they firmly believe they would take the right measures to help their child.

We also need to mention certain limitations as far as the research is concerned – a small sample size of the parents participating in the study. Our findings demonstrate that a sample of parents taking part in such a research should be extended in order to be able to improve the quality of the research work and to be able to gather more detailed findings. Another limitation is that we were not personally present, by not being made available to them while the questionnaire was being completed, for the interpretation of possible ambiguities when addressing the questionnaire. The fact is that there was a number of questions having multiple possible answers. However, it might have been better for each question to have only one possible answer. Finally, this study could be improved by comparing the answers we obtained with the answers given by other parents in several other institutions, perhaps also by making a comparison among various Slovene places and municipalities.

Conclusions

Parents are faced with fever their child is struggling with throughout their entire childhood. They often wonder what to do and how to handle the situation when their children have fever. Because they are anxious and concerned, in most cases parents turn to the child's doctor (pediatrician), whom they trust and rely on their guidance, so that they can raise questions to them regarding fever, since it is they who should already have the way of knowing and having all the answers to these questions. Parents should be aware of the fact that there is a lot of information that is easily available on the Internet about different medical conditions, as well as about fever and febrile seizures. However, much of the available information on fever is non-fact-checked and incomplete, which may stir confusion among parents. Such information should be provided to parents by healthcare professionals, who are professionally trained in health care education. Parents mostly trust healthcare professionals and are quick to rely on their guidance.

The fact is that healthcare professionals are professionally trained and thus qualified also in the field of health education. What is more, in addition to the theoretical knowledge that the healthcare professionals hand over to par-

ents, it might be also useful to introduce practical examples and talk about life events to parents as well. We believe that during preventive examinations of children, programmes of parenthood preparation and community nursing services when a registered nurse comes to visit her patients at home, it would be more than reasonable to address fever, and in particular the occurrence of febrile seizures.

In-depth knowledge and awareness can facilitate encounters with febrile seizures for parents, since it makes it easier for them to recognize the onset of the condition and at the same time it reassures them such convulsions are not life-threatening. Moreover, knowledge and subsequent recognition of the pathological phenomena can help parents reduce the level of stress, anxiety and fear they might experience in such circumstances. Therefore, we firmly believe that healthcare professionals should be the most reliable source of quality information for parents. However, it is vital that even healthcare professionals are able to provide the key information to a child's parents and at the same time choose the most suitable method of passing it on.

References

- American academy of pediatrics. (2015). *Fever and your baby*. Pridobljeno 21. 12. 2020 s <https://www.healthychildren.org/English/health-issues/conditions/fever/Pages/Fever-and-Your-baby.aspx>
- American academy of pediatrics. (2017). *Febrile seizures*. Pridobljeno 8. 10. 2020 s <https://www.healthychildren.org/English/health-issues/conditions/head-neck-nervous-system/Pages/Febrile-Seizures.aspx>
- Cantrell, M. A. (2011). *Pediatric nursing* (1st ed.). New York: McGraw-Hill
- Capovilla, G., Mastrangelo, A., Romeo, A. in Vigevano F. (2009). *Recommendations for the management of »febrile seizures« ad hoc task force of LICE guidelines commission*. Pridobljeno 16. 10. 2020 s <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1528-1167.2008.01963.x>
- Herlihy, J., D'Acremont, V., Burgess, D. in Hamer, D. (2016). *Diagnosis and treatment of the febrile child*. Pridobljeno 10. 10. 2020 s <https://www.ncbi.nlm.nih.gov/books/NBK361919/>
- Miklič, M. (2010). *Vročinski krči pri otroku, oskrba na terenu in transport* (diplomska naloga). Maribor: Univerza v Mariboru, Fakulteta za zdravstvene vede. Pridobljeno s <https://dk.um.si/Dokument.php?id=16876>
- Nase, J. in Nase, B. (2016). *Otroške bolezni* (1. izd.). Ljubljana: Mladinska knjiga.
- National collaborating centre for women's and children's health. (2019). *Febrile illness in children: assessment and initial management in children younger than 5 years*. Pridobljeno 10.10.2020 s <https://www.ncbi.nlm.nih.gov/books/NBK247907/>
- National institute of neurological disorders and stroke. (2020). *Febrile seizure fact sheets*. Pridobljeno 12. 10. 2020 s <https://www.ninds.nih.gov/Disor->

ders/Patient-Caregiver-Education/Fact-Sheets/Febrile-Seizures-Fact-Sheet#top

Pediatrična klinika Ljubljana. (b. d.). *Povišana telesna temperatura*. Pridobljeno 23. 12. 2020 s <http://cms.siel.si/documents/131/docs/povisana-tele-sna-temperatura.pdf>

Strgar, M. (2019). *Antibiotiki, rezistenca na antibiotike, novi antibiotiki in nova odkritja*. Pridobljeno 17. 10. 2020 s <https://www.zdravstvena.info/preventiva/antibiotiki-rezistenca-na-antibiotike-novi-antibiotiki-nova-odkritja.html>

Victorio, M. C. (2020). *Febrile seizures*. Pridobljeno 11. 1. 2021 s <https://www.msdmanuals.com/en-sg/home/children-s-health-issues/neurologic-disorders-in-children/febrile-seizures#>

The impact of the environment on the distress and suicidal behaviour of children and adolescents

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Abstract

Suicide is a serious public health problem, with adolescents being one of the vulnerable groups for suicidal behaviour. This paper provides an overview of environmental risk and protective factors for suicidal behaviour in adolescents, focusing on the importance of peers, the school environment, the wider community and the media. For each of the factors described, the potential for preventive interventions to reduce the risk of suicidal behaviour in adolescents is also presented. Due to the complexity of suicidal behaviour, preventive interventions need to be carefully planned and adapted to an understanding of the specifics of adolescence as a developmental stage. Through the factors described, each of us can contribute to the prevention of suicidal behaviour in adolescents by talking about these issues appropriately, reporting on them appropriately, and empowering young people to resolve distress and seek help by creating a safe and receptive environment.

Keywords: suicidal behaviour, adolescents, risk factors, protective factors, preventive activities

Introduction

Suicide is a serious public health problem; every year, around 800,000 people die by suicide (WHO, 2021a), i.e. one person every 40 seconds (NIJZ, 2020). In Slovenia, about 400 people die by suicide every year, but a significant decrease in the suicide rate has been observed for several years (SURS, 2022b). The suicide rate (number of deaths by suicide per 100,000 people), which is usually 20, was 17.08 in 2018. This was the lowest rate since 1965, i.e. since we have been systematically recording the suicide rate in Slovenia (NIJZ, 2020).

Vulnerability to suicidal behaviour among adolescents

Although suicide rates increase with age and are highest in older age groups, adolescents are considered a particularly vulnerable group for suicidal behaviour. Suicide is one of the leading three causes of death among adolescents (SURS, 2022a; WHO, 2021a). In Slovenia, approximately 20 children and adolescents between the ages of 10 and 19 died by suicide every year in the past. In recent years, i.e. since 2005, this number has slightly decreased, but we still record about 10 suicides per year in this youngest age group (SURS, 2022b). A similar decrease can be observed in other OECD countries (Organisation for Economic Co-operation and Development), but the decline in the rate is only for boys, while there is no similar decrease for girls; there is even an increase (Roh et al., 2018).

When we talk about suicidal behaviour, we are not only talking about deaths by suicide but also suicide attempts and suicidal thoughts, which are more common among adolescents than in other age groups (WHO, 2021b). Suicidal behaviour rarely occurs before the age of 12 and is most frequent between the ages of 14 and 19 (Tančič, 2009).

Adolescence is characterised by numerous changes at the social, emotional, physical and cognitive levels (Zupančič, 2009). The adolescence is full of various demands, both external and internal, which are related to the adolescents' developmental tasks. During this time, the adolescent has to adapt to physical changes, become emotionally independent, form a social gender role, establish new social relationships with peers, develop socially responsible behaviour, prepare for job, partnership and family, and form value orientations. The unsuccessful accomplishment of developmental tasks can lead to self-dissatisfaction, disapproval by others and poorer mental health. Furthermore, unsuccessful coping with developmental tasks in adolescence can also lead to unsuccessful managing of developmental tasks later in life (Roškar, 2009).

Due to the developmental characteristics, there are many obstacles when it comes to seeking help in times of need. These obstacles are (i) self-reliance or feeling that adolescents are responsible for solving their problems, (ii) fear of professional help or believing that professionals will not help them because they do not care or do not know how to help, (iii) suicidal ideation, which include social withdrawal and fear of the reactions of those around them, (iv) shame or fear of stigmatisation; (v) unavailability of support systems, where the barrier is both insufficient availability and unawareness of possible sources of help; (vi) fear that others will misunderstand the need; and (vii) feeling that those around them are indifferent or that no one cares (Rodham et al., 2004).

Risk factors and protective factors for suicidal behaviour in adolescents

There is never just one cause of death by suicide, as different factors interact - risk factors that increase a person's vulnerability to suicidal behaviour and

protective factors that reduce that risk. Risk factors and protective factors can be further divided into individual factors, interpersonal factors and environmental factors (WHO, 2014). Individual factors include genetic and biological factors, personality traits, problem-solving characteristics, alcohol and other psychoactive substances use, mental health problems (especially anxiety and depression), social skills, self-esteem, etc. At the level of interpersonal relationships, the family is particularly important for children and adolescents, i.e. strategies for solving problems in the family environment, the presence of conflicts, violence or abuse, the socio-economic status of the family and deaths in the family, especially deaths by suicide. At the environmental level, the influences of peers, school and the media are especially important for children and adolescents. Factors in the wider environment are also important, such as access to professional help, information about mental health, stigmatisation of mental health problems and attitudes towards suicide (Gili et al., 2019; Kim, 2021; Werbart Törnblom et al., 2020; WHO, 2014).

The more risk factors present in an adolescent's life and the fewer protective factors present, the greater the adolescent's vulnerability to suicidal behaviour. However, suicidal behaviour is a complex process, so we cannot completely predict which factors increase the risk of suicide the most. Each person is unique, with their life history and experiences. Individual factors may be stronger in one adolescent and have a greater influence on suicidal behaviour than in other adolescents. Therefore, it is not only the number of risk factors or protective factors that is important, but also how important each factor is for young person and what role it plays in their life. Nevertheless, knowledge of the risk factors and protective factors is important for understanding the suicidal process, as it is a necessary prerequisite for effective prevention of suicidal behaviour.

The following chapters discuss environmental factors that are an important source of opportunities for preventing suicidality in children and adolescents (WHO, 2014). The factors addressed are peers, school, the wider community and the media.

The importance of peers regarding distress and suicidality of children and adolescents

The influence of peers and social groups is very important during adolescence. They provide a group and support to which the young person can turn in times of need and talk about problems they do not confide in their parents. They provide an environment where a young person can develop, connect with others and prove themselves. As part of a peer society, young people are usually well connected and spend a lot of free time together (Zupančič & Svetina, 2009). Close circles of friends are one of the strongest protective factors against suicidal behaviour (Barzilay et al., 2017). In close groups, distress can be recognised earlier and appropriate action can be taken (Barzilay et al., 2017; Fiegelman & Gorman, 2008; Werbart Törnblom et al., 2020).

Peer groups, however, can be a double-edged sword. An important risk factor for suicidal behaviour in peer groups is the group's approving attitude towards self-harming and suicidal behaviour and the display of maladaptive coping strategies in dealing with adverse life events (Fiegelman & Gorman, 2008). Conformity, belonging to a group and pressure from group members can influence the formation of specific attitudes that may contradict community attitudes and represent adolescents' resistance to norms, regardless of whether they benefit or harm adolescents (Zupančič & Svetina, 2009). Drug and alcohol abuse in the peer group can further increase the risk of suicidal behaviour (Werbart Törnblom et al., 2020).

Young people often imitate the behaviour and problem-solving strategies of their friends (Zupančič & Svetina, 2009). This can be particularly problematic when it comes to self-harming and suicidal behaviour (Fiegelman & Gorman, 2008; Gili et al., 2019; Werbart Törnblom et al., 2020). Therefore, when a young person dies by suicide, interventions need to address their close friends and the whole school. It is important to highlight the sources of help available to young people, to show and encourage constructive ways of resolving difficulties, and to provide space for conversations (Poštuvan et al., 2020).

Protective factors are mainly good peer (and teacher) relationships, the feeling of belonging to a group and the adolescent's feeling that peers like their presence in the group (Barzilay et al., 2017). Good peer relationships are a key factor in preventing suicidality in young people. Therefore, suicide prevention strategies must focus on connecting and building quality interpersonal relationships. Given the diverse profile of young people at risk of suicide, this is a protective factor that simultaneously improves their mental health and provides them with an additional support (Campisi et al., 2020).

The importance of the school environment regarding distress and suicidality of children and adolescents

Risk factors for suicidal behaviour in the school environment include peer violence, social exclusion and school failure. School professionals familiar with adolescents' home environments may also be attentive to chaotic or dysfunctional conditions in which adolescents live, such as poor living conditions, chronic illness and outbreaks of violence among adolescents (Greydanus & Calles, 2007).

Risk factor related to the school environment is also academic success or failure. Studies have shown that the main stressor for most adolescents between the ages of 12 and 18 is academic performance. Stress, related to school, school success and further education increase with age. It is reported by 45.6% of twelve-year-olds and 68.9% of eighteen-year-olds. Adolescents, exposed to long-term stress, also have a higher risk of experiencing anxiety, depression and suicidal behaviour (Kim, 2020).

Particular risk factors in the school environment are different forms of peer violence: physical, verbal or social (e.g., rumours), resulting from different dynamics of peer groups. More aggressive groups may use peer violence as an activity, causing “non-members” of the group to experience or deepen feelings of anxiety through rejection, ridicule or humiliation, which can lead to a lack of feelings of acceptance and loneliness in the person who is a victim of peer violence (Fiegelman & Gorman, 2008). Victims of peer violence are at higher risk of developing self-harming behaviour, anxiety, depression, suicidal ideation, suicide attempts and death by suicide. There are gender differences in victims of peer violence and the types of violence adolescents report. Boys are more likely to report physical and verbal violence, while girls are more likely to report relationship violence. Each form of violence can increase the likelihood of suicidal ideation among victims by 28% to 39% (depending on gender and form of violence) (Barzilay et al., 2017). Peer violence is the most important predictor of suicidal ideation in girls, while severe injuries, lack of friends and participation in fights significantly predict suicidality in boys (Campisi et al., 2020).

When it comes to peer violence, both sides need to be considered - the victim and the bully, because increased suicidal thoughts do not only occur in the victims. Peer violence does not directly affect death by suicide, but it does have a significant impact on suicidal ideation. Some studies also suggest that physical violence may contribute to an increased risk of suicide attempts (King & Merchant, 2008).

Participation in various forms of physical activity at school and in extracurricular activities has a positive impact on young people’s mental health and is an additional protective factor. A good relationship with parents is also an important protective factor in adolescence. From a school perspective, this includes parents’ involvement in the child’s activities and tasks (interest in their child, participation in parents’ meetings, etc.) and from an interpersonal perspective, it includes understanding and helping to solve problems, encouraging independence, accepting the child’s opinion, being willing to talk about life and difficult issues, and caring and loving the child. The absence of traits contributes to the risk of suicidal behaviour in adolescents (Campisi et al., 2020; Barzilay et al., 2017).

The school environment can be an important protective factor for adolescents. Teachers, counsellors and other school staff can quickly recognize warning signs and changes in adolescent behaviour. When distress is identified, they can also talk to the adolescent, make them feel safe and accepted, and refer them to the appropriate sources of help (Poštuvan et al., 2020).

The suicide of young people has an impact on the whole environment in which they lived, especially the school they attended and the community in which they lived. Therefore, it is most effective when suicide prevention in the school environment address different levels and target young people as well as school counsellors and teachers. It is important to act preventively, but it is also necessary to be prepared for postvention that follows death by suicide, as this is

an effective way to prevent further deaths by suicide. The most successful prevention programmes focus on raising awareness, reducing risk factors and promoting protective factors. Programmes implemented in adolescence are particularly important because they promote developmentally appropriate skills and a support system that is maintained into adulthood. They show the greatest effectiveness when introduced in the school setting (Singer et al., 2020). The results of interventions are visible at multiple levels. Teachers and professionals recognise young people in distress earlier, know how to talk to them and can offer appropriate help more quickly, which helps to reduce suicidal behaviour in schools (Poštuvan et al., 2020; Singer et al., 2020). Young people who participate in interventions are more socially integrated, seek help earlier and express fewer self-harming behaviours and suicide attempts. These young people are also more open-minded, perceive the distress of their peers earlier and act more properly. The interventions also influence attitudes toward suicidal behaviour and help-seeking in the school environment (Singer et al., 2020).

In our country, under the UP IAM Slovene Centre for Suicide Research, the project Do You Understand (Yourself)?!, financed by the Ministry of Health, is being implemented. The project ensures a holistic approach by involving all relevant groups through cooperation with the school system. It includes training for teachers and school professionals, training for parents, prevention workshops for young people and postvention activities for schools if a young person dies by suicide (Poštuvan et al., 2020).

The importance of the wider environment regarding distress and suicidality of children and adolescents

The wider community can play an important role in increasing and decreasing the risk of suicide. This is particularly important when dealing with young people who are more integrated into the community due to the specific characteristics of the life period (e.g. mandatory schooling).

At the community level, the risk of suicidal behaviour may be increased by limited access to professional help, as most adolescents at increased risk of suicide do not receive professional support. The latter may be due to several factors, including the lack of staff to provide quality treatment to children and adolescents in need and geographical limitations (Campo, 2009), as qualified professionals may be geographically distant (Fenichel et al., 2002). The stigmatisation of help-seeking and mental health problems can also make it difficult to access appropriate professionals and services (WHO, 2014). As a result, adolescents often find it difficult to admit that they need professional help (Moskos et al., 2007). Stigmatising attitudes towards family and friends (e.g., seeking help is a sign of weakness), lack of knowledge about the characteristics of mental health problems and available sources of help can further hinder recognition of distress or help (Moskos et al., 2007; WHO, 2014).

Nevertheless, the wider community can play an important role in preventing suicidal behaviour in children and adolescents. Protective factors at the broader community level include good relationships with friends and community, cultural and community beliefs that discourage youth from suicidal behaviour, and access to proper mental health services (CDC, 2021a). Geographical limitations in accessing suitable mental health services for children and adolescents are being overcome with new technologies and internet-based services. Online counselling can be equally effective in enabling the receipt of important information, helping to protect the life of a person in need, and choosing a specialist with the appropriate skills (Fenichel et al., 2002). In addition, access to appropriate services may be related to combating stigma. A recent study (Poštuvan et al., 2019) on young people belonging to sexual minorities showed that a community that accepts and supports these young people can help mitigate the adverse effects of bullying and victimisation and consequently reduce the risk of suicidality.

Connecting children and adolescents with the wider community is an important protective factor. Good relationships and connections with people from the wider community can strengthen the adolescent's sense of belonging to the community, which can reduce the risk of suicidal behaviour. Young people may be more motivated to find constructive solutions due to a sense of belonging, and community members may be more motivated to observe and refer a young person in distress to appropriate professional sources of help (CDC, 2021b). Therefore, for effective prevention of suicidal behaviour in children and adolescents, prevention work aimed at reducing stigma and providing information about the problem at the community level, not just at the level of those at risk, is important. Knowing sources of help and having the attitude that it is not a sign of weakness to seek (professional) support in an emergency can be extremely important (Gilchrist & Sullivan, 2006).

