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Exploring physical activity of female secondary school students from selected regions of Slovakia

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ABSTRACT

The aim of study was to analyse and compare physical activity of female secondary school students from selected regions of Slovakia. The study group consisted of 1,972 female secondary school students from grammar and vocational schools from five regions of Slovakia. The study data were analysed for each region by using chi-square test at $p < .01$, $p < .05$. During the work week, 52.43% of study group have on average 1 to 3 hours of leisure time. The most significant difference in the amount of leisure time, between the work week and the weekend, was recorded in the Banská Bystrica Region, Košice Region, Prešov Region and Žilina Region with 40% of the female students stating that they have more than 5 hours/ day of leisure time at the weekend. Within the Bratislava Region, the amount of weekend leisure time only increased by 11% ($p < .01$). The female students from the Bratislava Region predominantly (60.62%) spend their leisure time passively, while most of female students from the Banská Bystrica Region (56.57%) and Košice Region (60.25%) spend their leisure time actively. Significant differences between the female students from the Bratislava Region and female students from the other regions were also recorded in other areas ($p < .01$, $p < .05$).
Keywords: Physical education, Female students, Period of adolescence, Physical activity, Secondary school.

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INTRODUCTION

Physical activity is closely related to health, quality of life and lifestyle and its absence lowers physical performance, which has been stagnating in Slovakia (Nowák, 1997). This tendency has been observed not only in the general student population, but also in the actively sporting population (Antala et al., 2014). The lack of physical activity affects human health and has a significant impact on physical fitness and performance. Although regular physical activity can serve as a preventive tool, 70% of student population spends their leisure time in a sedentary behaviour, which leads to physical inactivity in adulthood and old age (Hallal et al., 2006, Belanger et al., 2009). Physical inactivity may trigger health risks, since it consumes little energy and leads to a deteriorating physical condition (Hills et al., 2007, Mackett, Paskins, 2008).

An inactive student population has a lower likelihood of being motivated to perform regular physical activity. Given this fact, it is necessary to identify the behavioural aspects which contribute to regular physical activity in the student population (Vašíčková et al., 2014). The identification of factors, which affects the movement behaviour and maintains an adequate level of physical activity, is crucial in developing strategies to support physical activities.

Moderate-to-vigorous physical activity is very important for health and it is indispensable in the period of personality development (Hendl, Dobrý, 2011) because healthy lifestyle based on regular physical activity tends to persist from the stage of adolescence into the other stages of personality development. Long-term moderate-to-vigorous physical activity improves academic performance (Basch, 2010) and health indicators, such as bone density, metabolism and body weight (Wiley, Blackwell, 2010). Based on the listed recommendations, it is very important to respect determinants of the general and actively sporting populations, mainly when it comes to adopting and maintaining positive attitudes towards physical activity (Hubinák, 2011; Uherová, 2012).

In the period of adolescence, the volume of physical activity tends to fall below the recommended amount to only 6 to 8 hours/ week, which is just 1 hour/ day (Teplý, 1995). Bendíková, Kostencká (2013) recommend that adolescents should be physically active for 3 hours/ day and World Health Organization (2010) explains that more than 1 hour/ day of moderate-to-vigorous physical activity provides many health benefits. However, aerobic physical activity should also be increased. Yet, in spite of these recommendations, the regular physical activity of the general student population has significantly decreased (Mitchell et al., 2012, Corder et al., 2015). Harding et al. (2015) point to the decrease in moderate-to-vigorous physical activity, predominantly in the male student population. This finding has been refuted by Currie et al. (2012) who have discovered that in Slovakia, the male student population was more physically active than the female student population. A positive fact is the increasing tendency for physical activity in the female population, which has increased by 5%, 3%, and 1% (for girls aged 11, 13, and 15), however, the volume of physical activity in the physical activity regimen of student population is still considered low (National Action Plan, 2017). During the period of adolescence, 81% of student population was physically inactive, performing moderate-to-vigorous physical activity for less than 1 hour/ day (World Health Organization, 2010).

Nonetheless, the physical activity affects 50% of health and it is considered as one of the basic biological needs. However, this need cannot be met due to the insufficient volume of physical activity, which tendency is now stagnating rather than increasing (Blažej, 2004). The failure to meet this need leads to increased incidence of diseases in the student population (Hills et al., 2007).

The aim of study was to analyse and compare physical activity of female secondary school students from selected regions of Slovakia.

MATERIAL AND METHODS

Participants

The study group consisted of female secondary school students with the Slovak as the language of instruction. 1,972 correctly filled-in surveys were included in the study data interpretation process. The study group consisted of the female final year (4th) students of grammar and vocational schools with the average age of 18.68 ($\pm$). A more detailed description of the study group from the point of view of each region is included in Table 1.

Table 1. Description of study group according to regions of Slovakia.

Region	Study group					Total number
	B. Bystrica	Bratislava	Košice	Prešov	Žilina	
Total number	426	292	161	606	487	1,972

Legend: B. Bystrica - Banská Bystrica.

Measures

When collecting the data, the method of survey was used. It was created purposely and consisted of 8 survey items, concerned with physical activity and secondary school students. Inspired by several authors, the survey was created and its content was related to the female secondary school students, attitudes about leisure time and physical activity (Nemec, Adamčák, 2013; Soares et al., 2013). The basic information about the identity was not taken, so that the survey was answered objectively. In addition, the survey was given to each female secondary school student who inscribed the answers, within the pre-printed forms. After inscribing the answers, the survey was given to authors of study.

Procedures

The study data were collected through the survey distributed from January to December, 2019. The study group consisted of female secondary school students from grammar and vocational schools from five regions of Slovakia:

- Western Slovakia - Bratislava Region (Ba);
- Northern Slovakia - Žilina Region (Za);
- Central Slovakia - Banská Bystrica Region (Bb);
- Eastern Slovakia - Košice Region (Ke), Prešov Region (Po).

