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BABEŞ-BOLYAI



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CAUSES OF MIGRATION AND WORKING CONDITIONS ABROAD AMONG PHYIOTHERAPISTS

VIZSY MÁRIA¹, PÓNUSZ RÓBERT¹, SÉLLEYNÉ GYURÓ MONIKA¹,
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ABSTRACT. Introduction: The migration of health professionals severely affects the current number of physicians and professionals in a country. **Aim:** The aim of our work was to investigate the reasons for the departure of physiotherapists already working abroad, to learn the working conditions abroad, and to explore the conditions for returning home. **Method:** Our data were obtained by a self-edited, online questionnaire survey. The number of items in our sample was 112 (N = 112) physiotherapists working abroad. Our research was conducted between November 2018 and February 2019. **Results:** Results of the most influential factors of migration were as follows: 62.5% (70 people) had a lack of financial reward, 55.4% (62 people) had a sense of uncertainty about the future, 49.1% (55 people) did not trust the Hungarian health care organization. The monthly salary of professionals working abroad varied between 1001-2000 Euros in 38.4% (43 people), between 2001 and 3000 in 38.4% (43 people) and was over 3000 Euros in 23.2% (26 people). 76.8% (86 people) didn't take a second job because they didn't need it. Factors influencing return were the following: 1) in 69.6% (78 people) "more favorite financial conditions", 2) in 51.8% (58 people) "better working conditions", 3) in 42.9% (48 people) "a better organized health care system. **Conclusion:** Physiotherapists working abroad have left mainly due to a better quality of life, a more predictable vision and more favorite financial conditions, and a change in these conditions would encourage them to return home the most.

Keywords: *migration, physiotherapist, salary, return home*

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Introduction

The migration of health professionals has become a global phenomenon, raising more and more health policy issues. The lack of specialists has a decisive impact on the operation and quality of the health care system in a given country, as well as on the health status of the population (Eke, Girasek, & Szócska, 2009). In many countries of our continent, the number one agenda item for professional policy activities is to acquire and retain a well-trained workforce to meet high-level, complex health needs. To this end, a joint action plan has been set up to monitor the recruitment and retention of professionals in the various European countries to make the labor market more predictable at a later stage (European Commission, 2011, 2012).

However, the international migration of health professionals is an advantage for many countries, as it helps to provide adequate care, to replace the number of staff, but at the same time it can provide opportunities for professional development, exchange of experience and the spread of various procedures and techniques. Within the European Union, especially in the last decade, as a result of the enlargement of the EU, the flow of health workers has intensified, due to the principle of free movement of persons and services. As a matter of fact, working abroad is usually decided by citizens of lower-income countries (Ognyanova, Maier, Wismar, Girasek, & Busse, 2012; Glinos, 2014).

Due to the intensification of migration processes, the most severe concern is the lack of human resources in the health care system. Trends and triggers in the emigration of health professionals are an area studied not only in Europe but also studied worldwide (Castro-Palaganas, et al., 2017; Suciu, Popescu, Ciumageanu, & Buzoianu, 2017; Galbany-Estragués & Nelson, 2016; Duvivier, Burch, & Boulet, 2017; Labonté, et al., 2015; Gavin & Bruce, 2017).

Unfortunately, the migration of health professionals is also severely affecting Hungary. Based on the data of the Licensing and Administrative Office of Health and the State of Health Care Center for Human Resources Directorate General for Development about 500 doctors ask for an official certificate of foreign employment for the first time per year, which means that approximately 300-350 people actually leave the country. Among health professionals, the same request was made by 568 people in 2013, 548 people in 2014, 567 people in 2015, 486 people in 2016, 407 people in 2017, and 292 people in 2018 (National Hospital Directorate General, 2020).

The lack of financial and professional esteem can be found in the background of medical and professional migration, but the decisive criterion is also the different health care and economic status of the countries (Pónusz, et

al., 2016; Szekanecz, Tóth, Hamar, & Láncki, 2017; Sipos, et al., 2018; Somogyi, 2014; Gyórfy & Girasek, 2014; Gyórfy & Széll, 2018; Molics, et al., 2015). Unfortunately, the decrease of social migration among Hungarian doctors cannot be expected in the future (Girasek, Eke, & Szócska, 2018; Girasek, Molnár, Eke, & Szócska, 2011).

The multi-stage salary development program implemented in health care can be favorable for keeping workers in the Hungarian health care system in order to reduce migration, due to financial appreciation. Based on the salary development plan, the development of the gross monthly salary of the starting F-category employee on the basis of the salary and wage scale of the health care professionals is as follows: 256,338 HUF (732 EUR) from 25 July 2019, 289,662 HUF (828 EUR), from 1 January 2020, 2020 from 337,456 HUF (964 EUR) from November 1 2020, 408,332 HUF (1,166 EUR) from January 1 2022. (1 EUR=350 HUF) (Government Decree, 2019)

The main focus of our research was to examine the reasons for the migration of physiotherapist, to get to know the working conditions abroad, and to explore the conditions for their returning home.

Data and Methods

In our questionnaire survey, we used a simple, non-random sampling method. We sent the questionnaires to colleagues working in the target countries primarily by e-mail as well as through social media. The target group was physiotherapists graduated in Hungary but practiced their profession in a foreign country. Our online questionnaire was completed by a total of 116 people, of which we were able to use 112 evaluable sheets (N = 112).

We conducted the research between November 2018 and February 2019. The data collection was operated by self- edited questionnaires. The questionnaire consisted of 29 questions based on the former Hungarian literature of migration. The groups of questions were as follows: socio-demographic data, education, language proficiency data, working conditions, the satisfaction with it, the migration causes, and a possible return.

In order to get an accurate picture of the factors for colleagues leaving the country we compiled a list of 15 aspects. From this list, the person filling in the items could choose the statements characteristic of her in any number. After selection, we asked for a ranking of the factors. Examining the possibilities of returning home, we similarly asked the respondent to mark the characteristic of her from a list of seven factors, and to rank them in case of several answers.

Results

A total of 112 people completed the questionnaire. Regarding the territorial distribution of our sample, it can be stated that most people, 33.9%, completed our questionnaire in France (n = 38) and 32.1% of them in Austria (n = 36). We received answers, 10.7% from Germany (n = 12), 9.8% from Switzerland (n = 11) and 8% from colleagues in England (n = 9), 2-2 persons from Italy and the United Arab Emirates (1.8%), and from 1-1 persons from Sweden and Belgium (0.9%). (Table 1)

Table 1. Territorial distribution of respondents to the questionnaire survey

Workplace	n	%
France	38	33.9%
Austria	36	32.1%
Germany	12	10.7%
Switzerland	11	9.8%
England	9	8%
Italy	2	1.8%
United Arab Emirates	2	1.8%
Sweden	1	0.9%
Belgium	1	0.9%
Altogether:	112	100%

42.9% of the physiotherapists participating in our research left Hungary 5-10 years ago to work abroad (n = 48). Respondents in the lowest number were those who left the country more than 10 years ago: 5.4%. 23.2% of them did not work at all at home prior to leave Hungary (n = 26) and 48.2% of them spent at least 5 years at home (n = 54). At the time of leaving, 23.2% of them imagined their future abroad forever (n = 26), and 24.1% planned for at least 5-10 years (n = 27). (Table 2)

Table 2. Circumstances and reasons for leaving at the time of departure abroad

How long did you leave Hungary?	n	%
0-24 months	24	21.4%
25-59 months	34	30.4%
5-10 years	48	42.9%
more than 10 years	6	5.4%

Did you work in Hungary before leaving?		
Yes, 0-24 months	27	24.1%
Yes, 25-59 months	27	24.1%
Yes, 5-10 years	22	19.6%
Yes, more than 10 years	10	8.9%
No	26	23.2%
How much time did you plan to work abroad on leaving?		
0-24 months	20	17.9%
25-59 months	19	17.0%
5-10 years	27	24.1%
More than 10 years	20	17.9%
forever	26	23.2%
Due to what factors did you decide to leave?		
Workload level	20	17.9%
The lack of financial esteem	70	62.5%
Workplace conditions	41	36.6%
The state of the Hungarian healthcare system	55	49.1%
Uncertainty about the future	62	55.4%
I have not worked in my home country	26	23.2%

38.4% of physiotherapists working abroad earned between 1001-2000 Euros per month (n = 43), also 38.4% of them earned between 2001 and 3000 Euros, and 23.2% reported salaries above 3000 Euros (n = 26). 41.1% received a fringe benefit. 76.8% did not take a second job because they did not need it (n = 86), only 7.1% (n = 8) took an extra job for financial reasons. 73.2% of them considered their situation to be average in the country where they lived (n = 82), 20.5% of respondents considered it to be above the average existential level (n = 23).

53.6% of physiotherapists leaving Hungary would be satisfied with a net monthly salary of between HUF 350,001 (1,000 EUR) and HUF 500,000 (1,429 EUR) at home (n = 60), however, 27.7% would be satisfied with a net monthly salary of between HUF 250,001 (714 EUR) and HUF 350,000 (1,000 EUR) (n = 31).

47.3% of them considered realistic the amount to be between 250,001 (714 EUR) and 350,000 (1,000 EUR) HUF (n = 53), but also 39.3% of those, who put the value of real net monthly salary between 150,000 (429 EUR) and 250,000 (714 EUR) in Hungary at the time of completing the questionnaire (n = 44). (Table 3)

Table 3. Income expectations and realized income

Monthly net salary (EUR)	n	%
1001-2000	43	38.4%
Between 2001-3000	43	38.4%
Over 3000	26	23.2%
Do you receive a fringe benefit?		
Yes	46	41.1%
No	66	58.9%
Do you take a second job?		
Yes because I need it	8	7.1%
Yes, but not for financial reasons	12	10.7%
Well, I do not need it	86	76.8%
No, not allowed	6	5.4%
How do you see the financial situation of yours in the country where you live?		
Below average	7	6.3%
Average	82	73.2%
Over average	23	20.5%
Net monthly salary, you would be satisfied with at home (HUF)		
250.001-350.000 (714 – 1,000 EUR)	31	27.7%
350.001-500.000 (1000 – 1,429 EUR)	60	53.6%
Over 500,000 (1,429 EUR)	21	18.8%
Monthly net salary that you think is realistic at home (HUF)		
150,000-250,000 (429-714 EUR)	44	39.3%
205.001-350.000 (714-1,000 EUR)	53	47.3%
350.001-500.000 (1,000 – 1,429 EUR)	13	11.6%
Over 500,000 (1,429 EUR)	2	1.8%

For 77.7%, the factor that played a prominent role in leaving is the “better quality of life, more predictable vision”, which was ranked 1st. 77.7% also cited the statement “more favorable financial conditions” as the reason for leaving, which was ranked 2nd among our respondents. The proportion of physiotherapist who left Hungary due to the “hope of better working conditions” was 57.1%, and this statement was ranked 3rd overall in the sample. “Professional challenge,

development” was the reason for leaving for 44.6%, while “lack of professional esteem” was the reason for leaving for 37.5%. These two factors occupied the 4th place in the ranking of our respondents. “Desire for adventure” drove 48.2% of our sample, “more favorable development of the future of family aspects and family members” was the driving force for 25.9%, these statements came in 5th place in the ranking. The proportion of respondents was not negligible who had migrated abroad for “language learning”, since this accounts for 43.8%, and 34.8% of the respondents chose “seemingly predictable economic system of the country of destination”. An attractive factor for 31.3% was the “better organized health care in the destination country”, and 17.5% left our country due to “failure to find a job at home.” The four statements just listed all ranked 6th. 33.3% of our respondents were affected by “lack of social esteem” and 18.8% of them were affected by “bad experiences gained while working / studying at home”, these two statements were ranked 7th. 5.4% of the research participants were attracted abroad by the “opportunity for scientific work”, which is the 8th statement in the ranking. Finally, 2.7% cited “burnout” as the reason, ranking last 9th. (Table 4)

Table 4. Factors involved in leaving and their ranking

Factors of leaving	n	%	ranking
Better quality of life, more predictable vision	87	77.7%	1.
More favorable financial conditions	87	77.7%	2.
Hope for better working conditions	64	57.1%	3.
Professional challenge, development	50	44.6%	4.
Lack of professional esteem	42	37.5%	4.
Desire for adventure	54	48.2%	5.
Family aspects, more favorable development of the future of family members	29	25.9%	5.
Language learning	49	43.8%	6.
Better organized health care in the destination country	35	31.3%	6.
Unsuccessful job search at home	19	17.5%	6.
The more predictable economic system of the destination country	39	34.8%	6.
Lack of social esteem	37	33%	7.
Bad experiences during work / study at home	21	18.8%	7.
Possibility of scientific work	6	5.4%	8.
Burnout	3	2.7%	9.

The “more favorable financial conditions” was ranked in the highest proportion, accounted for 69.6%, that would affect repatriation. The statement was also ranked 1st. 51.8% of the respondents would return home in the case of “better working conditions”, ranking 2nd. 42.9% would be motivated to return home by a “better organized health care system”, ranking 3rd. 42.9% would return home in the case of a “more predictable economic system”, and 41.1% would want a “higher professional esteem”, these factors ranked 4th. In the case of 25% of the respondents, the “increase in social esteem” would be an influencing factor, which was 5th in the ranking. For 1.8% of the respondents, the “opportunity for scientific work” would be important, which ranked last in 6th place. Among the eight factors, the “no such factor” category was also an option, marked by 26.8% of colleagues working abroad. (Table 5)

Table 5. Distribution and ranking of factors influencing repatriation

Factors influencing repatriation	n	%	ranking
better financial conditions	78	69.6%	1.
better working conditions	58	51.8%	2.
A better organized health care system	48	42.9%	3.
higher professional esteem	46	41.1%	4.
A more predictable economic system	47	42%	4.
Increase in social esteem	28	25%	5.
Opportunity for scientific work	2	1.8%	6.
No such a factor	30	26.8%	-

23.2% imagined their future abroad when they left (n = 26) and 24.1% planned for at least 5-10 years (n = 27). At the moment of completing the questionnaire, this number has become even higher, as 46.2% (n = 52) of the respondents planned to live abroad forever, and 20.5% (n = 23) of them definitely planned to live abroad for more than 10 years.

Discussion

The worldwide phenomenon of migration of health professionals associated with our country can be recognized and treated as a fact. Learning the motivation for migration, we can state the fact that working abroad will continue to be an existing process in the coming years. Among physiotherapists

working in Hungary, the intention to work abroad is present in 43.7% (Pónusz et al., 2016). 33.6% of medical students prepare to go abroad immediately after graduating from the medical faculties in Hungary (Gyórfy & Széll, 2018).

Concerning those who had already worked abroad, there was also a difference between the number of years they spent working at home before working abroad, as well as the time they planned to work abroad. Almost half (48.2%) of the physiotherapist working outside Hungary had less than 5 years of practice at home, while 23.2% did not work in the profession at home before. A significant part of doctors (91.1%), were employed in Hungary for the first time in their profession, however, after an average of 10.8 years of work, they were still able to give up their jobs at home and leave the country (Szekanecz, Tóth, Hamar, & Láncki, 2017). The physiotherapist specialists plan to work abroad for 5-10 years or forever, while almost half of the doctors do all this in a shorter time interval, up to 5 years (Szekanecz, Tóth, Hamar, & Láncki, 2017), as now medical students consider leaving only in 2-5 years (Gyórfy & Széll, 2018).

In general, it can be stated that with the start of working abroad, the idea of staying there permanently or for a longer period of time is strengthened in the professionals in contrast with their initial plans. 46.4% of physiotherapists who have completed the questionnaire plan to live permanently in the given country, while in the case of doctors this would increase from 13.58% to 38.27% (Szekanecz, Tóth, Hamar, & Láncki, 2017).

The difference between the salaries of the professionals at home and abroad was conceivable, but its extent was striking. When completing the questionnaire, the newly graduated physiotherapists received 327,350 HUF (935 EUR) gross in category F based on the already modified salary scale of health professionals valid from 1 November 2018. 38.4% of their colleagues working abroad earned between HUF 700,000 (2,000 EUR) and HUF 1,050,000 (3,000 EUR) net per month, but 23.2% of them earned even more.

Regarding the additional work undertaken by physiotherapist working abroad and at home, it can be stated that the vast majority of those working abroad no longer took a second job (76.8%), primarily because they did not need it, while colleagues working at home (51, 63%) had a second job (Pónusz, et al., 2016).

However, employees' perception of their own financial situation is similarly high among those working at home or abroad. The majority of those working abroad considered their financial situation to be average in the country where they currently lived (73.2%) and 84.6% of them felt the same at home (Pónusz, et al., 2016). In addition to the differences in the living conditions between countries, it can be assumed that the consideration of the salaries of second jobs undertaken due to low pay also played a role in assessing the financial situation at this level.

Among the reasons for leaving, the desire for financial security can also be established on the basis of our sample and the results of other works. The largest number of participants in our study cited the statement “better quality of life, more favorable vision” and “more favorable financial conditions” as the reason for leaving, while physicians included “higher salary”, “lack of career model/sense of security/professional vision” (Szekanecz, Tóth, Hamar, & Láncki, 2017). Medical students considered working conditions, pay and living conditions to be the most significant factors influencing employment abroad (Gyórfy & Széll, 2018). 95.74% of physiotherapists- working at home, but with migration thoughts, considered the more favorable financial esteem to be the main reason for emigration (Pónusz, et al., 2016).

More favorable financial conditions (69.6%), better working conditions (51.8%) could have the greatest effect on the return of physiotherapists, and a more secure financial esteem and improvement of the organizational culture would significantly support the return of doctors. Among other factors contributing to employment at home after working abroad, the improvement of working conditions and pay is emphasized elsewhere. (Gyórfy & Széll, 2018) The recognition and encouragement of human resources is a key issue in the financing of the Hungarian health care system (Boncz & Sebestyén, 2006; Kriszbacher , Oláh, Bódis, & Boncz, 2007; Greenberg, Mohamed Ibrahim, & Boncz, 2014; Horváth, és mtsai., 2014; (Endrei, Zemlényi, Molics, Ágoston, & Boncz, 2014; Péter, et al., 2017; Varga, et al., 2019; Eisingerné Balassa, Csákvári, & Ágoston, 2019), appropriate benefit implementation of the system as soon as possible (Molics, et al., 2013; Boncz, et al., 2015; Molics, et al., 2013).

The foreign employment of doctors abroad has been a long-standing problem in Hungary. Foreign employment of the health science professionals, physiotherapists, nurses, ambulance officers, dieticians, radiographers, etc., however, is a relatively recent phenomenon. Retaining health professionals and modernizing their careers at home is a significant health policy challenge (Boncz, Nagy, Sebestyén, & Kőrösi, 2004; Bethlehem, Boncz, Kriszbacher, Oláh, & Bódis, 2007; Gulácsi, és mtsai., 2009; Bethlehem, et al., 2014; Boncz, Vajda, Ágoston, Endrei, & Sebestyén, 2014; Molics, et al., 2015; Sebestyén, Mester, & Vokó, 2015).

Our results correlate well with the previous literature and confirm the demand, often expressed in Hungary, that further salary increases and working conditions should be improved in the case of physiotherapists in order to maintain the health workforce.

Statement

The publication has not previously been published in another journal and has not been submitted elsewhere.

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PHYSICAL ACTIVITY IN THE TIME OF COVID-19 PANDEMIC

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ABSTRACT. On 31 January 2020, the World Health Organization (WHO) declared a global state of public health threat following the outbreak of a new coronavirus responsible for COVID-19 infection. To prevent spreading of the disease, various measures such as closing institutions, curfews, locking the country, and targeted quarantine for suspects and infected people are implemented in different countries. Physical inactivity caused by long-term quarantine measures may reduce the regulatory capacity of organ systems to resist viral infections, such as the coronavirus SARS-CoV-2. This article aims to advise on how the physical population should exercise physical activity and athletes who are quarantined or, as a result of the measures, are unable to fully exercise in public facilities. As a solution to the lack of physical activity, taking into account the limitations of this time, we proposed a movement program, which we want to contribute to the prevention of disease in COVID-19 and to better manage the current pandemic situation.

Key words: *COVID-19, physical activity, physical program, upper respiratory tract infection, pandemic*

Introduction

COVID-19 is an infectious disease caused by the coronavirus SARS-CoV-2. It was first identified in patients with severe respiratory disease in December 2019 in Wu-chan, China. In particular, COVID-19 infects the respiratory system, in severe cases causes severe pneumonia and can often lead to severe systemic failure and death of the patient (Bergendi, 2021 Yuki et al, 2020). On 30 January 2020, the World Health Organization (WHO) declared the outbreak of the

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disease to be a “public health emergency of international concern” and described it as a pandemic on March 11, 2020 (WHO, 2021). The COVID-19 pandemic caused by SARS-CoV-2 results in a devastating threat to human society in terms of health, economy and lifestyle. The new coronavirus COVID-19 currently accounts for more than 118 million confirmed cases, and more than 2.6 million people have died worldwide from complications related to the disease (WHO, 2021).

The viral infection is transmitted by droplets of secretion during coughing, sneezing and talking. It endangers persons who are in close or prolonged contact with the infected person. The infection is also transmitted through contaminated objects (Bergendiová, 2021). Recent findings show that a “bubble” with a diameter of 2 m can no longer be considered safe during movement, so we appeal to increased vigilance during physical activity. When running or cycling, a stream of dirty air is created behind the athlete, and it is therefore necessary for the person following the infected person to keep a distance of at least 5 to 20 meters and should not move in a straight line behind the person (Blocken, 2020).

Restriction of movement due to long-term quarantine also reduces social contact between people, which negatively affects the human body's ability to resist viral infections, resulting in an increased risk of damage to individual organ systems of the human body (Woods, et al., 2020). Public health recommendations for the prevention of the spread of COVID-19 tend to negatively affect the daily dose of physical activity. However, these findings need to be considered, as daily exercise of appropriate intensity can help fight disease by strengthening our immune system and suppressing some of the co-morbid conditions such as obesity, diabetes, hypertension and severe heart disease, which make us more susceptible to severe COVID-19 (Siordia, 2020).

Positive physical activity during the COVID-19 pandemic

At present, the issue of the influence of physical fitness on the course of SARS-CoV-2 infection is addressed by a lack of studies. However, it is documented that adaptations induced by regular physical activity lead to an improvement in the body's defenses, the actual level of which could affect the course of SARS-CoV-2 infection (Krüger, et al., 2016). According to Bergendi (2021), the immune system and immunity against viruses and bacteria are affected by various factors, including physical activity. Recreational sports or appropriate short-term physical exercise 3 to 4 times a week lasting 15-60 minutes at 40-60% of the intensity of maximum oxygen consumption (VO₂ max) has stimulating effects on the immune system, or does not significantly affect its activity. This is also confirmed by experiments on animals given influenza viruses. They have shown

that even low physical activity and strength training, which patients performed before or after the disease, reduces the symptoms of viral load, morbidity and mortality from infection (Kohut, et al. 2009; Lowder, et al., 2005).

Physical activity acts as a modulator of the immune system. During and after exercise, pro- and anti-inflammatory cytokines are released and lymphocyte circulation increases. Such an approach has an effect on the lower incidence, intensity of symptoms and mortality from viral infections observed in people who regularly exercise. However, its proper implementation needs to be considered to avoid damaging the immune system (Da Silveira, et al., 2021). Other available scientific evidence suggests that regular exercise is beneficial to the immune system and reduces the risk of infection with certain types of infections, such as upper respiratory tract infections (Fondell, et al. 2011; Nieman, 1997). In this regard, several studies have revealed that mild or intense exercise results in several positive changes in the immune system (Nieman, 2000; Nieman, et al., 2005). Immunoglobulin A (IgA) is the predominant antibody contained in the secretions of the mucosal immune system, one of the body's first lines of defense against attack by upper respiratory tract pathogens (Yousfi, et al., 2020). Klentrou et al. (2002) reported that IgA concentration and excretion rate at rest were significantly increased in individuals with regular moderate physical activity.

Movement exercises performed with medium intensity have proven to be the most suitable for increasing the immunity of the human body (Li, et al. 2020). A large observational study lasting 8 years found that a group of people who performed 15 minutes of daily physical activity 6 days a week of low volume activity reduced overall mortality by 14%, cancer mortality by 10% and cardiovascular mortality by 20% compared to individuals in the inactive group (Wen, et al., 2011).

Negatives of physical activity during the COVID-19 pandemic

Nevertheless, pilot studies have confirmed the relationship between intense exercise and increased morbidity and susceptibility to viral respiratory infections (Murphy, et al., 2008). Prolonged and intense training, which is part of the top or performance sport more than 5 times a week at more than 80% VO₂ max without sufficient regeneration, can weaken the immune system and cause reduced immunity of the individual (Bergendiová, 2021). The acute and chronic effects of physical activity on the immune response have been extensively studied in athletes (Jesus, 2021; Nieman, Wentz, 2019). Various epidemiological studies confirm that athletes who participate in races such as marathons or other endurance races have been at increased risk of upper

respiratory tract infections (Nieman, Wentz, 2019; Svendsen, et al. 2015; Gleeson, et al. 2013; Matthews, et al., 2002). For example, in a large group of 2,311 endurance runners, nearly 13.0% reported disease within a week of the Los Angeles Marathon compared to 2.2% of control runners (Nieman, et al., 1990). A one-year retrospective study of 852 German athletes showed that the risk of upper respiratory tract infection was highest in endurance athletes who simultaneously reported severe stress and sleep deprivation (König, et al. 2000). These studies have suggested that the risk of disease may increase when an athlete participates in competitive events, repeatedly undergoes unusually high load cycles, or experiences other stressors affecting the immune system, such as sleep deprivation or mental stress (Nieman, Wentz, 2019).

Excessive exercise is an intense exercise associated with an increased risk of disease attributed to immune dysfunction. After intense and long-term exercise, increased inflammatory biomarkers and an increased risk of upper respiratory tract infections have been observed in athletes. In the post-competition period, the increased risk of disease correlated with suppressed salivary IgA release, decreased activity of innate immune cells, and decreased T- and B-cell function (Jesus, 2021; Nieman, Wentz, 2019; Sharman, et al., 2019). After strenuous physical activity, there is a short-term transition period of reduced immune resistance (the so-called immunosuppressive window), which can last depending on the length and intensity of the exercise for about 3-12 hours (eg in endurance days). The period after intense exercise leading to increased inflammation, muscle damage, and a higher risk of infections may tend to expose the athlete to an increased risk of COVID-19 infection and subsequent slower recovery after infection. Therefore, close monitoring of respiratory and cardiac symptoms after overcoming COVID-19 infection is important (Bergendi, 2021).