The importance of the media regarding distress and suicidality of children and adolescents

The media and the way suicidal behaviour is portrayed in the media may increase or decrease the risk of suicide. The risk may increase if the way suicide is portrayed in the media is inappropriate (WHO, 2017) or if a person in distress identifies with a person reported in the media who has died by suicide. A person may identify with another person because of similar personality traits, life circumstances, or because of the person's status (e.g. the deceased was famous) (Pirkis et al., 2006). Since a famous person often enjoys the respect of the public and is perceived by people as a role model, the risk of imitating that person's behaviour is even greater if that person dies by suicide (Samaritans, 2020). The way suicide is portrayed in the media can also increase the risk of suicide. If the type of coverage reinforces suicidal behaviour (e.g. romantic or glamorous portrayal of a person and their (attempted) suicide) or if an adolescent is exposed to more extensive reporting of suicide, the risk is higher (Pirk-

is et al., 2006). The latter also increases with sensationalist reporting (e.g., simplified explanation of risk factors, graphic representation of the method used) (Samaritans, 2020).

One of the vulnerable groups particularly prone to imitate the behaviour displayed in the media or suicidal behaviour are adolescents (Gould, 2001), among whom the internet and (new) media are particularly popular (Maloney et al., 2014). In particular, the content published online can have an (even) greater influence on the users of these media (Pirkis & Nordentoft, 2011). In addition to (some) inappropriate media articles about suicide, other inappropriate content is also available on the internet (e.g. chat rooms that allow discussions about suicide, websites with factual information about suicide, and websites that encourage suicidal behaviour) (Biddle et al., 2008), which can provide very explicit descriptions of methods and information on how to obtain the desired method (Pirkis & Nordentoft, 2011). The internet also enables interaction with others who are thinking about or have accepting attitudes towards suicide, and young people are among the groups most frequently exposed to such and similar content (Dunlop et al., 2011).

Although the risk of imitating a suicide is higher if the person who died by suicide was real (i.e. it was not a fictional character from a series or movie) (Pirkis & Nordentoft, 2011), adolescents tend to imitate the suicidal behaviour of a fictional person (Pirkis & Blood, 2010). A recent study (Bridge et al. 2020) confirmed the link between the release of the television series *13 Reasons Why*, which focuses on a 17-year-old girl death by suicide, and the rise in suicides among American adolescents. Because of their similar age and similar problems, some adolescents who watched the series found it easier to identify with the main character of the series and, in certain cases, to imitate her suicide (Notredame et al., 2017), while other adolescents who had previously contemplated suicide reported feeling worse after watching the series (Rosa et al., 2019).

These findings highlight the need for the responsible and safe portrayal of suicidal behaviour in media content since responsible reporting on suicide can be a protective factor. Such content should, therefore, not contain information that could lead to identification with the deceased but should inform about the topic, highlight sources of help, and tell stories of people who have coped with distress in a constructive way (Maloney et al., 2014). Thoughtful reporting on suicide that does not sensationalise the topic but focuses on the real consequences of an (attempted) suicide can reduce the risk of imitation (Pirkis & Blood, 2010).

For people in need, various (more or less) interactive websites raise awareness, provide verified information and sources of help, and encourage a constructive solution to the distress (Barak & Grohol, 2011). One such website in the Slovenian setting is the psychoeducational website zivziv.si, which aims to raise awareness and provide information about suicidal behaviour. Preventive measures can be important as they help young people to deal with the problem

more constructively. This is even more important during adolescence, as most young people do not yet have as much experience with similar situations and therefore do not have a wide range of possible coping strategies.

Conclusions

Suicide is often just the end of a complex process that may have begun long before the actual act, and in the course of which the decision to die by suicide has changed, sometimes more, sometimes less. In this paper, we have examined the environmental factors that significantly influence the process in children and adolescents either as protective factors or as risk factors.

There are differences in which risk and protective factors are most important or have the greatest influence on the well-being of children and adolescents. For this reason, we have presented those that can be influenced with appropriate interventions.

Due to the complexity of suicidal behaviour, prevention measures need to be carefully planned and adapted to the understanding of the specific risk group (van der Feltz-Cornelis et al., 2011). Suicide in children and adolescents can be prevented. In this regard, peers, the school environment, the media and the wider community make an important contribution to prevention by discussing and reporting on these issues appropriately and empowering young people to resolve difficulties and find help. This can help create a safe environment for honest conversations and show that even major problems and hardships can be solved.

References

- BARAK, A. and GROHOL, J. M., 2011. Current and Future Trends in Internet-Supported Mental Health Interventions. *Journal of Technology in Human Services*, vol. 29, no. 3, pp. 155–196.
- BARZILAY, S., BRUNSTEIN KLOMEK, A., APTER, A., CARLI, V., WASERMAN, C., HADLACZKY, G., HOVEN, C. W., SARCHIAPONE, M., BALAZS, J., KERESZTENY, A., et al., 2017. Bullying Victimization and Suicide Ideation and Behavior Among Adolescents in Europe: A 10-Country Study. *Journal of Adolescent Health*, vol. 61, no. 2, pp. 179–186.
- BIDDLE, L., DONOVAN, J. L., HAWTON, K., KAPUR, N. and GUNNELL, D., 2008. Suicide and The Internet. *BMJ*, vol. 336, no. 7648, pp. 800–802.
- BRIDGE, J. A., GREENHOUSE, J. B., RUCH, D., STEVENS, J., ACKERMAN, J., SHEFTALL, A. H., HOROWITZ, L. M., KELLEHER, K. J. and CAMPO, J. V., 2020. Association Between the Release of Netflix's 13 Reasons Why and Suicide Rates in the United States: An Interrupted Time Series Analysis. *Journal of the American Academy of Child and Adolescent Psychiatry*, vol. 59, no. 2, pp. 236–243.

- CAMPISI, S. C., CARDUCCI, B., AKSEER, N., ZASOWSKI, C., SZAMATARI, P. and BHUTTA, Z. A., 2020. Suicidal Behaviours among Adolescents from 90 Countries: A Pooled Analysis of the Global School-Based Student Health Survey. *BMC Public Health*, vol. 20, pp. 1102.
- CAMPO, J. V., 2009. Youth Suicide Prevention: Does Access to Care Matter? *Current Opinion in Pediatrics*, vol. 21, no. 5, pp. 628–634.
- CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC), 2021a. *Risk and Protective Factors* [online]. [viewed 30 April 2022]. Available from: <https://www.cdc.gov/suicide/factors/index.html>
- CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC), 2021b. *Strategic Direction for the Prevention of Suicidal Behavior: Promoting Individual, Family, and Community Connectedness to Prevent Suicidal Behavior* [online]. [viewed 30 April 2022]. Available from: http://www.cdc.gov/ViolencePrevention/pdf/Suicide_Strategic_Direction_Full_Version-a.pdf
- DUNLOP, S. M., MORE, E. and ROMER, D., 2011. Where do Youth Learn about Suicides on the Internet, and What Influence Does This Have on Suicidal Ideation? *Journal of Child Psychology and Psychiatry*, vol. 52, no. 10, pp. 1073–1080.
- FEIGELMAN, W. and GORMAN, B. S., 2008. Assessing the Effects of Peer Suicide on Youth Suicide. *Suicide and Life-Threatening Behaviour*, vol. 38, no. 2, pp. 181–194.
- FENICHEL, M., SULER, J., BARAK, A., ZELVIN, E., JONES, G., MUNRO, K., MEUNIER, V. and WALKER-SCHMUCKER, W., 2002. Myths and Realities of Online Clinical Work. *Cyberpsychology and Behavior*, vol. 5, no. 5, pp. 481–497.
- GILCHRIST, H. and SULLIVAN, G., 2006. Barriers to Help-Seeking in Young People: Community Beliefs About Youth Suicide. *Australian Social Work*, vol. 59, no. 1, pp. 73–85.
- GILI, M., CASTELLVÍ, P., VIVES, M., DE LA TORRE-LUQUE, A., ALMENARA, J., BLASCO, M. J., CEBRIÀ, A., GABILONDO, A., PÉREZ-ARA, A., LAGARES, C., et al., 2019. Mental Disorders as Risk Factors for Suicidal Behavior in Young People: A Meta-Analysis and Systematic Review of Longitudinal Studies. *Journal of Affective Disorders*, vol. 245, pp. 152–162.
- GOULD, M. S., 2006. Suicide and the Media. *Annals of the New York Academy of Sciences*, vol. 932, no. 1, pp. 200–224.
- GREYDANUS, D. E. and CALLES, J. 2007. Suicide in Children and Adolescents. *Primary Care: Clinics in Office Practice*, vol. 34, no. 2, pp. 259–273.
- KIM, K. M., 2021. What Makes Adolescents Psychologically Distressed? Life Events as Risk Factors for Depression and Suicide. *European Child & Adolescent Psychiatry*, vol. 30, pp. 359–367.

- KING, C. A. and MERCHANT, C. R., 2008. Social and Interpersonal Factors Relating to Adolescent Suicidality: A Review of the Literature. *Archives of Suicide Research*, vol. 12, no. 3, pp. 181–196.
- KIRSH, S. J., 2010. *Media and Youth: a Developmental Perspective*. West Sussex: Wiley-Blackwell.
- MALONEY, J., PFUHLMANN, B., ARENSMAN, E., COFFEY, C., GUSMÃO, R., POŠTUVAN, V., SCHEERDER, G., SISASK, M., VAN DER FELTZ-CORNELIS, C. M., HEGERL, U. et al., 2014. How to Adjust Media Recommendations on Reporting Suicidal Behavior to New Media Developments. *Archives of Suicide Research*, vol. 18, no. 2, pp. 156–169.
- MANZAR, M. D., ALBOUGAMI, A., USMAN, N. and MAMUN, M. A., 2021. Suicide Among Adolescents and Youths During the COVID-19 Pandemic Lockdowns: A Press Media Reports-Based Exploratory Study. *Journal of child and adolescent psychiatric nursing*, vol. 3, no. 2, pp. 139–146.
- MOSKOS, M. A., OLSON, L., HALBERN, S. R. and GRAY, D., 2007. Utah Youth Suicide Study: Barriers to Mental Health Treatment for Adolescents. *Suicide and Life-Threatening Behavior*, vol. 37, no. 2, pp. 179–186.
- NACIONALNI INŠTITUT ZA JAVNO ZDRAVJE (NIJZ), 2020. 10. September – Svetovni dan preprečevanja samomora Preprečevanje samomora je družbena naloga [online]. [viewed 13 June 2022]. Available from: <https://www.nijz.si/sl/10-september-svetovni-dan-preprecevanja-samomora-preprecevanje-samomora-je-druzbena-naloga>
- NOTREDAME, C. E., GRANDGENÈVRE, P., VAIVA, G. and SÉGUIN, M., 2017. At Least One More Reason Why. *European Child and Adolescent Psychiatry*, vol. 27, no. 2, pp. 259–260.
- PIRKIS, J. and BLOOD, R. W., 2010. *Suicide and the Entertainment Media: A Critical Review*. Canberra: Commonwealth of Australia.
- PIRKIS, J. E., BURGESS, P. M., FRANCIS, C., BLOOD, R. W. and JOLLEY, D. J., 2006. The Relationship Between Media Reporting of Suicide and Actual Suicide in Australia. *Social Science and Medicine*, vol. 62, no. 11, pp. 2874–2886.
- PIRKIS, J. and NORDENTOFT, M., 2011. Media Influences on Suicide and Attempted Suicide. In: O'Connor, C., Platt S. in Gordon, J., eds. *International Handbook of Suicide Prevention: Research, Policy and Practice*. West Sussex: Wiley Blackwell, pp. 531–544.
- POŠTUVAN, V., MARS BITENC, U., PODLOGAR, T., ZADRAVEC ŠEDIVY, N. and RAHNE, M., 2020. *Stiske in samomorilno vedenje mladostnikov: preprečevanje samomorilnega vedenja v šolskem okolju*. Koper: Založba Univerze na Primorskem.
- POŠTUVAN, V., PODLOGAR, T., ZADRAVEC ŠEDIVY, N. IN DE LEO, D., 2019. Suicidal Behaviour Among Sexual-Minority Youth: A Review of the

- Role of Acceptance and Support. *The Lancet Child & Adolescent Health*, vol. 3, no. 3, pp. 190–198.
- ROH, B.-R., JUNG, E. H. and HONG, H. J., 2018. A Comparative Study of Suicide Rates among 10–19-Year-Olds in 29 OECD Countries. *Psychiatry Investigation*, vol. 15, no. 4, pp. 376–383.
- RODHAM, K., HAWTON, K. and EVANS, E., 2004. *By Their Own Young Hand: Deliberate Self-harm and Suicidal Ideas in Adolescents*. London: Jessica Kingsley Publishers.
- ROSA, G., ANDRADES, G. S., CAYE, A., HIDALGO, M. P., OLIVEIRA, M. and PILZ, L. K., 2019. Thirteen Reasons Why: The Impact of Suicide Portrayal on Adolescents' Mental Health. *Journal of Psychiatric Research*, vol. 108, pp. 2–6.
- ROŠKAR, S., 2009. Kakšni so mladi – jih poznamo? In: TANČIČ, A., POŠTUVAN V. and ROŠKAR, S., eds. *Spregovorimo o samomoru med mladimi*. Ljubljana: Inštitut za varovanje zdravja RS, pp. 23–28.
- SAMARITANS, 2020. *Media guidelines for Reporting Suicide* [online]. [viewed 13 June 2022]. Available from: https://media.samaritans.org/documents/Media_Guidelines_FINAL.pdf
- SINGER, J. B., ERBACHER, T. A. and ROSEN, P., 2020. School Based Suicide Prevention: A Framework for Evidence Based Practice. *School Mental Health*, vol. 11, no. 3, pp. 54–71.
- STATISTIČNI URAD REPUBLIKE SLOVENIJE (SURS), 2022a. *Umrli po zunanjem vzroku smrti* [online]. [viewed 1 April 2022]. Available from: <https://pxweb.stat.si/SiStatData/pxweb/sl/Data/-/05L3010S.px/table/tableViewLayout2/>
- STATISTIČNI URAD REPUBLIKE SLOVENIJE (SURS), 2022b. *Umrli po zunanjem vzroku smrti (MKB-10, poglavje XX), po starostnih skupinah in spolu, Slovenija, letno* [online]. [viewed 1 April 2022]. Available from: <https://pxweb.stat.si/SiStatData/pxweb/sl/Data/-/05L3010S.px/>
- TANČIČ, A., 2009. Tako mlad pa že samomorilen. In: TANČIČ, A., POŠTUVAN V. and ROŠKAR, S., eds. *Spregovorimo o samomoru med mladimi*. Ljubljana: Inštitut za varovanje zdravja RS, pp. 33–49.
- VAN DER FELTZ-CORNELIS, C. M., SARCHIAPONE, M., POŠTUVAN, V., VOLKER, D., ROŠKAR, S., GRUM, A. T., CARLI, V., MCDAID, D., O'CONNOR, R., MAXWELL, M., et al., 2011. Best Practice Elements of Multilevel Suicide Prevention Strategies: A Review of Systematic Reviews. *Crisis*, vol. 32, no. 6, pp. 319–333.
- WERBART TÖRNBLUM, A., SORJONEN, K., RUNESON, B. and RYDELIUS, P.-A., 2020. Who is at Risk of Dying Young from Suicide and Sudden Violent Death? Common and Specific Risk Factors among Children, Adolescents, and Young Adults. *Suicide and Life-Threatening Behavior*, vol. 50, no. 4, pp. 757–777.

- WORLD HEALTH ORGANIZATION (WHO)., 2014. *Preventing Suicide: A Global Imperative*. Luksemburg: World Health Organization. [viewed 31 July 2022]. Available from: http://apps.who.int/iris/bitstream/handle/10665/131056/9789241564779_eng.pdf?sequence=1
- WORLD HEALTH ORGANIZATION (WHO)., 2017. *Preventing suicide: a resource for media professionals, update 2017*. Geneva: World Health Organization. [viewed 31 July 2022]. Available from: <http://apps.who.int/iris/bitstream/handle/10665/258814/WHO-MSD-MER-17.5-eng.pdf?sequence=1>
- WORLD HEALTH ORGANIZATION (WHO), 2021b. *Suicide* [online]. [viewed 22 August 2022]. Available from <https://www.who.int/news-room/fact-sheets/detail/suicide>
- WORLD HEALTH ORGANIZATION (WHO), 2021a. *Suicide Data* [online]. [viewed 22 August 2022]. Available from http://www.who.int/mental_health/prevention/suicide/suicideprevent/en/
- ZUPANČIČ, M., 2009. Opredelitev razvojnega obdobja in razvojne naloge v mladostništvu. In: MARJANOVIČ UMEK, L. and ZUPANČIČ, M., eds. *Razvojna psihologija*. Ljubljana: Rokus Klett, pp. 510–524.
- ZUPANČIČ, M. and SVETINA, M., 2009. Socialni razvoj v mladostništvu. In: MARJANOVIČ UMEK, L. and ZUPANČIČ, M., eds. *Razvojna psihologija*. Ljubljana: Rokus Klett, pp. 589–611.

The influence of Roma women's education regarding their reproductive health on the health of their children

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Abstract

Introduction: The influence of education regarding their reproductive health on Roma women - women with a unique way of life in special community conditions - on the health of their children has been little researched in Slovenia. The objective of the research was to analyse the perceived consequences of health education intervention on the awareness of Roma women regarding their reproductive health and consequently on the health of Roma children. *Methods:* Qualitative research approach was used. In July and August 2015 three focus groups were created; 11 health professionals, who deal with the reproductive health of Roma women and the health of children, participated. *Results:* 10 categories were identified, in which 147 codes with a total frequency of 187 were identified. They were grouped under 4 topics. These are: (1) General education of Roma women and their knowledge in the field of reproductive health. (2) The benefits of a health education leaflet and this research. (3) Care for reproductive health and children's health. (4) Medical problems and doctor's appointments. *Discussion and conclusion:* Opportunities for progress in Roma women's reproductive health care lie in raising their awareness of the possibilities of access to reproductive services, the treatment offered by health services, and their inclusion in health education programs. Roma women's lack of general education is closely linked to their rejection of reproductive health education. Education must be adapted to their understanding, using pictorial material and straightforward messages. Furthermore, using a great deal of empathy and time considerations, they can be encouraged by visits or organization of lectures in their home environment. Roma women do not possess enough knowledge about pregnancy and childbirth, which is also due to the fact that reproductive health care knowledge is no longer passed down from generation to generation as it used to be. However, there has been some progress in the care of infants, especially

regarding the hygiene and improved living standards. A major problem is unhealthy lifestyle, especially smoking of pregnant women, smoking indoors near children, and poor nutrition of both mothers and children. Some major issues are also their reluctance to follow the advice received when visiting a gynaecological dispensary and occasional negative experiences with communication styles and feelings of discrimination.