Besides the geographical division of Slovakia, the decision of choosing these regions as the study group was also influenced by factors, such as:

- The region of the capital city - Bratislava, is the richest region in Slovakia. The gross domestic product in purchasing power parity is 2.5 times higher than the average in Slovakia, while the Prešov region has been the poorest region for many years. What is more, it amounts to 58%, while other regions are more lagging behind the average of Slovakia (Banská Bystrica Region - 70%, Košice Region - 77% (Doležal, 2016).
- The unemployment rate in eastern Slovakia differs significantly in Slovakia. Even though, the unemployment has declined, compared to the previous period (2017) (9.9 % - Prešov Region, 9.7% - Košice Region, 8.7% - Banská Bystrica Region), as the average unemployment rate in the other regions has been around 3.7% (Marcinčin, 2018).

Analysis

The survey was generated and interpreted using the Tap3 programme, designed by the company - Gamo Banská Bystrica. The method of percentage (%) and arithmetic mean ($\pm$) was used, while the difference between each region was evaluated by method of inductive statistics - chi-square test, at the level of significance of $p < .01$ and $p < .05$.

RESULTS

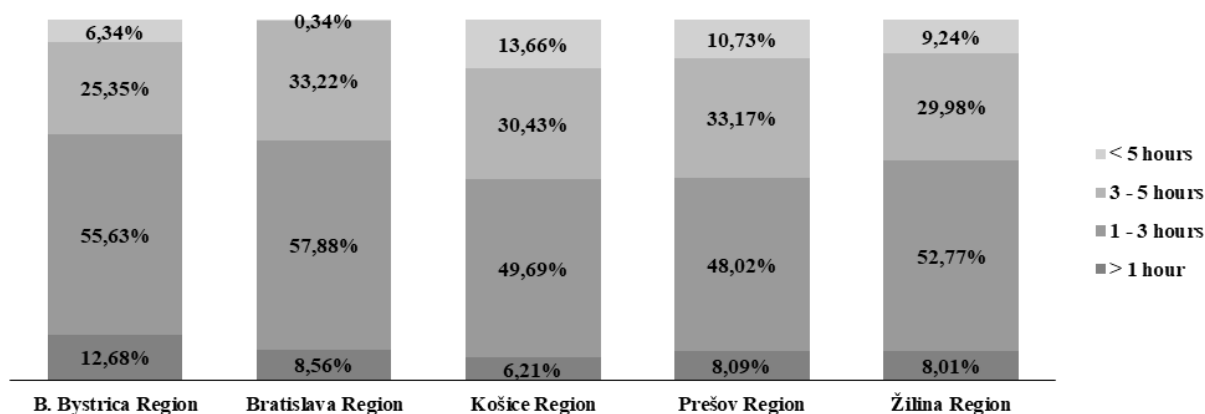


Figure 1. Average leisure time in the study group during the work week (hours/ day).

The first part of the survey focused on the number of hours/ days devoted to the leisure time in the study group from the selected regions of Slovakia (Figure 1). The response of more than 5 hours/ day was the most frequent in the study group from eastern Slovakia (Košice Region - 13.66% and Prešov Region - 10.73%), the least frequent in the study group from western Slovakia (Bratislava Region - .34%). The most frequent response in the study group (overall) was 1 to 3 hours, ranging from 48.02% (Prešov Region) to 57.88% (Bratislava Region). As many as 12.68% of study group (Banská Bystrica Region) stated that they had less than 1 hour/ day of leisure time during the work week. The study results of the statistical data processing included in Table 2 show that statistically significant differences were not recorded in the study groups from northern (Žilina Region) and eastern (Košice Region, Prešov Region) Slovakia ($p > .05$) (Table 2).

Table 2. Statistical interpretation of average leisure time in the study group (hours/ work week).

Region	Study group				
	B. Bystrica	Bratislava	Košice	Žilina	Prešov
B. Bystrica		5.02E-05**	3.07E-03**	2.46E-02*	3.27E-04**
Bratislava	5.02E-05**		2.18E-08**	9.42E-06**	3.73E-07**
Košice	3.07E-03**	2.18E-08**		3.86E-01	5.90E-01
Žilina	2.46E-02*	9.42E-06**	3.86E-01		4.44E-01
Prešov	3.27E-04**	3.73E-07**	5.90E-01	4.44E-01	

Legend: B. Bystrica - Banská Bystrica; ** - Statistical significance at the level of $p < .01$; * - Statistical significance at the level of $p < .05$.

In addition, the study focused on the number of hours/ day the study group had during the weekend (Figure 2). The most positive change in the amount of leisure time between the weekend and work week was recorded in the survey item - "more than 5 hours/ day" in the entire study group, while the increase recorded

in regions of Banská Bystrica, Košice, Prešov and Žilina was greater than 40 %. Within the Bratislava Region, the amount of leisure time increased only by 11%. It relates to the fact that the smallest change, in the amount of leisure time (work week vs. weekend) was recorded only in Bratislava Region. The statistical interpretation included in Table 3 shows that statistically significant differences were not recorded only in the study groups from northern (Žilina Region) and eastern (Košice Region) Slovakia ($p > .05$) (Table 3).

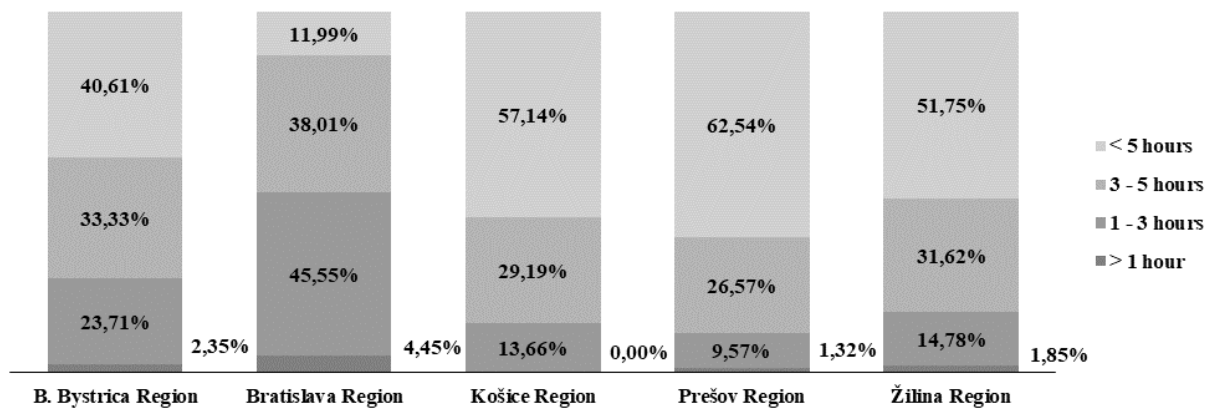


Figure 2. Average leisure time in the study group during the weekend (hours/ day).