The negative of the COVID-19 viral disease is also probably damage to the heart and its failure during physical activity, these conditions can occur even after overcoming the infection. Physical activity is not recommended during systemic viral disease (Inciardi, 2020; Yang, Jin, 2020). With COVID-19, there are concerns about the increased risk of complications after returning to sport, and we are slowly showing the possible short-term and long-term consequences of overcoming COVID-19. The consequences can range from heart problems to lifelong lung damage, and for many, returning to "normalcy" in everyday life can be a challenge, and sometimes it is necessary to take a break from sports in this case. Even after the asymptomatic COVID-19 infection, it is recommended to temporarily reduce the frequency and intensity of training focused on maintaining fitness for at least 2-4 weeks (Bergendiová, 2021).

Recommended physical activity during the COVID-19 pandemic

The above-mentioned studies document that intensive training or long-term intense physical activity can lead to a reduction in the body's defenses. It is not recommended to start an intensive exercise program unless the individual is adapted to these activities and has completed a professional examination. It is recommended to start the activity in low intensity and short load time and gradually increase the intensity. The World Health Organization recommends that physical activity be performed for 150 minutes of moderate-intensity physical activity per week. Bergendi (2021) recommends starting physical activity gradually and slowly and performing it according to her health condition. He considers it appropriate to set his movement routine with an easier exercise strengthening the stabilization system (so-called core), or exercises focused on flexibility - stretching or yoga. In addition, strength training should be included in the training, but should not exceed 60 minutes. For those who have health problems, it is recommended to consult their general practitioner before starting the exercise program. Before continuing the intensive training process, a thorough medical examination - preventive physical education and medical examination - should be performed.

Based on the many studies and recommendations mentioned above, we propose to perform physical activity through the first part of a comprehensive physical training program focused on the development of mobility. The program is primarily intended for professional soldiers, but with minor individual adjustments, we consider it a suitable physical activity for the general public. The exercise program can be used within the current temporal, spatial and material constraints caused by the pandemic situation. This program was scientifically verified in the field of increasing physical performance by Markovic (2018a, b). Comprehensive exercise program - the development of mobility consists of three parts. The first part consists of imitation exercises, which are performed as preparatory exercises for physical activity, which are performed at low or medium load intensity. These exercises are described in more detail in his article Markovič (2019). The second part consists of open palm blows to activate the muscles with a predominance of phasic tasks, but also as a means of increasing resistance to painful stimuli. The intensity of the strokes is determined by the instructor himself. The third part consists of compensatory exercises aimed at stretching the often shortened muscle parts with a predominance of tonic tasks and strengthening the muscle parts with a predominance of phasic tasks, which tend to weaken. Stretching is performed by the method of postisometric relaxation and strengthening in an isometric way (Markovič, 2020). Based on previous findings, we recommend performing this exercise 4 times a week for 20 minutes. For the more fit, we recommend a 10-minute supplement (a total of 30 minutes of exercise). We recommend maintaining a low to medium intensity, which you regulate individually based on the interval of exercise and rest.

Interval	Description	COMPLEX MOVEMENT PROGRAM - DEVELOPMENT OF MOBILITY MONDAY, THURSDAY	
20s + 10s			
30		eye gymnastics - eye movements to shape +	Marković (2019)
1		athletic alphabet - low skipping	
1:30		athletic alphabet - medium skipping	
2		athletic alphabet - high skipping on the place	
2:30		athletic alphabet - trip over on the place	
3		athletic alphabet - active on-site kick-off	
3:30	APNEA in breath to 20s, ventilation from 10s	imitation climbing - leg out scrunch on the place	
4		imitation swim - free style legs	
4:30		imitation swim - breaststroke legs	
5		imitation cross-country skiing - classic style	
5:30		imitation cross-country skiing - classic style	
6		imitation close-combat - kick knee / rope skipping - basic	
6:30		imitation close-combat - straightforward kicking / rope skipping - bell	
7		imitation close-combat - direct kick swing / rope skipping - skier	
7:30		imitation close-combat - side kick / rope skipping - one leg	Marković, Šimonek (2020)
8		imitation close-combat - back kick / rope skipping - one leg	
8:30	punches with open palm (30s)	the area of abdominal muscles	
9		the area of gluteal muscle	
9:30		the outer and inner sides of the thighs	Marković (2020)
10		the area of the tibia	
10:30	exercise 20s, rest 10s, PNF / PIR stretching, isometric strengthening	stretching the hip flexors	
11		stretching the hip flexors	
11:30		strengthening the gluteal muscle	
12		strengthening the gluteal muscle	
12:30		stretching the hip flexors	
13		stretching the hip flexors	
13:30		strengthening the gluteal muscle	
14		strengthening the gluteal muscle	
14:30		stretching the lumbar erector	
15		stretching the lumbar erector	
15:30		strengthening abdominal muscles	
16		strengthening abdominal muscles	
16:30		stretching the lumbar erector	
17		stretching the lumbar erector	
17:30		strengthening abdominal muscles	
18		strengthening abdominal muscles	
18:30		stretching muscles back of the lower limb	
19		stretching muscles back of the lower limb	SUPPLEMENT
19:30		Strengthening the front of the lower leg muscles and leg muscles	
20		Strengthening the front of the lower leg muscles and leg muscles	
20:30	imitation of animal movement for 20s, rest 10s	"crocodile" movement imitation	
21		"crocodile" movement imitation	
21:30		"kangaroo" movement imitation	
22		"kangaroo" movement imitation	
22:30		"crab" movement imitation	
23		"crab" movement imitation	
23:30		"cat" movement imitation	
24		"cat" movement imitation	
24:30		"gorilla" movement imitation	
25		"gorilla" movement imitation	
25:30		"monkey" movement imitation	
26		"monkey" movement imitation	
26:30		"frog" movement imitation	
27		"frog" movement imitation	
27:30		"bear" movement imitation	
28		"bear" movement imitation	
28:30		burpee	
29		burpee	
29:30		Jacik's test	
30		Jacik's test	

Figure 1. Scheme of a complex movement program - development of mobility 1 (Markovič, 2020)

PHYSICAL ACTIVITY IN THE TIME OF COVID-19 PANDEMIC

Interval 20s + 10s	Description	COMPLEX MOVEMENT PROGRAM - DEVELOPMENT OF MOBILITY TUESDAY, FRIDAY	
30 1 1:30 2 2:30 3 3:30 4 4:30 5 5:30 6 6:30 7 7:30 8	APNEA in breath to 20s, ventilation from 10s	eye gymnastics - eye accommodation	Marković (2019)
		imitation climbing - upper body movements	
		imitation of swimming - slow hand movement in freestyle	
		imitation of swimming - slow hand movement in backstroke style	
		imitation of swimming - slow hand movement in breaststroke style	
		imitation of close combat - front + rear direct punch	
		imitation of close combat - front + rear side punch (hook)	
		imitation of close combat - front + rear bottom punch (uppercuts)	
		imitation of close combat - front + back side elbow punch	
		imitation of close combat - block against direct punch	
		imitation of close combat - block against direct punch	
		imitation of close combat - block against side punch	
		imitation of close combat - block against direct kick	
		imitation rope climb	
		imitation throwing - left hand	
		imitation throwing - right hand	
8:30 9 9:30 10	punches with open palm (30s)	the area of head the area of the bottom ribs and the lower fixators of the scapula the area of right upper limb the area of left upper limb	Marković, Šimonek (2020)
10:30 11 11:30 12 12:30 13 13:30 14 14:30 15 15:30 16 16:30 17 17:30 18 18:30 19 19:30 20	exercise 20s, rest 10s, PNF / PIR stretching, isometric strengthening	stretching of paravertebral muscles in the sagittal plane	Marković (2020)
		stretching of paravertebral muscles in the sagittal plane	
		strengthening the deep muscles of the torso	
		strengthening the deep muscles of the torso	
		torso rotation - in a kneeling position rotation of the spine on the right (left)	
		torso rotation - in a kneeling position rotation of the spine on the right (left)	
		spinal torsion exercise	
		spinal torsion exercise	
		stretching the upper fixators of the scapula	
		stretching the upper fixators of the scapula	
		stretching the upper fixators of the scapula	
		strengthening the deep flexors of the head and neck	
		strengthening the deep flexors of the head and neck	
		strengthening the deep flexors of the head and neck	
		stretching the pectoral muscles	
		stretching the pectoral muscles	
		strengthening the lower fixators of the scapula	
		strengthening the lower fixators of the scapula	
		push-ups	
		push-ups	

Figure 2. Scheme of a complex movement program - development of mobility 2 (Marković, 2020)

CONCLUSION

The global pandemic of COVID-19 in recent months has had a major strain on all spheres of human life and has not bypassed physical activity and sport. The recommended anti-pandemic measures have not demonstrated a 100% ability to reduce the growth of infected individuals. Currently, the most effective public health measure available is vaccination in combination with other anti-pandemic measures, which also include appropriately selected low- or medium-intensity physical activity, which contributes to strengthening the immune system and a healthier lifestyle. Strengthening the immune system is essential in such a period of restricted exercise. Adherence to the above recommendations can help people cope with the special situation that this situation brings, and we believe that they will contribute to improving the quality of life of the population and help to return to normal as soon as possible. We should not forget the prevention, which is a long-term result of continuous and systematic building of the immune system, which would make it easier for the body to overcome respiratory diseases. It is assumed that COVID-19 will not disappear from the population and new infectious diseases will emerge, which we will have to fight as a population, therefore preventive strengthening of the immune system in the form of appropriately selected physical activity is one of the effective forms of protection. Further research is needed to elucidate the greater implications associated with physical activity and COVID-19 disease, which will demonstrate clearer insights in this area.

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A SHORT REVIEW OF VALIDATED QUESTIONNAIRES FOR EVALUATING LEVELS OF PHYSICAL ACTIVITY IN CHILDREN AND ADOLESCENTS

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ABSTRACT. Childhood and adolescent obesity becomes a worldwide health problem, as for the past years the prevalence of obesity amongst youngsters has reached very high levels. The increased levels of obesity at younger age rises concern at a global basis, therefore the prevalence of childhood obesity sets enormous pressure on healthcare system. Obesity is a complex trait influenced not only by genetic factors, but also by other such as: physical inactivity and unhealthy diet or overeating as well as weight status misperception. Some of the measures needed to overcome these factors is that the intervention programs used to prevent or combat obesity, must include assessment and correction of these factors, as well as monitoring their evolution over time. Questionnaires are efficient instruments that can be used for the evaluation of such parameters. This study aims to revise the scientific literature, from the last five years, to identify and centralize the most reliable and valid questionnaires created and used for the assessment of physical activity in children and adolescents.

Keywords: *obesity, children, adolescent, questionnaires, physical activity*

REZUMAT. *O scurtă revizuire a literaturii științifice cu privire la chestionarele validate utilizate în evaluarea nivelului activității fizice la copii și adolescenți.* Obezitatea la copii și adolescenți devine o problemă de sănătate la nivel mondial, deoarece în ultimii ani prevalența obezității în rândul tinerilor a atins niveluri foarte ridicate. Nivelul crescut de obezitate la vârste mici crește îngrijorarea la nivel global astfel că, prin creșterea prevalenței obezității la copii se creează o presiune enormă asupra sistemului de sănătate. Obezitatea este o afecțiune complexă influențată nu numai de factori genetici, ci și de alții precum: inactivitatea fizică și dieta nesănătoasă sau supraalimentarea precum și de percepția greșită asupra statutului ponderal propriu. Unele dintre măsurile necesare pentru depășirea acestor factori constau în faptul că programele de intervenție utilizate pentru

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prevenirea sau combaterea obezității trebuie să includă evaluarea și corectarea acestor factori, precum și monitorizarea evoluției acestora în timp. Chestionarele sunt instrumente eficiente care pot fi utilizate pentru evaluarea acestor parametri. Acest studiu își propune să revizuiască literatura de specialitate pentru a identifica și centraliza cele mai fiabile și valide chestionare create și utilizate în ultimii 5 ani pentru evaluarea activității fizice la copii și adolescenți.

Cuvinte cheie: *obezitate, copii, adolescenți, chestionare, activitate fizică*

Introduction

Childhood and adolescent obesity becomes a worldwide health problem, as for the past years the prevalence of obesity amongst youngsters has reached very high levels. In 2016, data provided by WHO stated that over 340 million children and adolescents were overweight or obese. Moreover, from a number of 1.9 billion adults, aged 18 years and older, diagnosed as overweight, 650 million were obese (34.21%). The situation is therefore critical, as shown by data from 2019, as an estimated 38 million children under the age of 5 years were overweight or obese. (WHO, 2016; Wiseman, Rossmann, & Harris, 2019).

The increased levels of obesity at younger age rises concern at a global basis, therefore the prevalence of childhood obesity sets enormous pressure on healthcare system, by the fact that an obese child often will maintain its weight status as an adult, developing several medical conditions that will severely affect his life (Kumar & Kelly, 2017).

Obesity is a complex trait influenced not only by genetic factors, but also by other such as: physical inactivity and unhealthy diet or overeating (Kim, Hou, Wang, & Arcan, 2019) as well as weight status misperception (Bayles, 2010; De La O et al, 2009; Figueroa, Ip, Gesell, & Barkin, 2008; Strava, 2017).

Some of the measures needed to overcome these factors is that the intervention programs used to prevent or combat obesity, must include assessment and correction of these factors, as well as monitoring their evolution over time. Questionnaires are efficient instruments that can be used for the evaluation of such parameters. In order to ensure the success of an obesity intervention program, it has been shown that measures must be taken at a very young age (Flynn et al., 2006; Lanigan, Barber, & Singhal, 2010).

This study aims to revise the scientific literature, from the last five years, to identify and centralize the most reliable and valid questionnaires created and used for the assessment of physical activity in children and adolescents.

Materials and methods

Literature Search

Bibliometric analysis was carried out in order to summarize and describe useful validated questionnaires regarding as tools for assessing physical activity in children and adolescents. In the present work, all bibliometric data were obtained from PubMed, Scopus and Google Scholar, from a period of five years, from January 2015 until April 2020. The search strategy on PubMed was based on the following keyword combination: „physical activity” OR „motor activity” AND „Reliability and Validity” AND „Questionnaire” AND „children”. For Scopus searches, we used the same keyword combination, but we selected only the papers from medical field. Finally, for Google Scholar searches, we selected articles that contained the keyword combination in the title.

Inclusion and Exclusion Criteria

In order to be included and discussed in this review paper, the selected articles have to describe a questionnaire that meets the following criteria:

- must measure the level of physical activity at children and adolescents (<18 years)
- the questionnaire should be applicable to general children and adolescent population, having either one specific target group, or a general one
- the article must be written in English
- the questionnaire must have passed the Reliability and Validity process.

Exclusion criteria

- systematic review/meta-analysis paper were excluded
- articles that describe questionnaires that lack reliability and validity were eliminated
- studies that use target groups, other than children and adolescents, were also excluded.

Selection of Papers

The selection of the studies to be included in this review paper was a three-phase process, as following:

- First, two reviewers (SCC and MD) independently searched literature studies that meet the requirements needed to be included in this review paper
- For the second phase, searches for both reviewers were compared, duplicates were eliminated and also papers that did not meet the inclusion criteria, based on abstract readings
- For the final phase of the selection process, after all papers were read in full, studies that meet the requirements were included in this review paper. For the last two phases of the selection process, a third reviewer (OM) offered assistance when needed.

Data Extraction

Data extraction, from the selected studies, was performed using The Quality Assessment of Physical Activity Questionnaires (QAPAQ) checklist (Terwee et al., 2010). Thus, we selected the following information: year of publication, title of the questionnaire, setting, recall period, language of questionnaire, items, parameters of measurement, as well as statistical data from the Test–Retest Reliability and Construct Validity process.

Results

After the first searches on PubMed, Scopus and Google Scholar, based on the keyword combination mentioned above, we identified a number of 493 articles. In the second phase of the selection process, based on inclusion criteria, and after all papers abstracts were read, we further identified 28 papers.

For the last phase of the selection process, after the full reading of the articles, of the 28 studies, we selected a final number of 10, which were included and thorough discussed in this review. A schematic representation of the selection process is presented in Figure 1.

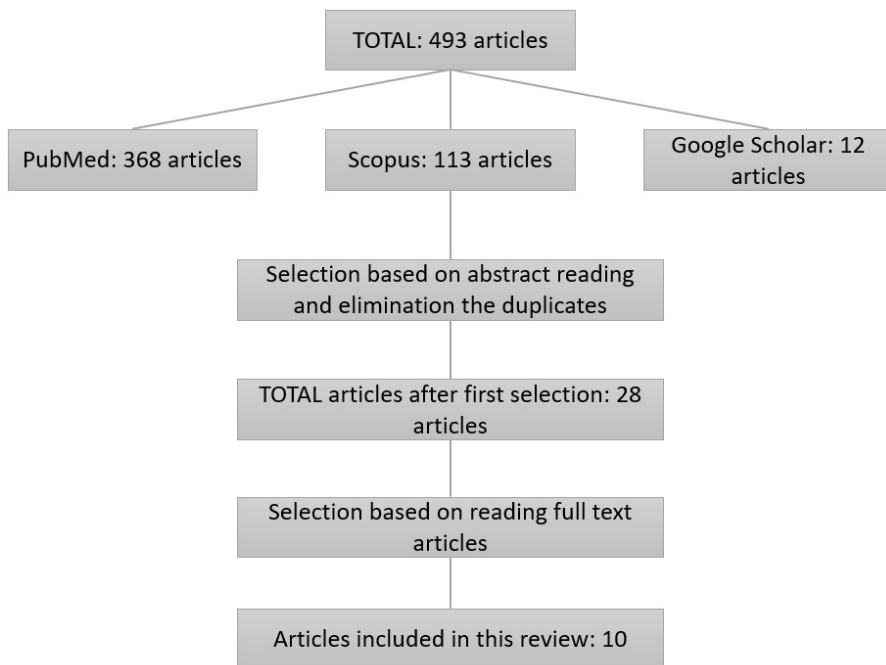


Figure 1. Schematic representation of the selection process of the articles

Description of Questionnaires

Table 1 presents a description of the questionnaires included in this review paper, based on following data: year of publication, title of the questionnaire, setting, recall period, language of questionnaire, items, parameters of measurement.

Test-Retest Reliability and Construct Validity

Statistical data obtained from the Test-Retest Reliability and Construct Validity process are shown in the table below (Table 2). Beside the results, we included data regarding study population that participated in the Reliability and Validity phases, the time interval needed for the retesting, as well as the instrument used to correlate the questionnaire score in order to obtain validation.

Table 1. Description of the questionnaires included in this review paper

Year	Questionnaire	Study population	Setting	Construct		Items	Results Parameters
				Recall period	Language		
2020	Madras Diabetes Research Foundation Physical Activity Questionnaires [MPAQ(c)] (Mehreen et al., 2020)	n=104 M/F=49/55 age: 14.4 yr.	various physical activities performed during a year	last 7 days	English	74 items	intensity, duration and frequency
	Physical Activity Questionnaire for Older Children (PAQ-C) (Turkish version) (Erdim, Ergün, & Kuşuoğlu, 2019)	n=784 age: 9–14 yr.	sports and leisure	last 7 days	Turkish	9 items	frequency
2019	International Fitness Scale, in the Portuguese language version (IFIS-LP) (De Moraes, Vilanova-Campelo, Torres-Leal, & Carvalho, 2019)	n1=190 age: 6.7 ± 2.1 yr. n2=110 age: 14.6 ± 1.8 yr.	self-reported physical fitness		Portuguese	5 items	Likert-scale

2019	Physical Activity Questionnaire for Older Children (PAQ-C) Japanese version (Isa et al., 2019)	Reliability: n=154 age: 9-12 yr. Validity: n=184 age: 9-12 yr.	sports and leisure	last 7 days	Japanese	9 items	frequency
2019	The Chinese Children Physical Activity Questionnaire (CCPAQ) (Xi et al., 2019)	Reliability: n=119 M/F=56/63 boys, age: 13.15 ± 2.4 yr Validity: n=106 M/F=53/53 age: 13.05 ± 2.45 yr.	physical activity pattern	last 7 days	Chinese	23 items	frequency and time spent
2018	The South American Youth/Child Cardiovascular and Environment Study (SAYCARE) Physical Activity (PA) questionnaire (Nascimento-Ferreira, et al., 2018)	Reliability: n=119 M/F=41.7% / 58.3% age: 11–18 yr. Validity: n=60 M/F=44% / 56% age: 11–18 yr.	physical activity at school, physical activity at leisure time, and physical activity while commuting	last 7 days	English	47 items	frequency and intensities
2017	Youth Leisure-time Sedentary Behavior Questionnaire (YLSBQ) (Cabanas-Sánchez, et al., 2018)	Reliability: n=194 M/F=96/98 age: 10–18 yr. Validity: n=1207 age: 8–18 yr.	time spent by youth in a wide range of leisure-time sedentary behaviors	last 7 days	Spanish	12 items	frequency

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2016	Physical Activity Questionnaire for older Children (PAQ-C) (Spanish version) (Benítez-Porres, et al., 2016)	n= 83 M/F=46/ 37 age: 10.98 ± 1.17 yr.	sports and leisure	last 7 days	Spanish	9 items	frequency
2016	Physical Activity Questionnaire for older Children (PAQ-C) (Chinese version) (Wang, Baranowski, Lau, Chen, & Pitkethly, 2016)	n=798 M/F=445/ 353 age: 8-13 yr.	sports and leisure	last 7 days	Chinese	9 items	frequency
2016	Early Years Physical Activity Questionnaire (EY-PAQ) (Bingham et al., 2016)	Reliability: n=104 M/F=52/ 57 age: 3.3 ± 0.8 yr. Validity: n=196 age: 3.2 ± 0.8 yr.	physical activity and sedentary time in young children	last 7 days	English/ Urdu	16 items	frequency and duration

Table 2. Statistical data obtained from the Test–Retest Reliability and Construct Validity

Year	Questionnaire	Study population	Reliability		Validity	
			<i>Time interval test-retest</i>	<i>Results</i>	<i>Comparison measure</i>	<i>Results</i>
2020	Madras Diabetes Research Foundation Physical Activity Questionnaires [MPAQ(c)] (Mehreen et al., 2020)	n=104 M/F=49/55 age: 14.4 yr	14 days	Total score: ICC=0.77	Acc. Actigraph (model Actilife 5 GT3X+) Triaxial Accelerometer	MPAQ(c) score were correlated with ACC: for sedentary behavior: $r=0.52$; for moderate-vigorous: $r=0.41$
2019	Physical Activity Questionnaire for Older children (PAQ-C) (Turkish version) (Erdim, Ergün, & Kuşuoğlu, 2019)	n=784 age: 9–14 yr.	7–10 days	Total score: ICC=0.91		CVI=0.95
2019	International Fitness Scale, in the Portuguese language version (IFIS-LP) (De Moraes, Vilanova-Campelo, Torres-Leal, & &Carvalho, 2019)	n1=190 age: 6.7 ± 2.1 yr. n2=110 age: 14.6 ± 1.8 yr.	15 days	Total score: for children $\kappa \geq 0.93$; for adolescents $\kappa \geq 0.88$	Physical Fitness Tests	$\kappa \geq 0.40$ in children and adolescents
2019	Physical Activity Questionnaire for Older children (PAQ-C) Japanese version (Isa et al., 2019)	Reliability: n=154 age: 9-12 yr. Validity: n=184 age: 9-12 yr.	2 months	Total score: ICC=0.83	Athletic competence; self-efficacy; body fat percentage; cardiovascular fitness	athletic competence ($r=0.41$, $P<.05$); self-efficacy ($r=0.65$, $P<.01$), body fat percentage ($r=-0.19$, $P<.01$), cardiovascular fitness ($r=-0.32$, $P<.05$), BMI ($r=-0.09$, $P=.21$)

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2019	The Chinese Children Physical Activity Questionnaire (CCPAQ) (Xi et al., 2019)	Reliability: n=119 M/F=56/ 63 boys, age: 13.15 ± 2.4 yr Validity: n=106 M/F=53/ 53 age: 13.05 ± 2.45 yr.	1 day	Total score: ICC=0.63- 0.93	Acc. ActiGraph (model wGT3X-BT) cut-points: SB 0- 400 cpm; LPA 401- 1,900 cpm; MPA 1,907- 3,918 cpm; VPA ≥3,918 cpm	Correlation between TSTPA and: SB were all 0.32 (P < 0.001); PAEE was 0.58 (P <0.001) Correlation between MVPA and LPA with Acc. (r _s = 0.20, P = 0.040; r _s = 0.19, P = 0.054)
2018	The South American Youth/Child Cardiovascular and Environment Study (SAYCARE) Physical Activity (PA) questionnaire (Nascimento-Ferreira et al., 2018)	Reliability: n=119 M/F=41.7 % / 58.3% age: 11- 18 yr. Validity: n=60 M/F=44 % / 56% age: 11- 18 yr.	15 days	Active commuting: r _s = 0.51; PA at school: r _s =0.63; PA at leisure time: r _s =0.68; MPA: r _s =0.36; VPA: r _s =0.93; weekly total MVPA: r _s =0.60 % of agreement with current PA guidelines≥6 0 min/day: κ 0.56	Acc. Actigraph MTI (model GT3X) cut-points: light (101- 1,999 CPM), moderate (2,000-4,999 CPM), and vigorous (4,000 CPM)	MPA vs. acc. MPA: r _s =0.11, VPA vs. acc. VPA: r _s =0.65, Weekly total MVPA vs. acc. total MVPA: r _s =0.88, % of agreement with PA guidelines≥60 min/day: κ=0.51
2017	Youth Leisure-time Sedentary Behavior Questionnaire (YLSBQ) (Cabanas-Sánchez, et al., 2018)	Reliability: n=194 M/F= 96/98 age: 10- 18 yr. Validity: n=1207 age: 8-18 yr.	7 days	Total score: ICC=0.66	Acc. Actigraph TM	Correlation between sedentary time assessed and acc. (r = 0.36; p < 0.001)

2016	Physical Activity Questionnaire for older Children (PAQ-C) (Spanish version) (Benítez-Porres et al., 2016)	n= 83 M/F=46/ 37 age: 10.98 ± 1.17 yr.	6 h	Total score: ICC=0.96	Acc. Actigraph (model GT3X) cut-points: SB* 0– 100 cpm; LPA* 101– 2296 cpm; MPA* 2296– 4011 cpm; VPA* ≥4012 cpm	($r_s = 0.228$ - 0.278, all ps < .05) were observed between PAQ- C and accelerometry
2016	Physical Activity Questionnaire for older Children (PAQ-C) (Chinese version) (Wang, Baranowski, Lau, Chen, & Pitkethly, 2016)	Reliability: n=92 M/F=51/ 41 age: 8–13 yr. Validity: n=358 age: 10.5±1.1 yr.	7–10 days	Total score: ICC=0.82	Acc. ActiGraph (model GT3X) cut-points: MPA* 2296– 4011 cpm; VPA* ≥4012 cpm	PAQ-C score were significantly correlated with MVPA: in males ($r=0.38$, $P<0.01$); females ($r=$ 0.26, $P<0.05$) and all children ($r=0.33$, $P<0.01$)
2016	Early Years Physical Activity Questionnaire (EY-PAQ) (Bingham, et al., 2016)	Reliability: n=104 children M/F=52/ 57 Age: 3.3 ± 0.8 yr. Validity: n=196 age: 3.2 ± 0.8 yr.	5 - 7 days	ST (ICC = 0.47) MVPA (ICC = 0.35)	Acc. Actigraph (model GT3X+)	The rank correlation coefficient was non- significant for ST ($r_s = 0.19$) and significant for MVPA ($r_s =$ 0.30)

Legend: ICC = intraclass correlation coefficient; r_s = Spearman correlation coefficient; ACC= Accelerometer; PA= physical activity; ST= sedentary time; SB= sedentary behavior; LPA= light-intensity PA; MPA= moderate-intensity PA; VPA= vigorous PA; MVPA= moderate to vigorous PA; κ =Cronbach alpha; yr.=years; M=male; F=female

Discussion

Based on literature searches from the past five years (January 2015 – April 2020) and as a result of the selection process, in this review we analyzed and discussed 10 studies. The questionnaires differ by several aspects, such as the language of the questionnaire, number of items used, accuracy, and other. Therefore, we found questionnaires written in English (Bingham et al., 2016; Mehreen et al., 2020; Nascimento-Ferreira, et al., 2018), Chinese (Wang, Baranowski, Lau, Chen, & Pitkethly, 2016; Xi, et al., 2019), Spanish (Benítez-Porres, et al., 2016, Cabanas-Sánchez, et al., 2018), Japanese (Isa et al., 2019), Portuguese (De Moraes, Vilanova-Campelo, Torres-Leal, & Carvalho, 2019); Turkish (Erdim, Ergün, & Kuşuoğlu, 2019) and Urdu (Bingham et al., 2016).