Key words: Roma women, reproductive health, awareness, intervention study, education

Introduction

Roma women live mostly in communities defined by ethnicity. Their health culture is specific, but it is changing under the influence of the culture of the majority population and modern media. They need special attention when maintaining their reproductive health, whereby their own health awareness of extreme importance (Logar, 2016). This is not self-evident, it is influenced by self-initiative, education, community attitudes within the Roma population and the majority population (Zelko, 2015). It is precisely in these environments that Roma face discrimination both in this country and in Europe: in the family on the basis of gender, in the wider environment on the basis of ethnicity (Kymlicka, 2017). In the results of her research, Čvorović (2019) states that traditional Roma marriage can have a protective effect on the reproductive and general health of Roma women. However, other factors such as poor literacy, socio-economic conditions, violence and exclusion have a negative impact (Logar, 2016; Kymlicka, 2017; LeMasters et al., 2019).

In the last decade, many initiatives have been implemented in Slovenia to take care of the reproductive health of Roma women. Increasing health literacy, empowerment in the use of health services (Rodrigues Derecho, 2013), knowledge regarding reproductive health, the importance of gynaecological examinations, adequate motivation with approaches appropriate for Roma culture, health promotion programs - all of the above has led to greater awareness of reproductive health (Second national conference on the health of the Roma population, 2009; Rodrigues Derecho, 2013). The consultation "Roma women" (2015) also indicated a distinct need to include Roma women in the discourse on their situation and the need for greater care for sexual and reproductive health.

Health education can have a significant impact on the improvement of health of individuals and communities. It is a combination of learning experiences through which people acquire knowledge, which in turn affects the improvement of the health of an individual or a community. It is important to take into account the profession and cultural messages from the environment where educational work takes place (Zaletel Kragelj et al., 2007).

With the help of health and educational measures and interventions, certain habits and behaviours can be changed in favour of the individual's care for

health. This can be done in the form of individual counselling, preventive examinations, educational workshops, with education for responsible parenting, changing the lifestyle and reaction to illness. In dispensaries for women, various aids are used, including educational leaflets. By presenting targeted content, they try to influence the improvement of life and problem solving as an aid in self-education and personal interest in achieving goals in the field of reproductive health (Logar, 2016).

Purpose and objectives

The purpose of the research was to study the opinions and attitudes of health workers after the implemented health-educational intervention and to determine the potential changes in the behaviour of Roma women in caring for their reproductive health.

The objectives of the research were to identify the message value and usefulness of the health-educational leaflet *I care about my health*, to determine the links between education and awareness of health as a value, to analyse the gradual adoption of positive changes in the care for reproductive health. The following research questions were posed:

- How does the education of Roma women affect reproductive health care?
- How do the participants of the focus groups evaluate the health-educational intervention and the educational leaflet?
- What factors influence the development of modern-day diseases in Roma women and their children?

Methods

A prospective interventional study was conducted; qualitative methodology was used. Three focus groups were formed to determine the impact of the health-educational intervention on Roma women's greater awareness and concern for their reproductive health and the health of their children.

Instrument description

Open-ended research questions enabled the participants to discuss the issues, exchange experiences and views on the problems (Poplas Susič, 2014). In this way, we wanted to obtain an assessment of the success of Roma women's education based on the content presented in the educational leaflet. Eighteen initial questions were formed. In addition to the socio-demographic questions, we included questions about the message value of the leaflet, general evaluation of the health-educational intervention, expressed encouragement to visit the dispensary for women more often, awareness of the preservation of reproductive health, the usefulness of this type of education, methods of further education

and about general health- educational approaches in the medical treatment of Roma women and Roma children.

Sample description

The participants of the focus groups were health workers who had contact with Roma women in their work. They were able to, directly or indirectly, perceive the results of the health-educational intervention. The first focus group consisted of women's dispensary employees and a general practitioner, the second was focused on employees of the preschool dispensary (paediatrician), and the third was made up of community nurses and a student from the Faculty of Health Sciences. Ten participants had more than fifteen years of experience in the medical treatment of Roma women or children.

Description of research and data processing

Focus groups were made with eleven female health workers in the selected health centre. Based on the presence of employees, three focus groups were formed. After presenting the purpose and process of work in a focus group, they were familiarised with the basic principles of the discussion, the principle of confidentiality and anonymity, and the key contents of the research were generated (Poplas Susič, 2014). They were again shown the health and educational materials that were distributed to the Roma in the settlement or in the dispensary. Before answers were recorded, they filled out a form with demographic data, level of education, occupation, work experience expressed in years, work experience with Roma women. With these questions, we tried to establish Roma women's acceptance of the leaflet by, their response to invitations from women's dispensary, acceptance of the learned rules in the health centre regarding timing, ordering, prevention, etc. The primary texts of the focus groups were analysed according to the principles of qualitative text analysis. The preparation phase was followed by open coding, category formation and abstraction (Schreier, 2012). The obtained drafts were qualified according to their properties and dimensions (Vogri-nec, 2008; Friese, 2012).

Results

Based on the independent coding of the transcripts of all three discussions, 10 categories were formed, in which 147 codes were found with a total frequency of 187. The number of codes and the corresponding topics are shown in Table 1.

Table 1: Focus group categories and topics

Categories	Focus group 1	Focus group 2	Focus group 3	Number of codes in individual categories	Topics
Demographics	12	9	12	33	Medical personnel work.
Education of Roma women	7	2	1	10	General education of Roma people and their education in the field of (reproductive health).
Health education	9	4	6	19	
Leaflet	20	2	9	31	The usefulness of the leaflet and this research.
Research into Roma women	0	0	1	1	
Pre-natal and post-natal care	7	3	12	22	Care for reproductive health and the health of children.
Children	1	9	9	19	
Medical check-ups	12	6	4	22	Health problems and doctor's appointments.
Health problems	5	12	8	25	
Miscellaneous	0	1	4	5	

The purpose of the focus groups was to analyse the impact and results of the health-educational intervention, but the participants also talked about other areas related to Roma health care. They will also be presented, as they are connected to the findings of the members of the focus groups on the impact of education on care for reproductive health and children's health (Petek, 2014).

General education of Roma people and their education in the field of reproductive health

The general education of Roma men and women who visit their health centre is rather low. Children avoid attending school. According to some in the groups, the most effective way to stop financial assistance to parents is if the child plays truant.

“Why is there no Roma woman in this school district who has finished primary school during the compulsory education period? How can this be allowed?” (F1,S3)

“I think they have to go to school for nine years and that's it. They always repeat classes and then finish.” (F1, S2)

“11 children didn't go to school because they had health problems.” (F1,S1)

“A gypsy woman said that a girl left when she was 13 years old and that she went to social services and was told her that the girl was an adult and there was no sense going after her. (F1, S4)

Lack of basic education is associated with rejection of reproductive health education.

“Why don’t they come to the maternity school? They get an invitation. Not one has shown up in the 15 years I’ve been here.” (F1, S4)

“I came to the village at 11:00 am. They wanted come at 12:00. Then an employee from the centre went from door to door so that some of them came.” (F1, S2)

“They should make a plan for two or three of them to visit them at the settlement.” (F3, SS2)

The respondents believe that education should be brought closer to the Roma women, should be adapted to their habits and understanding, organised in their settlements, and small gifts should be provided.

“They don’t understand what you want from them, they don’t understand the words. They take everything literally.” (F3, S1)

“I don’t mind if we hold a lecture there, but I won’t go there in my free time.” (F1, S2)

“It is very important to give them something. I went to the pharmacy, where they gave me towels and soap. You know how many showed up then, before there were only three.” (F3, S2)

“You have to scare them a little and they go.” (F3, S1)

The usefulness of the health-education leaflet and the present research

The participants of all focus groups evaluated the educational leaflet positively from the point of view of its impact on greater awareness of reproductive health, encouragement to make appointments, and the appearance, importance of the present research in general.

“It is the first step, progress; however, it will take a long time for all of this to be seen: it is necessary to start with this in school, in kindergarten.” (F1, S1)

“The leaflet is good, visually very nicely organised and equipped with pictures and numbers for making appointments and working hours.” (F3, S2)

“We really like that it says we can also teach them about baby care; and with that, in this way we are also included in this leaflet. Yes, this

is how we see our role, in cooperation with other services and so on.”
(F3, S2)

“If nobody did any research and we just let everything as it was, you know how it would be. Just like it used to be; one path, everything dirty. They were all in shirts and barefoot. I think it’s necessary to do research.” (F3, S3)

The comments mainly concerned the font size, the translation into Roma language. They pointed out that the intervention was not long enough.

“I wouldn’t translate everything. The first page, yes, so that they feel addressed. They are part of our society and must learn Slovenian language.” (F3, S2)

“This is probably one of the forms of raising their awareness. You were able to establish more order in the women’s dispensary, but there is no way for this to be achieved in general clinics.” (F1, S1)

Caring for reproductive health and the health of children

The participants of the focus groups believe that Roma women still know too little about pregnancy and childbirth, perhaps even less than in the past.

“It’s true, they don’t know anything. They no longer pass down knowledge. They are terrified when they come for the first doctor’s appointment.” (F1, S3)

Nowadays Roma women give birth in maternity hospitals, whereas in the past they had babies at home or in the forest. Progress can also be detected in childcare. Mothers also come for check-ups, but these visits become fewer with time.

“Now they go to the hospital because they are afraid for themselves and the child, but it is true that they leave already in the evening. If there are problems, they stay.” (F3, S2)

“Now community nurses bathe the babies during home visits. They have water waiting for us when we arrive. They have basins and also prams.” (F3, S2)

“We are trying our best, the most important thing is to gain trust.”
(F3, S1)

According to the community nurses who participated in the focus groups, the health of both mothers and children is affected by smoking and heat in their houses, as well as poor nutrition. Roma women refuse to breastfeed.

“It’s very hot in their homes. They smoke inside. And nutrition is a problem. Poor, bland, unhealthy. Sweet soda drinks.” (F3, S2)

“Very few women breastfeed. Maybe the first month, but not after that. They buy processed food, it’s the new fashion for them.” (F2, S1, S2, S3)

In the children’s dispensary, they encounter problems regarding the mandatory vaccination of children.

“Vaccination of children depends on the mother. There are problems with prevention, there is no problem with curative treatment. We then “catch” them and vaccinate them.” (F2, S1)

Health problems and doctor’s appointments

Experts point out unhealthy eating habits, obesity, diabetes and cardiovascular diseases.

“There are many people who suffer from diabetes and obesity. Cardiovascular problems and heart attacks are present among Roma people.” (F1, S1)

“There is one child who is only sent to kindergarten for lunch, but he can’t even hold a pencil. He is so fat. I ask them if they ever cook spinach, and they just look at me strangely. Burek, pizzas, iced tea, carbonated drinks, this is what Roma children love. And adults too.” (F2, S1)

“We should put more effort into ensuring proper nutrition, so it would be a good idea to organize courses and education.” (F2, S2)

Research participants note progress in hygiene and dental care.

“As far as cleanliness and hygiene are concerned, it’s different now. They are nicely dressed. They used to be toothless. It’s a little better now, they do brush their teeth.” (F2, S2)

They point out that general awareness of health care is still weak. Roma women often do not come for examinations, even if they have an appointment, they take advantage of the on-call service.

“If we order them at 7:00 a.m., they won’t be there. Then we say say at 12:00. We say that something will be wrong with the child and they come.” (F1, S2)

“The main thing is not to wait.” (F1, S4)

“Online ordering, well, that’s what I’d like to see. We are not there yet. They don’t know the basics yet.” (F1, S1, S2, S3, S4)

Discussion

Regardless of their perception of health, people and the public expect high-quality treatment - on time and equally accessible to everyone (Prevolnik Rupel, Simčič and Turk, 2014). In Slovenia, there is no equality regarding health between the majority population and the Roma. They face basic problems, such as lack of access to drinking water and electricity, poorer living conditions, exclusion, which in turn affects their integration into the education system, attitudes to health, especially in preventive activities and causes unhealthy eating habits (World Roma Day, 2021).

Roma women in Slovenia have equal access to public health as the rest of the population, but in practice they make insufficient use of these opportunities (Logar Čuček, 2020). Taking care of their health is of secondary importance for Roma women, due to their position in the family, poorer social status, and lower level education. Health workers included in this research confirm this. They find that in the researched area, few Roma women complete primary school education due to the delayed start of schooling, repetition of classes. They can acquire certain skills in the last triad of primary school education, but they usually do not get that far. Lack of basic education also discourages them from participating in various educational workshops on reproductive health, infant care and maternity schools. For greater responsiveness, Roma women must be motivated in a culturally acceptable way by taking into account language barriers, the influence of tradition, and by adapting to Roma customs and understanding. They also drew attention to the problems in communication between them and Roma women and, as a result, poorer cooperation and lack of information, which is in line with the findings of similar research (Watson and Downe, 2017; LeMasters, 2019; Komidar, 2019).

The research, which was carried out in the selected Roma settlement in three phases (2016), has an applicative character, as the results were used to create health and educational material, which included guidelines for more effective access of Roma women to the women’s dispensary where they could get help and advice. The usefulness of the “I take care of my health” leaflet was also verified with focus groups consisting of health workers responsible for women’s reproductive health. The participants confirmed the usefulness of the leaflet from the point of view of both its design and content: the location of the medical centre, following the day of the week and working hours, the purpose of the medical card, methods of making appointments. This would reduce visits to emergency care. Areas where health workers can help them in taking care of their health and the health of their children were presented. They emphasized the usefulness of information regarding the importance of gynaecological examination, pregnancy, childbirth, protection, breastfeeding. They found

that such material has an impact only if certain conditions are met, such as at least minimal literacy of the target group and the fact that the user (in this research, these were women of reproductive age) can identify with the content. Older Roma women would need educational materials for preventive examinations, combined with information how to recognize possible symptoms of diseases. Illiterate women should be offered pictorial illustrations.

In the conversation with the health workers, we noticed some progress in taking care of reproductive health and children's health. They give birth in a hospital, take care of their own and their children's hygiene; they react very quickly to health problems in children, because for Roma, children represent joy. Most of them gave up breastfeeding. That being a mother is a mission for Romani women is also confirmed by other research (LeMasters et al., 2019). There are many obese children, which they attributed to low-quality nutrition. They often catch colds due to inadequate living conditions. Smoking is present. The possibility of discrimination was denied by the health workers, but Romani women sometimes they are also "provoked" because they are Roma or by different approaches to medical treatment, non-observance of instructions, treatment procedures, etc. This is also confirmed by research conducted by other authors (Colombini et al., 2012; Watson and Downe, 2017).

Our research cannot be representative of all areas of Slovenia, but it brings valuable insights of health workers, as they were able to express and exchange their opinions for the first time about their experience with Roma people, their health and the health of their children.

Conclusion

The findings of this research show that Roma people should be encouraged to take care of their health. Various methods of education, talks, workshops are available to achieve this goal. Their traditions must be considered, messages must be unambiguous and supported by images. They should be educated continuously, using similar intervention materials, modern media, planned research, and the findings should be implemented into practice. The effects of the intervention should be compared in different settlements in Slovenia. Only in this way can a conceptual framework for a more unified approach and solving weak points in caring for the reproductive health of Roma women and the health of Roma children be obtained.

References

- COLOMBINI, M., RACHEL, B. and MAYHEW, S.H., 2012. Access of Roma to sexual and reproductive health services: qualitative findings from Albania, Bulgaria and Macedonia. *Global Public Health*, vol. 7, no. 5, pp. 522–535.

- ČVOROVIC, J., 2019. Self-rated health and teenage pregnancies in Roma women: increasing height is associated with better health outcomes. *Journal of Biosocial Science*, vol. 51, no. 3, pp. 444–456.
- DRUGA NACIONALNA KONFERENCA O ZDRAVJU ROMSKE POPULACIJE, 2009. Zdravje romskih žensk. [online] [viewed 1 August 2022]. Available from: [http://mz.gov.si/zdravje romskih žensk porocilo o konferenci.doc](http://mz.gov.si/zdravje_romskih_zensk_porocilo_o_konferenci.doc)
- FRIESE, S., 2012. *Qualitative Data Analysis with ATLAS.ti*. London: Sage.
- KOMIDAR, K., 2019. Upoštevanje medkulturnosti pri opravljanju zdravstvene dejavnosti. *Revija za zdravstvene vede*, vol. 6, no. 2, pp. 3–21.
- KYMLICKA, W., 2017. In: SOSA L., ed. Empirical case in Europe: Roma women and domestic violence. [in press]. *Cambridge University press*, pp. 173–204. [viewed 1 August 2022]. Available from: <http://doi.org/10.1017/978136771525.007>
- LeMASTERS, K., BABER WALLIS, A., CHERECHES, R., GICHANE, M., TEHEI, C., VARGA, A. in TUMLINSON, K., 2019. Pregnancy experiences of women in rural Romania: understanding ethnic and socioeconomic disparities. *Culture, Health, Sexuality*, vol. 21, no. 3, pp. 249–262.
- LOGAR, M., 2016. *Vpliv zdravstveno-vzgojne intervencije na osveščenost Rominj o reproduktivnem zdravju*: doctoral thesis. Ljubljana: Univerza v Ljubljani, Medicinska fakulteta, pp. 2, 8–9, 23, 53–60, 71, 74.
- LOGAR ČUČEK, M., 2020. Odnos Rominj do reproduktivnega zdravja in do stika z ginekološkimi zdravstvenimi službami: kvalitativna opisna raziskava. *Obzornik zdravstvene nege*, vol. 54, no. 4, pp. 304–314.
- PETEK, D., 2014. Interpretacija podatkov – kvalitativna metodologija. In: KLEMENC-KETIŠ, Z. and ŠVAB, I., eds. *Raziskovanje v družinski medicini: priročnik*. Ljubljana: Katedra za družinsko medicino Medicinske fakultete, pp. 52–56.
- POPLAS SUSIČ, T., 2014. Kvalitativna metodologija. In: KLEMENC-KETIŠ, Z. and ŠVAB, I., eds. *Raziskovanje v družinski medicini: priročnik*. Ljubljana: Katedra za družinsko medicino Medicinske fakultete, pp. 38–44.
- PREVOLNIK RUPEL, V., SIMČIČ, B. and TURK., E., 2014. Terminološki slovar izrazov v sistemu zdravstvenega varstva. Ministrstvo za zdravje, pp. 92–100.
- RODRÍGUEZ DERECHO, N., ANCONA VALDEZ, C., PERNAS RIAÑO, B. and FRANCO ALONSO, Ó., 2013. Pregled romske kulture. In: GAŠPERŠIČ, M. and PAVŠELJ, M., eds. *Zdravje, preprečevanje zasvojenosti in romska mladina v Evropi: priročnik in delovanje v praksi*. Novo mesto: RIC, pp. 17–27.
- OB SVETOVNEM DNEVU ROMOV, ŠE VEDNO LJUDSTVO Z OBROBJA, 2021. [online]. [Viewed 2 August 2022]. Available from: <http://www.bakos.si/druzba/ob-svetovnem-dnevu-romov>

- SCHREIER, M., 2012. *Qualitative Data Analysis in Practice*. Los Angeles: Sage.
- VOGRINEC, J., 2008. *Kvalitativno raziskovanje na pedagoškem področju*. Ljubljana: Pedagoška fakulteta.
- WATSON, H.L. and DOWNE, S., 2017. Discrimination against childbearing Romani women in maternity care in Europe: a mixed-methods systematic review. *Reproductive Health*, vol. 14, no. 1, pp. 1–16.
- ZALETEL KRAGELJ, L., ERŽEN, I., PREMİK, M. and PAHOR, M., 2007. *Uvod v javno zdravje*. Ljubljana: Medicinska fakulteta.
- ZELKO, E., 2015. *Razvoj metodologije javnozdravstvenega pristopa v romski skupnosti*: doctoral thesis. Ljubljana: Univerza v Ljubljani, Medicinska fakulteta.
- ŽENSKÉ ROMINJE, 2015. [online]. Ljubljana: Ministrstvo za zdravje in Zveza Romov Slovenije. [viewed 3 August 2022]. Available from: <http://www.ric-nm.si/si/novice/oso-na-posvetuzenske-rominje-od-deklistva-dostarsevstva/3343/>

Factors related to oral health-related quality of life among children and adolescents in Slovenia

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Abstract

Introduction: Oral health is a part of general health. Problems with the oral cavity and/or teeth cause pain, discomfort and limitations in performing the function of the orofacial system and other daily tasks and reduce quality of life. Oral health-related quality of life (OHRQoL) can be used to assess the impact of oral health on an individual's life, self-image, social interactions and work/school performance. Understanding the demographic and socio-economic characteristics of groups of individuals with poorer OHRQoL is crucial for the preparation of successful and effective public health approaches to improve and strengthen oral health. **Methods:** In the »National Survey on Oral Health of Children and Adolescents in Slovenia in 2019« we used a questionnaire with which we also monitored 6 indicators of OHRQoL. Questions related to difficulties with eating food, tense feelings, difficulties in carrying out school work, the presence of toothache, the presence of sores/ulcers and awkwardness due to the appearance of teeth. Children aged 6–17 were included in the study. In the group of children with poorer OHRQoL we included individuals that answered at least one question with occasionally or more often. **Results:** At least one OHRQoL limitation occurred occasionally or more often in 22.5% of participants. Painful gums/sores in the mouth were the most common (10.6%), 6.6% of children and adolescents were embarrassed because of the appearance of their teeth, 6.0% felt tense because of oral cavity/teeth problems, 5.5% had toothache, 4.8% experienced difficulties with eating food due to oral cavity/teeth problems and 4.1% had difficulties carrying out school work due to problems with their oral cavity/teeth. One or more limitations were more frequent in girls (girls 24.9%, boys 20.4%). At least one of the limitations was more common in children aged 6–7 (24.5%), the proportion decreased in the age group 8–10 (19.5%) and increased to 25.2% at age 15–17 years. The proportion of children and adolescents

with one or more limitations decreased with higher levels of parental education (35.7% with primary education, 18.7% with a university degree).