Table 3. Statistical interpretation of average leisure time in the study group (hours/ weekend).

Region	Study group				
	B. Bystrica	Bratislava	Košice	Žilina	Prešov
B. Bystrica		8.98E-17**	6.74E-04**	1.09E-03**	4.92E-13**
Bratislava	8.98E-17**		6.20E-25**	2.01E-32**	4.93E-53**
Košice	6.74E-04**	6.20E-25**		2.64E-01	1.65E-01
Žilina	1.09E-03**	2.01E-32**	2.64E-01		2.30E-03**
Prešov	4.92E-13**	4.93E-53**	1.65E-01	2.30E-03**	

Legend: B. Bystrica - Banská Bystrica; ** - Statistical significance at the level of $p < .01$; * - Statistical significance at the level of $p < .05$.

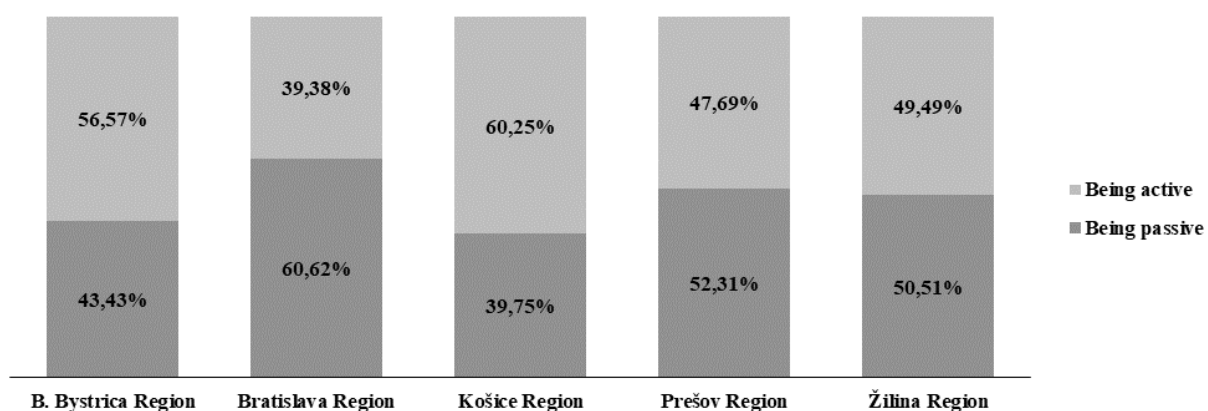


Figure 3. Main way of spending leisure time in the study group.

The Figure 3 shows that the study group' main way of spending the leisure time varies across the regions of Slovakia. Being passive predominated in the region of Bratislava, where 60.62% of the study group stated that they mostly spent their leisure time passively. On the other side, the opposite ratio was recorded in eastern Slovakia (Košice Region), where 60.25% of the study group stated that they mostly spent their leisure time actively. Another positive fact was that more than half of the study group from central Slovakia (Banská Bystrica Region - 56.57%) spent their leisure time actively, performing physical activity. In the other regions, similarly as Bratislava Region, a slight preference for being passive was recorded (Prešov Region, Žilina Region). The study results of the statistical data processing included in Table 4 show that statistically significant differences were not recorded in the study groups from central (Banská Bystrica Region), northern (Žilina Region) and eastern (Košice Region, Prešov Region) Slovakia ($p > .05$) (Table 4).

Table 4. Statistical interpretation of main way of spending leisure time in the study group.

Region	Study group				
	B. Bystrica	Bratislava	Košice	Žilina	Prešov
B. Bystrica		1.24E-28**	4.21E-01	3.24E-02*	2.19E-04**
Bratislava	1.24E-28**		2.05E-05**	6.14E-03**	1.91E-02*
Košice	4.21E-01	2.05E-05**		1.78E-02*	4.61E-03**
Žilina	3.24E-02*	6.14E-03**	1.78E-02*		5.55E-01
Prešov	2.19E-04**	1.91E-02*	4.61E-03**	5.55E-01	

Legend: B. Bystrica - Banská Bystrica; ** - Statistical significance at the level of $p < .01$; * - Statistical significance at the level of $p < .05$.