Comparing the number of items used for each questionnaire, we observed that the average for almost half of the questionnaires was of 9 items, while the longest questionnaire has 74 items (Mehreen et al., 2020), and the shortest questionnaire counts only 5 items (De Moraes, Vilanova-Campelo, Torres-Leal & Carvalho, 2019).

The age of the study groups varies also, starting with young children under the age of five (Bingham et al., 2016), and, in other cases, reaching to adolescence years (8–18 years) (Cabanas-Sánchez, et al., 2018).

The results presented in all questionnaires show the frequency at which a certain activity was performed on the last 7 days, while some questionnaires measure the intensity and duration of a physical activity. All these data are transformed in physical activity scores.

The accuracy degree for these questionnaires was obtained following the Reliability and Validity processes. For the Test-Retest Reliability process of eight of the questionnaires described in this review paper, the intraclass correlation coefficient (ICC) was used, giving a score between 0.35-0.96. the remaining two questionnaires the Cronbach's alpha (α) coefficient was used, giving a score of 0.56 - 0.88.

The retesting period for the Reliability process differs from one study to another. Hence, the shortest time interval for test-retest process was of 6 hours, whilst the longest was of two months.

According to the interpretation of Cicchetti et al. (1994) for the coefficients mentioned above, we presented questionnaires having a low degree of reliability (less than 0.40) and an excellent reliability score (between 0.75 and 1.00). For seven of the selected questionnaires, an accelerometer with different cut-point was used as a comparison instrument in the validity process. Some studies (De Moraes et al., 2019; Torres-Lea & Carvalho, 2019; Erdim et al., 2019; Isa et al., 2019) used different physical tests to correlate the results of

the questionnaires. Thus, the correlations will give different degrees of validity, based on the correlation coefficient, such as non-existent, weak, moderate, strong, and perfect.

Specifying the strengths of this review, we can mention that this study contributes to the field of interest by identifying the latest questionnaires that assess the level of physical activity and highlight their main characteristics. On the other side, as limitation of this study, we consider the relatively insufficient data regarding the interpretation of each questionnaire, one aspect that we will consider for further research.

Conclusion

This literature review paper offers a short list of studies that use questionnaires as instruments for measuring the level of physical activity. All of these questionnaires were subjected to the Reliability and Validity process, and were used and applied to children and adolescents. The questionnaires are instruments that can generate valid results, if all authors indications are being accomplished. The results will show data regarding the frequency to which a certain activity is performed on the last seven days. Moreover, some of the studies analyzed in this review paper use extra measurements, such as intensity and duration of certain physical activity. Finally, all these data are transformed into physical activity scores, which will provide a better and more accurate interpretation.

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CORRECTION OF LEARNING DISORDERS BY OPTIMIZING THE DEVELOPMENT OF SPATIAL AND TEMPORAL ORIENTATION

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ABSTRACT. Learning to read, write and calculate are proving to be some of the most significant cognitive processes in early education. The objective of this systematic review is to explore the associations between the psychomotor component and the academic achievement in writing, reading, and mathematics. An organized and methodical research of electronic databases was completed in order to determine significant studies. Twenty eligible articles were strictly evaluated, with extracted and summarized keywords. The two components of the psychomotor activity that influence reading were primarily the orientation ability and the fine motor skill, which is the one responsible for the correct spelling of “mirror-writing”. Differences in motor function were observed after intervention programmes. The results of all researchers have shown that there is a link between dysgraphia, dyslexia and the orientation ability or visual perception. Meanwhile, the role of cognitive and motor skills that underpinned mathematical performance was highlighted, and children who had a high capacity for spatial and visual orientation benefited from a better understanding and perception of geometric figures. However, the importance of students' spatial reasoning in relation to mathematics was identified, but only in terms of geometry. Poor quality of spatial notions has been found to be one of the causes of delay in the acquisition of reading, writing and mathematical calculation. The role of fine motor skills in the writing process was also noted, being of real importance in times when the child manipulates the writing tool and puts a word or a sentence on the page.

Keywords: *dyslexia, dyscalculia, spatial and temporal orientation, psychomotricity*

REZUMAT. *Corectarea tulburărilor de învățare prin optimizarea dezvoltării spațiale și temporale: analiză de tip review.* Învățarea scrierii, citirii și calculului se dovedesc a fi unele dintre cele mai semnificative procese cognitive în educația timpurie. Scopul acestei revizuirii sistematice este de a examina asocierile dintre componenta psihomotrică și performanța academică în scriere,

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citire și matematică. A fost efectuată o căutare sistematică a bazelor de date electronice pentru identificarea studiilor relevante. Douăzeci de articole eligibile au fost evaluate critic, cuvintele cheie fiind extrase și sintetizate. Cele 2 componente ale psihomotricității care influențează lectura au fost cu precădere capacitatea de orientare și abilitatea motorie fină, cea responsabilă de ortografia corectă a literelor și de evitarea scrierii tip „oglină”. După programele de intervenție, s-au observat diferențe la nivel motor. Astfel, rezultatele tuturor cercetărilor au arătat că există o legătură între disgrafie, dislexie și capacitatea de orientare sau de percepție vizuală. În paralel, s-a evidențiat rolul abilităților cognitive (spațiale) și motorii care au stat la baza performanței matematice, iar copiii care au avut o capacitate de orientare spațială și vizuală ridicată, au beneficiat de o mai bună înțelegere și percepție a figurilor geometrice.

Totuși, s-a identificat importanța raționamentului spațial al elevilor în raport cu matematica, dar doar în ceea ce privește geometria. S-a constatat că slaba însușire a noțiunilor spațiale poate fi una dintre cauzele întârzierii în însușirea cititului, scrisului și calculului matematic. De asemenea, s-a remarcat rolul abilităților motorii fine în procesul de scriere, fiind de o reală importanță atunci când copilul manipulează instrumentul de scris și așază în pagină un cuvânt sau o propoziție.

Cuvinte cheie: *dislexie, discalculie, orientare spațio-temporală, psihomotricitate*

Introduction

Learning to read, write and count are proving to be some of the most significant cognitive processes in early education which develop from others, such as experiencing one's own body, self-control and coordinating one's own body movements. In all cultures, the existence of children who have difficulties in acquiring language and mathematics, without showing any kind of problems in other fields, generates an increasing interest in the scientific community's study of the matter, which is currently still little known. The current situation and research that includes the subject of learning disorders presents a component that is closely related to them, namely the psychomotricity.

The “specific learning disorder” term refers to a heterogeneous group of neurobehavioral disorders that manifest as typical and constant difficulties in the powerful acquisition of reading, writing, and math skills. People with these deficits do not generally present any sensory disorders, but have a normal intellectual capacity and can be included in the regular school circuit, enjoying a regular socio-cultural opportunity (Benedicto-López & Sara, 2019). In the most comprehensive approach we can acknowledge the learning disorders to

be cognitive situations which affect one's ability to receive, process, investigate or store information. The learning disorder is defined as an unexpected predicament and persistence in acquiring reading, writing, calculation, and drawing skills, despite normal intelligence and proper schooling (Málaga & Arias, 2010). The field of learning disorders is extremely complex and constantly evolving. Thus, a broad classification would divide these difficulties into two broad groups: the group of dyslexic children (the most common one, including children with reading, writing, and literacy difficulties) and the group of discalculated children with non-verbal struggles (Snowling et al., 2003).

Dyslexia is a neurodevelopmental disorder characterized by difficulties in learning to read and spell, which is typically associated with phonological deficits (Snowling and Hulme, 2012; Vellutino, et al., 2004). Nonetheless, even if a phonological deficit appears to be the major proximal causal risk factor for dyslexia, there is evidence which supports the idea that dyslexia may be the product of several risk factors, and children with a wider range of cognitive and sensorimotor deficits are more likely prone to develop reading problems (Carroll, et al., 2016; Pennington, 2006; Pennington et al., 2012; Snowling, 2008; van der Leij et al., 2013).

Snowling and Melby-Lervåg (2016) analyzed a total of 15 studies performed on kids with dyslexia. Besides the extensively reported phonological deficiency, a meta-analysis showed that those who continue to be diagnosed with dyslexia face a wide variety of language difficulties. There is also suggestive evidence from neurophysiological studies that biomarkers of dyslexia prominent in childhood include difficulties in processing speech sounds (Leppänen et al., 2011; van der Leij et al., 2013). Altogether, these studies are perfectly stable with the concept that dyslexia is a type of language learning disorder.

On the other hand, although being less studied, but with a similar prevalence, there is dyscalculia. "Dyscalculia includes all the difficulties related to the concept of number, arithmetic calculation and mathematical reasoning" (Cadirola et al., 2016).

Some authors who have studied this matter (Gil-Madrona, 2013; Mendiara, 2008) state that both language and psychomotor skills are processes which are learned together in the human development. For his part, Berruezo (2008) affirms that a set of dimensions interacting with each other also contributes to the development of writing and reading skills: fine, gross motor skills, spatial and temporal orientation, laterality, balance. In this order, various research coincide in the affirmation of the previously written ones, which support the same idea, as that the psychomotor system has a great influence on the development of reading / writing (Ashford et al., 2006; Berruezo, 2008; Mendiara, 2008; Teixeira et al., 2015).

According to the Psychiatry American Association (1995), the preponderance of motor difficulties in child population varies from 6% to 8%. Of these percentages, it is predicted that 30% to 50% also have some sort of associated learning disorder, such as dyslexia or other different language difficulties (Ramus et al., 2003; O'Hare & Khalid, 2002; Visser, 2003). Of all these components of the psychomotor skills, spatial and temporal orientation is considered essential for learning to write. Due to this, girls and boys learn to locate their own body in space, an ability which is also reflected in the notebook, the child becoming aware of the orientation of writing, i.e. from left to right or from top to bottom. If this neurofunction is not developed and assimilated correctly by students, dysgraphia problems occur, which causes students to omit letters, enlarge them, replace them and so on (Marroquín et al., 2014). According to Espinoza (2003), "the elementary functions that need to be developed to achieve a good literacy process are: body scheme, lateral dominance, spatial and temporal orientation". Troubles in reading and writing areas are most commonly connected to motor coordination difficulties (Smits-Engelsman et al., 2001) whilst mathematical computational difficulties are linked with perceptual-motor problems, for instance spatial and temporal orientation and laterality (Bastos, 2006).

Numerous studies have emphasized the positive correlation between mathematical and spatial skills (Berciano et al., 2016; Cheng & Mix, 2014; Fernandez-Mendez, 2020). Much of this evidence comes from the fact that those who perform better on space tasks tend to perform better on math ability tests (Holmes et al., 2008; Rasmussen and Bisanz, 2005). There are certain studies that confirm that mathematics has a spatial nature (ex. Jones, 2002). Other studies suggest that in order to perform in mathematics, students must have the ability to imagine and visualize things and objects in space (Shea et al., 2001; Wei et al., 2012).

Objectives and hypotheses

Generally, a broader understanding of how the different components of motor competence are related to mathematics and reading skills in children in the early years of school is needed. Given this context, the aim of this systematic review is to examine the associations between the psychomotor component and the academic performance in mathematics and reading. Thus, the questions to be answered are:

1. According to other studies, is there a link between psychomotor skills and reading and writing disorders?

2. According to other studies, is there a link between psychomotor skills and computational disorders?

If the answers prove to be affirmative, the systematic review will also answer other questions:

3. According to other studies, which component of the psychomotor activity influences writing, reading and calculation disorders?

4. Is the ability of spatial and temporal orientation a determining factor in ameliorating writing, reading and arithmetic disorders?

Thus, the issued hypotheses are:

1. It is assumed that there is a link between psychomotor activity and learning disorders.

2. Spatial and temporal orientation, as a component of the psychomotor activity, positively influences academic performance in writing, reading and arithmetic.

Material and method

Study identification

In order to identify the relevant studies, it was performed a comprehensive search of databases. Electronic databases (PubMed, PsychINFO, Web of Science) were checked out using keywords such as: dyslexia, dysgraphia, dyscalculia, spatial orientation, temporal orientation, psychomotor activity, visual skills, visual-spatial skills, learning disorders, children, academic performance, spatial skills.

Study selection

In order to be included in this systematic survey, the research was in line with the following criteria:

Inclusion criteria:

- a sample of preschool and school children, aged between 5 and 15 years old;
- a sample of children diagnosed with one of the learning disorders, but also undiagnosed at that time;
- studies published between 2011-2021;
- experimental studies had to contain at least one component of psychomotor activity, in relation to one of the learning disorders;
- studies in English and/or Spanish;

Exclusion criteria:

- sample of children diagnosed with an intellectual/neurodevelopmental disorder/other associated comorbidities (ADHD, low IQ, autism, coordination disorders, etc.);

- studies that focused on an overall score of academic performance and not on one of the disorders were excluded;
- studies published in a language different than English/Spanish, without the possibility of translation.

The following figure (figure 1) shows the plan of the Prisma diagram used for the selection of studies:

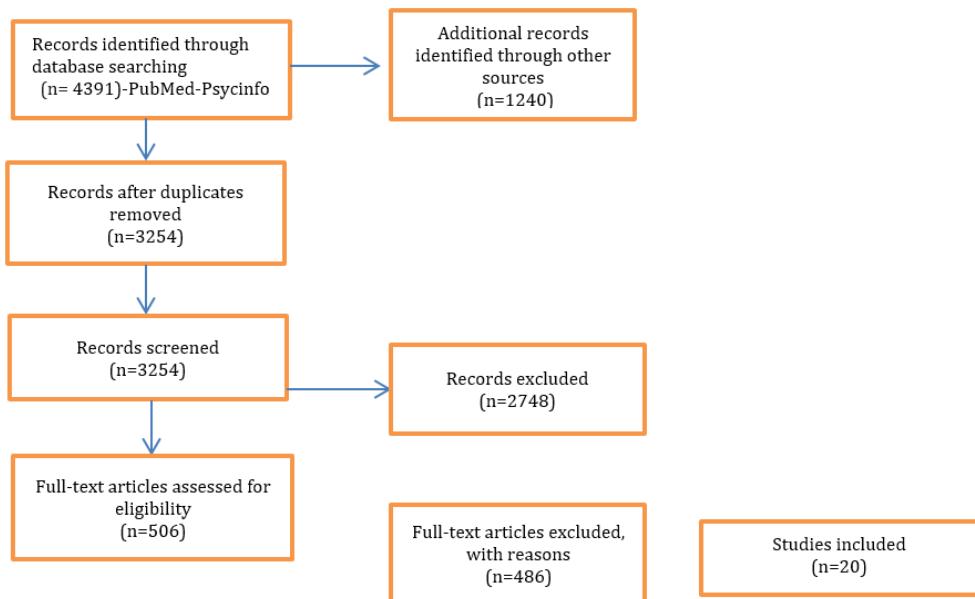


Figure 1. The Prisma diagram scheme

Results

After the specific selection's competition, 20 studies were considered worthy for inclusion. These studies, which were contained in the review, were published between 2011 and 2020. The total sample sizes involved in these studies ranged from 19 to 12.099 children. The participants in the study were mainly children, from the primary school, aged between 5 and 14 years. Among them, a total of 242 children were diagnosed as having a learning disorder before being included in the study, either by testing or by being characterized by a teacher.

A number of tools were used to assess the various components of psychomotor activity: questionnaires, observation sheets, spatial and temporal orientation test (TOTE), BOT-2 motor skills test (Bruininks-Oseretsky Test of Motor Proficiency, Bender Gestalt test, Motor development scale (MDS) described by RosaNeto (2002), Raven Test - Colorful Progressive Matrix Scale (MPC), Test of Visual-Perceptual Skills, Movement Assessment Battery for Children, Spatial Skills Test, Motor Assessment Scale, Spatial Reasoning Instrument, Movement Assessment Battery for Children-Second Edition (MABC-2 ; Henderson, Sugden & Barnett, 2007), Mental rotation task. A wide collection of tools has also been used to assess academic achievement in mathematics, reading and writing: questionnaires, observation sheets, Reading and Writing Analysis Test (TALE), Motor Dysgraphia Subtest (25 items) - Mabel Condemarin, Learning and Vocabulary Questionnaire (30 items)-David Wechsler, Dysgraphia Scale, Desempenho Escolar Tests (TDE), Mathematics test-geometry, Wechsler Test 2nd Edition (WIAT-II), Block design, Pattern Construction subscale of the BAS-II, NFER PiM, Mathematical achievement etc.

It is important to mention that out of the 20 studies included, a total of 12 studies address reading disorders (dyslexia), of which 8 are focused on writing (dysgraphia), and 8 are aimed at mathematical disorders. The 20 relevant studies are set out in Table 1:

Table 1. Bibliographical sources included in the review

AUTOR	METHODS	RESULTS
Klonari, A., Styliani Passadelli, A. (2019)	Objective: a. Investigation of spacial thinking b. The difference between dyslexic and non-dyslexic children in terms of orientation -50 children aged 13-14 (25- dyslexic, 25 non-dyslexic) A 3-part questionnaire: Demographic data, spatial thinking test, geographical thinking test	1) Non-dyslexics scored 222 points and dyslexics 152 points (p 0.002) 2) Non-dyslexics scored 255 points and dyslexics scored 117 (p .000) Non-dyslexics scored 102 and dyslexics scored only 35 (p 0.001) 3) The total score obtained by the non-dyslexic students in all exercises was 612, while dyslexics obtained 482 (p 0.042).
Timbila, H., Jesús, M. (2017)	Objective: To analyze the importance of spatial orientation. • Establishing the characteristics of the spatial orientation in kids aged 5	Between 50 and 75% of teachers say that almost always orientation in space facilitates the reading-writing process More than 40 of the children have difficulties with spatial orientation

- Establishing the types of strategies that teachers use to develop spatial orientation
50 children- 5 years
Testing tools:
questionnaire / observation / study
The orientation in space variable:
questionnaire / observation / study - laterality
- Marroquín, T., Vanesa, E. (2014) Objective: Determining the relationship between spatial and temporal orientation problems and dysgraphia among girls and boys in the third grade
Elaboration of an intervention guide in the spatial and temporal orientation, which should prevent the dysgraphia of the students.
Tools:
1. Reading and writing analysis test (T.A.L.E.)
2. Spatial and temporal orientation test (T.O.T.E.)
-208 children, the third grade
- Basantes- Colcha, C. P., a. Development of psychomotor activity through movements and games, C (2017)
- 1. There is a direct relationship between spatial orientation and the reading-writing process.
2. Spatial orientation develops and matures in different stages
3. There are various methods to help with the reading-writing process
- 1. According to the results of the TALE test, Writing Subtest, 60% of girls and boys make mistakes in writing.
2. The spatial and temporal notions which they do not identify are: size 43%; hours of the day 44%; succession of duration 75%; left-right orientation 75%; horizontal-vertical 44%; trajectory appreciation 54%. In spontaneous writing they present: irregularities/ oscillations. Regarding copying, there are speed errors while on dictation there are substitutions, omissions and consonant changes
3. The average percentage of girls and boys who make mistakes is 60%.
4. The predominant dysgraphic errors in writing are in 24 indicators (71%).
5. The exercises or activities that must be performed in order to correct the problems of orientation in space and time, as well as avoiding dysgraphia, are in the following dimensions: duration, order and succession, rhythm, left-right orientation, direction in space and location.
• The activities carried out with the students and parents who applied the guide and the psycho-pedagogical intervention technique

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	b. Improving children's writing through graphic expressions, letters, drawing and graphomotor exercises. c. The implement of a support program for teachers Tools: a. Reading and writing analysis test (T.A.L.E.) b. Observation sheet c. Questionnaire intervention + elements of orientation in space, time, visual coordination, fine motor skills -20 children, fourth grade	helped to decrease the dysgraphia of the boys and girls who had this problem, reaching very satisfactory results both quantitatively and qualitatively. • Children's writing has been greatly improved, by 90%
Cusín Yacelga, D. A., Cusín Yacelga, M. (2016).	Objective: Diagnosis of children with dyslexia and dysgraphia Identifying the characteristics of learning (reading-writing) in boys and girls in the third and fourth grade. The development of a teaching guide for teachers, students and parents containing strategies, techniques, and workshops suitable for the development of both reading and writing Tools <i>Questionnaire</i> <i>Observation Sheet</i> <i>Bender Gestalt Test</i> -98 children (51 from the third grade and 47 from the fourth grade)	There are greater difficulties in the third grade children, with higher percentages of the difficulties of visual motor coordination and perception of shapes. Regarding the results of the other tests applied, it is found that learning disorders have a higher incidence in children aged 7. The entire number of boys and girls who show symptoms of dyslexia and dysgraphia in the studied population is 39. The highest incidence is in the third grade, who have a poor reading comprehension, rigidity in writing and posture.
Okuda, P. M. M, Martins, P. (2014).	Objective: The characterization and comparison of students with learning difficulties' motor performance in relation to students with normal academic performance. Tool: BOT-2 (Bruininks-Oseretsky Test)	Students with dyslexia had lower physical activity as compared to the others. However, both groups in this study performed lower than expected for their age. A statistically compelling contrast was observed between the groups, especially in the areas regarding fine

Cacuango Chicaiza, M. (2020)	-79 children, aged 8-11 Group 1: dyslexia-19 Group 2: without dyslexia-60 Objective: Determining the skills development in the motor and sensory functions. Identifying the skills and functions that contribute to reading-writing A bibliographic review was conducted on studies similar to the study variables, which guides and provides guidance for research development. 3 stages: Sensory stage - motor or sensory motor. Pre-operational stage from 2 to 7 years old. The stage of concrete operations from 7 to 11 years old.	motor skills, manual control, manual coordination, endurance and nimbleness. The aspects which influence the development of the basic functions during the literacy process are: the cognitive development, the motor development, posture, tonicity, muscle coordination, balance, laterality, space, time and rhythm. The basic functions that affect the development of children's reading are the visual motor coordination, phonological awareness, temporal space, rhythm, laterality and directionality. The basic functions that affect the writing process are: muscle tone, posture, balance, attention, memory, dissociation of movements, and laterality.
Gallardo, Y. P., Gallardo, A. B., Cantuña, P. T. (2016)	Objective: studying spatial intelligence and its influence on reading / writing in third grade boys and girls Tools: Raven Test - Colorful Progressive Matrix Scale (MPC) Literacy Analysis Test - T.A.L.E - determines the level of reading and writing -85 children from the third grade	Out of the total population, just over two quarters obtained average scores in terms of spatial intelligence diagnosis, a little bit over a quarter are below average, while less than a quarter are at a deficit level. 10% of the evaluated children obtained a rank II score, making them children with a superior spatial intelligence to their age. Those who obtained a rank III are children evolved according to the requirements for their age, and in the last group, rank IV, are children who need attention and restructuring of the necessary skills for visual perception, such as: visual attention, visual memory, motor coordination; as well as in spatial structures: spatial orientation, spatial organization and spatial structuring,

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Palacios-Chachapoya, K. (2018)	Objective: Identifying a positive relationship between visual-spatial skills and writing / vocabulary. -54 students, aged 10-11 Motor dysgraphia subtest (25 items) - Mabel Condemarín Learning and vocabulary questionnaire (30 items) - David Wechsler	Significant correlation between visual-spatial skills and meaningful learning / vocabulary: -, 268 (Sig., 050)
Fernani Luiz, D. C. G., Prado, M. T. A., Fell, R. F., Reis, N. L., Bofi, T. C., Ribeiro, E. B., Blake, M. T., Monteiro, C. M. (2013)	Objective: Motor development assessment in children aged 6 to 11, with learning problems and school characteristics of delayed motor development, pre and post the motor intervention' application program (6 months, one hour / week) The intervention included jumping, moving, combining elements, exercises on music. Tools: Motor Development Scale (MDS) described by RosaNeto (2002), which assesses the fine motor skills areas, global motor skills, balance, body scheme, spatial and temporal orientation.	At the end of the intervention, higher scores were recorded, the data showing a numerically substantial distinction amongst the average of the initial tests and those from the re-evaluation. The motor ratios equivalent to the regions in the body scheme, spacial and temporal direction In the initial classification conducted one by one in the evaluation, most kids had a motor growth assigned as "normal to low". Despite that, in the reassessment, merely 4 of them did not evolve and remained to be categorized as "normal to low", mostly changing toward "normal to medium".
Silva, J., Beltrame, T. S., Oliveira, A. P., Sperandio, F. F. (2012).	Objective: The study intended to recognize learning and motor troubles in students with low educational achievement. 19 children, 10 years old, classified by teachers as having learning disorders Tools: <i>Desempenho Escolar Tests</i> (TDE) indicates which learning school domains are maintained or affected in the specific subject discussed (reading, arithmetic, writing) <i>Movement Assessment Battery for Children</i> – 4 task sets, which	With the exception of the arithmetic test, participants had a below average academic performance for their educational status, for both sexes, as reported by the TDE parameters. The boys had even a greater average assess in reading, writing and in the general outcome of the TDE, while the girls had a superior development in arithmetic, yet, according to statistics, this discrepancy was not established. Amid the 19 students appointed by educators, only one revealed no indication of a learning disorder,

include dexterity, ball skills, balance, etc.

whereas the other children were pronounced with difficulties in minimum one scholarly ability (many times in reading and writing). Regarding the motor indicator, it turned out that five of the children involved had limited motor issues. The examined statistical findings demonstrated that one as well as the other group of students had dysgraphia in the pre-test phase. Regarding perceptual-visual skills, GI showed lower performance compared to GII, including when it came to the writing quality. After experiencing the intervention program, the GI enhanced the medium of the right answers and strengthen the quality of the handwriting.