Discussion and conclusions: More than three quarters of children and adolescents did not experience limitations in their daily lives due to problems with the oral cavity and/or teeth. In the youngest age group, the problems were probably related to changing teeth and still present deciduous teeth. In the oldest age group problems with teeth and the oral cavity accumulate, and at the same time, they were probably linked to psychological changes related to growing up. Children and adolescents of parents with a high level of education had a better OHRQoL than children and adolescents of parents with a lower level of education. Oral health care was higher among the more educated individuals, which was reflected in the oral health of children and also had an impact on OHRQoL. Dental public health programs and interventions should be upgraded to incorporate activities of oral health promotion for those groups of children and adolescents.

Keywords: children and adolescents, oral health-related quality of life (OHRQoL), parental education

Introduction

Modern, evidence-based references consider oral health to be an integral part of overall health. Teeth, with their chewing, phonation and aesthetic functions, contribute significantly to a better quality of life and to social interactions, and their functional impairment affects general health (WHO, 2003; Ranfl et al., 2017; Baiju et al., 2017; Sischo et al., 2011). As such, oral health is not only the absence of disease in the oral cavity, but also enables individuals to engage in everyday activities and thus participate in interpersonal relationships (Baiju et al., 2017).

Various oral health conditions represent a major public health problem due to the burden of their frequency and the social, economic and psychological consequences at both individual and societal levels (Baiju et al., 2017; Johansson and Osterberg, 2015). These conditions cause pain and limitations in everyday tasks such as chewing, speaking, laughing, and thus reduce the individual's quality of life (Paredes-Rodriguez et al., 2016).

In 1988, Locker introduced the oral health-related quality of life (OHRQoL) model, which led to the inclusion of the patient's perspective in treatment (Locker, 1988). This is important because the biomedical view of health has been upgraded to a biopsychosocial model also in the field of oral health. OHRQoL is a concept that can be used to assess the impact of oral health on an individual's daily life, i.e. self-image, social interactions, school and work performance, and more (Sischo et al., 2011; Gherunpong et al., 2006). Assessment of OHRQoL varies over the course of an individual's life and is associated with different factors: functioning (chewing, speech), pain and discomfort (acute pain, chronic pain), psychological factors (contentment with

appearance, self-image) and social factors (interpersonal relationships, communication) (Bennadi et al., 2013). Individuals usually understand their health in a broader sense - as the presence or absence of disease.

In particular, during childhood and adolescence, in addition to its effects on eating and speech, oral health has an important impact on social participation and interpersonal relationships. During this period, children and adolescents' relationships with peers become important, where self-image, physical self-image, including facial appearance and psychological well-being play an important role (Rando et al., 2018). Oral and/or dental problems can also affect a child's/adolescent's daily functioning, such as school performance. Oral and/or dental problems can have a negative impact on school performance, as pain interferes with a child's sleep, resulting in poorer academic performance (Krisdapong et al., 2013).

Subjective assessment of OHRQoL is also important because it has an impact on an individual's actions to take care of his or her own health, and are in turn reflected in their health status. Finally, the assessment of OHRQoL is important in the light of inequalities in access to dental care (Sischo et al., 2011). Research on OHRQoL is important to identify groups at increased risk of poor oral health, as poor oral health in childhood may continue into adulthood (Kragt et al., 2016).

Methods

The data were collected as a part of the cross-sectional »National Survey on Oral Health of Children and Adolescents in Slovenia in 2019«. A representative sample of 3,200 children and adolescents under the age of 18 was included. The survey was carried out using the EGOHID questionnaire. Questions related to OHRQoL were addressed to children and adolescents aged 6 years or older. The children and adolescents included in the study received an invitation to participate in the survey at a home address, with a password to access the online questionnaire. The survey took place in spring 2019, and participants received another postal reminder during the survey period. The questionnaire was completed by parents, but young people aged 11–17 were offered the opportunity to complete the survey by themselves.

The data collected from the survey were reviewed in »Microsoft Excel 2016«. The data were weighted by age and gender, taking into account one-year age groups. The analysis of the weighted data per sample and population was carried out in the computer software IBM SPSS Statistics for Windows', version 21.0 (IBM, 2020).

The OHRQoL questionnaire contained six questions on the frequency of dental problems when eating, the frequency of feeling tense, the frequency of difficulties in carrying out schoolwork, the frequency of toothache, the frequency of painful gums/sores in the oral cavity and the frequency of embarrassment with the appearance of the teeth. Respondents could choose from five

possible answers on a 5-point Likert scale (never, hardly ever, occasionally, often, very often). We defined occasional, frequent and very frequent as the most common occurrence of limitations. For further analysis, we included only the answers given by parents and only individuals who answered all 6 questions related to quality of life.

The interpretation of the results is based on the number and percentages of persons in the selected categories, according to demographic variables such as gender, age, parental/guardian education and living environment.

Results

According to the exclusionary factors taken into account in further data analysis, the final sample size was 725 persons. There were slightly more boys/men and slightly fewer adolescents aged 15 years or older. Most of the parents had at least a secondary education. The detailed data are shown in Table 1.

Table 1: Demographic data of the individuals included in the analysis (N=725).

	Total	725 (N)	100 (%)
Gender	Boys	387	53.4
	Girls	338	46.6
Age	6–7 years	159	21.9
	8–10 years	241	33.2
	11–14 years	218	30.1
	15–17 years	107	14.8
Parental education	Primary school	14	1.9
	High school	245	33.8
	College education (vocational)	209	28.8
	University degree	257	35.4
Living environment	Urban	229	31.6
	Suburban	184	25.4
	Rural	309	42.6

At least one OHRQoL limitation occurred occasionally or more often in 22.5% of the participants. One or more limitations were more frequent in girls (girls 24.9%, boys 20.4%). In the age group 6–7 years, the prevalence of at least one limitation was 24.5 % and dropped to 19.5% in age group 8–10 years. In the next age group, it rose again and was the highest in the group of youngsters 15–17 years old. Prevalence of limitations was also dropping with higher parental education; it was the highest in a group of children whose parents had only primary education and was the lowest in a group where parents had a university

degree. Prevalence of at least one limitation was also higher in more rural local environments/settlements. For detailed results see Table 2.

Table 2: Demographic data by frequency of occurrence of particular problems or limitations (N=725).

		No limitations (N)	One or more limitations (N)	Participants with limitations (%)
Total		562	163	22.5
Gender	Boys	308	79	20.4
	Girls	254	84	24.9
Age	6–7 years	120	39	24.5
	8–10 years	194	47	19.5
	11–14 years	168	50	22.9
	15–17 years	80	27	25.2
Parental education	Primary school	9	5	35.7
	High school	180	65	26.5
	College education (vocational)	164	45	21.5
	University degree	209	48	18.7
Living environment	Urban	185	44	19.2
	Suburban	152	32	17.4
	Rural	222	87	28.2

Table 3: Prevalence of specific limitations (N=725).

	Occasionally or more often (N)	Participants with limitations (%)
Having difficulty eating food	35	4.8
Felt tense	44	6.0
Difficulties with school work	29	4.1
Toothache	40	5.5
Sore gums/sores in the mouth	77	10.6
Embarrassed by the appearance of his/her teeth	48	6.6

Most of the participants had no limitations. From those who had some, most had only one limitation which was present in 13.9% of the total sample, two limitations were present in 4.9% of the total sample, three or more limitations were present in 3.7% of the total sample. There were also differences in the prevalence of specific limitations, of which the most common limitations were painful gums and mouth sores (10.6%), the second most prevalent feeling was embarrassment because of the appearance of their teeth (6.6%) and only 4.1%

had difficulties in carrying out schoolwork due to problems with their oral cavity/teeth. Detailed data are presented in Table 3.

Discussion

The results of the analysis show that almost a quarter of children and adolescents experienced at least one symptom or feeling that affected their OHRQoL occasionally (or more often). Similar results on the prevalence of limitations have also been found in cross-sectional studies on the impact of oral health problems on children's experience of limitations in everyday life (Rozier, 2008; Nuttall et al., 2003).

More serious limitations, such as difficulties in carrying out daily tasks, were not as common. Sore gums and sores in the oral cavity were more likely to occur. The proportion of participants with limitations was higher in the youngest age group, which can be linked to changes and circumstances in school entry and tooth eruption and was also high in the 15–17 age group, where aspects of growing up and socialization also play a role. Dental dissatisfaction varies by age according to the developmental characteristics of the children and is different in childhood than in adolescence. Feelings of attractiveness in relation to oral health become more important in late childhood and adolescence (Nuttall et al., 2003). In adolescence, individuals become more sensitive to social norms and ideals, and how they are perceived by their peers becomes more important (Barbosa et al., 2008).

In a survey in the United Kingdom, pain was reported as the most common limitation across all age groups (15–25% of children reported having pain). This was consistent with our findings when combining the responses to the questions on the frequency of toothache and the frequency of sore gums. Some differences in the frequency of certain limitations in daily life due to oral and/or dental problems were also observed by gender, as parents of girls/adolescents were more likely to report the presence of at least one limitation. Results from the study on the impact of oral health problems in children in the UK did not confirm significant gender differences in the frequency of limitations due to oral health problems (Nuttall et al., 2003).

We also observed some differences in the prevalence of limitations in daily life for children/young people regarding the education of their parents/guardians. Education is an important determinant of health-related behavior. While tooth-brushing with regular check-ups at the dentist is an important part of a healthy lifestyle, taking care of one's own oral health is one of the most important factors of oral health and, consequently, also an important factor in promoting health. With lower levels of education, we can expect poorer oral health care, as we know that children of parents with lower education are less likely to brush their teeth, as shown also by the results of our study (Artnik et al., 2020).

Results of our study were consistent with the research on inequalities in OHRQoL in children, which had shown that children from families with lower socioeconomic status (which includes parental education) had lower OHRQoL than children from families with higher socioeconomic status (Kragt et al., 2016; Kumar et al., 2014; Locker, 2007). The systematic review on the impact of parental/caregiver socioeconomic status on children's OHRQoL showed a direct association between parental/caregiver education level and children's quality of life. Children of parents/caregivers with high levels of education were more likely to have better OHRQoL than children of parents/caregivers with lower levels of education, and a particularly significant association was found between maternal education and child OHRQoL (Kumar et al., 2014). Family socioeconomic status, which may be related to parental educational status, has a significant impact on children's oral health through the ability of parents or caregivers to respond to children's oral health needs and habits (Chaffe et al., 2017).

Similarly, differences in OHRQoL also emerged according to the living environment. The proportion of children/adolescents who often or occasionally experienced limitations in their daily life due to oral and/or dental problems was higher among children/adolescents from a rural living environment than among children/adolescents from an urban or suburban living environment. Differences by living environment for individual limitations were also confirmed in the detailed analysis, and these were particularly evident for the occurrence of painful wounds or ulcers in the oral cavity and toothache (Artnik et al., 2020).

We decided to limit the analysis to parental responses only, because the younger age group was not expected to complete the survey themselves, and because there was some ambiguity in the responses of the adolescents who completed the survey themselves regarding their or their parents' educational qualifications. This brings some limitations for the interpretation of the data. Subjective assessment of OHRQoL, especially when reported by parents/caregivers for their children, should be seen as a complement to, and not a substitute for, dental needs assessment or clinical oral health assessment (Allen, 2003).

In order to get a precise overview of the prevalence of each limitation and to determine the proportion of the population with more than one limitation, we decided to limit the analysis to individuals who answered all six questions. For individuals who answered only one or a few questions, we could not assess whether they have other limitations.

Conclusions

Oral health is an integral part of general health and has great influence on quality of life. Children and adolescents in Slovenia occasionally feel some lim-

itations and symptoms regarding oral health. OHRQoL is lower in children of parents with lower education and in children in more rural settlements. Dental public health programs and interventions should be upgraded to incorporate activities of oral health promotion for those groups of children and adolescents.

References

- ALLEN, P. F., 2003. Assessment of oral health related quality of life. *Health and quality of life outcomes*, vol. 1, no. 40.
- ARTNIK, B., RANFL, M., BLATNIK, J., MAGAJNA, A. and ROSTOHAR, A., 2020. *Ustno zdravje otrok in mladostnikov, 2019: nacionalna raziskava o ustnem zdravju otrok in mladostnikov v Sloveniji leta 2019*. Elektronska izd. [online]. [viewed 28 June 2022]. Available from: https://www.nijz.si/sites/www.nijz.si/files/publikacije-datoteke/publikacija_otroci_ustno_zdravje.pdf
- BAIJU, R. M., PETER, E., VARGHESE, N. O. and SIVARAM, R., 2017. Oral health and quality of life: current concepts. *Journal of clinical and diagnostic research*, vol. 11, no. 6, pp. ZE21–ZE26.
- BARBOSA, T. S. and GAVIÃO, M. B., 2008. Oral health-related quality of life in children: part I. How well do children know themselves? A systematic review. *International journal of dental hygiene*, vol. 6, no. 2, pp. 93–99.
- BENNADI, D. and REDDY, C. V., 2013. Oral health related quality of life. *Journal of international society of preventive & community dentistry*, vol. 3, no. 1, pp. 1–6.
- CHAFFEE, B. W., RODRIGUES, P. H., KRAMER, P. F., VÍTOLO, M. R. and FELDENS, C. A., 2017. Oral health-related quality-of-life scores differ by socioeconomic status and caries experience. *Community dentistry and oral epidemiology*, vol. 45, no. 3, pp. 216–224.
- GHERUNPONG, S., SHEIHAM, A. and TSAKOS, G., 2006. A sociodental approach to assessing children's oral health needs: integrating an oral health-related quality of life (OHRQoL) measure into oral health service planning. *Bulletin of the World Health Organization*, vol. 84, no. 1, pp. 36–42.
- INTERNATIONAL BUSINESS MACHINES CORPORATION (IBM), 2020. SPSS Statistics 21.0 available for download [online]. [viewed 19 July 2022]. Available from: <https://www.ibm.com/support/pages/spss-statistics-210-available-download>
- JOHANSSON, G. and ÖSTBERG, A. L., 2015. Oral health-related quality of life in Swedish young adults. *International journal of qualitative studies on health and well-being*, vol. 10, no. 1, pp. 27125.
- KRAGT, L., VAN DER TAS, J. T., MOLL, H. A., ELFRINK, M. E., JADDOE, V. W., WOLVIUS, E. B. and ONGKOSUWITO, E. M., 2016. Early caries pre-

- dicts low oral health-related quality of life at a later age. *Caries research*, vol. 50, no. 5, pp. 471–479.
- KRISDAPONG, S., PRASERTSOM, P., RATTANARANGSIMA, K. and SHEEHAM, A., 2013. School absence due to toothache associated with sociodemographic factors, dental caries status, and oral health-related quality of life in 12- and 15-year-old Thai children. *Journal of public health dentistry*, vol. 73, no. 4, pp. 321–328.
- KUMAR, S., KROON, J. and LALLOO, R., 2014. A systematic review of the impact of parental socio-economic status and home environment characteristics on children's oral health related quality of life. *Health and quality of life outcomes*, vol. 12, no. 41.
- LOCKER D., 1988. Measuring oral health: a conceptual framework. *Community dental health*, vol. 5, no. 1, pp. 3–18.
- LOCKER D., 2007. Disparities in oral health-related quality of life in a population of Canadian children. *Community dentistry and oral epidemiology*, vol. 35, no. 5, pp. 348–356.
- NUTTALL, N. M., STEELE, J. G., EVANS, D., CHADWICK, B., MORRIS, A. J. and HILL, K., 2006. The reported impact of oral condition on children in the United Kingdom, 2003. *British dental journal*, vol. 200, no. 10, pp. 551–555.
- PAHEL, B. T., ROZIER, R. G. and SLADE, G. D., 2007. Parental perceptions of children's oral health: The Early Childhood Oral Health Impact Scale (ECOHIS). *Health and quality of life outcomes*, vol. 5, no. 6.
- PAREDES-RODRÍGUEZ, V. M., TORRIJOS-GÓMEZ, G., GONZÁLEZ-SERRANO, J., LÓPEZ-PINTOR-MUÑOZ, R. M., LÓPEZ-BERMEJO, M. Á. and HERNÁNDEZ-VALLEJO, G., 2016. Quality of life and oral health in elderly. *Journal of clinical and experimental dentistry*, vol. 8, no. 5, pp. e590–e596.
- RANDO, G. M., JORGE, P. K., VITOR, L., CARRARA, C., SOARES, S., SILVA, T. C., RIOS, D., MACHADO, M., GAVIÃO, M. B. and OLIVEIRA, T. M., 2018. Oral health-related quality of life of children with oral clefts and their families. *Journal of applied oral science: revista FOB*, no. 26, pp. e20170106.
- RANFL, M., OIKONOMIDIS, C., KOSEM, R. and ARTNIK, B., 2017. *Vzgoja za ustno zdravje: prehrana in higiena: strokovna izhodišča*. Ljubljana: Nacionalni inštitut za javno zdravje.
- ROZIER, R. G. and PAHEL, B. T., 2008. Patient- and population-reported outcomes in public health dentistry: oral health-related quality of life. *Dental clinics of North America*, vol. 52, no. 2, pp. 345–365.
- SISCHO, L. and BRODER, H. L., 2011. Oral health-related quality of life: what, why, how, and future implications. *Journal of dental research*, vol. 90, no. 11, pp. 1264–1270.