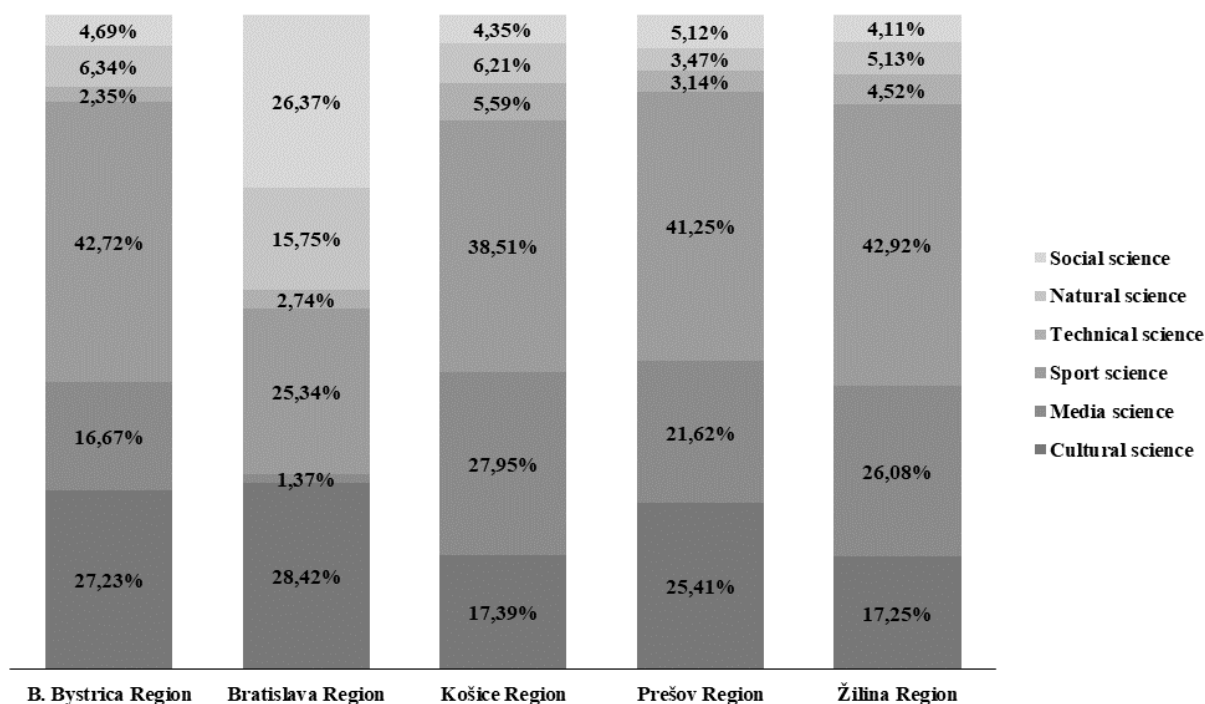


Figure 4. Main leisure time interest area in the study group.

The Figure 4 presents a positive finding was that in terms of main interest area, the sport science predominated among the study group from Banská Bystrica Region, Košice Region, Prešov Region and

Žilina Region. The frequency of response of this survey item across these regions ranged from 38.51% (Košice Region) to 42.92% (Žilina Region). In the study groups from eastern (Košice Region - 27.95%) and northern (Žilina Region - 26.08%) Slovakia, the media science was the second most common interest area. In the study groups from central (Banská Bystrica Region - 27.23%) and eastern (Prešov Region - 25.41%) Slovakia, the cultural science was the second most common interest area, while in region of Bratislava; the distribution of interest areas was significantly different. The study groups' main area of interest was the cultural science (28.42%), followed by the social science. The sport science was ranked third with only 25.34% of responses. The technical science received the lowest number of responses (overall). The responses for this interest area did not surpass 6% in any of regions. The aforementioned significant differences between the regions of Slovakia manifested in the statistical interpretation (Table 5). Any significant differences were recorded between the regions of Banská Bystrica and Prešov, Košice, Žilina and Prešov ($p > .05$).

Table 5. Statistical interpretation of main leisure-time interest area in the study group.

Region	Study group				
	B. Bystrica	Bratislava	Košice	Žilina	Prešov
B. Bystrica		3.81E-26**	5.63E-03**	2.79E-04**	1.24E-01
Bratislava	3.81E-26**		2.24E-23**	5.86E-39**	1.78E-37**
Košice	5.63E-03**	2.24E-23**		9.36E-01	6.15E-02**
Žilina	2.79E-04**	5.86E-39**	9.36E-01		1.29E-02*
Prešov	1.24E-01	1.78E-37**	6.15E-02	1.29E-02*	

Legend: B. Bystrica - Banská Bystrica; ** - Statistical significance at the level of $p < .01$; * - Statistical significance at the level of $p < .05$.

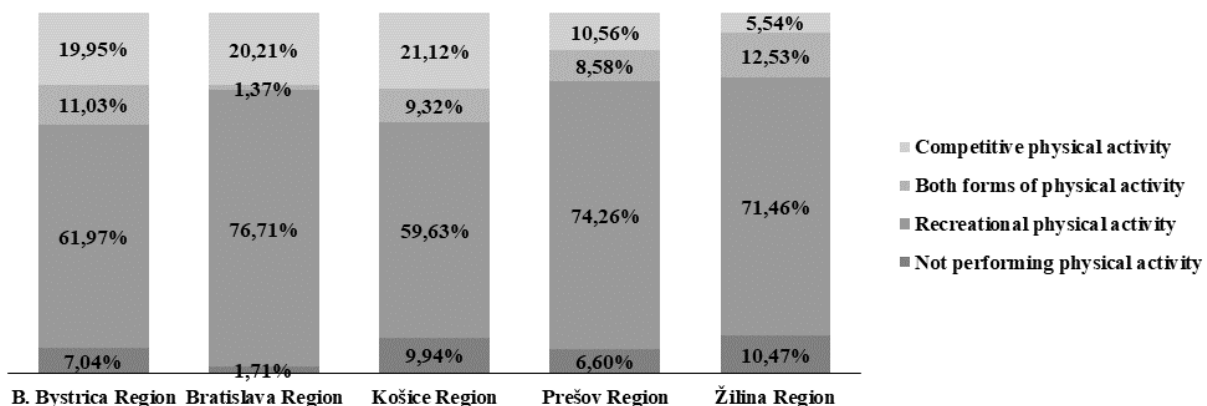


Figure 5. Main nature of leisure-time physical activity in the study group.

The Figure 5 presents the study groups' main form of physical activity and shows that recreational form of physical activity predominated in all study groups from the selected regions of Slovakia. The highest incidence was recorded in the study group from the Bratislava Region with 76.71% of responses. A preference for predominantly competitive physical activity was recorded in the study groups from central (Banská Bystrica Region - 19.95%), western (Bratislava Region - 20.21%) and eastern (Košice Region - 21.12%) Slovakia. A preference for both forms of physical activity was recorded in the study groups from western (Košice Region - 12.53%) and central (Banská Bystrica Region - 11.03%) Slovakia. The study group from the Bratislava Region was, on the other side, the most stable study group with only 1.31%, preferring

these forms of physical activity. A positive fact was that only 1.71% of study group from western (Bratislava Region) Slovakia stated that they did not perform physical activity, which was much lower result, compared to the other selected regions of Slovakia. In the Žilina Region, for instance, it was 10.47%. In addition, the statistical interpretation revealed significant differences at $p < .01$, in the responses of the study groups from all of the selected regions of Slovakia, with the exception of mutual statistical comparison between the Banská Bystrica Region and Košice Region, where the difference was statistically insignificant ($p > .05$) (Table 6).