Fusco, N., Objective: Checking the effectiveness of a perceptual-visual and motor intervention program for students with dyslexia.
Giseli, D. G.,
Capellini, S. A. (2015).
-20 students, aged 8-11, from the third and fourth grade
Group I (GI; 10 students with developmental dyslexia) and Group II (GII; 10 students with fine school performance).
A perceptive and vision-motor intervention program was implemented, which included targeted-motor coordination exercises, visual memory, vision-spatial coordination. In the pre and post test situations, both groups were tested of Visual-Perceptual Skills, and for writing the Dysgraphia Scale test.

Macdonald, The focus of this survey was to
K., Milne, N., investigate the connections
Orr, R. between fine and gross motor
(2020). skills and academic performance in mathematics and reading in preparatory class children.
Tools:
Motor competence
Complete Bruininks-Oseretsky Engine Proficiency Test Form (BOT-2), *Academic performance in mathematics and reading*
Wechsler Test Second Edition (WIAT-II) -5 of the 9 individual subtests.
-55 children, 25 boys-30 girls, class 0, 6-8 years old

A significant positive association was found between the scores from the total motor tests and the scores of the mathematical tests ($r = .466$, $p < .001$).
Scores in terms of fine motor skills were significantly associated with both mathematical scores ($r s = .572$, $p < .001$) and reading scores ($r s = .476$, $p = .001$).

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|---|---|--|
| <p>Berciano, A., Jiménez-Gestal, C., Salgado-Somoza, M. (2016).</p> | <p>Objective: Designing a didactic proposal for the development of the classroom orientation, to promote / use mathematics. Evaluation and analysis of content activities. The importance of using spatial orientation exercises from a mathematical perspective is analyzed. A context is presented, the purpose of which is to search for a hidden treasure somewhere in the school. Subsequently, following the curriculum lines, it is analyzed which mathematical processes are used. Eventually, it is examined to what extent the implementation of this activity in a school helps girls and boys to develop the properties of space, especially the three-dimensional one.</p> | <p>The activity: we worked with certain mathematical concepts related to orientation: up, down, right, left. The exploration of the school took place through a guided intervention and the principles of the proposal mentioned at the beginning were satisfied. The content analysis had different activities completed by the children: listening to the story of the treasure, the answers they were guided by, searching for the treasure by interpreting the icons, verbal communication, etc.</p> |
| <p>Lowrie, T., Logan, T., Ramful, A. (2017).</p> | <p>Evaluating the effectiveness of a visual space intervention program to determine the effect on students' spatial reasoning and mathematical performance</p> <p>-20 children, 5 years old</p> <p>-120 children, 66 control group (10-12 years old), undiagnosed. The program lasted for 10 weeks, 20 hours.</p> <p>Tools:</p> <p>a.Spatial Reasoning Instrument – spatial orientation, visual orientation, mental orientation. Mathematics test – geometry</p> | <p>The space intervention program led to improvements in both spatial ability and mathematical performance in relation to the control group.</p> |
| <p>Cheng, Y. L., Mix, K. S., (2014).</p> | <p>Objective: investigate a potential causal relationship between spatial capacity and mathematical skills. Pretest-design-posttest intervention</p> <p>-59 children (6-8 years old)- 32 in the experiment group and 27 in the control group.</p> | <p>It has been found that a short spatial orientation intervention can develop mathematical skills. Spatial intervention significantly improved children's scores from post-test, ($t(31) = 3,587, p = .001$), whereas children in the control group did not ($t(26) = .635, p = .53$)</p> |

Tools: Spatial skills test, with 32 items. 2 Math tests with 27 and 16 items, respectively

Intervention-Working with different objects

Oliveira, C. Objective: To describe and to contrast the children's motor performance with developing dyslexia, learning disorders and educational difficulties.

-40 students, 7-11 years old
GI: 10 students with dyslexia
GII: 10 students with learning disabilities
GIII: 10 students with learning difficulties and GIV: 10 students with good academic performance

Tool:
Motor Assessment Scale.

Cetin, S. Y., Objective: To evaluate motor performance in children with dyslexia, through the DSM-IV-TR

Kitiş, A., Kösem, F. Ş. (2018). -28 dyslexic children and 28 without dyslexia, 7-12 years old. Motor skills were assessed with the Bruininks Oseretsky motor skills test (BOTMP 2-SF)

Gilligan, K. Objective: This study explored the associations between math and spatial skills in 5 and 7year olds.

A., Flouri, E., Farran, E. K. (2017). 12,099 children who participated in both Wave 3 (mean age = 5; 02 [years; months]) and Wave 4 (mean age = 7; 03)

1. Measures included a standardized assessment of the mathematics and construction scale of British Ability Scales II models to assess intrinsic-dynamic spatial skills (BAS-II).
2. NFER PiM is an assessment of mathematical ability and includes a wide range of questions about numbers, shapes, measurement, etc.

Kruskal-Wallis, Mann-Whitney, Friedman, Wilcoxon Signed Posts and the Spearman correlation, signifying that groups I and II performed lower on the tests of balance and spatial orientation. These groups differed from each other in the gross motor tests, in which the GI scored lower than all other groups and the GII was lower than all other groups in the temporal orientation, while the children belonging to GIII and GIV showed motor skills.

There was a significant difference between the results of the two groups on motor skills, functional status and quality of life ($p < 0.05$).

The results indicate that there was a significant difference in performance between boys and girls for all tasks, except for the mathematical performance, where male scores were above those of the girls.

There were differences between the groups in terms of reading and construction skills.

Post-hoc tests revealed significant differences between all SES groups ($p < .01$ for all).

Model 1- Word reading at Wave 4 had the highest correlation with NFER mathematical scores ($r = .529$, $p < .001$), followed by Model Construction scores at both Wave 4

($r = .479$, $p < .001$) as well as at Wave 3 ($r = .430$, $p < .001$).

Model 2- it was indicated that word reading and the models' construction from Wave 4 had the greatest impact on mathematics scores.

The language measures introduced in step 3 explained 19.8% of the scores obtained in mathematics.

Both spatial and linguistic measures were significant predictors in this model ($p < .001$ for all).

Model 3

Spatial ability was accounted for 15.4% of the mathematical variation, while language measurement was accounted for 5.0% of the variation.

Model 4- Word reading had the greatest impact on mathematics, followed by the model construction scores (13.5%).

Analysis

All studies addressing the issue of reading and writing disorders have in common the purpose of determining and identifying how the spatial and temporal orientation contributes to the reading and writing process. Out of the 12 studies, 2 present a motor intervention program, 1 with an emphasis on visual-motor coordination exercises, visual memory, visual-spatial coordination, sequential memory (Fusco et al., 2015) and 1 on fine motor skills, global motor skills, balance, body layout, spatial orientation and temporal orientation (Fernani et. al, 2013). Although at the initial tests all children included in these 2 studies were diagnosed with dyslexia and dysgraphia, after both interventions the quality of the handwriting improved. The motor ratios corresponding to the areas in the body scheme, spatial orientation and temporal orientation represent, according to the results, the components from which significant differences were observed, having the highest increase compared to the others. Alongside with the improvement of writing, differences were also observed at the motor level, except for 4 children, who did not evolve, continuing to be classified as having a "low" capacity (Fernani et. al, 2013).

The other 10 studies are not based on an intervention program, but instead they correlate the results of reading and writing tests with motor tests. According to this research, there is an unanimous correlation between the motor component and the ability to read and write. However, one study does

not show low motor abilities in children diagnosed with dyslexia (da Silva et al., 2012). The common results show that even if the writing component includes the ability to process duration, order, sequence, left-right orientation, space and location, the ability to write is largely influenced by fine motor skills and manual control. In addition to the trouble of not placing the letters and words on the page correctly, which is influenced by their orientation and space, these children have writing rigidity and problems holding the pencil. In conclusion, the results of all research have shown that there is a link between dysgraphia and dyslexia and the ability to orient or visual perception in space. While seeming different, the 2 components of psychomotor skills that influence reading, being of real importance, are mainly the ability to orient, along with fine motor skills, which is responsible for the correct spelling of the letters and the avoidance of "mirror" writing.

The 8 studies that address the issue of computational disorders, among others, share the impact of dyscalculia in these deficits, emphasizing its association with spatial and visual skills, except for one study which also mentions the involvement of the fine motor skills (Macdonald et al., 2020). Among these, 2 contain an intervention program with an emphasis on spatial orientation (Cheng and Mix, 2014; Lowrie et. al., 2017). These programs are designed to determine how this spatial component influences children's performance in math. Thus, according to the results, the role of cognitive (spatial) and motor skills which underlie the mathematical achievements of primary school children is being highlighted. Again, as with writing disorders, these studies identify the importance of students' spatial reasoning in relation to mathematical performance, but only in terms of geometry. Spatial orientation, visual and mental orientation are mentioned in the theoretical components of this research, and children who have these skills benefit from a better understanding and perception of geometric figures. On the other hand, in relation to orientation, it is argued that the ability to calculate depends largely on the ability to memorize, then on attention and last but not least on the direction (left-right, up-down) (Gilligan et al., 2017). Still here, it is mentioned that there are several genetic and developmental factors that could contribute to the calculation. However, no link was identified between temporal orientation and mathematical skills.

Discussion

This systematic review examined the significant connections among various elements of motor competence and academic skills in writing, reading, and arithmetic. There was proof that answered positively to the first 2 questions

of the review, namely that there is a link between motor competence and reading disorders, but also between motor competence and mathematics. These confirmations were found especially in students in the first years of school (6-9 years old), the results being substantially supported by those of Mix et al. (2016). To a very large extent, children included in the studies, who had one or more disorders, had a lower level of one or more components of motor skills, and all children diagnosed with dyslexia scored lower on motor tests, compared to the undiagnosed ones. In a survey of a study which compared the motor skills of children with learning disorders with those of children who develop normally, it was found that the former scored lower on both locomotor subtests and those for handling objects. A correlation between these skills and reading was observed, while finding a relationship between mathematics and object control skills. Moreover, this research highlights the relevance of particular interventions that facilitate both motor skills and academic skills (Westendorp et al., 2011), while supporting the confirmation of the first hypothesis.

4 relevant experimental studies were identified, which supported the psychomotor program as an aid to learning disorders. Despite the fact that the samples were composed of children aged 8-9 years, being the most appropriate time to detect certain disorders (second/third grade) this aspect may become valid at older ages, although there are zero or no relevant adult studies to date. Intervention programs included, among others, speed, agility and balance, but significant differences in motor ratios were observed in the area of body scheme and spatio-temporal orientation, being also the components with the highest growth compared to the others (Fernani et. al., 2013). Despite this, another important component found in several studies was the fine motor skill, which is responsible for the correct spelling of the letters and holding the handwriting tool. This is consistent with other research studies examining the link between fine motor skills, mathematics and reading skills in school-age children (Pienaar et al., 2014). For example, the same autor found that fine motor and visual skills are more strongly associated with math and writing than the total of motor skills. However, there was no qualitative difference between the 2, spatial ability and fine motor skill, therefore it is not known from studies which of them influences to a greater extent the process of writing, reading or calculating. Thus, the answer to the third question remains uncertain.

At the same time, the determining role of spatial skills in the process of writing and reading was identified, mainly due to the presence at the level of this structure of motor, psychomotor and psychological causes. This result is also consistent with other studies, which claim that if there are no physical causes, the predominant factor is the link between the motor skill and literacy (Capellini et al., 2010; Okuda and Capellini, 2011; Rochelle and Talcott, 2006; Rommelse et al.,

2009; Rosenblum et al., 2010). The temporal component was found only in terms of writing, not mathematical calculation in the revised studies. Thus, it was found that the poor mastery of spatial notions: up, down, before, left, right, may be one of the causes of the delay in learning to read, and mathematical writing and calculation. An important aspect is the identification of the spatial component as having a decisive role only in a certain part of mathematics, more precisely in geometry or graphical forms and not in mathematical calculus, which depends to a large extent on the ability to memorize, pay attention and only then the left-right orientation, up-down (Gilligan et al., 2017). This particularly interesting finding may indicate a positive role of early spatial skills on the processes of reading and math acquisition, which is consistent with the recognition of the second hypothesis, the one that highlights the impact that spatial orientation can have on writing, reading and calculation.

Strengths and limitations of the study

First, this review systematically summarized the findings of 20 studies, including a large sample of participants, aged between 5 and 15 years old (between 19 and 12,099 children), from different countries. Secondly, a comprehensive search of databases on all learning disabilities was carried out, in line with the Prisma guidelines, followed by a systematic screening approach to identify eligible studies. Thirdly, the search took place in 2 languages of international circulation (English and Spanish), which led to the maximization of the identification of suitable studies. Finally, this review allowed a deeper examination of the associations between the components of psychomotor skills and three of the fundamental learning skills (reading, writing and math), focusing on each and every one in an equal way compared to other researches, which addresses only one or just two components.

Even so, it is essential to recognize that there were some boundaries in this examination. Primarily, there has been a relatively small number of experimental studies (4), which may lead to an uncertain outcome and make motor intervention programs uncertain due to the limited number. Secondly, studies have focused on spatial skills rather than on temporal ones, which led to this component's relationship with writing and reading only, not with mathematics. Again, the result could be uncertain and uncertain, given that the association between the above was not paramount. Indeed, the search strategy was restricted to comprising studies that specifically examine the associations between the motor component and academic performance in writing, reading, and arithmetic. Nevertheless, it is clear that many covariates may as well have had an effect on the findings stated in the studies. These covariates included demographic factors, cognitive factors, and physical factors (body mass index,

fitness level]). The third limitation is found in the identification of the main component of psychomotor skills that influence writing, reading and arithmetic disorders. Considering the included studies, it was not possible to highlight the primordality between fine motor skill and spatial and temporal orientation, in terms of learning skills. Being two different components, oriented towards physical skills and mental skills, we can say that it is difficult to compare the two and clearly interpret the results.

Conclusions

Following the systematic review of the 20 researches, the first hypothesis was confirmed, finding that there is a link between psychomotor components and reading, reading and arithmetic disorders in children who are 5 to 15 years old. All children diagnosed with one of the learning deficits had a lower level of one or more components of motor skills. At the same time, following the motor intervention programs, all the children improved their motor skills, except for 4 of them, who remained at the same level.

The second hypothesis was also confirmed, identifying the impact that spatial and visual skills have on the literacy process, especially on geometric components. In addition to the spatial orientation, which correlated with all 3 domains, the temporal orientation was identified only for writing and reading. Thus, it was found that the poor mastery of spatial notions may be one of the causes of the delay in mastering reading, writing and mathematical calculation. Furthermore, the role of fine motor skills in the writing process was noticed, being of real importance when the child manipulates the writing tool and wants to put a word/sentence on the page.

Due to inconsistent or insufficient evidence supporting the associations of the other components of motor competence, further investigation is needed, using several experimental studies, focusing on several components, tested separately and not together. In order to further explore the influence of motor intervention programs on academic performance, it is essential to focus on the functions which contribute to the process of writing, reading and mathematical calculation, keeping in mind a possible effect of them, obtaining a clear possibility, that is to determine the impact that motor skills have on the academic performance.

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THE DIDACTICS OF ONLINE VIDEOS, WHICH SUGGEST INDIVIDUAL PHYSICAL ACTIVITIES AT HOME, TARGETTING STUDENTS OF PRIMARY AND MIDDLE SCHOOL, DURING THE 2020-2021 PANDEMIC SCHOOL YEAR

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ABSTRACT. As COVID-19 swept across the world, educators, including those responsible for teaching physical education, were left wondering about those teaching methods that could work best for the remote learning situation, taking into consideration the apocalyptic circumstances (Morris, 2018). Unfortunately, these detrimental situations are unpredictable and challenging to prepare for. Difficulties have arisen due to the education's way of responding to the COVID-19 crisis. **Objective of the study:** The objective of this study was to analyze some of conclusive video tutorials for online physical education classes, tutorials suggested by the Education and Research Minister in Romania. Furthermore, we would like to put into spotlight a few striking issues that might need to be improved in terms of form and content in video tutorials. **Methods:** We used a comparing protocol document to differentiate the characteristics of the YouTube tutorials from the scholar physical education theory and methodology. We analyzed 30 tutorials, which were suggested as educational contents meant to be used in online physical education classes. **Conclusions:** Technology can be useful in numerous ways, by helping physical education teachers and improving student engagement and assessment. A lot of mistakes will be made on the way, but it will be worth it as long as the guidelines of physical education didactics are applied. The study can be used by teachers and students in the future to improve their video tutorials used in online learning physical education classes or to practice spare time physical activities.

Key words: *Physical Education, online learning, YouTube, tutorials, COVID-19.*

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REZUMAT. *Didactica tutorialelor video, care propun activități fizice acasă, pentru elevii din ciclul primar și gimnazial, în anul școlar 2020-2021.* În martie 2020, profesorii de educație fizică din toată țara au fost forțați să își asume un rol nou, necunoscut pentru mulți, cel al profesorului distant, îndepărtat. Cursurile de educație fizică online, instituite aproape la nivel mondial în timpul pandemiei din 2020, au fost o experiență complet nouă atât pentru profesori, cât și pentru elevi. Trecerea bruscă la cursurile online i-a lăsat pe profesori nepregătiți fiind nevoiți să lupte cu metode de predare necunoscute, obligându-i să recurgă la încercări noi, asumându-și anumite erori în abordări. **Obiectivul studiului:** Obiectivul acestui studiu a fost analizarea unor tutoriale video utilizate pentru lecțiile de educație fizică online, sugerate de Ministerul Educației și Cercetării din România. Am menționat câteva particularități care ar trebui îmbunătățite în ceea ce privește forma și conținutul unui tutorial video educațional. **Metode:** Am folosit un protocol de analiză pentru a diferenția caracteristicile tutorialelor video YouTube din prisma teoriei și metodologiei educației fizice școlare. Am analizat 30 de tutoriale, care au fost sugerate ca și conținut educațional menite să fie utilizate la cursurile de educație fizică online. **Concluzii:** Tehnologia poate fi utilă în numeroase moduri, ajutând profesorii de educație fizică și îmbunătățind motivația elevilor de a participa activ la aceste lecții în mediul online. Studiul poate fi folosit de profesori / studenți în viitor pentru a-și îmbunătăți tutorialele video folosite în lecțiile de educație fizică online sau pentru a practica activități fizice de timp liber. În aceeași ordine de idei, studiile viitoare ar trebui să examineze, de asemenea, eficiența tutorialelor video de pe platforma YouTube, folosite în lecțiile de educație fizică și sport din mediul online, contribuind astfel la crearea unei structuri standard unui tutorial de bună practică care să poată fi folosit atât în domeniul Educației fizice și sportului cât și în activitățile fizice de timp liber.

Cuvinte cheie: Covid-19, educație fizică online, tutoriale video, YouTube.

Introduction

Video tutorials are not tools that all teachers use, but nevertheless, in times of crisis, this is recommended as a lifeline to deal with a variety of difficult circumstances in education. Proponents of virtual education highlight the many strengths of online education. These include flexibility for the traditional and non-traditional model, increasing diversity, and increasing access to education (Deming, Goldin, Katz, & Yuchtman, 2015).

There is no way to avoid them, digital technologies are everywhere. When technology is available in a classroom, it can be used for educational purposes, and when used effectively by teachers and students, it creates an indispensable tool for education today. Physical education can also benefit from a multitude of great ideas whilst including technology in the teaching process.

During the Covid-19 pandemic, the interactions between teacher and student were transposed into the digital environment, so for the development of physical education and sports classes in the online environment, various educational platforms were used. However, the use of video tutorials through the YouTube platform has been declared to be an indispensable tool for both teachers and educators in the 2020-2021 school year (MEC, 2021).

A tutorial in education, is a method of transferring knowledge and can be used as a part of a learning process. In an educational setting, a tutorial is a regular meeting between a tutor or teacher and one or more students to discuss a topic that is being studied. More interactive and specific than a book or lecture, a tutorial seeks to teach by example and demonstration and also to provide information to complete a particular task. A tutorial can be viewed in many forms, ranging from a set of instructions to complete a task to an interactive problem-solving session.

As a teaching supplement, YouTube can be used to support those students who, because of their digital learning style, are more accustomed to learning through technology than through more traditional learning methods. By the means of this innovative online resource, teachers help educators create and use content that is processed by specialists in the field, thus providing a more engaging and alluring learning environment.

Online learning cannot be applied in the same way for every student's imagination, but whether or not it is successful in the learning process depends on the students' desire to learn. The success of the learning process can be seen from the reciprocity of the teacher-student relationship, such as behavior, attitudes and interests for this process.

Objectives of the study

The first objective was to build a reference model that respects the guidelines of physical education didactics and it should be applied on every tutorial building process.

The second objective was to analyze video tutorials that propose physical activities at home for primary and secondary school students used in online physical education lessons.

At the same time, the third objective was to highlight some errors of form or content, encountered in educational video tutorials, mistakes that may expose the student to the risk of injury or misinterpretation of the material presented.

Subjects and methods

Our sample research consisted of 19 content creators who published video tutorials, as follows:

- 8 teachers and / or special organizations in the field of physical education and sports;
- 6 individuals and / or non-specialized organizations;
- 5 persons and / or organizations about whom no information is displayed regarding the field in which they work or the knowledge they acquire, but who have proposed teaching materials on the YouTube platform for activities in school physical education online during the pandemic COVID-19.

The research took place between December 2020 - March 2021 and was carried out by accessing the YouTube platform and the forums of the county board of education made available for teachers in Romania. The actual research started on 03.12.2020 when the Ministry of Education and Research broadcasted on YouTube an online meeting dedicated to the discipline of Physical education and sports, in support of teachers who work with the support of technology. The meeting took place in the form of an interactive presentation in order to highlight possible didactic approaches of teaching-learning-assessment, in the online context created by the pandemic situation caused by COVID-19 in Romania. After watching this online meeting, we created in the Microsoft Excel application a table of criteria that we used for our methodical approach when we analyzed tutorials on YouTube platform. The next step was the detailed analysis of 30 video materials proposed by the county school inspectorates on the YouTube platform, following the organized observation and the systematic analysis of their didactics. The last step was the interpretation of the results obtained after the systematized analysis of the materials and the formulation of some recommendations regarding the structure and didactics of the tutorials for educational purpose in online school physical education.

Results

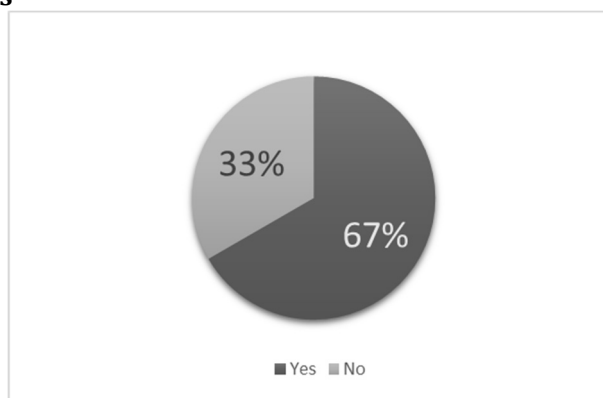


Chart 1. Specifying the part of the lesson

From the Chart. 1, it appears that in 67% of the analyzed videos is mentioned the part of the lesson for which the physical exercises are presented, and in 33% of cases it is not mentioned

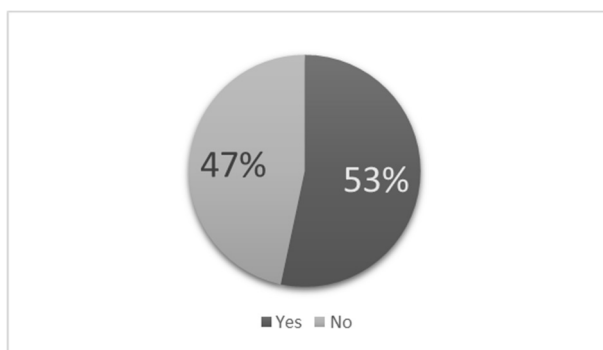


Chart 2. Specifying the necessary materials

From Chart 2. it results that in 53% cases, data of the materials necessary for carrying out physical activities were mentioned, and in 47% of the lessons they were not mentioned.

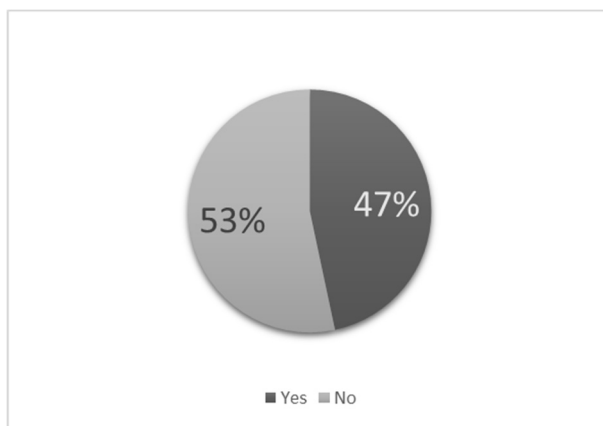


Chart 3. Details for organizing the workspace

The results in Chart 3. show that in 47% of the videos, information related to the workspace was specified and in 53% this information was not mentioned.

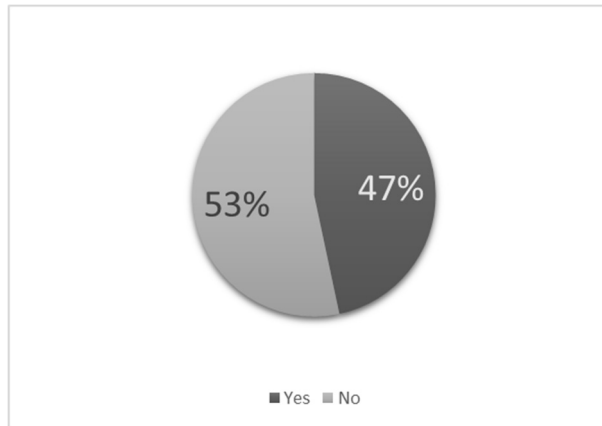


Chart 4. Mentioning the age group

From the fourth feature of the tutorials watched, the results in Chart 4 show that 47% focused on mentioning the age group for which the exercises were proposed, and in 53% of the tutorials no such details appear.