WORLD HEALTH ORGANIZATION (WHO), 2003. *The World Oral Health Report 2003. Continuous improvement of oral health in the 21st century - the approach of the WHO Global Oral Health Programme*. Geneva: World Health Organization.

The effect of inspiratory muscle training on the maintenance of swimming abilities

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Abstract

Introduction: Swimming, especially competitive, is one of the biggest challenges for the respiratory muscles. Muscles are weaker in the horizontal position, the hydrostatic pressure requires greater muscle force during inhalation, in addition, the respiratory muscles are also involved in stabilizing the torso during swimming. Limited breathing time is an additional challenge. The purpose of our study was to examine whether inspiratory muscle exercise also affects the maintenance of swimming abilities during a swimming break. According to the literature, increasing the strength of the inspiratory muscles has a major impact on improving respiratory and swimming efficiency and performance. *Methods:* The study involved first-year students of the Applied kinesiology program ($n = 19$, age: 19.7 ± 0.9 years), who were divided into an intervention group ($n = 11$) and a control group ($n = 8$). They were included in the program of an eleven-day swimming course, after which we performed the first measurements. The second measurements were performed ten days after the end of the course. In the intervening period, none of the subjects performed any swimming training. The intervention group conducted an inspiratory muscle training program twice a day with the Powerbreathe Plus device. *Results:* The results showed a trend of improvement in maximal inspiratory strength, maximal inspiratory flow, test of CO₂ tolerance, breath holding after a relaxed exhalation (Buteyko test) and in under water breathe holding test. Statistically significant effect of time was shown in the 50-100 m and 0-100 m swimming test. In both tests the result deteriorated in the intervention and control group, but a significant trend was shown. Namely, in both tests the swimming time in the control group was longer than in the intervention group. *Discussion and conclusions:* In the literature reviewed, we found that simultaneous exercises of specific sports and inspiratory muscles for at least four weeks, in most cases,

affect the improvement of respiratory functions and results in various sports. Based on the results of our research and the literature reviewed, we can conclude that the inspiratory muscle training in the period without swimming-specific training, shows a trend of positive effect on maintaining swimming results.

Keywords: inspiratory muscles, breathing, maintenance of abilities, Powerbreathe, swimming

Introduction

The aquatic environment is one of the most demanding for respiratory muscles (hereafter RM), and competitive swimming represents one of the biggest challenges for them (McConnell, 2011). Lomax and McConnell (2003) showed that swimming causes a 29% drop in inspiratory muscle (hereafter IM) strength after exercise, compared to “land” sports, where the drop is between 10% and 20%. Breathing with the chest submerged requires greater IM force due to hydrostatic pressure (Wylegala, Pendergast, Gosselin, Warkander, and Lundgren, 2007) and IM are 16% weaker in the horizontal position (McConnell, 2011). The breathing pattern requires a high degree of body mobility in order to minimize the negative impact on stroke mechanics (Lomax and Castle, 2011, Leahy et al., 2019). Due to better hydrodynamics, swimmers strive to reduce the number of breaths and time when the head is out of the water McConnell (2011), so they must breathe quickly and as deep as possible (Leahy et al., 2019). In addition, during swimming, RM participate in trunk stabilization during propulsive moments (Vašičkova et al., 2017), and muscles with several roles simultaneously, are more susceptible to fatigue, reduced capacity and sport performance (McConnell, 2011).

Inspiratory muscle training (hereafter IMT) is mentioned in the literature as an effective method for improving efficiency and performance in various sports. RM are highly adaptive to repeated exercise and show changes in structure, strength improvement, contraction speed and endurance (Ramirez-Sermiento, 2002; McConnell and Romer, 2003, McConnell, 2011). In a study by Downey et al. (2007), after four to eight weeks of IMT against resistance, biopsy has shown an increase in diaphragm thickness by 12%. In addition they noticed an improvement in inspiratory strength by 24% after four and 41% after eight weeks of exercise.

Some effects of IMT on performance in sports are already known. An improvement in the endurance of underwater (33% - 50%) and surface (38% - 88%) fin swimming was shown, the respiratory volume increased (12%), respiratory frequency decreased by 19% and energy expenditure by 7,8% (McConnell, 2011). In underwater swimmers, the improvement was shown in maximal inspiratory pressure (hereafter MIP), inspiratory volume (hereafter IV) and underwater swim distance (USD) (Pupišova, Pupiš, Jančokova and Pivovarniček, 2014). Kilding, Brown and McConnell (2010) found an increase in MIP and swim-

ming time for 100m and 200m after six-week IMT, the similar results Nahtigal (2015) found in 14- to 16-year olds after eight weeks of training.

The purpose of our study was to examine whether IMT also affects the maintenance of swimming abilities during a swimming break. The purpose of the research is particularly meaningful at the time, when restrictions and recommendations due to the declared epidemic of the covid-19 disease occasionally limited the implementation of swimming activities in swimming pool facilities.

Methods

19 students (5 male and 14 female) of the first year of the undergraduate study program Applied Kinesiology participated in the research. They were divided into an intervention (n = 11; 6 women, 5 men) and a control group (n = 8; 8 women, 0 men).

As a part of the study course, the participants were included in the eleven-day swimming course program, after which we took the first measurements. The second measurements were taken ten days after the course. In the meantime, no swimming activities were performed. The intervention group performed an IMT with the Powerbreathe Plus device (A division of Gaiam Ltd., Northfield Road, Southam, Warwickshire, CV47 ORD, UK). Exercise consisted of 30 rapid maximum forced inhalations and relaxed exhalations, twice a day. The intensity (resistance on the device) was set to 60% of the maximal inspiratory power (S-index) (McConnell, 2011; Finta, Boda, Nagy and Bender, 2020), which was measured in the first measurements. A specific intensity of 60% MIP has been justified as effective IMT based on optimal response in context of blood flow and generated pressure (Sheel et al., 2001, McConnell and Griffiths, 2010). The subjects were taught the independent and correct use of the training device before the intervention.

Statistical package IBM SPSS Statistics 25.0 (Armonk, NY:IBM Corp.) was used for statistical data processing. Shapiro-Wilk test was used to check the normal distribution of variables. Analysis of the differences between the individual variables between the groups in the initial state was performed using the independent samples t-test or its non-parametric version, i.e. the Man-Whitney U-test. The analysis of progress for normally distributed variables was checked with the analysis of variance for repeated measurements (Two-way/Factorial RM ANOVA) with the time and group factors (Field, 2009). We also calculated the interaction of time and group to determine the effect of the intervention. For non-normally distributed variables, we used non-parametric version, the Wilcoxon signed rank test. In accordance with selected test, we calculated the effect size (eta squared (η^2)), defining the effect size as small for values > 0.01 , medium for values > 0.06 and large for values > 0.14 (Cohen, 1988; Fritz, Morris and Richler, 2012). After the analysis of variance, we performed a paired-samples t-test, to check statistically significant differences for individual variables

within the group with respect to time. Wilcoxon signed rank test was used for non-normal distributions. R-value was used to determine the effect size. Values > 0.3 represented a medium effect size and values > 0.5 a large effect size (Field, 2009). The level of statistical risk was determined at a value of $p < 0.05$.

Results

The results of Wilcoxon signed rank test show that the intervention had a statistically significant effect, with a large effect size ($Z = -2.934$, $p = 0.003$; $r = -0.626$), on the result (11,5%) in maximal inspiratory power in the intervention group (Figure 1). Statistically significant differences (14%) were also found in control group ($Z = -2.023$, $p = 0.043$; $r = 0.640$). Results of the same test show a statistically significant influence of the intervention with a large effect size ($Z = -3.413$, $p = 0.001$, $r = 0.588$) on the result (9,0%) of the intervention group in the maximum inspiratory flow parameter (Figure 2). After ten days the results (10,9 %) also improved in control group ($Z = -2,023$; $p = 0, 043$, $r = -0,649$). Time and group factors could not be calculated in non-parametric tests.

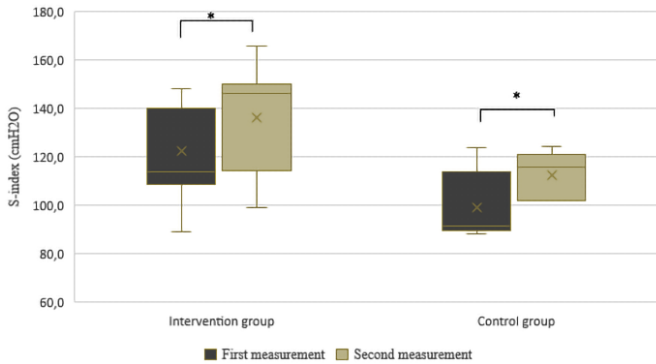


Figure 1: Graphic representation of the box with whiskers for the values of the variable maximal inspiratory power (cmH₂O)

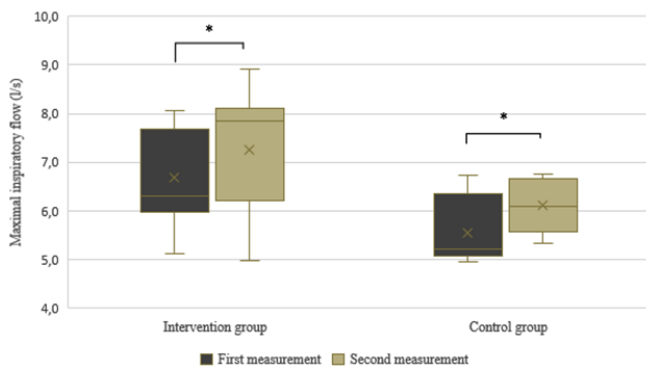


Figure 2: Graphic representation of the box with whiskers for the values of the variable maximal inspiratory flow (l/s)

For the variable FEV₁/FEVC ($F(1,14) = 4.600$; $p = 0.019$; $\eta^2 = 0.335$), a statistically significant effect of time with a large effect size was shown (Figure 3). The score decreased in the intervention (-1.8%, $p = 0.255$) and control group (-11.9%, $p = 0.174$). The intervention group showed less deterioration than the control group.

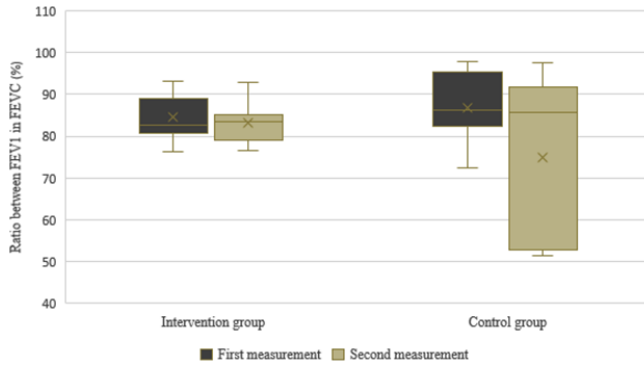


Figure 3: Graphic representation of the box with whiskers for the values of the variable ratio between FEV₁ in FEVC

The results of Buteyko control pause test shows statistically significant differences in the effect of time ($F(1,13) = 4.667$; $p = 0.000$; $\eta^2 = 0.661$) and time and group ($F(1,13) = 4.667$; $p = 0.044$; $\eta^2 = 0.278$) with a large effect size (Figure 4). The result increased significantly in the intervention group (52.3%, $p = 0.001$) and insignificantly in the control group (111.3%, $p = 0.052$). Based on the results, we can conclude that the control group was better and the intervention had a negative effect on this variable.

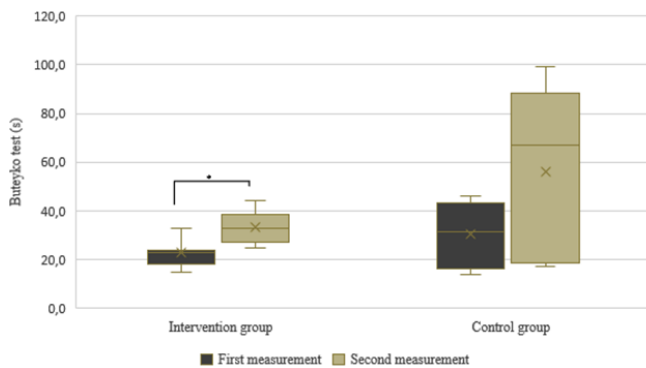


Figure 4: Graphic representation of the box with whiskers for the values of the variable Buteyko test (s)

The results of the test of CO₂ tolerance (hereafter T_{TCO₂}) parameter show statistically significant differences in the effect of time ($F(1,14) = 4.600$; $p = 0.005$; $\eta^2 = 0.441$) with a large effect size (Figure 5). The T_{TCO₂} score sig-

nificantly increased in the intervention (44.2%, $p = 0.037$) and control group (37.8%, $p = 0.001$). We observe a trend towards slightly greater improvement in the intervention group.

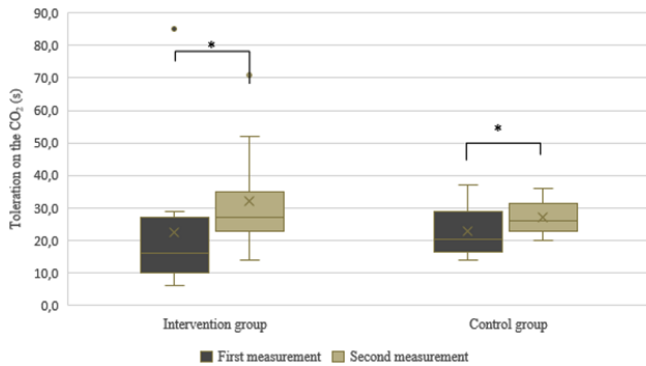


Figure 5: Graphic representation of the box with whiskers for the values of the variable $TTCO_2$ (s)

For the other variables measured (FVC, FEV₁, PEF, IV, counting time after maximum inspiration) there is no statistically significant effect of time or time and group.

The result of the 50-100m swimming time test show statistically significant differences in the effect of time ($F(1,14) = 4.600$; $p = 0.000$; $\eta^2 = 0.895$) with a large effect size (Figure 6). The result of the test increased significantly in the intervention group by 30,7% ($p = 0.000$) and in the control group by 40,1% ($p = 0.001$). The trend of a smaller decrease in swimming time in the intervention group is shown.

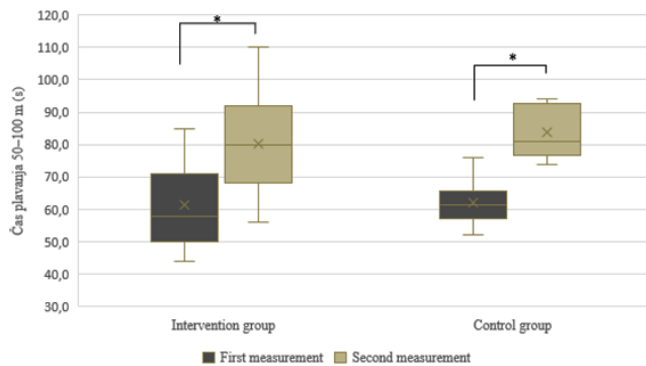


Figure 6: Graphic representation of the box with whiskers for the values of the variable swim time 50-100 m (s)

The results of the 0-100m swimming time test also show statistically significant differences in the effect of time ($F(1,14) = 4.600$; $p = 0.000$; $\eta^2 = 0.830$) with a large effect size (Figure 7). The result increased statistically significant-

ly in the intervention group by 15,5% ($p = 0.000$) and in the control group by 23.6% ($p = 0.007$). Trend of a smaller decrease in swimming time in intervention group is shown, and thus the impact of the intervention on swimming skills.

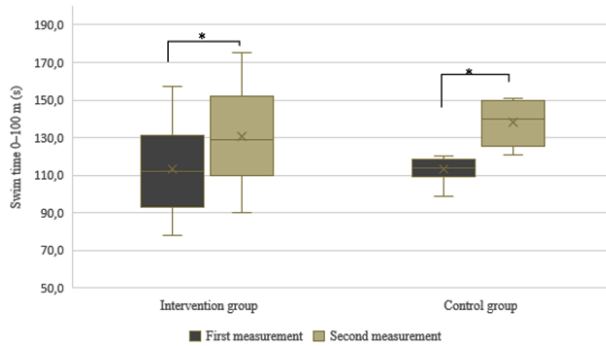


Figure 7: Graphic representation of the box with whiskers for the values of the variable swim time 0–100 m (s)

Despite statistically insignificant differences, we can mention the result improvement in intervention group (15.5%, $p = 0.124$) and control group (2.3%, $p = 0.949$) in the breath holding under water test. A trend towards a greater improvement in the result in the intervention group is shown.

For other variables (swimming time 0–25 m, 25–50 m, 50–75 m, 75–100 m, 0–50 m, glide length, USD) there is no statistically significant effect of time or time and group.

Discussion

The analysis of the results showed some changes in variables after the ten-day intervention. Changes in maximal inspiratory strength were statistically significant and the results increased in intervention and control group. Based on the results, we cannot say with certainty that the increase in inspiratory muscle strength is due to the intervention, although the statistical power is greater in the intervention group. Task learning has also an effect, which is reflected in gradual improvement of inspiratory pressures with repeated measurements (McConnell, 2011), but this theory can be refuted, since the subjects had the opportunity to try a few breaths before the first measures. In addition, we considered only the best result achieved. We assume that the intervention time was too short to get larger differences between the group results. The results of our research are consistent with the findings of the reviewed studies (Volianitis et al., 2001, Romer et al., 2002a, Romer et al., 2002b, Griffiths and McConnell, 2007, Kilding et al., 2010, Janssens et al., 2014, Okrzymowska et al., 2019), from which it is possible to determine the trend of greater progress in relation of time.

Like the previous variable, result change in maximal inspiratory flow was statistically significant and increased in intervention and control group. Based on the obtained results, we cannot claim that the improvement is due to intervention. We can conclude that maximal flow of inhaled air per second increased because of better IM strength, which enable faster and stronger inhalation. Romer and McConnell (2003) claim the exact thing, therefore the peak inspiratory velocity is proportional to inspiratory strength and increases with training and reduction in fatigue response.

The results of the T_{TCO₂} showed statistically significant effect of time but not time and group. The improvement of the result was shown in the intervention and control group. Although the improvement of carrying the CO₂ in the system was greater in intervention group, we cannot certainly say that this is the result of the intervention. Improving CO₂ tolerance means less generalized anxiety perception, lower cortisol levels and thus better physical and mental performance (Crux fitness, 2020).

In Buteyko control pause test the effect of both time, and time and group was statistically significant and the results improved in both groups. Although the improvement in control group was not significant, was greater, therefore we assume that the intervention had a negative effect on this variable. The intervention included just IM, and it seems that expiratory muscle inactivity affected the worse exhalation control. The “assymetry” in strength and stiffness could somewhat affect the performance. Even with Buteyko’s test there is a possibility of experience influencing the second measurements. Subconsciously, a person may exhale less air knowing, that he will have to hold his breathe as long as possible.