Table 6. Statistical interpretation of main nature of leisure-time physical activity in the study group.

Region	Study group				
	B. Bystrica	Bratislava	Košice	Žilina	Prešov
B. Bystrica		2,31E-08**	6.24E-01	9.48E-10**	5.44E-05**
Bratislava	2,31E-08**		1.16E-07**	7.17E-18**	1.45E-08**
Košice	6.24E-01	1.16E-07**		1.38E-07**	7.27E-04**
Žilina	9.48E-10**	7.17E-18**	1.38E-07**		5.91E-04**
Prešov	5.44E-05**	1.45E-08**	7.27E-04**	5.91E-04**	

Legend: B. Bystrica - Banská Bystrica; ** - Statistical significance at the level of $p < .01$; * - Statistical significance at the level of $p < .05$.

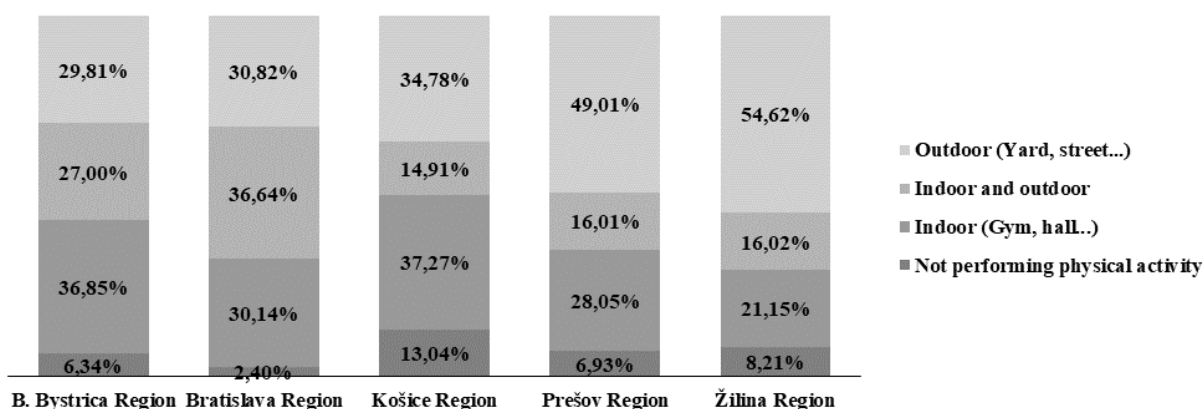


Figure 6. Main place of performing physical activity in the study group.

Table 7. Statistical interpretation of main place of performing physical activity in the study group.

Region	Study group				
	B. Bystrica	Bratislava	Košice	Žilina	Prešov
B. Bystrica		4.13E-03**	2.23E-03	2.76E-14**	2.03E-09**
Bratislava	4.13E-03**		2.68E-08**	1.96E-15**	6.52E-13**
Košice	2.23E-03**	2.68E-08**		1.42E-05**	1.75E-03**
Žilina	2.76E-14**	1.96E-15**	1.42E-05**		6.04E-02
Prešov	2.03E-09**	6.52E-13**	1.75E-03**	6.04E-02	

Legend: B. Bystrica - Banská Bystrica; ** - Statistical significance at the level of $p < .01$; * - Statistical significance at the level of $p < .05$.

Based on the study results, the study groups from eastern (Prešov Region - 49.01%) and northern (Žilina Region - 54.62%) Slovakia performed physical activity predominantly outdoors, while the study groups from central (Banská Bystrica Region - 36.85%) and eastern (Košice Region - 37.27 %) Slovakia performed

physical activity mostly indoors in sports facilities. Surprisingly, the study group from the Bratislava Region spent the same amount of time performing the physical activity outdoors (30.82%), indoors (30.14%) and in combination of both environments (36.64%). Less than 14% of the study group stated that they did not perform the physical activity. The frequency of each region's response was comparable with the one in previous survey item (Figure 6). The statistical interpretation revealed that there were not significant differences between the regions of Košice and Banská Bystrica and Prešov and Žilina ($p > .05$) (Table 7).

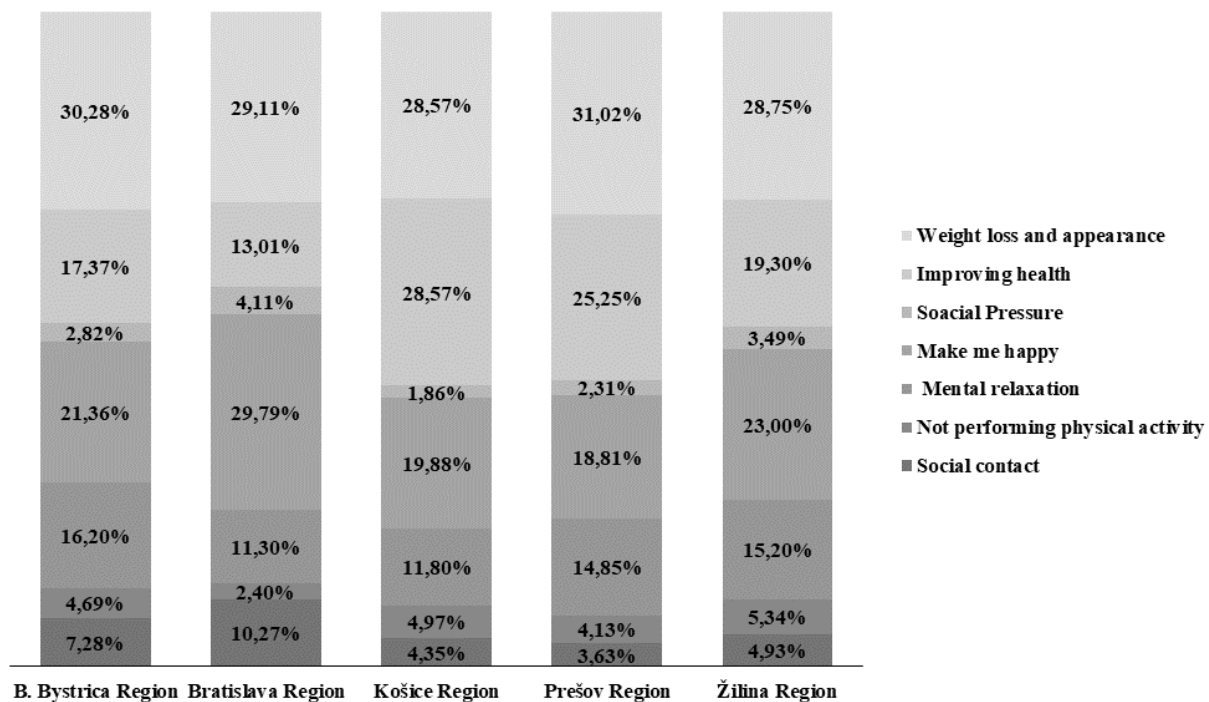


Figure 7. Main motive of performing physical activity in the study group.