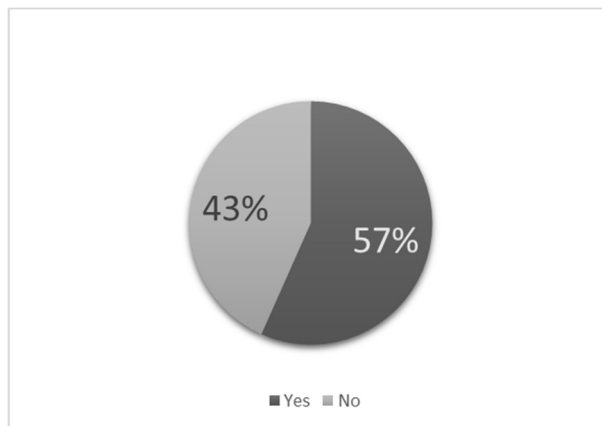


Chart 5. Information about content creators

Chart 5 shows that in 57% of the videos, information about the people who uploaded the materials is visible, and in 43% of the contents are not mentioned at all.

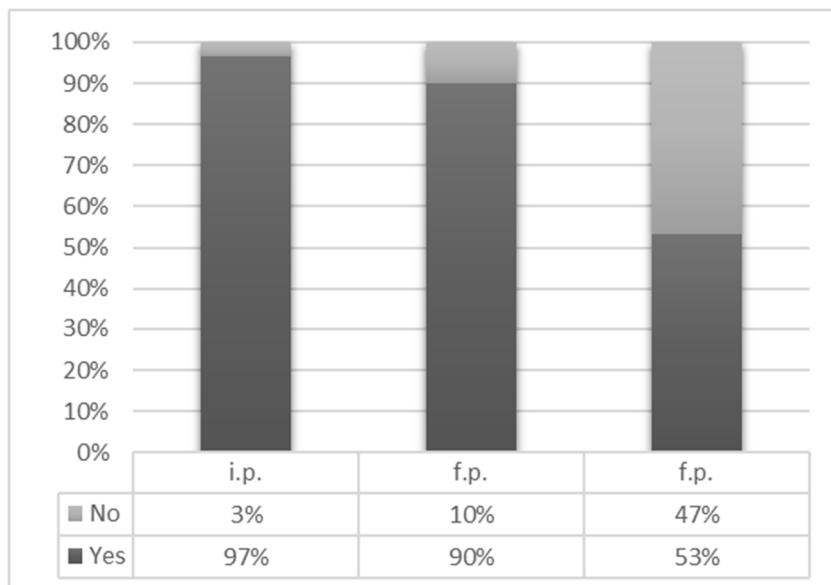


Chart 6. Corresponding structure

Chart 6 shows that 3% did not have the introductory part, 10% did not have the fundamental part, and 47% of the tutorials did not have the final part in their structure.

Discussions

Physical education teachers have been exploring various implementations of technology for quite some time. The strong development of the Internet has inspired teachers to use web technology to access educational resources and connect to professional organizations, access various educational content, and supplement digital materials in the classroom (Ellery, 1997).

Platforms for hosting digital resources such as video tutorials, as YouTube, are important for teachers who apply the traditional style, to establish a sense of community in the classroom and to achieve an effective teaching approach even online. Through this platform, instructors have a new educational tool that communicates with the educators of the new millennium and is oriented towards the learning style of those who are more accustomed to learning online.

We have the certainty that the video tutorials hosted on online platforms, such as Youtube, are and will continue to be indispensable supplies in the conduct of physical education and sports lessons in the online environment, being used as educational teaching materials for certain presentations, demonstrations, etc.

A video tutorial is built according to a certain structure that includes an introductory, fundamental part and a final part (Grosseck & Malița, 2015). The didactics of physical education and sports require that in the introductory part of a tutorial to be presented, in general, organizational information about the activity to be carried out. The next part is a demonstration of physical exercises along with explanations of the practice. The final part represents the end in an appropriate and academic style of a physical activity by appreciating the effort made by the participants and formulating recommendations regarding the practice of physical activities in their free time.

Because in our research we analyzed both complete physical education and sports lessons, as well as certain parts of a lesson, we propose that in the introduction of educational video tutorials proposed for online physical education and sports lessons, to specify the part of the lesson where it falls the structure of the content created. This aspect guides both teachers who use these tutorials, and people who use them for their own purposes to practice physical leisure activities.

Physical education and sports in the online environment take place as a separate phenomenon of each individual, either teacher or educable. From our point of view, the notions of “workspace” and “necessary materials” have taken on a completely different meaning by comparing the terms used in traditional didactics of physical education and sports. Thus, we claim that it is essential to mention the aspects related to the workspace for physical exercises, within an educational video tutorial.

In our opinion, any user of the YouTube platform, when viewing a video content, could check the profile of its creator. We believe that it is essential to present the data of the creator or creators of the tutorials, because it is important to know about these creators if they have knowledge in the field in which they published the video resource.

For the analysis of the educational contents from the online environment, we created 2 tables in which we mentioned the minimum requirements that should be met in order to create a successful video tutorial. In terms of form, the size and format of the videos, the soundtrack, the accessibility of the playback in slow motion, the clarity of the teacher's voice, the distance from the device during the representation, the size, color and font of the text used, and the data of the content creators.

Tabel 1. Aspects regarding the form of video tutorials

Form
Video size / format should be accessible from 480p (854 x 480) to the highest quality. (HD, full HD etc.)
The soundtrack of the tutorials should be copyrighted to use songs from other content creators on YouTube.
Willingness to play video tutorials in slow motion.
The voice of the instructor / teacher should be clear, not disturbed by various background sounds during teaching of the contents.
During the demonstration of some movements, the instructor / teacher should be at a suitable distance from the recording device.
The text displayed on the screen during the tutorials should not be displayed over other content and should be legible in terms of the size, color and font of the characters used.
To be mentioned in text form, in the educational tutorial or below it, data about the content creator, and the date of publication of the material.

Table 2 presents aspects strictly related to the content of educational tutorials. The content was divided into 3 parts -introduction part; fundamental part; final part - and conclusion of video tutorials, clarity of explanations and accuracy of demonstrations, fluency of presentation, specification of necessary teaching materials, terminology, dynamism of information, capturing attention, and the presence of advertisements in educational tutorials. These aspects, if they are properly respected and implemented, will create a good didactic tool.

Tabel 2. Aspects regarding the content of video tutorials

Content
The content of the tutorials should be structured in at least 3 parts: -introduction part; -fundamental part, -final part.
The educational content should be explained / demonstrated clearly and precisely.
The educational content should be taught fluently and without excessive deviations from the subject of the content.
To specify the didactic materials necessary for the active participation of the educators / subjects in the development of the lesson with the help of video tutorials.

The language of the instructor / teacher should be an academic one, respecting the specialized terminology in the field of the created tutorial.
The information of the didactic content should be rendered dynamically, through images, demonstrations, representations rather than just being listed and explained verbally or through text.
The playback of the educational content should be done in such a way as to capture the attention of those who view the video tutorial.
The educational tutorial should not be interrupted by advertisements that could disturb the lesson.

Conclusions

Online physical education courses, instituted almost worldwide during the 2020 pandemic, have been a completely new experience for both teachers and students. The sudden transition to online courses has left teachers puzzled, having to struggle with unknown teaching methods, forcing them to resort to new techniques, assuming certain errors in their approaches.

We strongly suggest that it is necessary to review and systematize the approaches in the proposed tutorials for physical education and sports lessons in the online environment, because online courses are continuing to develop and will become critical for current and future teachers of the online environment. Thus, the correct use of technology to improve students' learning in virtual environments is mandatory and we hope that these recommendations will be properly implemented in the online education of future generations.

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THE IMPORTANCE OF A HEALTHY LIFESTYLE AND THE ROLE OF PHYSICAL ACTIVITY IN THIS PLAN

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PATRASCU ADRIAN¹

ABSTRACT. **Introduction** The concept of free time has evolved over the centuries according to various socially organized models. Thus, it was found that mankind has always enjoyed a certain type of leisure organization, various forms and activities of organization. **Objective** The study aims to identify a concept of physical education for free time, stimulating the desire to exercise, developing the spirit of initiative, ensuring continuity in the practice of motor activities. **Methods** Major benefits of web-based questionnaires and surveys are that they do not require the administration of materials in person, are accessible world-wide, and are therefore available cross-culturally. **Results** A majority of the subjects (68.5%) view a healthy diet as “very important” for a sport point of view. If we were to couple this with the “important” answer to this question we would find that a vast majority (94.4%) view diet and nutrition as a key component of physical activity. **Conclusions** Leisure physical activity helps for a healthy lifestyle, regardless of the profession you practice. Through this paper we intend to create a guide in the practice of physical leisure activities and to help in their practice. Nevertheless, many different types of exercise have been shown to be beneficial, including aerobic training, resistance or strength training, walking, hopping, swimming, aquatic exercise, as well as exercises to improve flexibility and balance for a healthy lifestyle.

Keywords: *leisure physical activities, sports, time management, health.*

REZUMAT. **Importanța unui stil de viață sănătos și rolul activității fizice pe acest plan.** **Introducere** Conceptul de timp liber a evoluat de-a lungul secolelor în funcție de diferite modele organizate social. Astfel, s-a constatat că omenirea s-a bucurat întotdeauna de un anumit tip de organizare a timpului liber, de diferite forme și activități de organizare. **Obiectiv** Studiul își propune să identifice un concept de educație fizică pentru timpul liber, stimulând dorința de exercițiu, dezvoltând spiritul de inițiativă, asigurând continuitatea în practica

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activităților motorii. **Metode** Avantajele majore ale chestionarelor și sondajelor bazate pe web nu necesită administrarea personală a materialelor, sunt accesibile în întreaga lume și, prin urmare, sunt disponibile transcultural. **Rezultate** Majoritatea subiecților (68,5%) consideră o dietă sănătoasă drept „foarte importantă” din punct de vedere sportiv. Dacă ar fi să cuplăm acest lucru cu răspunsul „important” la această întrebare, am descoperi că o mare majoritate (94,4%) consideră dieta și nutriția ca o componentă cheie a activității fizice. **Concluzii** Activitatea fizică de agrement ajută la un stil de viață sănătos, indiferent de profesia pe care o practicați. Prin această lucrare intenționăm să creăm un ghid în practicarea activităților de agrement fizic și să ajutăm în practica lor. Cu toate acestea, multe tipuri diferite de exerciții s-au dovedit a fi benefice, inclusiv antrenament aerob, antrenament de rezistență sau forță, mers pe jos, sărituri, înot, exerciții acvatice, precum și exerciții pentru îmbunătățirea flexibilității și echilibrului pentru un stil de viață sănătos.

Cuvinte cheie: *activități fizice de timp liber, sport, managementul timpului, sănătate*

Introduction

The contemporary world, faces multiple global problems - The COVID-19 pandemic, also known as the coronavirus pandemic, the imbalance of the ecological system, interethnic and religious conflicts, the crisis of jobs, destructive human vices, the crisis of identity, property, values, etc., and education, as an action for the betterment of the human being, is called to contribute to the formation-development of the personality in order to prepare for the solution of these problems. In this sense, the human becoming expected by education means not only the change of some internal, personal properties, but also the formation of skills of intelligent management of some given sources, such as, for example, time. At the same time, education, as a project of human becoming, but also as a real phenomenon, refers to the concept of time and temporality, as it involves a process and its succession in time, an extension even outside the normal pedagogical time, therefore the issue of rational use of time becomes a concern both for the designers of education and for each employee in the educational process. (Lucaciu G., 2013)

Leisure education is a specialized form of the integral / basic educational process, which includes several fields (cultural-artistic, tourist, social, economic, etc.) and considers the training of students in the competence of leisure management. From the perspective of lifelong learning, it proves to be a cost-effective family, health, social and economic education, and its importance will

increase with the implementation in the Republic of Moldova of the concept of lifelong learning, which requires mastery by young people. the competence to manage the value of free time in favor of the development of a cultural personality and the promotion of an active citizenship. (Clichici V., 2018)

The concept of free time has evolved over the centuries according to various socially organized models. Thus, it was found that mankind has always enjoyed a certain type of leisure organization, various forms and activities of organization. Ancient civilizations based the well-being of their culture on the development of entertainment, during which time people practiced sports (competitive wrestling, gymnastics, Olympics, hunting); arts (music, dance, theater), forms of religious worship and other fields of general culture. But each civilization had a specific use of leisure, for example, in Egypt the temples were equipped with troops of animators; in Assyria and Babylon music and dance were predominant on feasts and royal assemblies. In Israel, the major contribution of the population was to observe the seventh day of the week called the "Sabbath" - a time for human rest and worship of the Divinity, being proclaimed at the level of the Law or Commandment, however, in Greece, the behaviors of ancient citizens were considered much more perfect models due to the interdependence of time and education. (Clichici V., 2018)

According to the 2011 census, the data collected shows that 46.8 million adults aged 20 and over currently live in the UK. A large proportion of these people do not meet the recommended requirements of physical activity, beneficial to health. These low levels of physical activity are of major interest because they demonstrate the importance of physical activity for overall health and for the prevention of chronic diseases that continue to increase. Physical inactivity is the fourth leading cause of global mortality and ill health in today's society. Heart disease, cancer and type 2 diabetes could be prevented or reduced if more people became active in sports. The costs of health and chronic illness could be reduced if more people became physically active, and physical inactivity cost the UK economy more than £ 5bn a year. This evidence of physical inactivity for adults aged 16 to 65 summarizes the benefits of taking part in physical activity, stimulating the UK adult population to physical activity. (Physical activity for adults. Evidence briefing, 2015)

In 2002, the World Health Organization adopted a recommendation that everyone should practice at least 30 minutes of daily physical activity. In its White Paper on Sport, the Commission noted that studies show that more daily physical activity is recommended. This suggests that promoting physical activity in the EU would be beneficial for different age groups, such as children and young people, adults and the elderly. These EU sport guidelines, by proposing more concrete action guidelines, are intended to address decision-making forums at all levels

(European, national, regional, local), both in the public and private sectors. The EU guidelines seek to define useful steps to help implement the proposed objectives, also following another strategic document adopted by the Commission. A strategy for Europe on health issues related to obesity, overweight and nutrition, adopted on 30 May 2007, "considers that Member States and the EU must take proactive measures to reverse the decline in physical activity levels in recent decades caused by many factors. "The EU does not limit the discussion on obesity, but supports a strong argument for taking action to increase physical activity and address current deficits. Organizational and structural factors that influence people's ability to be physically active must also be addressed through an Adequate coordination of nutrition, overweight and obesity policies on the importance of physical activity in the fight against obesity and related diseases was emphasized by both institutions (Anders LB, et.al. 2008).

The EU continues to support measures for the collection and dissemination of new methods of intervention and coordination at local and regional level for nutrition, health and physical activity. In many EU Member States, sports organizations tend to focus only on the organization of competitions for professional competitions. They should be encouraged to implement strategies for sport that take into account the promotion of grassroots sport and the impact of sport on public health, social values, gender equality and cultural development. (Anders L.B., et al. 2008)

Sports clubs through their versatility and profitability can help meet the needs of the population for daily physical activity. A challenge for the future is the organized sports sector, which needs to offer quality health-related exercise programs at the national level. Trainers and managers of sports organizations play an important role in promoting physical activity. Their professional experience guarantees the necessary expertise to help people in training and physical activity. Physical activity must be present in daily life and cannot be limited to time spent in the sports or leisure center, thus, access to adequate information on how to increase activity in daily life, at home, as well as and at work and when moving from home to other locations. Physical activities such as cycling or walking from home to the sports center increase the benefit for the person concerned, as well as for his environment. (Anders L.B., et al. 2008)

Physical activity outside of school can be greatly promoted by making school sports facilities available after school hours. Teachers should provide them with the necessary expertise to convey clear and precise messages to students and parents, to make them aware that physical activity is an essential requirement for health. Healthcare entrepreneurs need to be prepared to provide advice on physical activity in relation to people's specific conditions. Information on the need for physical activity, lifestyle changes should be

available to all health professionals during their studies, and continuing education in this growing field should be mandatory. In addition, it would be useful to recognize sports medicine as a specialty in the EU, an important part of sports medicine is prevention to promote physical activity that improves mood and human health. (Schulenkorf N., Siefken K., 2019)

Scientists, organized in a reference group could be useful, especially to test ideas and messages. Community involvement should be achieved through the use of the Internet, to raise awareness, to send materials to doctors, companies, schools, local press releases, to ask local community experts to write articles and involve local celebrities in promoting activities. physical leisure. Media professionals play a key role in making changes in public and individual attitudes. Given the relevance of the media, especially television but also of the Internet, in determining lifestyles, it becomes important for professionals active in this field to be aware of the problems of physical inactivity related to the impact on health and the possibilities that the media possesses them to influence people's behavior. (Anders L.B., et al. 2008)

Objective

This work was possible with the financial support of the Operational Programme Human Capital 2014-2020, under the project number POCU 123793 with the title „ Researcher, future entrepreneur - New Generation“. The paper includes scientific data on: the development of the concepts of leisure and leisure education, the perspectives of approaching leisure education, the functions, principles and pedagogical conditions necessary for leisure education, analysis of theories and ideas.

The study aims to identify a concept of physical education for free time, stimulating the desire to exercise, developing the spirit of initiative, ensuring continuity in the practice of motor activities. This paper is intended to be a "tourist guide" on the complex map of factors that, in an interdisciplinary way, outline factual efficiency and which through practical "exploitation" can maximize the duration and quality of life. In a materialized eventuality, this theoretical guide can be continued through an orientative framework of practical activity, which is not a commitment, but a desire.

Methods

The major benefits of internet-based questionnaires and surveys do not require personal administration of materials, are available worldwide, and are therefore cross-cultural. Thus, once the recruitment posts were sent, the

administration of the questionnaire and the registration of the answers was self-run on the socialization and email channels. Email addresses were made available to interested parties for any questions or feedback regarding the questionnaire. The final stage of data collection was the satisfaction of the answers for their participation.

Previous reports have indicated that one of the benefits of online questionnaire-based research is easy to collect data. An important aspect considering the number of responses we received, it is necessary to allocate time to complete the online questionnaires. If the response rate does not reflect data from other studies, or their number is not high enough then time-related problems may arise in collecting data and responses for each person interested in analyzing the results.

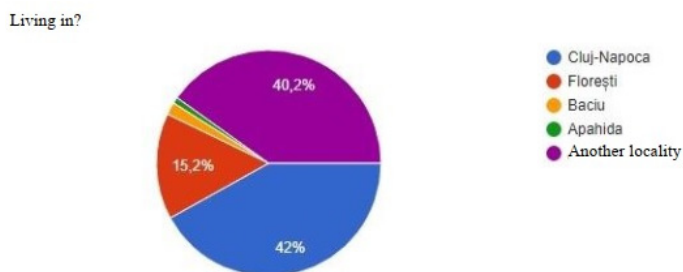
Subjects

Gender and Age (Graphic No. X1 and No. X2) from the data that I collected from the beginning of the questionnaire, I can see that my sample consisted of more male than female participants. I can also say that the majority of participants were between ages 19 and 22. This is because these questionnaires were mainly handed out to students. The target group of the questionnaire was people who have at least finished high school working or studying in Cluj-Napoca. The total age gap was between ages of 15 and 50. This may help me think of a suitable dissemination of findings for a specific age group, based on the results of this questionnaire.

Once a questionnaire has been constructed and tested, the next step is to recruit respondents willing to complete the questionnaire. We located a series of discussion groups on the internet and social networks that were concerned with organizing physical activities in their free time. Recruitment was done by posting a message to the groups indicating the nature of the questionnaire and the link on the questionnaire. Before participating, there was the opportunity to ask questions by e-mail or on social networks where the link was disseminated. A dedicated e-mail address was created for the study, which was intended to reinforce the study, while providing a central contact address. This address has been monitored so that we are aware of any problems and their resolution.

Our study was meant as a pilot research into management of factors and how they influence QoL and *leisure-time physical activity*, and as such we worked on descriptive statistical data. Our parameters were unique and weren't correlated with the others. Through this pilot study we tried to observe a broad picture of the status quo in regards to QoL and sports. We displayed quantitative raw and percentile data of each parameter and interpreted in the context of known empiric data from day-to-day habits of students in Cluj-Napoca.

Most subjects were either from Cluj-Napoca itself (42%) or from another town (40.2%). The least amount of subjects was from small towns or villages around Cluj-Napoca (total of 11.8%). This suggests that our findings will be related to either Cluj-Napoca permanent residents or temporary ones.

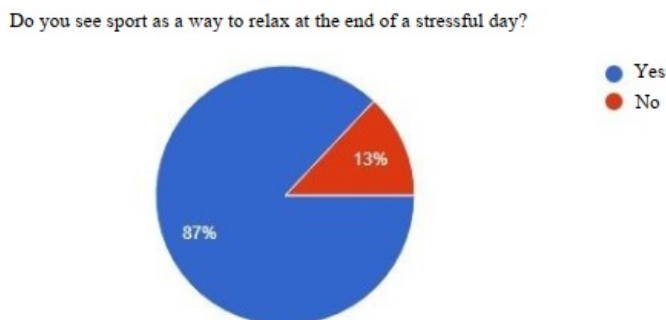


Graphic No. 1 Subjects Location

Results and Discussion

2. Do you see sport as a way to relax at the end of a stressful day?

From Graph No. 2 we can clearly tell that using physical activity/sport as a way of relaxing after a stressful day is the most popular amongst our subject pool. Perhaps this is a de-stressing method that we can look deeper into in the future. We may also search for elements of emotional, affective and cognitive relaxing and recharging that may emerge from using sport as a distressing method.

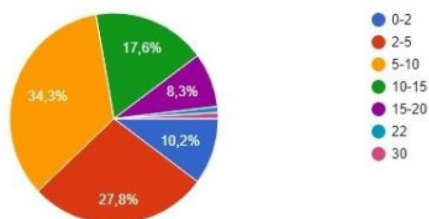


Graph No. 2 Do you see sport as a way to relax at the end of a stressful day?

3. How many hours of physical activity do you do per week?

Out of the subjects, 27.8% answered that they spend between 2-5 hours per week practicing sport (or a physical activity), while 34.3% answered that they do the same thing between 5-10 hours per week. The percentage difference between the two groups is relatively small (6.5%), which means that at any time the first group may outtake or rebalance the percentages. The majority of the subjects answered that they practice sport between 2 and 10 hours per week. Worrying is the fact that 10.2% of the subjects only spend less than 2 hours per week doing sport (Graphic No. 3).

How many hours of physical activity do you do per week?

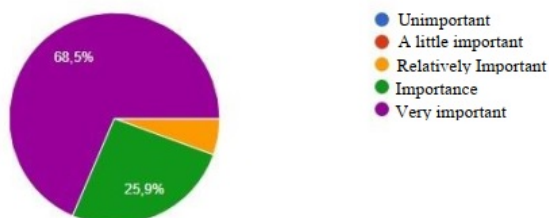


Graphic No. 3 How many hours of physical activity do you do per week?

4. How important is a healthy diet for a sports-active person?

A majority of the subjects (68.5%) view a healthy diet as “very important” for a sport point of view. If we were to couple this with the “important” answer to this question we would find that a vast majority (94.4%) view diet and nutrition as a key component of physical activity. This was surprising because of previous knowledge and trends. Moreover, the lack of a strong and organized sport culture and education in schools has led us to believe that not many people understand the link between diet/nutrition and sport (Graphic No. 4).

How important is a healthy diet for a sports-active person?

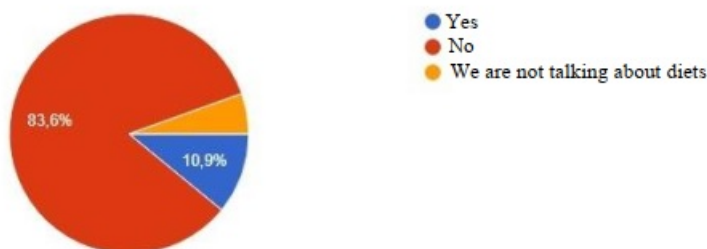


Graphic No. 4 How important is a healthy diet for a sports-active person?

5. Do you work with a coach to establish a diet to help you get in better physical condition?

On the other hand, Graph No. 5 displays that the majority of subjects (83.6%) don't get help from a specialist or trainer for calculating, setting or figuring out a diet that would allow them to achieve higher performance and better fitness. There were 5.5% of the responders that admitted they never discuss diet with their trainers. This is a bit worrying because this means that either the trainer doesn't know anything about diet (or how important it is) or the trainer doesn't care about the client and wants to have an easy work focused on routine elements of the workout. The rest (10.9%) answered that they do talk or request advice from the trainer about their diet.

Do you work with a coach to establish a diet to help you get in better physical condition?

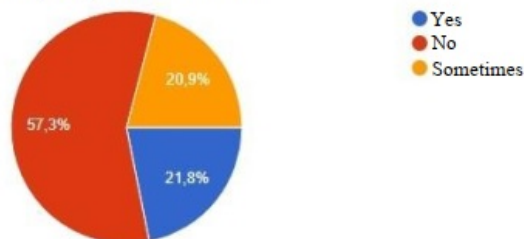


Graph No. 5 Do you work with a coach to establish a diet to help you get in better physical condition?

6. Do you take dietary supplements for athletes?

A small majority of the participants (57.3%) admitted they never use diet supplements aimed at athletes. This can go to show that these types of supplements are of no interest to most people. On the other hand, a fifth of the subjects said that they either use it frequently or sometimes. Together these 2 groups make up for 42.7% which is a very high number. This may be a problem if the use and administration of such supplements is done without a proper training and a strong knowledge of their effects. An incorrect use of supplements may be detrimental for the outcome of a workout or the results may not be the ones intended in the first place (Graph No. 6).

Do you take dietary supplements for athletes?

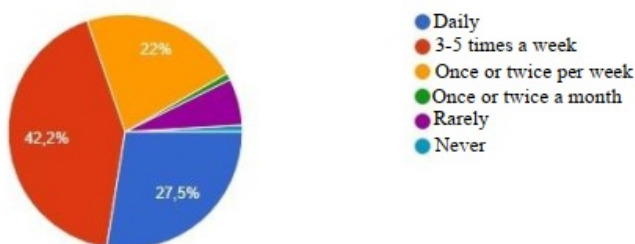


Graph No. 6 Do you take dietary supplements for athletes?