As already mentioned, in some articles we found a connection between inspiratory function improvement and certain swimming skills. We were mainly interested in maintaining or as little decrease of swimming abilities as possible.

The analysis showed statistically significant effect of time in the swim time 50-100m and 0-100m test. We observe an increase of time in both groups in both tests. As the time decreased less in intervention group in both tests, we observe a trend of smaller decline in swimming skills after intervention, and conclude that IMT had an impact on maintaining swimming skills.

Considering that S-index and PIF increased in both groups and the swimming result decreased while the effect of time and group was not statistically significant, we cannot confirm the connection between S-index and swimming time. We assume that the intervention influenced on easier overcoming of hydrostatic pressure during swimming, since there is no difference between the groups outside the water. The difference was noticeable only in the water. We did not find any research studying the effect of IMT without simultaneous

sport-specific training, but Nahtigal (2015) and Kilding et al. (2010) found improvement in swimming after additional IMT in the training process.

Additional IMT to swimming, improves the ability to maintain a deeper and slower breathing pattern, which improves the efficiency of breath-motor coordination (McConnell, 2011). Ability to inhale faster and maintain a high lung volume is improved. This results better body position and stroke mechanics, it is also possible to reduce number of breaths per stroke, all of which is reflected in faster swimming.

In the underwater breath holding test we can also notice a trend of improvement due to higher result increase in intervention group, but no changes or differences were confirmed in USD test as McConnel (2011) and Pupisova et.al. (2014) detected.

Conclusions

We cannot claim that the improvement of IM strength and PIF is a result of the intervention, however a positive trend of improvement is shown. We can confirm that there is a relation between MIP and PIF. A significant improvement was also shown in the TTCO₂ and Buteyko test, where the contribution of the intervention also cannot be confirmed, because of the increase of result in both groups. However, a positive trend towards improvement can be seen. A significant effect of time was shown in 50-100m and 0-100m swimming tests. Although the result deteriorated in both groups and tests, an important trend can be observed, namely, in both tests swimming time in the control group increased more than in the intervention group. The result suggests that the intervention may have an impact on the maintenance of swimming ability during the non-training period.

Based on the reviewed literature and our research, we can conclude that IMT in the period without swimming-specific training shows a trend of positive effect on maintaining the swimming result.

We encountered some limitations that should be improved in next similar research. We suggest a longer intervention period, as we assume the effect would be greater. There should be only one gender included or at least evenly distributed as some studies confirm no differences between gender. There was a dropout of control group subjects, so we could use only measurements of five subjects. Larger number of participants should be provided. A third test is suggested after at least twenty days to control the effect of time. In addition, better monitoring to insure a completely correct implementation would be necessary.

RM exercises offer an additional opportunity to develop the swimmer himself and swimming result. According to the literature, there is a certain protocol (intensity, duration, number of repetitions and number of sets) to achieve the success of such training. This is the way we can make the most progress in the shortest time possible.

References

- CRUX FITNESS. (2020). *The CO₂ tolerance test and why you should be working on your lungs*. Acquired 5. 7. 2021 from <https://www.cruxfit.com/the-co2-tolerance-test-and-why-you-should-be-working-on-your-lungs/>
- DOWNEY, A. E., CHENOWETH, L. M., TOWNSEND, D. K., RANUM, J. D., FERGUSON, C. S. and HARMS, C. A. (2007). Effect of inspiratory muscle training on exercise responses in normoxia and hypoxia. *Respiratory physiology and neurobiology*, vol. 156, no. 2, pp. 137–46. Available from: doi: 10.1016/j.resp.2006.08.006/
- FIELD, A. P. (2009). *Discovering statistics using SPSS: (and sex and drugs and rock „n“ roll)* (3rd ed.). London: SAGE.
- FINTA, R., BODA, K., NAGY, E. and BENDER, T. (2020). Does inspiration efficiency influence the stability limits of the trunk in patients with chronic low back pain? *Journal of rehabilitation medicine*, vol. 52, no. 3, jrm00038. Available from: doi: 10.2340/16501977-2645
- KILDING, E. A., BROWN, S. and McCONNELL, K. A. (2010). Inspiratory muscle training improves 100 and 200m swimming performance. *European journal of applied physiology*, vol. 108, pp. 505–511. Available from: doi: 10.1007/s00421-009-1228-x
- LEAHY, M. G., SUMMERS, M. N., PETERS, C. M., MOLGAT-SEON, Y., GEARY, C. M. and SHEEL, A. W. (2019). The mechanics of breathing during swimming. *Medicine and science in sports and exercise*, vol. 51, no. 7, pp. 1467–1476. Available from: doi: 10.1249/MSS.0000000000001902
- LOMAX, M. and CASTLE, S. (2011). Inspiratory muscle fatigue significantly affects breathing frequency, stroke rate and stroke length during 200m front crawl swimming. *Journal of strength and conditioning research*, vol. 25, no. 19, pp. 2691–2695. Available from: doi: 10.1519/JSC.obo13e318207ead8
- LOMAX, M. and McCONNELL, A. (2003). Inspiratory muscle fatigue in swimmers after a single 200 m swim. *Journal of sports sciences*, vol. 21, no. 8, pp. 659–664. DOI:10.1080/0264041031000101999
- MCCONNELL, A. K. and GRIFFITHS, L. A. (2010). Acute cardiorespiratory responses to inspiratory pressure threshold loading. *Medicine and science in sports and medicine*, vol. 42, no. 9, pp. 1696–703. Available from: doi: 10.1249/MSS.obo13e3181d435cf
- MCCONNELL, A. (2011). *Breathe strong, perform better*. United States, Campaign: Human Kinetics. Available from: https://www.researchgate.net/publication/233852299_Breathe_Strong_Perform_Better_-_Table_of_Contents
- PUPIŠOVA, Z., PUPIŠ, M., JANČOKOVA, L. and PIVOVARNIČEK, P. (2014). Changes of inspiratory parameters and swimming performance by influence of Powerbreathe plus level3. *Sport science*, vol. 7, no. 2, pp. 12–15. Available from: <https://www.researchgate.net/publication/270567073>

- RAMIREZ-SERMIENTO, A., OROZCO-LEVI, M., GUELL, R., BARREIRO, E., HERNANDEZ, N., MOTA, S. and GEA, J. (2002). Inspiratory muscle training in patients with chronic obstructive pulmonary disease. *American journal of respiratory and critical care medicine*, vol. 166, no. 11, pp. 1491–1497. Available from: doi: 10.1164/rccm.200202-075OC
- ROMER, L. M. and MCCONNELL, A. K. (2003). Specificity and reversibility of inspiratory muscle training. *Medicine and science in sports and exercise*, vol. 35, no. 2, pp. 237–244. Available from: doi: 10.1249/01.MSS.0000048642.58419.1E
- SHEEL, A. W., DERCHAKA, P. A., MORGAN, B. G., PEGELOW, D. F., JACQUES, A. J. and DEMPSEY, J. A. (2002). Fatiguing inspiratory muscle work causes reflex reduction in resting leg blood flow in humans. *Journal of physiology*, vol. 537, no. 1, pp. 277–89. Available from: doi: 10.1111/j.1469-7793.2001.0277k.x
- VAŠIČKOVA, J., NEUMANNOVA, K. AND SVOZIL, Z. (2017). The effect of respiratory muscle training on fin-swimmers performance. *Journal of sports science and medicine*, vol. 16, no. 4, pp. 521–526. Available from: <https://pubmed.ncbi.nlm.nih.gov/29238252/>
- WYLEGALA, J. A., PENDERGAST, D. R., GOSSELIN, L. E., WARKANDER, D. E. and LUNDGREN, C. E. G. (2007). Respiratory muscle training improves swimming endurance in divers. *European journal of applied physiology*, vol. 99, no 4, pp. 393–404. Available from: doi: 10.1007/s00421-006-0359-6

The role of muscle and fat mass in the expression of explosive power in preschool children

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Abstract

Introduction: Motor development, motor abilities, and physical fitness level in children are potent biomarkers of health from an early age. In order to assess motor abilities and physical fitness in young children practical and easy-to-perform tests are necessary. Explosive power is defined as the ability to perform the maximum effort in a minimum amount of time. Body composition has a significant impact on motor skills and consequently on motor development and health status. With this research we want to find out what the role is a muscle and fat mass in the expression of explosive power in preschool children according to their body weight status. *Methods:* A causal non-experimental method was used to obtain the data. The sample consists of 5-6-year-old children of both genders (N=75), divided into three groups based on body mass index (WHO BMI for age 5-19 years) – Normalweight (N=54), Overweight (N=5) and Obesity (N=16). The explosive power of the legs was measured with the motor test long jump from the site and the motor test counter movement jump tests on the ARS balance plate. Muscle and fat mass were measured with a Tanita DC 430-MA body composition analyzer. ANOVA (Eta squared / Effect Size) was used to compare results between groups and Pearson correlation for differences between groups. *Results:* Children in the Normalweight group achieved the best results on explosive power tests, and children in the Obesity group achieved the worst results. However, the differences between the groups are not statistically significant ($p > 0.05$). *Discussion and conclusions:* Reducing the proportion of fat mass in the body and increasing the proportion of muscle mass in the preschool period is important for well-developed explosive power. Children need to be offered enough exercise and sports activities, including jumping and running.

Keywords: muscle mass, fat mass, explosive power, preschool children

Introduction

Physical fitness is an indicator of health in youth and is related to later body composition in preschool age (Henriksson et al., 2019). The obesity epidemic, at one time confined to adults, has now penetrated the pediatric age range and shows every sign of a rapid escalation (McCarthy et al., 2006). Studies examining the association of health-related physical fitness and total and central body fat in a population of preschool children as young as 3 to 5 years old are scarce and mainly measured by one fitness test. Research data Martinez-Tellez et al. (2016) shows that excess body fat in preschool children results in poorer performance on all tests that require bodyweight movement. Explosive power is the ability to activate the maximum number of movement units in the shortest possible time, it appears as the maximum initial acceleration when moving the body in space (Pistotnik, 2011). It is characterized by the rapid production of a large amount of muscle power in a very short time. It manifests itself mainly in acyclic movement types of jumping, throws and kicks, and in short sprints (Pistotnik et al., 2002). Direct online control of movement is not possible without fast, explosive and instantaneous movements. This is done on the basis of sensory information at different levels: spinal cord, brain stem, subcortical centers and sensory-motor centers in the cerebral cortex. For preschool children engaged in an additional form of organized physical activity, the influence of morphological characteristics on the expression of strength is less obvious compared to children who do not have organized additional physical activity, primarily due to the reduction of subcutaneous fat and body mass as disruptive factors (Sadri et al., 2014). Appropriately designed and controlled strength training is safe for children, contributes to increasing muscle strength, better performance of other sports movements and reduces susceptibility to injuries. Such a method also improves the general health status of the child and has a positive effect on the psychosocial component of the child (Škof, 2016).

Methods

A causal non-experimental method was used to obtain the data. The sample consisted of 5-6-year-old children of both genders (N=75), divided into three groups based on body mass index (WHO BMI for age 5-19 years) – Normal-weight (N=54), Overweight (N=5) and Obese (N=16). The number of children in each BMI group was not balanced. The explosive power of the legs was measured with two motor tests – a long jump from the site and counter movement jump tests on the ARS force plate. Muscle and fat mass were measured with a Tanita DC 430-MA body composition analyzer. 1-way analysis of variance (ANOVA) with eta squared values for effect size, was used to compare the results between groups and Pearson correlation was used for assessing relationship between outcome variables.

The values of fat and muscle mass represent the independent variables. Explosive power, expressed as the average Z-value of the two motor tests, represents the dependent variable.

Results

The results of the research show descriptive data of variables, differences between BMI groups and the correlation of Explosive Power with fat and muscle mass.

Table 1: Descriptive statistic and ANOVA (according to the BMI rang) of motor tests results and body composites data

	BMI rang			p	η^2
	Normalweight N=54	Overweight N=5	Obesity N=16		
CMJ/Hft [m]	0,110	0,068	0,100	0,331	0,030
LJS [m]	1,073	1,120	1,062	0,847	0,005
FATp [%]	16,87	20,26	27,66	0,000	0,590
FATm [kg]	3,59	4,66	8,22	0,000	0,590
MUSCp [%]	77,81	63,10	68,36	0,000	0,249
MUSCm [kg]	16,39	17,42	19,69	0,000	0,266
ExPower [Z-Value]	0,038	-0,181	-0,073	0,787	0,007

CMJ/Hft - counter movement jump/jump height; LJS - long jump from the site; FATp - Fat percent; FATm - Fat mass; MUSCp - Muscle percent; MUSCm - Muscle mass; ExPower - average Z-Value of CMJ and LJS test results; p - Sig.; η^2 - Eta-squared (ANOVA Effect Size)

The best results on the CMJ height test and in overall explosive power scores were achieved by children in the Normalweight group, and the best result on the long jump test was achieved by children of the Overweight group. Children in the Obesity group achieved the worst result on the long jump test and in overall explosive power (Table 1). Differences between BMI groups are not statistically significant ($p > 0.05$). Eta Squared indicates a medium effect for the CMJ height ($\eta^2 < 0.01$) and small effect for long jump test and overall explosive power ($\eta^2 < 0.01$).

Table 2: Correlation of Explosive Power with fat and muscle mass

		FATm	FATp	MUSCm	MUSCp
Normal weight (N=54)	r	0,030	-0,032	0,065	-0,091
	p	0,832	0,819	0,640	0,515
Overweight (N=5)	r	0,609	-0,102	0,794	0,185
	p	0,275	0,870	0,109	0,766
Obesity (N=16)	r	-0,133	-0,093	-0,052	0,079
	p	0,624	0,731	0,849	0,770

r - Pearson correlation coefficient; p - Sig. (2-tailed)

In the Normal_weight group (Table 2) was detected a low degree of correlation between explosive power and muscle and fat mass ($r < 0.29$). In the Overweight group was detected a high degree of correlation between explosive strength and muscle and fat mass ($r > 0.50$), except for fat mass percentage, there is a low negative correlation ($r = -0.102$). In the Obesity group was detected a low degree of correlation between explosive power and muscle and fat mass ($r < 0.29$). In all BMI groups, the correlation of explosive strength with muscle and fat mass is not statistically significant ($p > 0.05$).

Discussion

The findings of our research are consistent with the findings of the research conducted by Matarma et al. (2018). Healthy-weight children had higher scores in strength and agility compared to overweight or obese children. Moreover, in a study by Reeves et al. (1999) higher body fat as measured by skinfolds in preschool children was associated with worse half-mile running time. Also, Henriksson et al. (2016) in their research found that in four-year-old children, body fat percentage was associated with a worse performance in the 20 m shuttle run, standing long jump and 4 x 10 m shuttle run tests.

Carnevale Pellino et al. (2020) investigated the difference between the sexes and reported that boys did not significantly increase their performance while growing up, while girls did improve their performance. Sadri et al. (2014) also found the same. In our study, possibly due to the small sample size, we did not detect gender differences.

Conclusions

Reducing the proportion of fat mass in the body and increasing the proportion of muscle mass in the preschool period is important for well-developed explosive power. Improvements in lower body muscle strength over the 12-month follow-up period are associated with decreases in body fat mass index and body fat percentage (Henriksson et al., 2019).

For the development of explosive power and consequently for good physical health it is necessary to offer children enough physical and sports activities, which include jumping and running, already in the pre-school period.

References

- CARNEVALE PELLINO, V., GIURIATO, M., CECCARELLI, G., CODELLA, R., VANDONI, M., LOVECCHIO, N., & NEVILL, A. M. (2020). *Explosive strength modeling in children: Trends according to growth and prediction equation*. Applied Sciences, 10(18), 6430.
- HENRIKSSON, P., CADENAS-SANCHEZ, C., LEPPÄNEN, M. H., DELISLE NYSTRÖM, C., ORTEGA, F. B., POMEROY, J., ... & LÖF, M. (2016). As-

- sociations of fat mass and fat-free mass with physical fitness in 4-year-old children: results from the MINISTOP trial.* *Nutrients*, 8(8), 473.
- HENRIKSSON, P., LEPPÄNEN, M. H., HENRIKSSON, H., NYSTRÖM, C. D., CADENAS-SANCHEZ, C., EK, A., ... & LÖF, M. (2019). *Physical fitness in relation to later body composition in pre-school children.* *Journal of Science and Medicine in Sport*, 22(5), 574–579.
- MARTINEZ-TELLEZ, B., SANCHEZ-DELGADO, G., CADENAS-SANCHEZ, C., MORA-GONZALEZ, J., MARTÍN-MATILLAS, M., LÖF, M., ... & RUIZ, J. R. (2016). *Health-related physical fitness is associated with total and central body fat in preschool children aged 3 to 5 years.* *Pediatric obesity*, 11(6), 468–474.
- MATARMA, T., LAGSTRÖM, H., HURME, S., TAMMELIN, T. H., KULMALA, J., BARNETT, L. M., & KOSKI, P. (2018). *Motor skills in association with physical activity, sedentary time, body fat, and day care attendance in 5-6-year-old children—The STEPS Study.* *Scandinavian journal of medicine & science in sports*, 28(12), 2668–2676.
- MCCARTHY, H. D., COLE, T. J., FRY, T., JEBB, S. A., & PRENTICE, A. M. (2006). *Body fat reference curves for children.* *International journal of obesity*, 30(4), 598–602.
- PISTOTNIK, B. (2011). *Osnove gibanja v športu: osnove gibalne izobrazbe.* Ljubljana: Fakulteta za šport.
- PISTOTNIK, B., PINTER, S. & DOLENC, M. (2002). *Gibalna abeceda.* Ljubljana: Fakulteta za šport.
- REEVES, L., BROEDER, C. E., KENNEDY-HONEYCUTT, L., EAST, C., & MATNEY, L. (1999). *Relationship of fitness and gross motor skills for five- to six-yr.-old children.* *Perceptual and motor skills*, 89(3), 739–747.
- SADRI, F., SADRI, I., & KRNETA, Ž. (2014). *Effect of Morphological Characteristics on Strength of Preschool Children engaged in different Physical Activities.* XIX International Scientific Conference. Niš, Serbia: Faculty of Sport and Physical Education.
- ŠARABON, N., GERŽEVIČ, M., ŠIMUNIČ, B. IN PIŠOT, R. (2010) *Povezanost statične moči nog in dinamike vertikalnega skoka pri štiriletnih otrocih.* V R. Pišot idr. (Ur.), 6. mednarodni znanstveni in strokovni simpozij *Sodobni pogledi na gibalni razvoj otroka.* (str. 336–369). Koper: Znanstveno-raziskovalno središče.
- ŠKOF, B. (2016). *Šport po meri otrok in mladostnikov: pedagoški, didaktični, psihosocialni, biološki in zdravstveni vidiki športne vadbe mladih.* 2. dopolnjena izdaja. Ljubljana: Fakulteta za šport, Inštitut za kineziologijo.
- WHO BMI for age 5-19 years. Available at <https://www.who.int/tools/growth-reference-data-for-5to19-years/indicators/bmi-for-age> (date of visit 2022/8/10).