Table 8. Statistical interpretation of main motive of performing physical activity in the study group.

Region	Study group				
	B. Bystrica	Bratislava	Košice	Žilina	Prešov
B. Bystrica		8.09E-03**	4.09E-02*	5.13E-01	8.99E-03**
Bratislava	8.09E-03**		9.94E-05**	8.14E-04**	5.00E-09**
Košice	4.09E-02*	9.94E-05**		1.86E-01	6.74E-01
Žilina	5.13E-01	8.14E-04**	1.86E-01		3.58E-02*
Prešov	8.99E-03**	5E-09**	6.74E-01	3.58E-02*	

Legend: B. Bystrica - Banská Bystrica; ** - Statistical significance at the level of $p < .01$; * - Statistical significance at the level of $p < .05$.

Weight loss and appearance was the main motive for performing physical activity, within the study group, except for those from the western (Bratislava Region) Slovakia (Figure 7), where the most common response was "make me happy" (29.27%). It received 0.68% more responses than weight loss and appearance. In addition, the motive of "make me happy" was the second highest motive for performing physical activity in the study groups from the Banská Bystrica Region (21.36%) and Žilina Region (23%). Improving health was the second highest motive for the study groups from the eastern (Košice Region - 28.57% and Prešov Region

- 25.25%) Slovakia. Establishing the social contacts was the highest motive for the study group from the Bratislava Region, with 10.27% of the responses, which was significantly more than in the regions of northern (Žilina Region - 3.49%) and eastern (Košice Region - 1.86% and Prešov Region - 2.31%) Slovakia. The survey item “*mental relaxation*” received relatively equal number of responses in all of the study groups. The responses ranged from 11.30% (Bratislava Region) to 16.20% (Banská Bystrica Region). What is more, the statistical interpretation of the responses is included in Table 8.

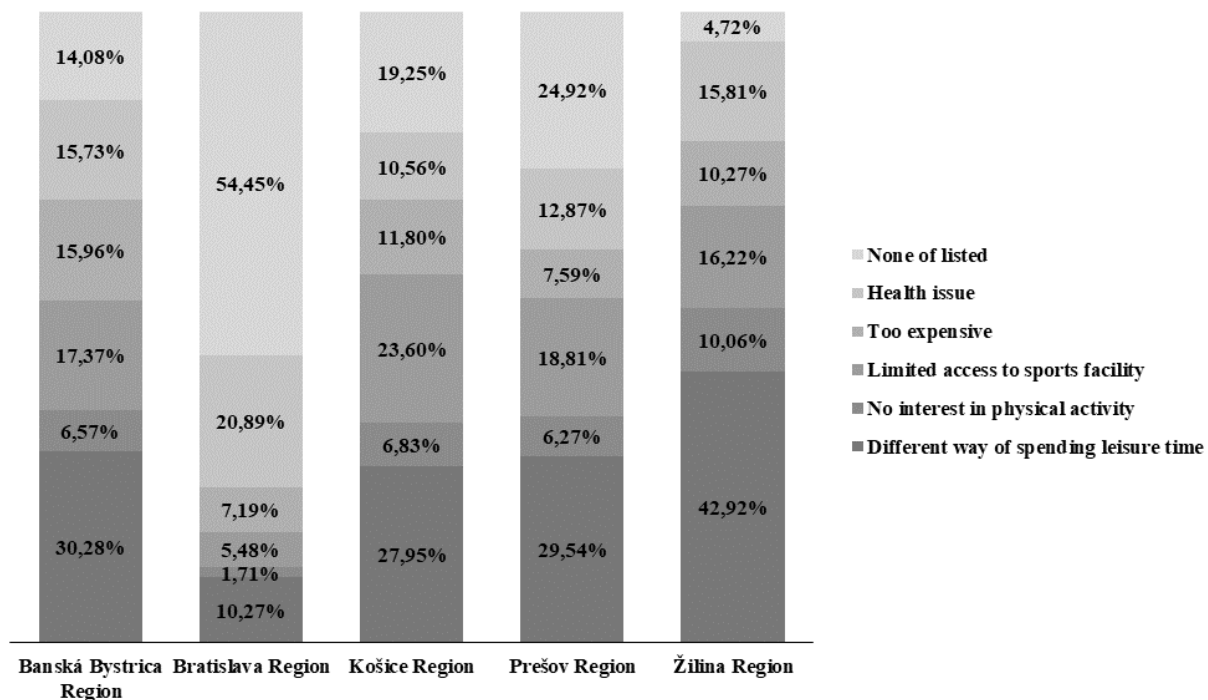


Figure 8. Main obstacle of performing physical activity in the study group-

Table 9. Statistical interpretation of main obstacle of performing physical activity in the study group.

Region	Study group				
	B. Bystrica	Bratislava	Košice	Žilina	Prešov
B. Bystrica		6,13E-34**	1.47E-01**	9.98E-08**	5.81E-06**
Bratislava	6,13E-34**		4.77E-19**	4.87E-62**	1.08E-24**
Košice	1.47E-01	4.77E-19**		1.35E-08**	2.54E-01
Žilina	9.98E-08**	4.87E-62**	1.35E-08**		1.97E-18**
Prešov	5.81E-06**	1.08E-24**	2.54E-01	1.97E-18**	

Legend: B. Bystrica - Banská Bystrica; ** - Statistical significance at the level of $p < .01$; * - Statistical significance at the level of $p < .05$.