7. How often do you participate in physical sports activities?

Out of all the participants, 27.5% of them said that they practice physical activities every day while 42.2% practice them 3-5 times per week. Added together, these two groups can signify the importance of sport activities and how regularly they are performed. A third of the participants said that they would practice sport activities less than 1 or 2 times per week. It seems as though physical activities are not yet viewed as important in day-to-day life, considering that a third don't include them in a more often manner in their daily routine (Graph No. 7).

How often do you participate in physical sports activities?



Graph No. 7 How often do you participate in physical sports activities?

8. When was the last time you practiced exercise / sports?

At the time when the questionnaire was filled, 62% of the responses mentioned that the last time sport activities were done was in the time frame of 48 hours. ??Due to the length of the study this may be misleading because

some late completion of the questionnaire may have coincided with a prior day of sport activities. The answers to this questions indicate that a small percentage (9.4%) have last been involved in a sport activity more than a month prior to the study. This result is a positive one which may indicate that even though physical activities have a less frequent rate during the week, they are still undergone within the timeframe of a month (Graph No. 8).

When was the last time you practiced exercise / sports?



Graph No. 8 When was the last time you practiced exercise / sports?

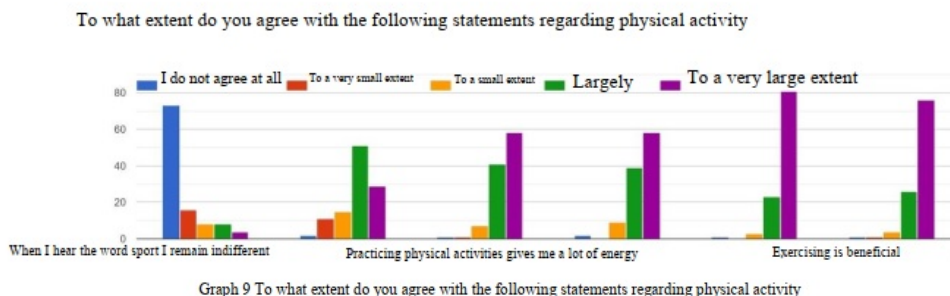
9. To what extent do you agree with the following statements regarding physical activity:

The answers in Graph No. 9 seemed to have corroborated with each other. All the answers were in favor of physical activity/sport in each item.

The first statement had an overwhelming percentage of responses saying they disagree with it. This means that our study group doesn't remain indifferent towards sport activities.

The statement regarding the competitiveness of sport has resulted in a majority of subjects affirming they do care for the most part. This indicates that even though this study focused on sport activities undergone in the subject's free time, competitiveness plays a major part in the subject's opinion.

The last four statements tried to find the participant's opinion regarding sport in: physical and mental health, daily energy and pleasure generation. All these statements received a majority of answers that were "strongly agree" or "agree". This means that the responders' attitude towards the use of sport activities for general wellbeing is important. Therefore, a more in-depth study should be conducted to identify the actual reasons and why the subjects think this. A strong understanding of these reasons may help future trainers and educators to construct a thorough methodology for improving the frequency of weekly physical activities.



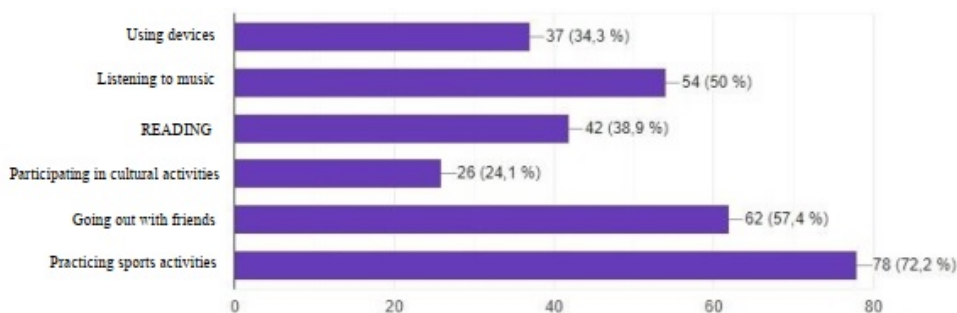
10. How do you spend your free time most of the time? (Please read the options and check all the situations that suit you).

This question Graph 10 aimed to identify what activities are the most common for the subjects to do in their free time. The answers may paint a picture of the activities that are currently in trend among our group of participants.

The results show that sport activities have been chosen by 72.2% of the participants. Moreover, social activities such as “hanging with friends” have also scored high (57.4%). Individual activities such as “reading” or “listening to music” situated at an average position, around half of the subjects admitted they would spend their free time doing these. Lastly, answers to items “using technology” or “attending cultural events” were the least chosen and not far apart from each other. These answers paint a structured priority list for our study group:

- On first place for preferred activities to do in their free time are: physical and social activities;
- On the second place are “alone activities” such as reading and listening to music;
- Lastly are cultural and technology-based activities.

How do you spend your free time most of the time?



Graph 10 How do you spend your free time most of the time?

Conclusions

At the end of this study we can say that either participant, depending on his motivation and attitude, can manage his free time, in which the practice of a motor activity is an essential factor with a major impact on his physical, moral and mental development. Each participant benefits, in addition to the usual occupations (work, school, current obligations) from a certain period of time (leisure) that can be used in order to create a state of well-being - pleasure and relaxation. We cannot notice the same thing when we want to identify in the participants a leisure management, this concept being almost completely missing, and the motor activities being practiced somewhat spontaneously. One cause may be the mentality of everyone, because when analyzing free time, this notion does not only mean the interval outside the regular hours - work, school and other current obligations, but the period that remains available to meet a need, desire, hobbies or motor activities.

A majority of the subjects view a healthy diet as "very important" for a sport point of view. If we were to couple this with the "important" answer to this question we would find that a vast majority view diet and nutrition as a key component of physical activity, we can clearly tell that using physical activity/sport as a way of relaxing after a stressful day is the most popular amongst our subject pool.

Leisure physical activity helps for a healthy lifestyle, regardless of the profession you practice. Through this paper we intend to create a guide in the practice of physical leisure activities and to help in their practice. Nevertheless, many different types of exercise have been shown to be beneficial, including aerobic training, resistance or strength training, walking, hopping, swimming, aquatic exercise, as well as exercises to improve flexibility and balance.

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SWIMMING AS A LEISURE PHYSICAL ACTIVITY DURING THE 2020-2021 PANDEMIC COVID-19 IN CLUJ-NAPOCA

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ABSTRACT. The Covid-19 pandemic has had a negative impact on the global community, leading to restrictive measures in all areas of activity, including sports. Starting with March 2020, most physical activities have ceased, due to the establishment of the state of emergency in Romania. Swimmers were restricted from accessing their main training facilities and were no longer allowed access to the pools. After a more sedentary period, in which each of us tried to adapt to the existing situation, the need to be involved in sports, the need for movement, and the need for socialization was growing. Thus, the instructors tried to find out alternatives to continue athletes training, so they do not completely lose their physical fitness. Some managed to continue their training in the water, at other pools, others organized workouts outside the pool, maintaining their physical condition at an optimal level. In fewer cases, coaches continued training with athletes online. The purpose of this study was to discover the training strategies applied by swimming coaches during the pandemic, during the State of emergency and the Alert state, in Cluj-Napoca. The results of our study can be used, in the future, by students, teachers and instructors to better reorganize their physical activities, especially swimming, when a special situation arises again.

Key words: Covid-19, swimming, training, methods, management, physical activity, leisure.

REZUMAT. *Înotul ca activitate fizică de timp liber în perioada pandemiei de Covid-19, în Cluj-Napoca, pe durata anilor 2020-2021.* Pandemia Covid-19 a avut un impact negativ asupra comunității la nivel global, ducând la impunerea unor măsuri restrictive în toate domeniile de activitate, inclusiv în sport. Începând cu luna martie 2020, majoritatea activităților sportive au încetat, instaurându-se starea de urgență pe teritoriul României. Înotătorilor le-a fost restricționat accesul la principala lor modalitate de antrenament, deoarece nu a mai fost permis accesul la bazin. După o perioadă mai sedentară, în care fiecare dintre noi am încercat să ne adaptăm situației existente, nevoia de a face sport,

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nevoia de mișcare, nevoia de socializare creșteau. Astfel, instructorii au încercat să găsească alternative pentru a continua antrenamentele înotătorilor, pentru ca aceștia să nu-și piardă complet condiția fizică. Unii au reușit să își continue antrenamentele în apă, la alte bazine, alții au organizat serii de antrenamente pe uscat, menținându-și condiția fizică la un nivel optim. În puține cazuri, antrenorii au continuat antrenamentele cu sportivii chiar și în mediul online. Scopul acestui studiu a constat în descoperirea strategiilor de antrenament aplicate de antrenorii/instructorii de înot în timpul pandemiei, atât în timpul stării de urgență cât și în timpul stării de alertă, în Cluj-Napoca. Rezultatele studiului nostru pot fi folosite, în viitor, de studenți, profesori, instructori și antrenori pentru a se informa în legătură cu modalitatea de reorganizare a activităților sportive, în special a înotului, când o situație deosebită apare din nou.

Cuvinte cheie: Covid-19, înot, antrenament, metode, gestionarea activității, activitate fizică, timp liber.

Introduction

Swimming is one of the most special physical activities, as it offers a varied and complex range of exercises from the simple entry into the water with immediate effects on adaptation of the major body functions (Ceontea, 2010). It is a sport with many benefits, the main beneficial effect being the harmonious physical development by involving the whole body in the activity.

When it comes to swimming training, there are basic, preparatory exercises that fall into two main categories: inside the pool and outside the pool (Pop, 2014). We believe that valuable results are inconceivable today without a specific training. Thus, by combining static and dynamic exercises we will have the effect of toning muscles, with a positive effect on body posture, which will significantly reduce back pain and lead to the formation of correct body postures (Vasile, 2007).

By March 2021, one year after the start of the pandemic, the SarsCov2 virus had infected more than 121,174,001 people and caused more than 2,701,543 deaths (Who.int. 2021). Thus, every athlete or individual, active swimmer of various physical activities, every sports organization, had to redefine themselves to a certain extent and find ways to minimize as much as possible the negative effects of the Covid-19 pandemic and restrictions imposed to prevent its spread.

The general need to reduce the transmission of the disease has had a major impact on all sports. Moreover, restrictions on outdoor exercise and the need to stay home have led to a reduction in physical activity and an increase

in sedentary behavior (Yeo, 2020). Thus, training outside pool has become essential during this period, as a way to maintain performance, it helps athletes to continue training, becoming an alternative to the usual training method.

Riewald & Rodeo (2015) in the book "Science of Swimming Faster" proposes the following ways of training outside the pool: elastic resistance bands, swimming bench and suspension system-TRX. In addition, (Haddad et al., 2021) also mentioned as important the following methods: running, cycling and circuit training.

On the same note, the communication between the athletes and the coach became a fundamental aspect during this difficult period. A very important principle in communicating with athletes is that of awareness and active participation, which involves "appreciation of the individual as a subject of their own development" (Dragnea, 2006, p.143). Training involves listening and active participation from both, the coach and the athletes. There must be a very good communication so that the athletes do not lose their motivation. Otherwise, athletes will have a low interest in their own training, will not stimulate the development of psychological traits such as will and perseverance (Bompa, 2001).

"The COMPASS model" proposes the following strategies that can maintain success and professional communication between athletes and coaches (Bateman & Jones, 2019): conflict management, openness in communication, motivation, positivity, advice, support and social networks used to maintain communication.

During the pandemic, people tend to be less physically active, leading to weight gain and loss of fitness (Yeo, 2020). Also, deconditioning, partial or complete loss of training-induced adaptations, have negative effects on cardiovascular adaptation, muscle function and energy metabolism (Mujika, 2001), which leads to one of the most important health problems among students, a decreased in ability to move (hypokinesia), accompanied by obesity (Pavlović et al., 2015).

Given these considerations, it is essential that swimming instructors know how to manage an extraordinary, crisis situation, an atypical situation in such a way as to maintain the highest possible pace of training for their students.

Study objectives

As a first objective, we checked if the sports activity of the swimmers continued after the pandemic situation in Romania started.

The second objective of the research was how the coaches managed to reorganize, as a matter of urgency, the training of swimmers so that they can continue physical activity in order to maintain, first of all, an optimal physical condition.

With the ultimate goal, for this research, we aimed to find out the most effective methods of preparation for swimming, used by coaches in Cluj-Napoca, through which students develop their qualities and motor skills specific to swimming, in special situations when they can't perform at the pool.

Material and methods

For this study, 25 instructors were chosen, aged between 21-52 years, the period spent as swimming instructors being between 2 to 27 years. The participants are part of the category of swimming instructors from Cluj-Napoca, having groups of children engaged in swimming, as a leisure activity. The research took place between March 2020 and March 2021.

As a method of data collection we chose the sociological survey (questionnaire), the analyzed period being from the beginning of the state of emergency March 16, 2020, for one year, until March 16, 2021. The questionnaire includes two sections: state of emergency and state of alert. The same set of questions was used in both periods.

Results

In the state of emergency, the swimming instructors had to completely interrupt their activity, and the data they provided us were not conclusive, so the results of our research refer only to the activity during the alert state.

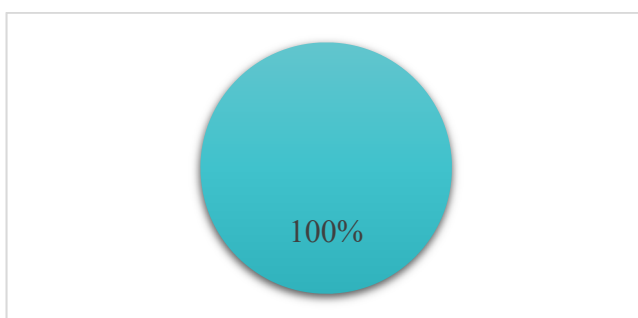


Chart 1. Swimmers whose workouts have been affected

This first chart shows that all athletes' workouts were affected by the Covid-19 pandemic.

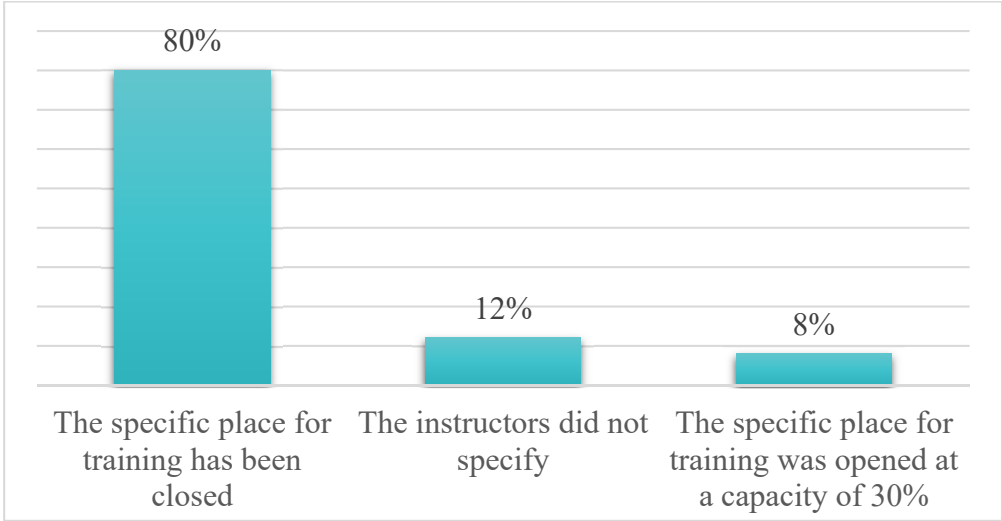


Chart 2. The extent to which the Covid-19 pandemic affected swimmers' training

Chart 2 shows that for 80% of the swimming instructors the pool closed, 12% of them did not specify, and 8% of those interviewed could work at a capacity of 30% at their pool, when legal regulations allowed them to do so.

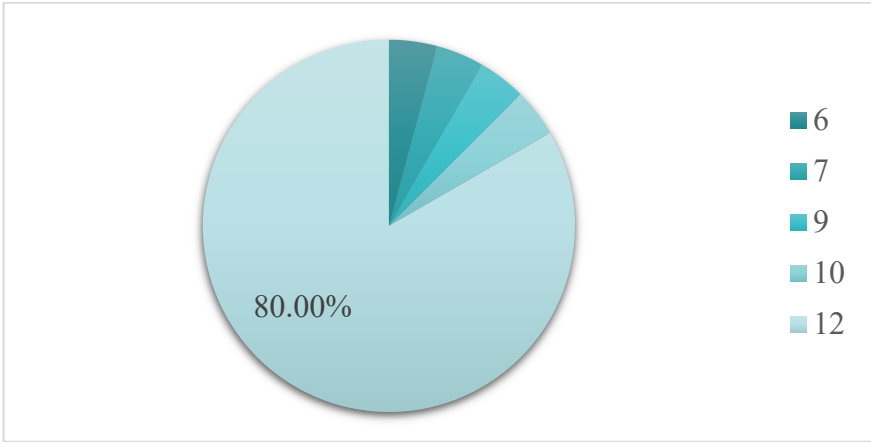


Chart 3. Period during which the pool was closed (months)

In Chart 3 it can be seen that for 80% of respondents the pool was closed for a period of 12 months.

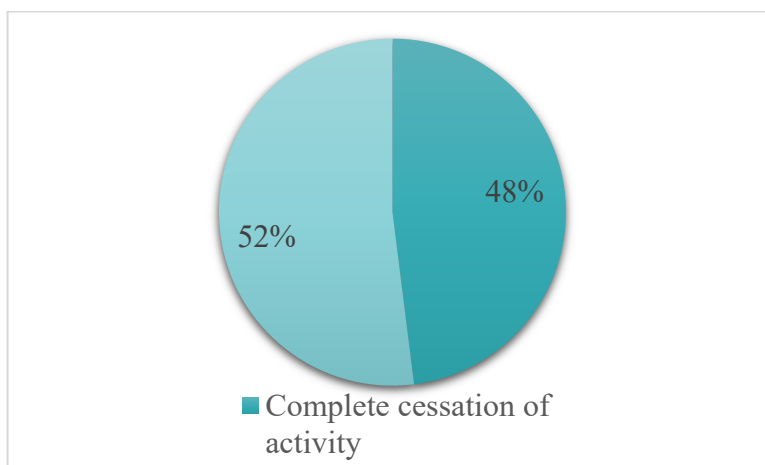


Chart 4. Alternatives for continuing the activity

Chart 4 shows that 48% of instructors completely stopped working in the context of the Covid-19 pandemic, while over 52% found alternatives to continue their work.

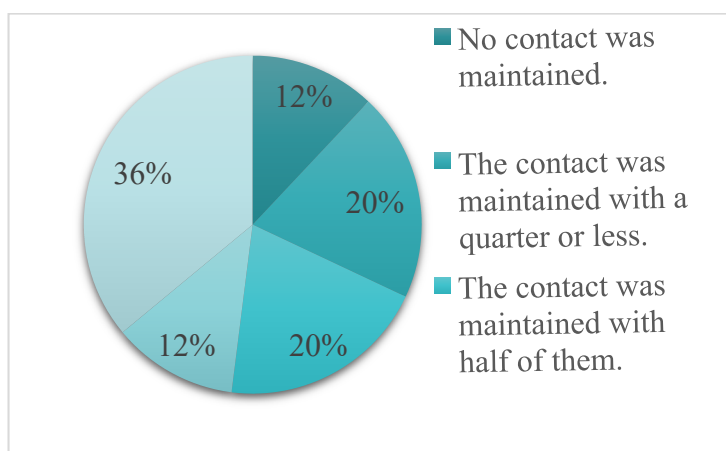


Chart 5. Maintaining contact with swimmers during the alert state

In the previous Chart it can be seen that 36% of the instructors kept contact with all swimmers, while 20% kept contact with half of them, and 12% did not kept contact with any swimmer, during the Covid-19 pandemic alert state.

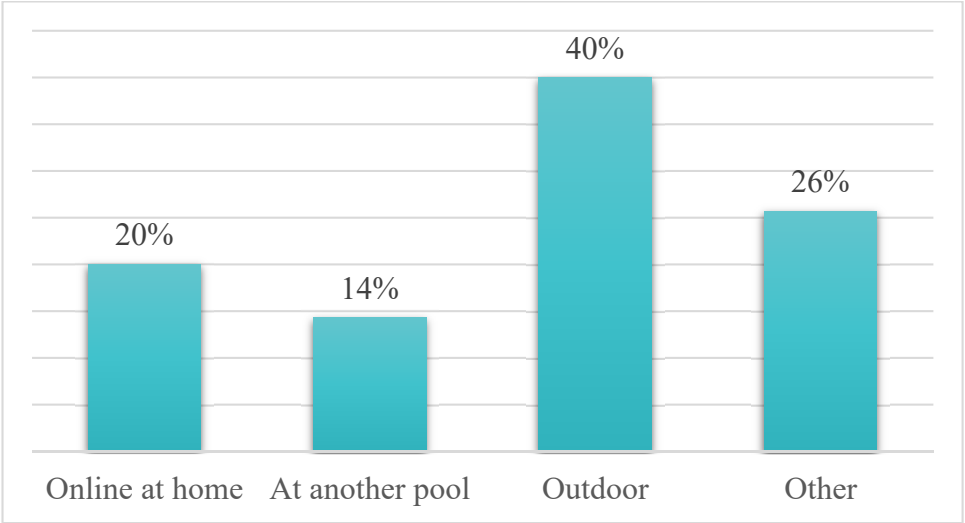


Chart 6. Training variants during the pandemic

In the Chart 6 it can be seen that 40% of the instructors chose to conduct their training outdoors, 20% online, and 26% specified other options for continuing training. Only a percentage of 14% opted to train to another pool.

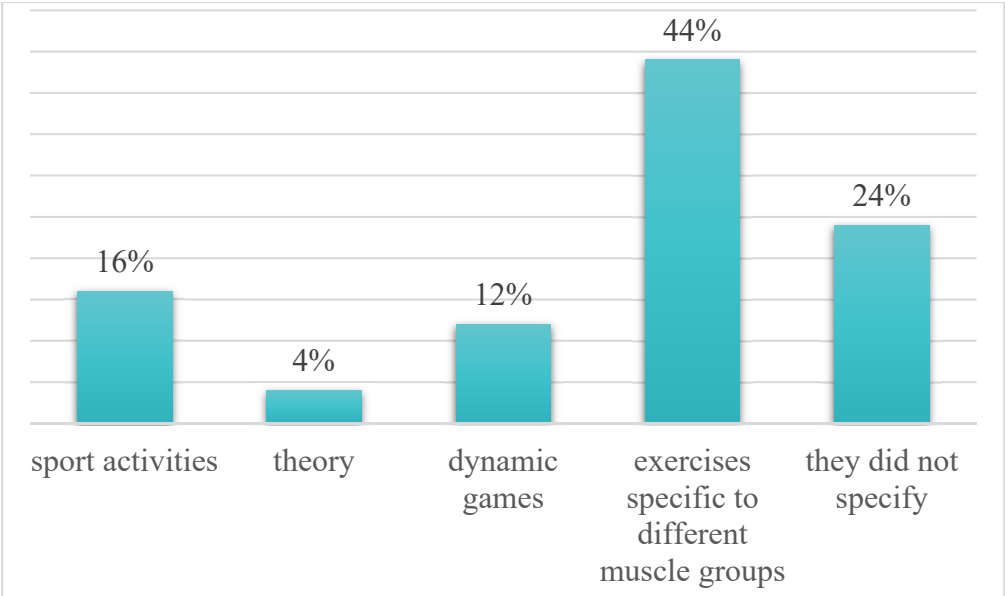


Chart 7. Proposed activities

Chart 7 shows the categories of activities that instructors used as complementary alternatives to continue training. Specific exercises to train different muscle groups were used by 44% of instructors, 16% of instructors involved swimmers in various sports activities, 12% of instructors used dynamic games, while only a percentage of 4% opted exclusively for theoretical training.

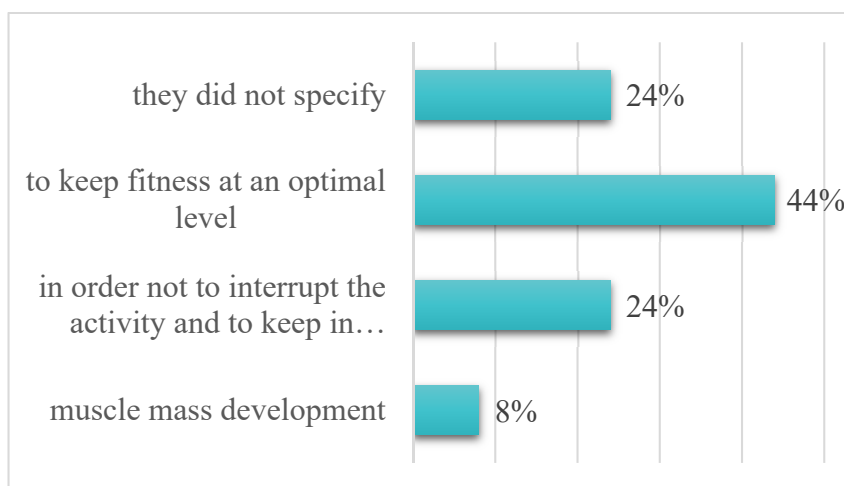


Chart 8. Reasons for choosing the implemented activities

As can be seen in the chart above, a large part of the interviewees chose categories of exercises that would keep the athletes in an optimal physical condition.

Discussions

As of March 2020, most sports activities have ceased, swimmers lost access to their main training establishment because they were no longer allowed access to the pool. It was expected that the swimming pools would be closed for a longer period of time given the restrictions imposed by the pandemic, affecting training with athletes 100%.

For most athletes (80%) the pool where they trained was closed for a period of 12 months starting with the beginning of the state of emergency in Romania, and for the rest (20%), the pool was closed for 6, 7, 9 and 10 months, respectively. During the state of emergency, all sports clubs had to stop completely their activities. During this time the instructors had to give the best advice to the athletes for maintaining mental and physical health.

Although the pools were closed, continuing the activity through various alternatives was essential to maintain fitness at an optimal level. Coaches and athletes had to find the best alternatives to continue their training. Therefore, 48% of respondents found alternatives to continue the activity, while the rest stopped activities completely.

The alternatives found by the instructors are very interesting, being mentioned the following: sports activities, dynamic games and exercises specific to different muscle groups. They are very effective for the continuous development of motor skills, for maintaining physical fitness at an adequate level and for strengthening the immune system which is crucial in this pandemic period. Thus, upon re-entering the swimming pool, the athletes will be physically prepared to start training and will be able to return to their original form as soon as possible.