Health education work in kindergartens

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Abstract

Introduction: Health education and health promotion are reflections of the general culture in each society. Health education work is a basic activity of care providers, which helps individuals to become active in improving and maintaining their health and preventing diseases. Health education should start at a young age, because children learn how to live as healthy as possible, which is a good investment for the future. The purpose of the research was to examine the importance of health educational activities in kindergartens and to determine the position of educators in this regard. The aim of the research was to determine how educators are active in health education with preschool children and how children are acceptable to these contents. *Methods:* The research was based on a qualitative working method, and the primary data were obtained through interview techniques. The sample in the research was engaged, six respondents from three different kindergartens participated in the interview. *Results:* The results show that kindergartens collaborate with health facilities, but the number of visits by health personnel varies from kindergarten to kindergarten. The children are receptive to the information provided by the health personnel and are happy to participate in the activities. In-service training is provided for kindergarten teachers as part of the “Health in Kindergarten” program, while another in-service training on health education is not planned. One of the interviewees said that she participated in first aid training, which should be a constant practice for all those who work with children, as they are unpredictable and appropriate action in case of accidents can save lives. *Discussion and conclusion:* Much more importance is given to health education today than in the past. However, health education activities should be more frequent in educational institutions. Especially during the epidemic, these activities continued. Children indeed learn to take care of their health at an early age, but to do so, they must

first be given relevant information in a way that they can understand. Unfortunately, many children are not introduced to health information until they are in kindergarten or school because parents do not have the relevant knowledge at home or do not consider such topics important. Interviewees agree that the content of health education is important, but it depends on each institution how much emphasis they place on it. There would be a need for a unified curriculum that includes health and education content in kindergartens and includes content for children, educators and also parents since parents are first and foremost role models for their children.

Keywords: health education, education, work in kindergartens, health content and kindergarten

Introduction

Health education is part of general education and reflects the culture of individuals and society. In the past, health education was not taken care of, but today it is extremely important in a developed society. We are aware that with an appropriate educational approach and lifestyle, we can at least partially influence our health. Health education is the responsibility of medical personnel, and in the case of children, it also involves educators and parents who need to be educated about certain health issues. If we want a person to have healthy habits, it is necessary to educate him/her in this direction already as a child, and for this purpose, it is also necessary to educate parents, because, after all, children are often a reflection of their parents, because they observe and imitate them. Kindergarten does not only mean an institution where the child is protected, but it also means that the upbringing and education of the child are taken care of in kindergartens. Therefore, it is extremely important to start health education at a young age, because in this way we inculcate healthy habits in the child, which he will maintain in adulthood. Slovenian kindergartens are involved in various healthy kindergarten projects, there are visits by medical personnel who work with children in various health education workshops, and children learn healthy habits through play.

In the past, kindergartens were primarily for child care, not education (Krek and Metljak, 2011; Devjak and Berčnik, 2018), but today Slovenian kindergartens are uniformly organized for care and education in the educational system (Rutar, 2022). The National Institute of Public Health manages and implements the Health in Kindergarten program, which aims to create opportunities to strengthen kindergartens to create environments where well-being and health are an important priority and to strengthen individuals' ability to maintain and improve their health throughout life (Health in Kindergarten, 2021). In Slovenian kindergartens, children learn about various health topics, such as proper oral hygiene, healthy eating, physical activity, body hygiene, healthy sleeping habits, traffic safety... However, it would be useful to introduce

a uniform scope and content of the topics discussed in all Slovenian kindergartens, which is not the case so far.

Methods

The research aimed to investigate the importance of health education activities in kindergartens and to find out what the educators' point of view is in this regard.

We set the following research questions:

- How often are kindergarten teachers trained on the topic of children's health education?
- What is the nature of the collaboration between kindergartens and health care providers?
- In what ways do kindergarten teachers involve children in health education activities?

The research was qualitative in nature; descriptive and comparative research methods were used. Primary data was obtained using the semi-structured interview technique. The interview was designed based on a review of domestic and foreign literature. The interview template consisted of two parts. In the first part we obtained the demographic data of the interviewees and in the second part, we obtained the answers to the research questions. The obtained data were analyzed, arranged in tables, written in codes and interpreted. Kindergarten teachers from three different kindergartens participated in the survey. The ethical principles of research were considered in the study.

Results

The sample was purposive. Respondents working in kindergartens participated in the study. The working age of the respondents ranged from 7 to 23 years.

We asked the respondents whether advanced training in children's health education are offered. According to the answers, this content is not constant and varies from kindergarten to kindergarten. One of the respondents said, "We do not have any training on children's health education. Every few years we have first aid training." Another is answering, "In our kindergarten, we have training on children's health education, both for staff and parents."

We asked respondents if they thought they had enough hours for health education. Half of them answered that these hours are sufficient, while the rest answered that it depends on the individual educator how many hours they dedicate to health education and that the curriculum itself does not sufficiently address these topics.

Regarding the areas included in preschoolers' health education, respondents answered fairly uniformly that the following activities are included: Hand washing, brushing teeth, exercise, and healthy eating.

When asked in what way the kindergarten cooperates with medical institutions, all respondents confirmed that they cooperate with medical institutions. These collaborations differ slightly depending on the frequency of training. In most of them, medical staff visits the kindergarten and conducts various workshops for children and staff, sometimes also for parents, and in some kindergartens children are also taken to a medical facility. The response of one of the interviewees was, “We are linked to the local health center. Once a month, throughout the year, different health workers come and prepare work with the children through short lectures and workshops. We then continue these topics on the following days with the educators, depending on the interest of the children.” According to this respondent’s answer, another’s answering differs significantly in terms of the frequency of visits by medical personnel: “In collaboration with the health center, we prepare workshops for children and parents every year. A nurse also visits us regularly.”

We have noticed that the children very much enjoy attending the lectures and workshops given by the medical staff. The children are attracted to various props, cartoons, and stories, and in such a way that they try something themselves, i.e. they are actively involved in the workshops. However, all interviewees agreed that children have very different hygiene habits that they have adopted in their families. There are also big differences in eating habits. Some are very hungry for everything, while others refuse almost everything: “Eating habits are very different. Some eat everything, while others are very picky.”

When asked about the number of daily meals in the kindergarten, all of them answered that there are four meals a day, prepared according to the guidelines for a healthy diet. One of the questions was related to their opinion about the impact of the acquired knowledge about healthy nutrition on the further development of the child. They all answered that this knowledge will naturally affect the further development of the child, as it is a good way for the rest of his life and these healthy habits will stay with him.

We also wanted to know if they think that today’s children are overfed and what they think is the cause of this. The vast majority of respondents agreed that today’s children are indeed overfed, attributing it to inadequate diet and lack of exercise. From their responses, it is clear that they make an effort in the kindergartens to ensure that the children are physically active as much as possible. They ensure this by going for walks, using the playground where they enrich the activities with different props and accessories, and adapting these activities to indoor exercise when the weather is bad. One of the interviewees responded, “Kids like to move. Every day we take a walk around the place, combined with a game in the playground, where we offer them free movement, polygons, different sports equipment, and games in playgrounds. In bad weather, we move to music, play elementary movement games, or do dance activities.”

When asked if the children take into account the acquired knowledge, all respondents answered “yes”. The following answer was particularly interesting:

“A child is a malleable material, so every option offered is a new challenge for him, which after repeated repetitions becomes a routine for him.

So that when he acquires a specific knowledge, he uses it regularly.” They believe that health and education lessons have a positive effect on the later development of the child and that it is necessary to start with health and education topics as early as possible, of course thematically adapted to the age of the child and presented understandably. Kindergartens participate in various health-related projects, such as Traditional Slovenian Breakfast, Healthy Kindergarten, Eco-School, and Safe in the Sun.

We asked them about the parent’s awareness of their children’s health education, and here the answers were quite different. Interviewee 1’s response, “They think they are informed because Uncle Google tells them what they want to know.” I do not think parents talk about health education at home, maybe when the kids start talking about what we did in kindergarten.”

When asked what should be changed to improve the quality of children’s health education, there were opinions that health content should be deepened and implemented more frequently, including parents. They said that it would be necessary to dedicate more training on this topic to the professionals in kindergartens.

Discussion

In our research, we found that professionals are inadequately trained on health, although this varies by kindergarten. Respondents expressed a desire for more such content, and it would be useful to include parents as well, since they are first and foremost role models for their children. Children’s lifestyles are initially influenced by family factors, while later in life this can change due to the influence of school and peers (Mollborn and Lawrence, 2018). Respondents answered that they organize two trainings per year as part of the Health in Kindergarten program. Participation in these trainings is only available to educators whose kindergartens are enrolled in this program. However, regular training within health and education institutions is not available. Summerbell et al. (2012) and Weihrauch-Blueher et al. (2018) claim in their study that we can take care of children’s health and prevent obesity with appropriate preventive measures such as healthy diet, physical activity, and proper sleep hygiene, and these measures must be implemented by parents and educators in kindergartens. According to Scaglioni et al. (2018), children’s eating habits are largely influenced by parents, as they are the ones who provide the child’s first experiences with food. Children adopt their parents’ eating habits and often practice this pattern later in life. Efforts are made to accustom children to healthy meals and a varied diet. Blomkvist, Wills, Helland, Hillesund and Øverby (2021) claim that neophobia is one of the main barriers to vegetable consumption in children because children are often unwilling to try unfamil-

iar foods. This is most pronounced between the ages of 2 and 6 years and gradually decreases (Dovey, Staples, Gibson and Halford, 2008).

Zajec et al. (2012) determined how educators rated the quality and quantity of physical education equipment available to them compared to their assistants. They concluded that teachers' ratings of the tools were lower than their assistants' ratings. The authors relate this to the level of education, age, and training on the subject, which they found should be supported by other authors.

The kindergartens that participated in the study are associated with local medical institutions, especially medical centers. The medical staff of the health centers give lectures and workshops on health education, during visits to the kindergarten or the children come to the health center, where a systematic examination of the children is usually carried out. The frequency of these visits depends on the particular kindergarten and the topics covered may also vary. Topics on healthy eating and proper hygiene are discussed; during the epidemic, much emphasis was placed on hand hygiene and healthy exercise and motor skill development. Children, especially children under the age of five, are highly susceptible to infectious diseases, which are often transmitted through inadequate hand hygiene (Biezen, Grando, Mazza and Brijnath, 2019; Sacri, GSerres, Quach, Boulianne, Valiquette and Skowronski, 2014). During the epidemic, dental hygiene was neglected because, due to epidemic measures, children in kindergartens were not allowed or still are not allowed to brush their teeth. This is very worrying, because unfortunately many children do not brush their teeth before going to kindergarten. Dental caries occurs most frequently in children, which is a serious health problem (Pitts et al., 2017; Kumari and Rani, 2016).

Videmšek and Pišot (2007) say that a child needs to acquire as many motor skills as possible during the preschool years that will benefit him or her in the future. Slovenian kindergartens have organized various physical activities with which kindergartens want to achieve that children, who do not have enough incentive for physical activities in their home environment, somehow satisfy themselves during their stay in kindergarten. In this way, they promote motor skills and physical fitness in children and adolescents (Zupančič Tisovec, Knific and Latnar Žbogar, 2019). O'Brien, Agostino, Ciszek, and Douglas (2020) warn that it is necessary to start regular physical activity in young children, as it has a positive effect on digestion and prevents cardiovascular diseases, improves the child's self-esteem, and reduces the likelihood of mental illness. According to their research, obese children are more at risk of emotional problems. If he does not master certain motor skills, it will be difficult for him to catch up later, but most importantly, it remains an important activity for him throughout his life. Unfortunately, Kobel et al. (2020) find that kindergarteners are not sufficiently physically active compared to previous generations. This impacts the likelihood of becoming overweight. Children begin to develop behaviors and attitudes about health around age 5 (Williams et al., 2018).

Lahe (2011) explains that the pedagogical work in kindergartens is based on the kindergarten curriculum, which is a national document. This curriculum is used in all state kindergartens in Slovenia. The content and scope of health education is to some extent at the discretion of the educator and the kindergarten, which is not necessarily positive. These decisions can be influenced by the educator's lifestyle. To the extent that the educator advocates a healthy lifestyle, active participation in sports activities, healthy eating, etc., he or she will try to pass this on to a greater extent to the children in the kindergarten. Wirth et al. (2016) claim that the health behaviors of kindergarten teachers are of concern because they do not eat enough, do not exercise enough, and smoke. It would be useful to create a uniform program at the national level to ensure that all children receive the same amount and content of health and educational treatment. We have found that you have to make the content understandable and interesting to children so that they remember it. You have to know how to motivate children. The study participants said that children can be attracted to the content being taught through cartoons, the use of various props, stories about the topic being covered, the active participation of children in the presentation of the content, etc. The content is useful for the children even before the lectures or to briefly introduce the workshops and prepare them for the training. In this way, they pay more attention later in the lectures, can follow more easily and remember the presented topic better. Children are an investment in the future and it is our responsibility to guide them to a healthy lifestyle that will pay off later in various areas.

Conclusion

In Slovenian kindergartens, sufficient attention is paid to the health education of children, but the extent and content of the teaching depend on the particular kindergarten or educator. It would be useful to standardize this at the national level and, as in many other countries, to appoint so-called "school nurses" to take care of this content. During the period of primary socialization, the child adopts behaviors and events from their immediate environment, and this is where kindergarten plays a very important role in shaping the child's personality. Therefore, it is crucial to introduce healthy habits already in childhood. Children are an investment in the future and it is our responsibility to guide them to a healthy lifestyle that will pay off later in various areas. Of course, the state, with the appropriate institutions, must provide adequate living conditions that enable us to live, or try to live, as healthy as possible.

References

- BIEZEN, R., GRANDO, D., MAZZA, D. and BRIJNATH, B., 2019. Visibility and transmission: complexities around promoting hand hygiene in young children - a qualitative study. *BMC public health*, vol. 19, no. 1, pp. 398. Available from: <https://doi.org/10.1186/s12889-019-6729-x>

- BLOMKVIST, E., WILLS, A. K., HELLAND, S. H., HILLESUND, E. R. and ØVERBY, N. C., 2021. Effectiveness of a kindergarten-based intervention to increase vegetable intake and reduce food neophobia amongst 1-year-old children: a cluster randomised controlled trial. *Food & nutrition research*, vol. 65. Available from: <https://doi.org/10.29219/fnr.v65.7679>
- DEVJAK, T. and BERČNIK, S., 2018. *Vzgoja predšolskega otroka*. Ljubljana: Pedagoška fakulteta.
- DOVEY, T. M., STAPLES, P. A., GIBSON, E. L. and HALFORD, J. C., 2008. Neofobija glede hrane in 'izbirčno/izbirčno' prehranjevanje pri otrocih. *Appetite* 2008, vol. 50, no. 2, pp. 181–193. doi: 10.1016/j.appet.2007.09.009.
- KOBEL, S., HENLE, L., LAEMMLE, C., WARTHA, O., SZAGUN, B. and STEINACKER, J. M., 2020. Intervention Effects of a Kindergarten-Based Health Promotion Programme on Motor Abilities in Early Childhood. *Frontiers in public health*, vol. 8, pp. 219. Available from: <https://doi.org/10.3389/fpubh.2020.00219>
- KREK, J. and METLJAK, M., eds., 2011. *Bela knjiga o vzgoji in izobraževanju v Republiki Sloveniji*. Ljubljana: Zavod RS za šolstvo.
- KUMARI, P. and RANI, M., 2016. To assess the Knowledge and Expressed and Expressed Practices of School regarding Prevention of Dental Caries in Ambala, India. *International Journal of Nursing Education*, vol. 8, no. 4, pp. 129–133.
- LAHE, M., 2011. Ohranjanje in krepitev zdravja predšolskih otrok. *Metodički obzori*, vol. 6, no. 12, pp. 153–158.
- MOLLBORN, S. and LAWRENCE, E., 2018. Family, Peer, and School Influences on Children's Developing Health Lifestyles. *Journal of health and social behavior*, vol. 59, no. 1, pp. 133–150. Available from: <https://doi.org/10.1177/0022146517750637>
- O'BRIEN, K., AGOSTINO, J., CISZEK, K. and DOUGLAS, K. A., 2020. Physical activity and risk of behavioural and mental health disorders in kindergarten children: analysis of a series of cross-sectional complete enumeration (census) surveys. *BMJ open*, vol. 10, no. 3. Available from: <https://doi.org/10.1136/bmjopen-2019-034847>
- PITTS, N. B., 2017. Dental Care. *Nature reviews*, vol. 3, pp. 1–6.
- ROK SIMON, M., ed., 2011. *Priporočila za ukrepanje v vrtcu ob nujnih stanjih in nenadno nastalih bolezenskih stanjih*. Ljubljana: Inštitut za varovanje zdravja Republike Slovenije.
- RUTAR, S., 2022. Celovit in enovit sistem predšolske vzgoje z integracijo vzgojno-izobraževalne, zdravstvene in socialne dimenzije. In: ČOTAR KONRAD S., BOROTA B., RUTAR S., DRLJIĆ K. and JELOVČAN G., eds. *Vzgoja in izobraževanje predšolskih otrok*, pp. 9–24.
- SACRI, A., GSERRES, G., QUACH, C., BOULIANNE, N., VALIQUETTE, L. and SKOWRONSKI, D., 2014. Prenos akutnega gastroenteritisa in

- bolezni dihal z otrok na starše. *Pediatric Infectious Disease Journal*, vol. 33, pp. 583–588.
- SCAGLIONI, S., DE COSMI, V., CIAPPOLINO, V., PARAZZINI, F., BRAMBILLA, P. and AGOSTONI, C., 2018. Factors Influencing Children's Eating Behaviours. *Nutrients*, vol. 10, no. 6, pp. 706. Available: <https://doi.org/10.3390/nu10060706>
- SUMMERBELL, C. D., MOORE, H. J., VÖGELE, C., KREICHAUF, S., WILDGRUBER, A., MANIOS, Y., DOUTHWAITE, W., NIXON, C. A., GIBSON, E. L. and ToyBox-study group, 2012. Evidence-based recommendations for the development of obesity prevention programs targeted at preschool children. *Obesity reviews: an official journal of the International Association for the Study of Obesity*, vol. 13, no. 1, pp. 129–132. Available from: <https://doi.org/10.1111/j.1467-789X.2011.00940.x>
- VIDEMŠEK, M. and PIŠOT, R., 2007. *Šport za najmlajše*. Ljubljana: Fakulteta za šport. Inštitut za šport.
- WILLIAMS, A. S., GE, B., PETROSKI, G., KRUSE, R. L., MCELROY, J. A. and KOOPMAN, R. J., 2018. Socioeconomic Status and Other Factors Associated with Childhood Obesity. *Journal of the American Board of Family Medicine: JABFM*, vol. 31, no. 4, pp. 514–521. Available from: <https://doi.org/10.3122/jabfm.2018.04.170261>
- WIRTH, T., KOZAK, A., SCHEDLBAUER, G. and NIENHAUS, A., 2016. Health behaviour, health status and occupational prospects of apprentice nurses and kindergarten teachers in Germany: a cross-sectional study. *Journal of occupational medicine and toxicology (London, England)*, vol. 11, no. 26. Available from: <https://doi.org/10.1186/s12995-016-0116-7>
- ZAJEC, J., VIDEMŠEK, M., ŠTIHEC, J., KARPLJUK, D. TUŠAK, M. and MEŠKO, M., 2012. Življenjski slog vzgojiteljev in pomočnikov vzgojiteljev kot element subjektivnih teorij. *Zdravstveni vestnik*, vol. 51, no. 2, pp. 95–104.
- Zdravje v vrtcu 2021-2022*, 2021. Nacionalni inštitut za javno zdravje. Available from: <https://www.nijz.si/sl/vabilo-k-sodelovanju-v-programu-zdravje-v-vrtcu-2021-2022>.
- ZUPANČIČ TISOVEC, B., KNIFIC, T. and LETNAR ŽBOGAR, N., 2019. Spodbujanje gibanja preko programa zdravje v vrtcu. In: PAJEK, M., ed. *Gibalna športna dejavnost za vso družino: zbornik prispevkov/14. kongres športa za vse*. Ljubljana: Olimpijski komite Slovenije, pp. 89–92.