The last survey item focused on the study group's main obstacle of performing physical activity (Figure 8). Different alternatives of spending leisure time was the most common response in all regions (above 27%), except for western (Bratislava Region) Slovakia. The highest percentage of responses (42.92 %) for this survey item was recorded in central (Žilina Region) Slovakia, while the most common response in the study group from the Bratislava region was “*none of listed*” (54.45%). The second most common response in all regions, except for western (Bratislava Region - 5.48%) Slovakia was “*limited access to sports facility*”, with

the responses ranging from 16.22% (Žilina Region) to 23.60% (Košice Region). Alarming, on average, 15.18% of the study group stated that they did not perform physical activity due to their health issues, with the highest percentage of responses coming from the study group of Bratislava Region (20.89%) Slovakia. The statistical interpretation revealed that there were not significant differences between the regions of Banská Bystrica and Košice and Košice and Prešov ($p > .05$) (Table 9).

DISCUSSION

The most frequent survey response in the research sample was 1 to 3 hours of leisure time during the work week (48.02% - 57.88%). Babiaková (2007) defined the leisure time as the period of time, which remains left after subtracting work time or time dedicated to study, school attendance, etc. The way in which leisure time is spent has changed significantly throughout the years. While in the past, more time was spent working to make a living, today, people's leisure time is constantly increasing (Gambovičová, Neslušanová, 2012). The Czech youth, for instance, has had on average 3 hours and 46 minutes of leisure time in the work week (Hofbauer, 2004). Krystoň (2003) researched the amount of leisure time of general student population and discovered that 66% of the respondents had from 2 to 4 hours/ day of leisure time. Gallo, Lenčo (2007) stated that 54.4% of their research sample, which consisted of participants aged 13 - 27, had 4 hours/ day of leisure time.

The amount of leisure time is increasing because of modern technologies. This fact also contributes to a passive way of spending leisure time, which predominated (60.62%) among the study group from western (Bratislava Region) Slovakia. The Youth Council of Slovakia's (2018) study revealed that 70% of the respondents spent their leisure time passively, playing video games, listening to music and watching television. The leisure time of the current generation is closely associated with watching television, while this passive way of spending leisure time is more prevalent among the primary school pupils (55.2%) compared to secondary school students (44.8%) (Slovíková, 2010). A similar tendency (73.85%) was recorded by Shin, You (2013) who pointed to excessive passive leisure time. An appropriate way of spending leisure time should be a part of everybody's life - especially children and young adults. Leisure time is associated with the creation of a value system; it contributes to personality development, social relationships, interactions (Čech, 2002). Passive leisure time does not provide the efficient impetus for the development of children and youth (Slepičková, 2005; Krška, 2008).

A positive fact was that the area of physical activity (38.51% - 42.92%) was found to be the main interest area. Primary schools, where the pupil population spends a significant amount of time, have a crucial role in building the relationship towards regular physical activity (Hanke, 1997). Together with compulsory sports and physical education, primary schools are a key place in which pupils develop their relationship towards physical activity. Sports and physical education needs to consider the interests of the student population, however, the number of children for whom compulsory sports and physical education represents only form of physical activity is increasing considerably. Nonetheless, the student population's passive (non)attendance at these classes, due to various but mostly subjective reasons, means that they are deliberately passing up this opportunity (Boreham, Riddoch, 2001; Zrnzević, Arsić, 2013).

The study group covered leisure-time physical activity of predominantly the recreational nature (59.64% - 71.71%). Regular physical activity of recreational nature is very important for health, quality of life, lifestyle, etc. It is also an indispensable part of leisure-time activities, which are directly conditioned by socioeconomic status (Jedlička, 2009). Recreational physical activities support the personal development, self-improvement and create space for self-activation (Bartík, 2009, Michal, 2010).

The place, where the study group performed the physical activity varies significantly. The study group from the Prešov Region (49.01%) and Žilina Region (54.62%) predominantly performed the physical activity outdoors, while 36.85% of the study groups from the Banská Bystrica Region and 37.27% from the Košice Region performed the physical activity indoors. The above findings are supported by Gülçin, Mefule (2018) who added that physical activities can be performed at various places depending on the range of physical activity.

All individuals are innately motivated to move and motivation should be strengthened throughout the life by intentional movement stimuli. Regular physical activity should be performed based on intrinsic motivation. The current environment, however, often leads to the loss of this motivation throughout life (Vašíčková 2016). In recent years, more attention has been paid to the issue of regular physical activity, because of constantly decreasing number of people performing physical activity not only spontaneously, but especially in an organized manner. Adolescence is considered to be a period of very significant changes in physical habits. Physical activity is influenced by large number of exogenous factors (demographic and socioeconomic). The main motive for performing the physical activity in the study group (except for the Bratislava Region) was the weight loss and appearance. Michal (2010) agreed with similar conclusion when he discovered that physical health (63.8%) was the most common motive for performing the regular physical activity. Buková, Uher (2010) obtained similar results and confirmed that health (40%) was the most common motivator for performing physical activity in both the male and the female populations. However, the other motives varied across the populations. While the motive of having a nice figure ranked fifth in the male population, the female population with its stronger aesthetic appreciation placed it right after health (20.7%).

Alternative ways of spending leisure time (32.68%) were the main obstacle to performing physical activity in the entire study group with the exception of the Bratislava Region. The most common response was *"none of listed"* (54.45%). According to Alsubaie, Omer (2015) the main obstacles to performing physical activity in the period of adolescence were the following: a) a lack of sports facilities in the community (74%), b) a lack of friends and peer support (59%), c) a lack of suitable public sport clubs in the community (54%). Kratochvílová (2010) addressed several issues related to leisure time activities and believes that they stem from a lack of options and opportunities. These are related to other factors such as parents' financial possibilities, distance from sports facilities, etc.