Maintaining communication during this period between the instructor and the athlete or parent is essential to maintain the swimmer's motivation. The fact that 12% of swimming instructors did not keep in touch with their athletes during this period, or 20% with a quarter or less, indicates that these athletes could have chosen to go to other swimming clubs that continued their activity. When the swimming instructor decides not to keep in touch with the athletes, there is a good chance that he will lose his clients and the connection with them, and when he will be able to resume his activity it will be difficult for him to gather the groups of children again.

Conclusions

More than half of the study's respondents found no alternatives for continuing physical activity during 2020-2021 pandemic Covid-19. About half of the instructors (48%) found complementary alternatives for maintaining fitness through which swimmers developed their qualities, skills and motor skills specific to swimming, for different periods of time, when they could not perform the usual training at the pool. The most commonly used activities were activities performed outdoors, whether we are talking about physical activities, dynamic games or exercises specific to some muscle groups.

Last but not least, even though a large part of the swimming instructors completely stopped the activity, they continued to communicate with the athletes during this period.

Finally, the above recommendations could help swimmers maintain an optimal level of physical activity and improve other skills in the event that in the future they will face special situations again, during which they cannot perform the usual workouts at the pool.

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THE IMPORTANCE OF USING CIRCUIT TRAINING IN THE DEVELOPMENT OF CONDITIONAL AND COORDINATIVE ABILITIES OF MALE U17 HANDBALL PLAYERS

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ABSTRACT. The necessity of a proper physical training of athletes and their harmonious development of also implies making them accustomed with the practice of circuit training within handball specific training sessions. This ensures the mastery of a complex set of exercises and its methods of execution.

Aims: We started from the premise that the chaining of several handball specific exercises within a training circuit can be beneficial for the development of conditional and coordinative abilities of the male U17 handball players.

Methods: The method used was mainly the experimental one, speed testing in different directions was performed, with emphasis on execution, acceleration and force speed, as well as agility and general coordination. Data interpretation was performed by applying the statistical-mathematical method, the method of graphical representations.

Results: The results show a statistically significant difference between mean results obtained by the subjects of the two groups in the "Training circuit 1" test for testing speed in different directions, with emphasis on execution, acceleration and force speed, as well as agility and general coordination, the average being 31.98 sec. for the experiment group and 34.48 sec. for the control group. As a result, the average of the experiment group is lower by 2.51 sec. (7.27%). **Conclusions:** The higher the motor skill indicators, the more the technical-tactical abilities of male U17 handball players will make the difference in achieving maximum efficiency.

Key words: male handball, U17, circuit training, conditional and coordinative abilities.

REZUMAT. *Necesitatea aplicării parcurșurilor aplicative în dezvoltarea capacităților condiționale și coordinative ale jucătorilor de handbal masculin, juniori II.* O pregătire fizică bună și o dezvoltare armonioasă a sportivilor, impune obișnuirea acestora cu practicarea parcurșurilor aplicative în

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cadrul antrenamentelor specifice disciplinei handbal, care să le asigure cunoașterea până la automatizare a unui complex de exerciții și a modului lor de execuție. **Obiective:** Am plecat de la premiza că înlănțuirea mai multor structuri specifice jocului de handbal în cadrul unui parcurs aplicativ poate fi benefică dezvoltării capacităților condiționale și coordinative ale jucătorilor de handbal masculin, juniori II. **Metode:** S-a utilizat în principal metoda experimentului, s-a realizat testarea vitezei pe direcții diferite, cu accent pe viteza de execuție, viteza de accelerare, viteza în regim de forță precum și agilitatea și coordonarea generală, iar interpretarea datelor s-a realizat prin aplicarea metodei statistico-matematice, metoda reprezentărilor grafice. **Rezultate:** Rezultatele indică o diferență semnificativă statistic între mediile rezultatelor obținute de subiecții celor două grupe la testul „Parcurs aplicativ 1” pentru testarea vitezei pe direcții diferite, cu accent pe viteza de execuție, viteza de accelerare, viteza în regim de forță precum și agilitatea și coordonarea generală, media având valoarea 31.98 sec. la grupa experiment, respectiv 34.48 sec. la grupa de control. Rezultă că media este mai mică la grupa de experiment cu 2.51 sec. (7.27%). **Concluzii:** Cu cât indicatorii motrici sunt la cote superioare, cu atât capacitățile tehnico-tactice ale jucătorilor de handbal masculin, juniori II vor face diferența în atingerea eficienței maxime.

Cuvinte cheie: *handbal masculin, juniori II, parcursuri aplicative, capacități condiționale și coordinative.*

Introduction

Handball is defined as a dynamic sport, in which players use their hands to dribble, pass and throw the ball at the opponent's goal. Therefore, handball is characterized by highly developed motor skills such as coordination, speed and agility, endurance, reaction speed and explosive power (Milanese, C., et.al., 2012, pp. 199-204).

Physical training provides the energy required for performance, stimulating the increase of functional and morphological indices and, consequently, of motor qualities. Thus, the increase of the body's general capacity for effort will help accentuate the technical-tactical skills required by competition regulations of the particular discipline practiced by the athlete (Nicu, A., 1993).

Good physical training and harmonious development of athletes implies their habituation with the practice of training circuits within handball specific training. This ensures the mastery of a complex set of exercises and their execution on an automatic level. Apart from the fact that they strengthen athletes' health and their psycho-physical balance, they also lay the foundations for a multilateral and harmonious development of the body and allow for a rich and assorted set of motor skills.

Training circuits are complex structures, consisting of basic motor skills (walking, running, jumping, shooting, catching), applied motor skills (climbing, balance, crawling, lifting and transporting weights, traction, pushing) and technical elements from sports disciplines, ensuring a wealth of motor resources in physical training, regardless of the existing material conditions.

Circuit training has shown an increased efficiency in the development of motor skills, because they contain elements of competition which increase efficiency due to their mobilizing nature, and the increase in repetitions makes the activity more attractive, more stimulating, stimulating the interest of athletes.

An all-round physical training and the proper development of general coordination skills implicitly leads to a faster and smoother development of specific coordinative abilities.

With the help of coordinative abilities, we can achieve the highest level of general coordination, from partial movements to the formation of general ones, if they are coordinated in a consistent way (Esfahankalati, A., et.al., 2013, pp. 42-46). They are important in the game of handball and their improvement is necessary from an early age. In particular, coaches who work with young players will need to include the development of coordination in their daily training program (Esfahankalati, A., Venkatesh, C., 2013, pp. 42-46). Thus, the efficient use of tactical capabilities is ensured, in situations that undergo continuous changes (Blumenstein, B., et.al., 2007, pp. 62-67). The higher the degree of coordination skills that are specific to the game of handball, the more complex actions an athlete can perform at progressively higher speeds, which explains the restriction of movements by the defenders' action, for example (Starosta, W., 2006, pp. 9-23).

Coordinative skills allow the execution of a group of qualitative movements, and their insufficient training limits the ability to perform at a higher level. (Blumenstein, B., 2007, pp. 62-77). Therefore, a good development of coordination skills provides a solid basis for fast and efficient learning, stabilization and variation of technique, as well as their successful execution in the moments of the game. (Pramanick, P., 2011, pp. 98).

It is assumed that a high level of basic motor skills, situational, cognitive and functional, is the essential condition for effective learning of new motor structures, their improvement and successful implementation (Hirtz, P., ş.c., 2002, pp. 19-28).

It is to be noted that, in the game of handball, it is not the perfection of technical execution that determines success, but its speed, precision and adaptation to momentary conditions.

Conditional and coordinative skills should be taken into account in the planning and organization of training programs as important elements of a complex training process of U17 male handball players, as it exerts a considerable influence on technical and tactical skills and increase their effectiveness.

Aims

The aim of this experiment is to achieve a significant increase in conditional and coordinative abilities by capitalizing on the specific elements of the game of handball in a homogeneous and unitary system, through circuit training. We started from the premise that the chaining of several structures specific to the game of handball within a training circuit can be beneficial to the development of conditional and coordinative abilities of male U17 handball players.

Materials and methods

The experimental research began in September 2018, when we identified the two groups of subjects, aged 15 and 16 (2003 and 2002 born), who practice organized handball systematically and continuously, as it follows: the experimental group, consisting of 15 athletes of the handball team Bucharest Municipal Sports Club (CSM), and the control group, consisting of 17 athletes of the handball team of Bucharest School Sport Club No. 2 (CSS nr.2). The experimental group underwent a training program consisting of general and multilateral physical training methods in the form of training circuits, for 30 weeks, three times a week, for 15 minutes (on Mondays, Tuesdays and Wednesdays).

At the beginning and at the end of the research period, the "**Training circuit 1**" test was applied to both groups. The test was designed to evaluate the speed indices specific to the various forms of attack and defense phases in U17 men's handball.

Aim: speed testing in different directions and angles, involving forward, lateral and backward movements, the ability to rotate in different directions and at different angles, with emphasis on execution, acceleration and force speed (lower limb expansion), agility and body control.

Equipment: gym bench, 20 training cones, stopwatch, handball, whistle, handball goal, tape measure, adherent surface.

Work procedure: After the whistle, from standing start position at the starting line (a), the athlete performs a 4 m sprint, to workshop 1, where, on the right side of the cone, he executes a figure eight run (there and back) between 2 longitudinally arranged cones located at a distance of 2 m between them, all the while facing forward, in the direction of movement. This is followed by a 3 m sprint, until workshop 2, where, on the right side of the cone, the athlete performs a figure eight side run (right then left), between 2 transversely placed cones and at a distance of 2 m between them, all the while facing forward, in the direction of movement.

Then he executes a 2 m sprint, to workshop 3, where the athlete, on the left side of the cone, performs a winding run, facing forward, in the direction of movement, among 4 longitudinally arranged cones, located at a distance of 1m between them. Next is a 2 m sprint, to workshop 4, where the athlete, from the right side of the 3 m long gym bench, performs 4 successive diagonal jumps, feet close together, over the bench, all the while facing forward, in the direction of movement.

It is followed by a 4 m sprint, to workshop 5, where the athlete, on the right side of the line of cones, performs a left side run facing the handball goal, among the first row of 4 transversely placed cones and at an interval of 1 m between them. At the end of the row of cones, the athlete sprints forward 2 m, towards row 2 of 4 transversely placed cones at an interval of 1 m between them and continues his right side run facing the handball goal, towards the last cone.

Next is a sprint of 3 m diagonally to the left, to workshop 6. Here the athlete, on the left side of the cone, runs facing the handball goal, there and back, bypassing the 2 longitudinally placed cones, at a distance of 2 m between them. The athlete continues the sprint of 3 m diagonally to the right, facing the handball goal, to workshop 7. From here, he picks up the handball from the ground, from a set point, with both hands. The athlete makes a 3 m free dribble diagonally, towards the left cone, towards workshop 8.

From here, alternately using both hands, he continues the dribbling, this time running in figure eight, around 2 transversely placed cones, at an interval of 2 m between them, always facing the goal. Next is 4 m free dribbling diagonally to the right, towards workshop 9, at the 9 m line (b). From here, the athlete performs an overarm jump shot, without crossing the 9 m line (b) at take-off, from the foot opposite the shooting arm. After the ball thrown towards the handball goal reaches the goal net, the timer stops.

Methodological instructions

The setup of the training circuit should begin with workshop 9; each subject is entitled to two attempts as warm up; each subject is timed separately, from the starting line (a) to the ball touching the net of the goal, after the overarm jump shot from the 9 m line (b); the subject performs the test only once and time will be recorded with an accuracy of 0.01 seconds; the following penalty criterion will be used: 2 seconds per violation whenever the athlete deviates from forward facing movement.

a. Subject one; b. Subject two; 1. Subject (a) picks the ball up from the first cone and executes two bounced passes with subject (b); 2. Lateral running and touching the left row cones with left hand and the right row cones with right

hand; between the two rows the subject runs facing forward; 3. Winding run forward through 4 cones; 4. Running round two cones facing forward; 5. 10 left and right jumps on both feet between cones (c), (d); 6. Running forward to cone (e), then backward movement to cone (f), sideways running between cones (f) and (g), forward running towards workshop (7); 7. Receiving handball with both hands; 8. Dribbling and shooting on goal by various procedures; h. 9 m line; i. Retrieving the ball and returning to workshop (7); j. Running back into formation;

Legend :1) The first cone where the subjects receives the ball is 5 m away from the starting line; 2) two rows of 3 cones each, 6 m away from workshop (1), the distance between rows being 4 m, the distance between cones 3 m; 3) 4 successively placed cones 4 m away from workshop (2), the distance between cones being 2 m; 4) 2 transversely placed cones 6 m away from workshop (3), the distance between the two cones being 4 m; 5) Two successively placed cones (c) and (d) 4 m away from workshop (4), the distance between the two cones being 8 m; 6) 3 cones placed in an equilateral triangle 4 m away from workshop (5), the distance between cones being 6 m; 7) Receiving a handball with both hands.

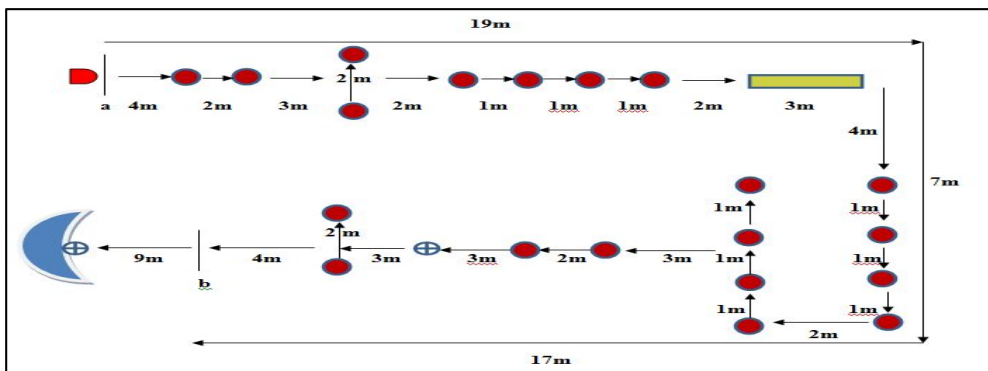


Figure 1. „Training circuit 1” test

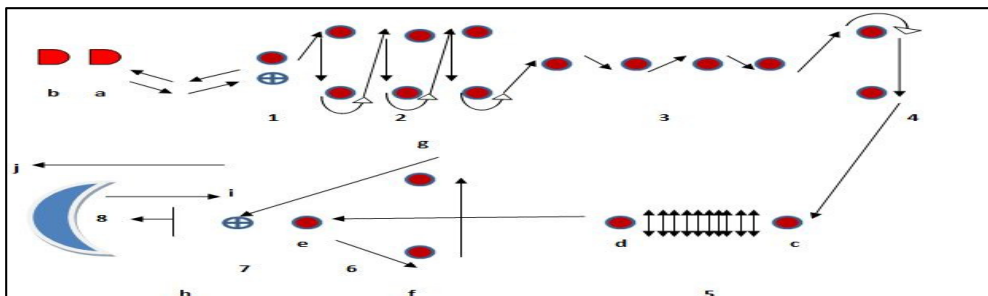


Figure 2. Training circuit 1

a. Subject one; b. Subject two; 1. Subject (a) picks the ball up from the first cone and executes two passes with subject (b), after the second pass the handball stays at the first cone; 2. 4 successive jumps with both feet over the gym bench; 3. Sideways run from left to right between two rows of cones each consisting of 4 cones, next time running in the opposite direction; 4. Running round a cone; 5. Jumping over cones with legs apart and touching the cone, landing with feet close together between cones, 4 times; 6. 4 jumps over gym bench with both feet; 7. Receiving a handball with both hands; 8. Dribbling and jump shot; c. 9 m line; d. Retrieving the ball and returning to workshop (7); e. Running back into formation. Legend: 1) The first cone is 4 m away from the starting line; 2) The gym bench is 4 m away from workshop (1); 3) 2 transversely placed rows of 4 cones each, the distance between rows being 4 m, the distance between cones 2 m; 4) Cone 4 m away from workshop (3); 5) 4 successively placed cones 4 m away from workshop (4), the distance between cones being 80 cm; 6) Gym bench 4 m away from workshop (5); 7) handball placed 6 m away from workshop (6).

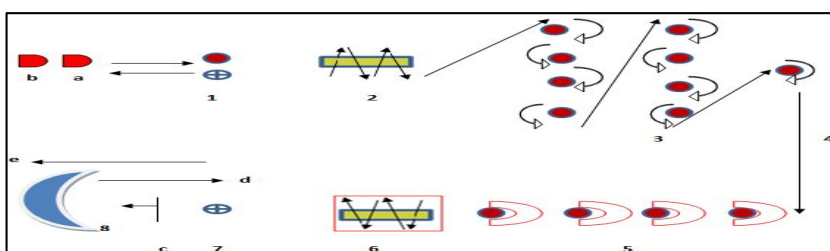


Figure 3. Training circuit 2

a. Subject; 1. Rotation round 3 cones from left to right, next time from right to left; 2. Touching the right cone with right hand and left cone with left hand, lateral shuffle between the two transversely placed cones, next time in the other direction; 3. Going round the two cones facing forward and backward, next time in the other direction; 4. Running round a cone; 5. Rotation round for cones running diagonally; 6. Receiving a handball with both hands; 7. Dribbling round two transversely placed cones, next time in the other direction; 8. Jump shot from the 9 m line (b); b. 9 m line; c. Retrieving the ball from the goal and running back to workshop (6); d. Running back into formation. Legend: 1) The first of the 3 cones is 3 m away from the starting line, the distance between the cones being 1 m; 2) The two transversely placed cones are 3 m away from workshop 1, the distance between the cones being 1 m; 3) The first of the two successively placed cones is 3 m away from workshop (2), the distance between

the cones being 4 m; 4) Cone 10 m away from workshop (3); 5) Four cones placed in a trapezium with the side of 4 m, 6 m away from cone (4); 6) Handball placed 4 m away from workshop (5); 7) Two transversely placed cones 4 m away from the handball, the distance between the two cones being 4 m; 8) Jump shot from the 9 m line (b).

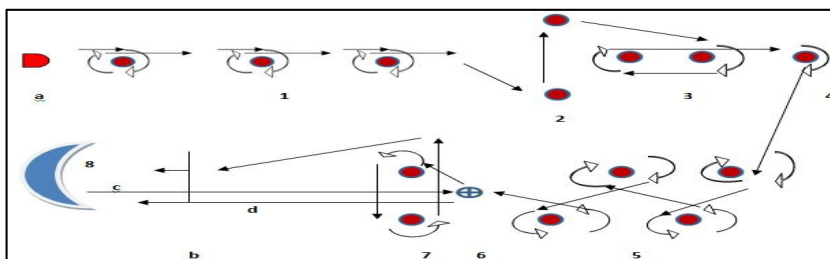


Figure 4. Training circuit 3

Results

Table 1. Experimental research – Experimental group
Initial and final testing - „Training circuit 1” test

No.	Initials	Year of birth	Age	„Training circuit 1” test - Unit – Seconds	
				Initial	Final
1	P.A.	2003	15	32.93	30.61
2	P.V.	2002	16	33.15	30.77
3	D.C.	2002	16	33.24	30.95
4	Z.A.	2002	16	33.48	31.04
5	C.C.	2002	16	33.57	31.32
6	C.S.	2002	16	33.88	31.57
7	V.D.	2002	16	34.04	31.79
8	B.A.	2003	15	34.17	32.09
9	D.D.	2003	15	34.42	32.18
10	M.F.	2003	15	34.79	32.44
11	T.F.	2003	15	34.91	32.53
12	C.A.	2003	15	35.08	32.81
13	L.M.	2003	15	35.22	32.84
14	J.A.	2002	16	35.28	33.14
15	K.A.	2002	16	35.41	33.58

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Table 2. Experimental research – experimental group – Analysis of statistical-mathematical indices before and after the training program - „Training circuit 1” test

Statistical index	I.T.	F.T.	Statistical index	F.T.-I.T. differences	
Mean	34.24	31.98	Mean	-2.26	
Median	34.17	32.09	Progress	6.6%	
Standard deviation	0.85	0.92	95% C.I.	(-2.34; -2.18)	
Minimum	32.9	30.6	Standard deviation	0.15	
Maximum	35.4	33.6	Dependent T-test	t	p
Amplitude	2.5	3.0		57.63	<0.001
Coefficient of variation	2.5%	2.9%	Effect size	14.88	

For the experimental group, the “Training circuit 1” test for testing speed in different directions, with emphasis on execution, acceleration and force speed, as well as agility and general coordination, showed a drop in mean execution time at the final testing by 2.26 sec. The progress made is 6.6%. The difference in averages is within the confidence interval (-2.34; -2.18). Variance is homogenous at both testing. The difference between means is large to very large and statistically significant, $p < 0.001$, with $t = 57.63$ and $df = 14$. **Chart 1** shows the recorded means, while **chart 2** the individual differences between final and initial results.

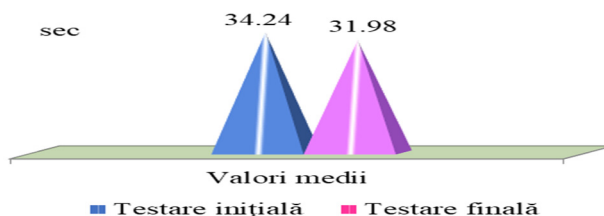


Chart 1. Experimental research – Experimental group – Initial and final testing – Mean values of individual results - „Training circuit 1” test

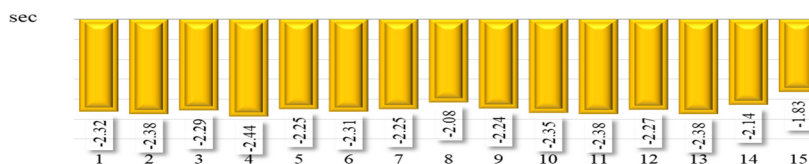


Chart 2. Experimental research – Experimental group – Initial and final testing – Differences between final and initial individual results - „Training circuit 1” test

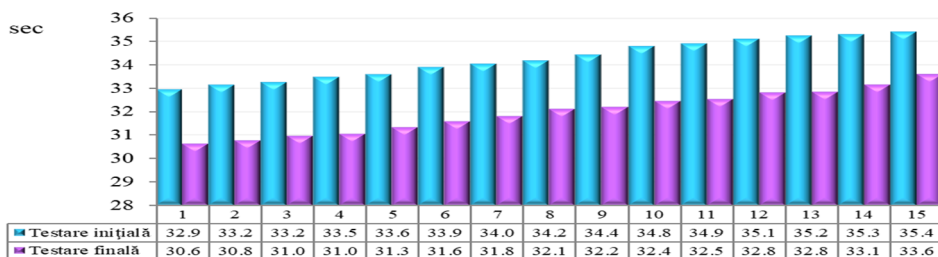


Chart 3. Experimental research – Experimental group – Initial and final testing – Final and initial individual results - „Training circuit 1” test

Table 3. Experimental research – Control group
Initial and final testing – „Training circuit 1” test

No.	Initials	Year of birth	Age	„Training circuit 1” test Unit – Seconds	
				Initial	Final
1	B.D.	2003	15	33.14	32.88
2	P.A.	2003	15	33.44	32.91
3	M.C.	2003	15	33.61	33.32
4	P.L.	2002	16	33.79	33.55
5	V.C.	2003	15	34.04	33.70
6	N.C.	2003	15	34.32	33.78
7	N.R.	2002	16	34.74	33.94
8	C.A.	2003	15	34.93	34.48
9	S.A.	2003	15	34.98	34.69
10	G.V.	2003	15	35.04	34.77
11	C.A.	2003	15	35.36	34.85
12	B.A.	2003	15	35.66	35,12
13	N.D.	2003	15	35.85	35.26
14	A.M.	2002	16	36.03	35.33
15	B.D.	2002	16	36.27	35.75
16	B.V.	2003	15	36.56	35.79
17	O.R.	2002	16	36.72	36.09

Table 4. Experimental research – control group – Analysis of statistical-mathematical indices before and after the training program - „Training circuit 1” test

Statistical index	I.T.	F.T.	Statistical index	F.T.-I.T. differences	
Mean	34.97	34.48	Mean	-0.49	
Median	34.98	34.69	Progress	1.4%	
Standard deviation	1.12	1.02	95% C.I.	(-0.58; -0.39)	
Minimum	33.1	32.9	Standard deviation	0.18	
Maximum	36.7	36.1	Dependent T-test	T	p
Amplitude	3.6	3.2		11.09	<0.001
Coefficient of variation	3.2%	2.9%	Effect size	2.69	

For the control group, the “Training circuit 1” test for testing speed in different directions, with emphasis on execution, acceleration and force speed, as well as agility and general coordination, showed a drop in mean execution time at the final testing by 0.49 sec. The progress made is 1.4%. With a confidence of 95% the difference in averages is within the interval (-0.58; -0.39). Variance is homogenous at both testings. The difference between means is large to very large and statistically significant, $p < 0.001$, with $t = 11.09$ and $df = 16$. **Chart 4** shows the recorded means, while **chart 5** the differences between final and initial results.