Relationship of body mass index with some motor abilities of preschool children

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Abstract

Introduction and purpose: The body mass index (BMI) is a rough, but the most commonly used indicator for determining children's nutrition. It is an indicator of body composition, which can also affect motor abilities, which are to some extent innate but are also highly dependent on the environment in which the child lives. The study aimed to determine the relationship between body mass index and explosive leg power, balance, and coordination of children in the preschool period. *Methods:* The sample included seventy-five 5-6-year-old preschool children, for whom we measured some motor skills (long jump from the city, one-legged jumps on the left leg, one-legged jumps on the right leg, walking through hoops back, walking backwards on the shaft, rotating around its axis, standing on one leg with open eyes) with the help of motor tests and calculated BMI (body mass index). This represents the ratio between the value of body height and body weight. By the doctrine of the World Health Organization (BMI-for-age 5–19 years), BMI was classified into three categories: normal body weight (N = 54), overweight (N = 5), and obesity (N = 16). To analyze the relationship between BMI and the results of motor tests of explosive power, and between the motor balance tests and the results of motor coordination tests, we calculated the Pearson correlation coefficient. *Results:* In the category of normal body weight, in the calculations of motor tests, a negative insignificant correlation was detected between the variables BMI and the results of motor tests of explosive leg power ($r = -0.059$). Thus, as the value of one variable (BMI value) increases, the value of the other (the result of motor tests of the explosive leg power) decreases. A negative insignificant correlation ($r = -0.013$) is also observed in this category between BMI variables and the result of motor balance tests. A weak correlation ($r = 0.264$) can be observed between BMI variables and the result of motor coordination tests in the overweight category. There is also a slight correlation in this

category between the variables BMI and the result of motor tests of explosive leg power ($r = 0.012$) and between BMI and the result of motor tests of balance ($r = 0.045$). In the obesity category, there is a negative weak correlation between BMI variables and the result of motor balance tests ($r = -0.21$). Thus, as the value of one variable (BMI) increases, the value of the other variable (the result of motor balance tests) decreases. A negative negligible correlation was detected between the BMI variables and the result of motor coordination tests in this category ($r = -0.129$).

Discussion and conclusions: We found that the higher the BMI, the greater the standard deviation in the results of motor tests of both explosive leg power, balance, and coordination. Children with lower BMIs thus achieved better results in motor tests. Among the mentioned variables, the results are not statistically significant ($p > 0.05$). From the obtained correlations indicated that there could be some influence of BMI and motor abilities.

Keywords: BMI, motor abilities, preschool children

Introduction

Obesity has become a common and worrisome problem that can hinder the development of children's motor abilities. The body mass index (BMI) represents the ratio between the value of body height and body weight. Otherwise, it is rough, but the most common indicator for determine body composition. Among other things, it can also affect motor abilities, which are to a certain extent innate, but are also very dependent on the environment in which the child lives.

Previous studies (Marshall et al., 2004; Must and Tybor, 2005; McMurray et al., 2008; Volmut et al., 2010) indicate that children and adolescents who are overweight or obese compared to children with normal body weight are less active and spend less time in moderate and high-intensity physical activity, as a result, they do not have enough motor experience and have poorly developed motor abilities. Matarma et al. (2018) states that children in the category of overweight have significantly lower results in all measured motor abilities compared to children in the category of normal body weight. Logan et al. (2021) found that preschool children classified as overweight and obese have poorer motor abilities than their peers with normal body weight and underweight. Gentier et al. (2013) found that children in the categories of overweight and obesity have less developed hand skills, gross and fine motor skills than children in the category of normal body weight. Award (2022) found that the motor skills of 6-8-year-old children are negatively related to BMI, and that children with a normal body weight have better motor abilities than overweight children. Webster et al. (2021) state that BMI does not take into account the essential characteristics of an individual's body composition, so in their research they studied the relationship between the development of motor abilities, body

composition and BMI. They found that in 6-8-year-old children, different components of body composition have different effects on the development of motor abilities. Thus, excess body fat may be a major morphological limitation in skillfully moving the body through space. In contrast, body composition did not significantly predict an individual's object manipulation performance. The researchers conclude that BMI has limited capabilities in assessing motor abilities. The purpose of our research was to determine the relationship between BMI and explosive power (leg), balance and coordination in preschool children. Rapid movement units are responsible for the expression of *explosive power*, but it is related to transverse dimensions of the body and muscle mass. Concentric muscle contractions occur in the manifestation of explosive power. Rarely, explosive power manifests itself in eccentric forms of muscle tension. Pistotnik (2011) states that explosive power appears as the maximum initial acceleration, which is achieved when moving the body in space or when acting on objects in the environment. So it is the ability to activate the maximum number of motor units in the shortest possible time. Innate explosive power is relatively high ($h^2 = 0.80$), so it can only be trained to a lesser extent. Videmšek & Pišot (2007) add that explosive power is the ability for a maximum initial acceleration of the body in space, such as starting, jumping and throwing. Pistotnik, Pinter & Dolenc (2002) believe that it is characterized by the rapid mobilization of a large amount of muscle power in a very short time. It manifests itself mainly in acyclic movement types of jumping, in throws and kicks, and in short sprints.

The development of *coordination* begins already in the fetal period, as the fetus gains its first movement experience in the mother's body. Pistotnik (2011) defines coordination as the ability to perform complex movement tasks and their effective design. Cemič (1997) describes coordination as the deliberate coordination of body movements in relation to space and time. The coefficient of innateness in coordination is relatively high ($h^2 = 0.80$), and its expressiveness depends on the good functioning of the central nervous system (Videmšek et al., 2003). Also Pistotnik et al. (2003) state the important role of sensory in the formation of movement programs and in their execution. Without adequate acceptance and discrimination of the spatial and temporal parameters of movements and without a good kinesthetic feeling, it is not possible to perform the coordination of the required movements. Videmšek & Pišot (2007) state that movement coordination is the ability responsible for the effective design and execution of complex movement tasks, and that this ability is the most characteristic of humans in the motor skills of all living beings.

Balance is the ability to quickly form compensatory or replacement movements, which are necessary to return the body to a balanced position when it is disturbed (Pistotnik, 2003), and at the same time, balance is the ability to maintain a stable position (Videmšek et al., 2003). In order to maintain balance, it is necessary to constantly and quickly create an appropriate movement

program that contains corrective movements. However, in order to design appropriate programs, it is necessary to combine information from the environment, the senses of sight and hearing, and the balance organ in the middle ear (Videmšek et al., 2003). The ability to balance is also important in everyday life. As a person ages, the ability to balance decreases, but with suitable exercises, it can be maintained even into old age (Videmšek & Pišot, 2007). Škof et al. (2016) call the ability to perceive the position of posture and movement of individual body parts in space and time proprioception - a continuous flow of information from peripheral receptors to the central nervous system. Skin, muscle, tendon and joint receptors, the organ of vision and the organ of balance are also involved. Based on these, movement responses are formed to maintain or establish balance. Pistotnik (2011) defines two emergent forms of balance: The ability to establish a balance position (as quickly as possible to position in a balanced position after previous disorders of the receptors of the vestibular apparatus) and the ability to maintain a balance position (quick formation of compensatory movements that are proportional to deviations of the body from a stable position in balance position). Pistotnik et al. (2002) believe that the ability to maintain balance comes to the fore when we move on a reduced surface (skating, alpine skiing, walking in the mountains, etc.). Then, during the movement, there are rapid and large changes in the position of the body (change in the direction of movement or stopping or after the completion of rotational movements).

Methods

The sample consists of five to six-year-old children ($N = 75$). We calculated BMI based on their height and weight, and with the help of motor tests (Rančnik, 2021) we evaluated their motor abilities: *explosive power*, *balance* and *coordination*.

For the *explosive power*, we used the results of motor tests that supposedly explain the explosive power of the legs (Long jump from a standing position, One-legged jumps on the left leg and One-legged jumps on the right leg). For the *balance*, we used the results of motor tests that supposedly explain balance (Walking backward on a beam, Spinning around one's axis, Standing on one leg with eyes open, One-legged hops on the left leg and One-legged hops on the right leg). For the *coordination*, we used the results of motor tests that supposedly explain coordination (Walking on all fours through rings backward One-legged hops on the left leg and One-legged hops on the right leg).

In accordance with the doctrine of the World Health Organization (WHO: BMI for age 5–19 years), the BMI value was classified into three categories (BMI rank): normal body weight ($N = 54$), overweight ($N = 5$) and obesity ($N = 16$). To analyze the association between BMI and motor test results, we calculated the Pearson correlation coefficient.

Results

The results of the association between variables *BMI* and *motor test results* are shown in Table 1.

Table 1: Correlation of BMI with the results dor motor tests

BMI rang	Statistic	Explosive Power	Balance	Coordination
Normalweight (N=54)	r	0,06	-0,01	0,01
	p	0,67	0,92	0,92
Overweight (N=5)	r	0,01	0,05	0,26
	p	0,99	0,94	0,67
Obesity (N=16)	r	0,19	-0,21	-0,13
	p	0,48	0,43	0,63

r- Pearson Correlation; *p*- Significance (0.05)

In the category of *normal body weight*, an insignificant negative correlation ($r = -.06$) was detected between variables BMI and the result of motor tests of *explosive power*. So, as the BMI value increases, the value of the explosive power test result decreases. In this BMI category, an insignificant negative correlation ($r = -.01$) was detected also between variables BMI and the result of motor tests of *balance*. In the BMI category *overweight*, a weak positive correlation ($r = .26$) was detected between variables BMI and the result of motor tests of *coordination*. In the BMI category *overweight*, an insignificant positive correlation was detected between variables BMI and the result of motor tests of *explosive power* ($r = .01$) and between variables BMI and the result of motor tests of *balance* ($r = .04$). In the *obesity* category, a weak negative correlation was detected between variables BMI and the result of motor tests of *balance* ($r = -.21$). So, as the value of one variable (BMI value) increases, the value of another variable (the result of motor tests of balance) decreases. In the *obesity* category, a slight negative correlation was detected between variables BMI and the result of motor tests of *coordination* ($r = -.13$). The association between the mentioned variables is not statistically significant ($p > .05$) in any BMI category.

We found that the higher the BMI, the greater the dispersion of motor test results as shown in Figure 1.

In the BMI category of *normal body weight*, the dispersion of motor test results is the smallest (Figure 1). Most of the results are located around the arithmetic mean of this category.

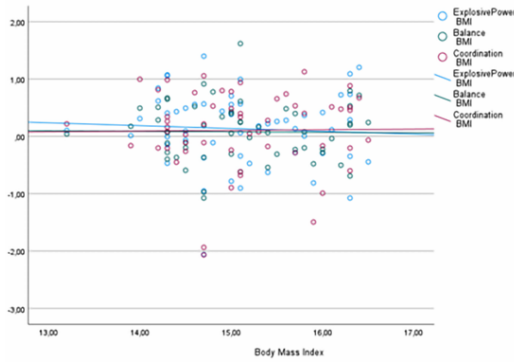


Figure 1: Dispersion of motor test results according to BMI (BMI rang Normal weight)

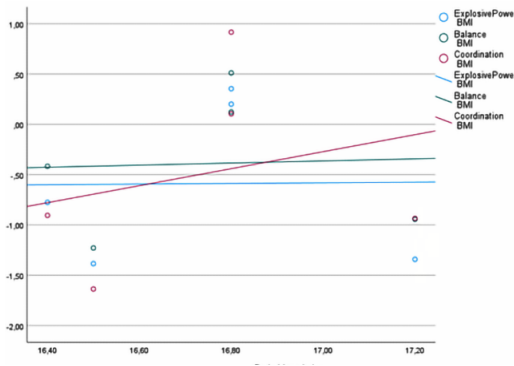


Figure 2: Dispersion of motor test results according to BMI (BMI rang Overweight)

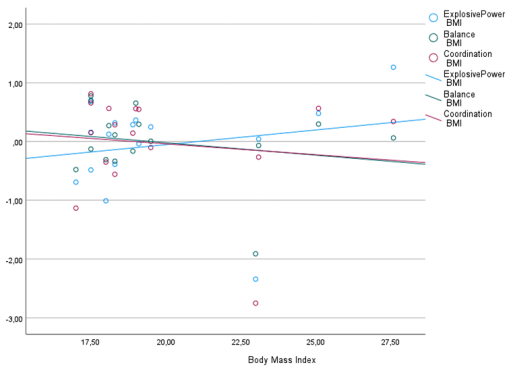


Figure 3: Dispersion of motor test results according to BMI (BMI rang Obesity)

There is a greater dispersion of motor test results in the BMI category *overweight*, as show in Figure 2. Most of the results are below the arithmetic mean of this category. Children with a lower BMI achieved worse results in

motor tests of *coordination*. This finding is relative, as there were only 5 children in these category.

As shown in Figure 3 the greatest dispersion of motor test results is in the BMI category *obesity*. Most of the results are located around the arithmetic mean of this category. Children with a lower BMI achieved worse results in motor tests of *explosive power* and better results in motor tests of *balance* and motor tests of *coordination*.

Discussion

When studying BMI values, we were positively surprised by the number of children in the BMI category *normal weight* - as much as 72.0% of the entire sample. However, we were concerned by the fact that as many as 21.3% of children are in the BMI category *obesity*. We did not look for the reasons for these two data, but it is a clue for future research. Brettschneider & Bnemann (2005; based on Šimunič, Volmut & Pišot, 2010) state that we must find out the causes of obesity, look for ways to reduce the phenomenon in the part of the population where the phenomenon is already present, and prevent the possibility of new cases.

We found that the higher the BMI, the greater the standard deviation in the results of all motor tests: explosive power, balance and coordination. Children with a lower BMI thus achieved better results in motor tests than children with a higher BMI.

Matarma et al. (2018) came to the conclusion in his research that attending an educational institution (kindergarten) has positive effects on the development of coordination, strength and flexibility. A smaller part of the fat mass could be detected by girls, which is associated with greater strength and agility. The associations between moderate to high physical activity and time spent in sedentary activities showed no influence on the development of motor abilities. The researchers conclude that attending kindergarten is very beneficial for the early prevention of obesity and overweight in children. The positive links between attending kindergarten, motor skills and physical activity show the importance of early learning, as a place to raise awareness and encourage physical activity and motor development of children.

Conclusions

According to the findings of our research, as BMI increases, motor abilities deteriorate. We conclude that for the development of motor abilities in the preschool period, in addition to varied and sufficient physical activity, regardless of the child's environment, it is also important to prevent overweight and obesity.

References

- AWAD, A. S., & ANEIS, Y. M. (2022). *Correlation between body mass index and motor proficiency in Egyptian children: a cross-sectional study*. Bulletin of Faculty of Physical Therapy, 27(1), 1–9.
- CEMIČ, A. (1997). *Motorika predšolskega otroka*. Ljubljana: Dr. Mapet.
- GENTIER, I., D'HONDT, E., SHULTZ, S., DEFORCHE, B., AUGUSTIJN, M., HOORNE, S., ... & LENOIR, M. (2013). Fine and gross motor skills differ between healthy-weight and obese children. *Research in developmental disabilities*, 34(11), 4043–4051.
- LOGAN, S. W., SCRABIS-FLETCHER, K., MODLESKY, C., & GETCHELL, N. (2011). The relationship between motor skill proficiency and body mass index in preschool children. *Research quarterly for exercise and sport*, 82(3), 442–448.
- MATARMA, T., LAGSTRÖM, H., HURME, S., TAMMELIN, T. H., KULMALA, J., BARNETT, L. M., & KOSKI, P. (2018). Motor skills in association with physical activity, sedentary time, body fat, and day care attendance in 5-6-year-old children—The STEPS Study. *Scandinavian journal of medicine & science in sports*, 28(12), 2668–2676.
- PISTOTNIK, B. (2003). *Osnove gibanja: gibalne sposobnosti in osnovna sredstva za njihov razvoj v športni praksi: osnove gibalne izobrazbe*. Ljubljana: Fakulteta za šport, Inštitut z šport.
- PISTOTNIK, B. (2011). *Osnove gibanja v športu: osnove gibalne izobrazbe*. Ljubljana: Fakulteta za šport.
- PISTOTNIK, B., PINTER, S. IN DOLENC, M. (2002). *Gibalna abeceda*. Ljubljana: Fakulteta za šport.
- RANČNIK, K. (2021). *Vloga nekaterih motoričnih sposobnosti pri skoku v višino v predšolskem obdobju*. Diplomsko delo. Maribor: Pedagoška fakulteta Univerze v Mariboru.
- ŠIMUNIČ, B., VOLMUT, T. IN PIŠOT, R. (2010). *Otroci potrebujejo gibanje. Otrok med vplivi sodobnega življenjskega sloga – gibalne sposobnosti, telesne značilnosti in zdravstveni status slovenskih otrok*. Univerza na Primorskem, Znanstveno-raziskovalno središče Koper – Inštitut za kineziološke raziskave, Univerzitetna založba Annales.
- ŠKOF, B. (2016). *Šport po meri otrok in mladostnikov: pedagoški, didaktični, psihosocialni, biološki in zdravstveni vidiki športne vadbe mladih*. 2. dopolnjena izdaja. Ljubljana: Fakulteta za šport, Inštitut za kineziologijo.
- VIDEMŠEK, M. BERDAJS, P. IN KARPLJUK, D. (2003). *Mali športnik: gibalne dejavnosti otrok do tretjega leta starosti v okviru družine*. Ljubljana: Fakulteta za šport; Inštitut za šport.
- VIDEMŠEK, M. IN PIŠOT, R. (2007). *Šport za najmlajše*. Ljubljana: Fakulteta za šport; Inštitut za šport.

- VOLMUT, T., ČEKLIĆ, U., PIŠOT, R. IN ŠIMUNIČ, B. (2010). Razlike v gibalnošportni aktivnosti otrok glede na maščobno maso. V R. Pišot idr. (Ur.), *Sodobni pogledi na gibalni razvoj otrok* (str. 405–407).
- WEBSTER, E. K., SUR, I., STEVENS, A., & ROBINSON, L. E. (2021). Associations between body composition and fundamental motor skill competency in children. *BMC pediatrics*, 21(1), 1–8.
- WHO: BMI for age 5–19 years. Pridobljeno 1.8.2022 na <https://www.who.int/tools/kits/growth-reference-data-for-5to19-years/indicators/bmi-for-age>

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