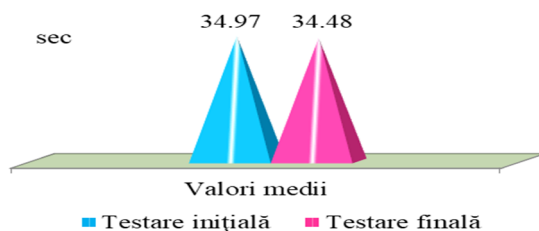


Chart 4. Experimental research – Control group – Initial and final testing – Mean values of individual results - „Training circuit 1” test

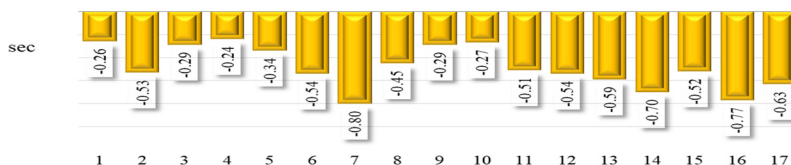


Chart 5. Experimental research – Control group – Initial and final testing – Differences between final and initial individual results - „Training circuit 1” test

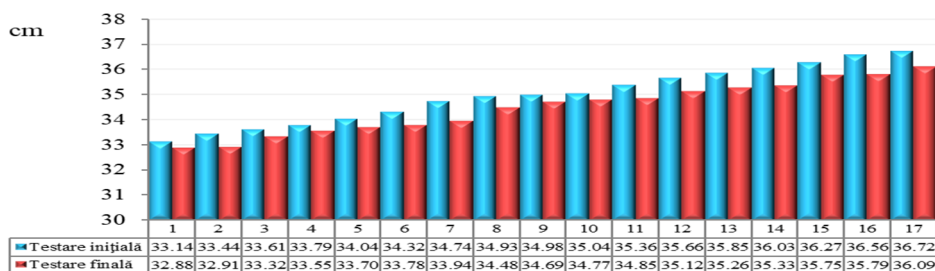


Chart 6. Experimental research – Control group – Initial and final testing – Final and initial individual results - „Training circuit 1” test

Table 5. Experimental research - Experimental vs control group – Comparative analysis of mean results in view of statistical-mathematical indices after the training program - „Training circuit 1” test

GROUP	Mean	Mean diff.	Median	Standard deviation	Minimum	Maximum	Amplitude	Coeff. variation
Experimental	31.98	-2.51	32.09	0.92	30.61	33.58	2.97	2.9%
Control	34.48		34.69	1.02	32.88	36.09	3.21	2.9%

Table 6. Experimental research – Independent T-test - „Training circuit 1” test

Test Levene for equality of variances		Equal variance ?	T-test for equality of variance				Effect size
F	Sig.		Mean difference	T	df	P	
0.263	0.612	YES	-2.51	7.272	30	0.000	2.58

The independent T-test for equality of variances, with $p < 0.001 < 0.05$ and $df=30$, shows a statistically significant difference between the mean results recorded by the subjects of the two groups when performing the “Training circuit 1” test for testing speed in different directions, with emphasis on execution, acceleration and force speed, as well as agility and general coordination. The mean value is 31.98 sec. for the experimental group and 34.48 sec. for the control group, meaning that the experimental group mean is shorter by 2.51sec. (7.27%). The effect size (2.58) indicates a large to very large difference between the mean values of the two groups. Variance is homogenous at both testing. **Chart 7** shows the mean values of subjects from both groups at the final testing.

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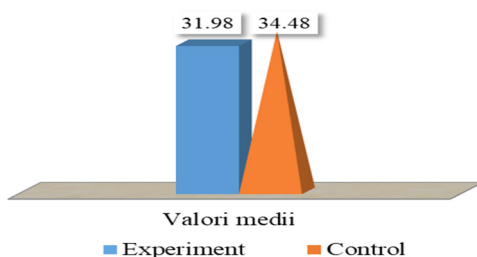


Chart 7. Experimental research – Experimental vs control group – Mean test values - „Training circuit 1” test

Discussion and conclusions

Many performances achieved by athletes, regardless of their sport, are due to the introduction of new elements in training by the teacher-coaches: resources, training methods, effort quantification, training system, etc.

The novelties, the innovations, the personal imprint of the teacher-coach, has in most cases meant, for the athletes or the team, the added value which has determined the winner during a sporting competition. Capitalizing on the potential of athletes at the highest levels is the main goal of every effort in training plans, an objective often accomplished due to the coach's skill to achieve an optimal ratio between specific and physical training.

While, in the case of male U17 handball players, a lot of the training time is allocated to sports specific training, we consider that physical training can also be improved by introducing resources and methods which can better harness their bio-psycho-motor potential.

Following the independent T-test for equality of variance, with $p < 0.001$ < 0.05 and $df=30$, the experiment has led us to observe a statistically significant difference between the mean values recorded by the subjects from the two groups after performing the “Training circuit 1” test for testing speed in different directions, with emphasis on execution, acceleration and force speed, as well as agility and general coordination. The mean value of the experimental group was 31.98 sec. while the control group had 34.48 sec. The result is a shorter time of execution by the experimental group by 2.51 sec. (7.27%).

There is a strong need to increase the importance of physical training in the training plans of handball coaches. This should be the basis for consolidating and improving the sports specific training of the male U17 handball player. The higher motor indicators are, the more the technical-tactical abilities of male U17 handball players will be able to make the difference in achieving maximum efficiency.

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STUDY REGARDING THE VALUE OF THE PLAYERS ANTHROPOMETRIC INDICATORS MEMBERS OF THE ELITE EUROPEAN HANDBALL TEAMS QUALIFIED AT THE FINAL TOURNAMENTS

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ABSTRACT. Introduction. Handball players who manage to perform at the highest level have certain specific qualities. Through the results obtained in all world competitions, European national teams are considered the best teams in the world. **Aim.** The aim is to determine the current trend about the value of anthropometric indicators, primarily the body mass index, and its role in achieving performance. **Materials and methods.** The data of anthropometric parameters (age, height, weight, and body mass index - BMI) from 966 handball players who participated in 2016, 2018, and 2020 editions of the European Men's Handball Championship had been analyzed. Next, the finalist and non-finalist teams' BMI was analyzed, and then its evolution according to playing position. **Results.** The analysis shows that in the last three editions of the European Championship, an approximately constant value of the studied indicators is kept. The differences between the editions are not statistically significant. The average age is 27 years, the average weight is about 94 kg, the average height is 1.92 m, and the BMI is 25. The body mass index did not register statistically significant differences for the same playing position in the last three editions analyzed. **Conclusions.** The data obtained from the study show what the current values of the leading anthropometric indicators of elite European handball players are. These indicators do not play an essential role in ranking in the first positions of the final tournament.

Keywords: elite handball players, anthropometric indicators, body mass index-BMI, European Championship.

REZUMAT. Studiu privind valoarea indicatorilor antropometrici ai jucătorilor de elită membri ai echipelor europene de handbal calificate la turneele finale. Introducere. Jucătorii de handbal care reușesc să performeze la

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cel mai înalt nivel au anumite calități specifice. Echipele naționale europene, prin rezultatele obținute la toate competițiile mondiale, sunt considerate cele mai performante echipe. **Scop.** Scopul este de a determina tendința actuală în ceea ce privește valoarea indicatorilor antropometrici, în special indicele de masă corporală și rolul său în atingerea performanțelor. **Materiale și metode.** Au fost analizate datele parametrilor antropometrici (vârstă, înălțime, greutate și indicele de masă corporală - IMC) de la 966 de jucători de handbal care au participat la edițiile 2016, 2018 și 2020 ale Campionatului European de handbal masculin. Apoi a fost analizat IMC-ul echipelor finaliste și non-finaliste și evoluția acestuia în funcție de posturile de joc. **Rezultate.** Analiza arată că la ultimele trei ediții ale Campionatului European se păstrează o valoare aproximativ constantă a indicatorilor studiați. Diferențele dintre ediții nu sunt semnificative din punct de vedere statistic. Vârsta medie este de 27 de ani, media greutății este de 94 kg, înălțimea medie 1,92 cm, iar IMC-ul este 25. Indicele de masă corporală nu a înregistrat diferențe statistic semnificative pentru același post de joc la cele trei ediții analizate. **Concluzii.** Datele obținute din studiu arată care sunt valorile actuale ale principalilor indicatori antropometrici ai handbaliștilor europeni. Acești indicatori nu joacă un rol decisiv în clasarea echipelor în primele poziții ale unui turneu final.

Cuvinte cheie: *jucători de elită, indicatori antropometrici, indicele de masă corporală-IMC, Campionat European.*

Introduction

The game of handball, worldwide, is one of the most popular team sports. Handball has long exceeded the limits of entertainment and, in recent decades, has become an increasingly interesting topic to be explored scientifically and increasingly addressed by specialists in the field (Magnúsdóttir, 2019; Massuça et al., 2014; Moss et al., 2015; Prieto et al., 2015; Weber & Wegner, 2016). The game itself has developed a lot. It has become very fast and dynamic and continuous changes have been observed by introducing new rules of the game.

A significant increase is also observed in the number of matches in which an elite player must perform. High-performance athletes can play around 80 national and international matches (Michalsik, 2018). The specialists involved in this phenomenon have concluded that certain anthropometric parameters specific to the handball player are needed to cope with such a large number of matches and achieve outstanding results.

Vila et al. (2012), cited by Moss et al. (2015), state that achieving handball performance in addition to specific motor qualities depends on a series of factors. They refer to technical knowledge and the ability of players to apply them in different tactical situations. The mental capacity and their biological characteristics, physiological and, anthropometric are also essential. Anthropometric measurements are used worldwide as determinants in training monitoring (Leão et al., 2019).

Norton & Olds (2001) radically replaced the phrase "the typology of the ideal athlete" proposed by Bemies (1900) with that of the "model" of highly specialized sports constitution for each sports branch. Michalsik (2018), analyzing and comparing, over several years, the anthropometric indices of several generations of athletes, finds a general progressive increase in height and weight and a significant progress in elite athletes. There were also evolutionary and genetical changes of the global population. The cited authors found that there is a correlation between athletes' height and weight and their sports career duration. The unanimous conclusion is that the number of centimeters and extra pounds are factors that influence the level of performance and determine the duration of a sports career.

We consider it extremely important to study and to be aware of as much information as possible about the players who manage to perform and get results at the highest level.

Taborsky (2007), quoted by Bilge (2012), considers that to determine the handball game's current evolutions, it is essential to carry out in-depth research of the bio-psycho-motor characteristics of the players participating in major competitions such as Olympic Games, World and European Championships. Bilge & Sevim (2007) point out that "teams in Europe make a significant contribution to the global development of the game of handball." European national teams have achieved outstanding results over time and they are consistently ranked first in world competitions.

The Body Mass Index (BMI) is a valuable physical parameter used to monitor body mass, respectively, the relationship between body weight and height (Arifi et al., 2019; Magnúsdóttir, 2019; Michalsik, 2018; Táboršký, 2007). A gradual development of the elite player's constitution is observed. Although it has some limitations, BMI can assess the optimal body weight for a certain height and correlate with fat and fat-free body weight (Nikolaidis & Ingebrigtsen, 2013).

BMI, along with age, weight, and height, are part of anthropometric indicators which are considered constitutional factors that contribute to achieving success in the game of handball (Weber & Wegner, 2016).

Aim

The primary aim of this paper is to determine the value of BMI in elite players participating in the 2016, 2018, and 2020 editions of the European Men's Handball Championship. The second goal is to determine if this anthropometric indicator has significant importance in achieving performance (ranking first four places) in a final continental championship tournament.

To achieve what we have proposed to do, we have analyzed the anthropometric indicators of height and weight data. Then the body mass index - BMI has been calculated. Additionally, we have analyzed the BMI according to the playing position.

Materials and methods

The study includes the participating teams in 2016, 2018, and 2020 editions of the European Men's Championship. The analyzed data has been taken from the official websites of the European Handball Federation. The analysis of statistical data is calculated on a sample of 966 players.

The averages for age, weight, height, and BMI of the three editions' players are calculated. BMI is calculated according to the kg / m^2 formula.

Statistical analysis

In the study, statistical analysis and graphical representations are performed using SPSS 20 (Statistical Package for the Social Sciences). SPSS is a modular line of fully integrated products for the analytical process - planning, data collection, access, data preparation and management, analysis, reporting, and presentation of results. The statistical data analysis is done on a sample of 966 handball players, participants in the last three editions of the European Men's Handball Championship. Descriptive analysis, t-test for independent samples, and Anova One-Way method are used.

Results

The results obtained in the table above show no statistically significant differences in terms of age, weight, height, and BMI in the last editions of the European Men's Handball Championship. The averages for the studied indicators are relatively constant. The average age is around 27 years old, the height-weight is approximately 1.92 m, and the BMI is around 25.

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Table 1. Anthropometric parameters: age, height, weight and BMI

Edition	National team	n	Age	Height (m)	Weight (kg)	BMI
2016	Belarus	17	26.29±5.08	1.9176±0.05	90.12±8.22	24.52±2.15
	Croatia	17	26.59±3.48	1.9324±0.09	97.53±10.97	26.05±1.57
	Denmark	16	28.31±3.68	1.9275±0.06	95.07±8.41	25.68±1.53
	France	17	27.71±5.78	1.9059±0.06	92.71±10.34	25.46±1.84
	Germany	18	24.78±3.62	1.9572±0.06	96.83±9.03	25.23±1.35
	Iceland	17	29.65±4.25	1.9247±0.05	94.71±6.29	25.56±1.44
	FYR Macedonia	17	29.06±4.96	1.9129±0.04	96.71±11.09	26.36±2.24
	Montenegro	17	26.41±4.06	1.9312±0.07	95.41±9.61	25.60±2.48
	Norway	16	26.75±4.00	1.9281±0.04	92.63±9.12	24.89±2.08
	Poland	19	29.42±4.42	1.9363±0.08	91.53±10.31	24.34±1.42
	Russia	17	28.65±4.48	1.9176±0.08	90.53±12.24	24.53±2.19
	Serbia	17	28.12±4.79	1.9429±0.05	95.47±8.44	25.25±1.36
	Slovenia	16	28.25±5.10	1.9031±0.07	94.25±9.69	25.97±1.51
	Spain	17	29.47±3.60	1.9165±0.06	96.35±11.95	26.18±2.46
	Sweden	18	26.22±5.07	1.9111±0.06	92.94±9.27	25.40±1.64
	Hungary	16	26.19±4.65	1.9494±0.08	96.19±12.29	25.19±1.52
	Total	272	27.62±4.59	1.9260±0.06	94.29±9.94	25.38±1.88
2018	Austria	17	26.53±5.07	1.9047±0.08	91.71±13.07	25.19±2.39
	Belarus	17	24.88±4.64	1.9200±0.05	88.12±8.98	23.89±2.07
	Czech Republic	17	27.71±5.12	1.9394±0.07	97.47±11.75	25.89±2.44
	Croatia	21	28.95±4.50	1.9419±0.09	97.14±12.08	25.69±2.04
	Denmark	18	28.89±3.83	1.9306±0.05	96.76±7.71	25.88±1.80
	France	18	26.89±5.33	1.9361±0.06	98.06±10.09	26.12±2.00
	Germany	18	26.61±3.07	1.9450±0.05	95.94±9.01	25.33±1.30
	Islanda	16	27.75±5.39	1.9131±0.05	93.06±7.14	25.40±1.16
	FYR Macedonia	18	29.00±5.44	1.9111±0.06	94.72±14.65	25.84±3.11
	Montenegro	18	27.61±4.06	1.9133±0.05	97.78±9.20	26.70±2.21
	Norway	18	26.22±3.94	1.9328±0.05	96.28±9.14	25.72±1.68
	Serbia	19	26.37±3.77	1.9432±0.06	92.95±9.62	24.54±1.27
	Slovenia	19	25.74±3.41	1.9200±0.07	95.89±9.97	25.95±1.34
	Spain	19	29.63±4.65	1.9347±0.05	95.58±10.12	25.49±1.91
	Sweden	18	25.94±2.92	1.9144±0.06	95.89±8.71	26.12±1.34
	Hungary	18	26.17±4.57	1.9233±0.08	95.11±12.91	25.58±1.88
	Total	289	27.20±4.50	1.9269±0.06	95.21±10.51	25.59±1.99
2020	Austria	17	27.59±4.45	1.9106±0.08	94.47±13.22	25.77±2.15
	Belarus	16	28.00±5.21	1.9350±0.06	92.75±7.23	24.75±1.18
	Bosnia Herzegovina	18	29.56±4.75	1.9411±0.04	99.28±8.29	26.31±1.42
	Czech Republic	18	27.83±5.87	1.9294±0.05	93.00±10.14	24.94±2.00
	Croatia	17	27.35±4.45	1.9371±0.07	99.06±10.94	26.35±1.96
	Denmark	18	29.17±4.48	1.9239±0.04	96.00±7.57	25.93±1.77

Switzerland	16	27.31±3.64	1.9150±0.06	92.31±9.39	25.13±1.76
France	16	27.63±5.84	1.9300±0.05	97.38±9.57	26.10±1.87
Germany	17	27.53±4.00	1.9412±0.06	96.88±9.23	25.67±1.60
Iceland	17	27.47±6.74	1.9118±0.05	92.94±9.36	25.41±2.08
Latvia	16	30.50±4.96	1.9119±0.09	93.25±15.18	25.34±1.78
North Macedonia	16	27.50±5.83	1.9150±0.06	92.44±11.38	25.18±2.67
Montenegro	16	27.38±4.04	1.9175±0.04	93.19±5.31	25.33±0.98
Norway	16	25.19±3.20	1.9250±0.06	93.44±7.52	25.18±0.99
Netherlands	16	27.31±5.30	1.9063±0.08	89.81±9.98	24.71±2.13
Poland	18	25.17±3.82	1.9161±0.08	91.83±14.32	24.87±2.30
Portugal	17	28.53±5.31	1.9171±0.07	98.00±12.45	26.57±2.22
Russia	17	29.18±5.23	1.9212±0.07	89.94±9.30	24.31±1.47
Serbia	16	26.75±2.79	1.9219±0.07	93.75±10.38	25.31±1.67
Slovenia	18	26.89±3.54	1.9217±0.07	95.33±10.19	25.75±1.40
Spain	17	30.53±4.87	1.9341±0.05	95.12±9.20	25.38±1.67
Sweden	18	26.56±3.77	1.9172±0.06	95.89±11.03	25.99±1.56
Ukraine	17	27.76±4.02	1.9441±0.06	99.59±13.30	26.24±2.26
Hungary	17	24.71±4.10	1.9335±0.07	93.82±12.36	24.97±1.79
Total	405	27.64±4.77	1.9242±0.06	96.08±32.03	25.86±7.69

The graph above shows the evolution of BMI in the last three editions of the European Championship. The highest value was reached in 2018, but the differences between editions are not statistically significant.

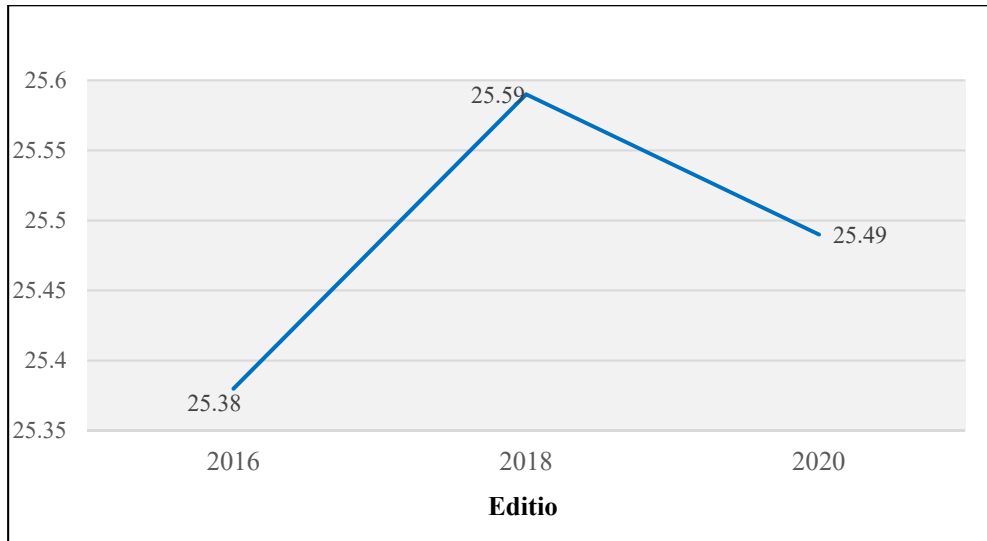


Figure 1. The evolution of BMI average

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In the 2016 edition, the participating players' average BMI was 25.38 and increased to 25.59 in the 2018 edition. In the 2020 edition, there is a decrease in the average BMI to 25.49, but higher than in the 2016 edition. There are no statistically significant differences between editions in terms of BMI. For the second goal, we calculated the BMI of the first four teams of the championship (for each edition), and we have analyzed the teams ranked in the other places.

At the 2016 edition, the first four ranked teams were Norway, Croatia, Germany, and Spain. France, Denmark, Spain, and Sweden have reached the final weekend of the 2018 edition. In 2020 the teams qualified for the finals were Slovenia, Norway, Spain, and Croatia.

In 2016, Germany had won the gold medal. The same Spain team won the 2018 and 2020 editions.

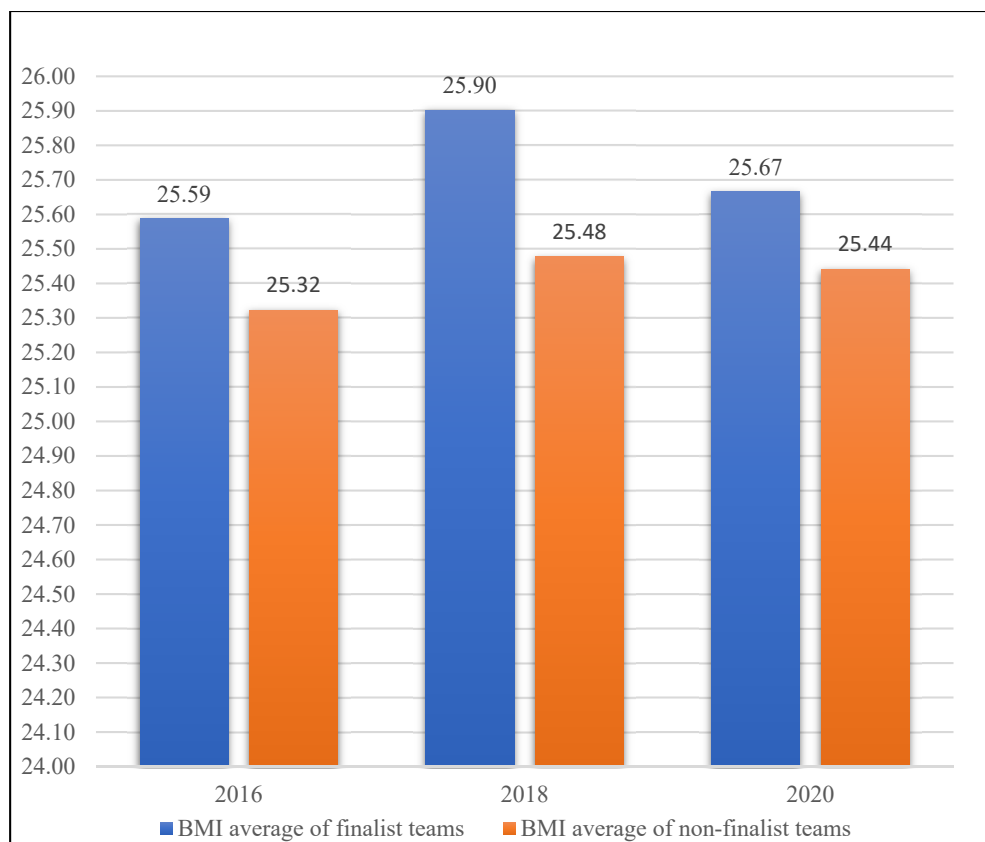


Figure 2. BMI average of finalist and non-finalist teams

The results presented in the figure above show that the finalist teams' average BMI is higher than the rest of the teams in all three editions, but the difference is not statistically significant.

The table and graph below show the BMI value for each item for all three editions.

Tabel 2. BMI average according to playing position

	Edition								
	2016			2018			2020		
	N	Average	SD	N	Average	SD	N	Average	SD
Goalkeeper (GK)	35	25.60	1.86	38	26.21	1.82	48	25.63	1.47
Left Wing (LW)	33	24.18	1.37	32	24.34	1.52	44	24.10	1.60
Right Wing (RW)	29	24.12	1.67	29	24.77	1.54	51	24.41	1.34
Left Back (LB)	45	25.21	1.60	49	25.33	1.70	75	25.38	1.44
Right Back (RB)	37	25.30	0.97	42	25.40	1.22	53	25.17	1.43
Center Back (CB)	41	25.43	1.60	45	25.02	1.69	54	25.19	1.43
Pivot (P)	51	26.86	2.21	52	27.26	2.42	79	27.38	1.95
Total	271	25.38	1.88	287	25.59	1.99	404	25.49	1.87

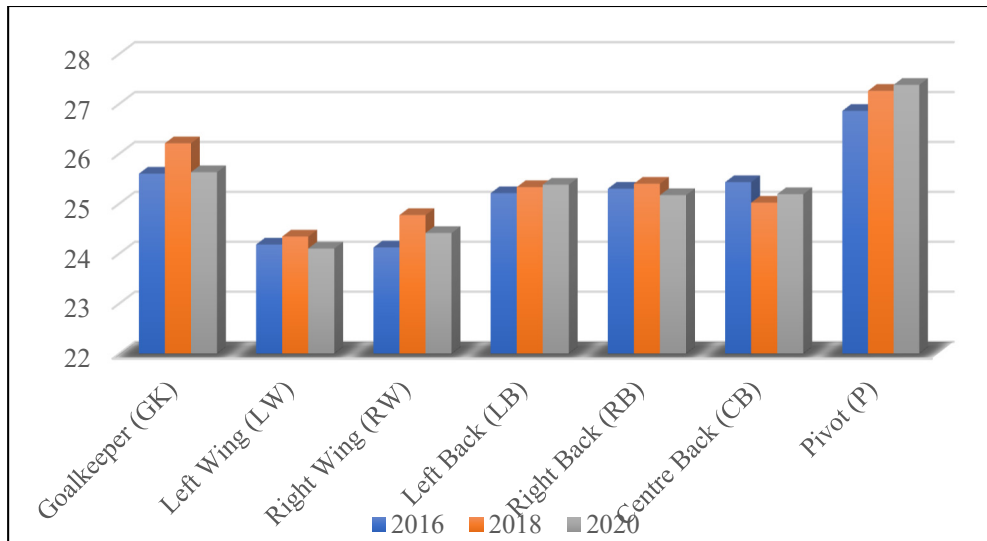


Figure 3. BMI average according to playing position

Table 2 and the graph above show the average BMI for the same playing position. The analysis is made according to all playing positions: goalkeeper, extreme left, extreme right, inter left, inter right, center, and pivot. The results show no statistically significant differences between the three championship editions for the same playing position. However, there are differences between the playing positions. This result is due to the specific requirements of each playing position.

Conclusions

The study's main purpose is to determine the actual value of BMI of elite handball players. The obtained results show that this indicator's value is approximately constant in the last three editions of the European Championship and that there are no statistically significant differences. Analyzing them individually, they show no statistically significant differences between the teams.

The second goal is to determine if this anthropometric indicator has a essential role in ranking the participating teams in the final tournament of the last three editions of the European Championship. By analyzing them, we find out that the finalist teams have a higher BMI than the rest of the teams in each edition, but the difference is not statistically significant. When analyzing the BMI according to the playing position, the results also show that this anthropometric parameter remains approximately constant for the same playing position. The differences found in comparing the BMI between different playing position are due to each position specific requirements.

The study concludes that the anthropometric indicators studied do not play a essential role in classifying a team in the first four positions of a European championship. Achieving great performance in the handball game depends on many factors which include anthropometric indicators. However, they do not have a specific role.

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