CONCLUSION

The aim of study was to analyse and compare physical activity of female secondary school students from selected regions of Slovakia. The study's results show that the study group's leisure time - in terms of hours (during the work week and weekend) and nature (passive and active) - varies significantly across the selected regions of Slovakia. These differences can be also perceived in the area of physical activity - their nature, main motives for and main obstacles to performing these activities. The most considerable differences were observed in the study group from the Bratislava Region, which is the most economically developed region in Slovakia and has the lowest rate of unemployment.

The results confirm that the volume of physical activity in the current generation of children and young adults, including adolescents, is below the threshold level considered as a biological need. These findings call for further investigation of causes responsible for this situation. Researching the socioeconomic requirements necessary for regular physical activity should help identify the causes of negative tendencies which affect the interest in regular physical activity.

Regular physical activity positively affects the health, quality of life, and lifestyle. The student population is in the optimal stage for building the strong relationship towards physical activity, in which a family plays an important role. A family life based on common physical activity supports the proper development and healthy lifestyle.

AUTHOR CONTRIBUTIONS

Stefan Adamcak (study design, data collection, statistical analysis, data interpretation, manuscript preparation, literature search). Pavol Bartik (data collection, statistical analysis, data interpretation, manuscript preparation, literature search). Michal Marko (data collection, statistical analysis, data interpretation, manuscript preparation, literature search).

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No potential conflict of interest was reported by the authors.

REFERENCES

- Alsubaie, A., & Omer, E. (2015). Physical Activity Behaviour Predictors, Reasons and Barriers among Male Adolescents in Riyadh, Saudi Arabia. *International Journal of Health Sciences*, 9 (4), 400-408. <https://doi.org/10.12816/0031229>
- Antala, B., Labudová, J., Šimonek, J., Strešková, E., Peráčková, J., Kyselovičová, O., Argaj, G., Kršjaková, S., & Melek, P. (2014). *Telesná a športová výchova a súčasná škola*. Bratislava: Univerzita Komenského v Bratislave.
- Babiaková, S. (2007). *Školský klub ako špecifické prostredie výchovy vo voľnom čase*. Pedagogika voľného času - teória a prax. Trnava: Trnavská univerzita v Trnave.
- Bartík, P. (2005). *Postoje žiakov 2. stupňa základnej školy k telesnej výchove*. Banská Bystrica: Acta Universitatis Matthiae Belii.
- Basch, C., (2010). Healthier Children, Better Learners. *Future of Children*, 2(3), 1-8.
- Belanger, M., Gray-Donald, K., O'Loughlin, J., Paradis, G., Hutcheon, J., Maximová, K., & Hanley, J. (2009). Participation in Organised Sports does not Slow Declines in Physical Activity during Adolescence. *International Journal of Behavioral Nutrition and Physical Activity*. 6 (22), 130-140. <https://doi.org/10.1186/1479-5868-6-22>
- Bendíková, E., & Kostencká, A. (2013). *Exercise Routine as Conditions of Early School Age Pupils' Health*. Bydgoszcz: Oficyna Wydawnicza.
- Blažej, A. (2004). Kvalita života z aspektu udržateľného rozvoja v 21. Storočí. *Kvalita života a rovnosť príležitostí*, 1(1), 21-26.
- Boreham, C., & Riddoch, C. (2001). Physical Activity, Fitness and Health of Children. *Journal of Sports Sciences*, 19(12), 915-929. <https://doi.org/10.1080/026404101317108426>

- Buková, A., & Uher, I. (2010). Dynamika faktorov motivácie mladých ľudí k pohybovej aktivite. *Pohybová aktivita v živote človeka*, 1(1), 87-95.
- Corder, K., Collings, P., Wijndaele, K., Westgate, K., Ridgway, C., Sharp, S., Dunn, V., Goodyer, I., Ekelund, U., & Brage, S. (2015). Magnitude, Change Determinants in Objectively Measured Physical Activity, Sedentary Time and Sleep Duration from Ages 15. *International Journal of Behavioural Nutrition, Physical Activity*, 12(1), 61-70. <https://doi.org/10.1186/s12966-015-0222-4>
- Currie, C., Roberts, C., Morgan, A., Smith, R., Settertobulte, W., Samdal, O., & Rasmussen, V. (2012). *Young People's Health in Context*. Copenhagen: World Health Organization.
- Čech, T. (2002). Efektívni využívaní voľného času jako součást životního stylu dětí v postmoderní společnosti. *Pedagogická orientace*, 2(1), 108-113.
- Doležal, F. (2016). Slovensko: Čo región, to iný svet. Euroactiv. Retrieved from: <https://euractiv.sk/section/podnikanie-a-praca/opinion/slovensko-co-region-to-iny-svet-023143/>
- Gallo, O., & Lenčo, P. (2007). *Čo si myslia mladí*. Bratislava: Rada mládeže Slovenska.
- Gambovičová, N., & Neslušanová, S. (2012). Kvalitatívna analýza voľného času príslušníkov štyroch generácií. Trnava: Trnavská univerzita v Trnave.
- Gülçin, T., Mefule, F. (2018). University Students' Sport Participation Rate. *International Journal of Humanities and Social Science Invention*, 7(5), 72-90.
- Hallal, P., Victoria, C., & Azevedo, M. (2006). Adolescent Physical Activity and Health. *Sports Medicine*, 36(12), 1019-1030. <https://doi.org/10.2165/00007256-200636120-00003>
- Hanke, A. (1997). Patří pohyb do školy? *Tělesná výchova a sport mládeže*, 63(4), 12-15.
- Harding, S., Page, A., Falconer, C., & Cooper, A. (2015). Longitudinal Changes in Sedentary Time and Physical Activity. *International Journal of Behavioural Nutrition, Physical Activity*, 12(1), 44-50. <https://doi.org/10.1186/s12966-015-0204-6>
- Hendl, J., & Dobrý, L. (2011). *Zdravotní benefity pohybových aktivit*. Praha: Univerzita Karlova v Praze.
- Hills, P., King, A., & Armstrong, P. (2007). Contributions of Physical Activity and Sedentary Behaviours to Growth, Development of Children and Adolescents. *Sports Medicine*, 37(2), 533-545. <https://doi.org/10.2165/00007256-200737060-00006>
- Hofbauer, B. (2004). *Děti, mládež a volný čas*. Praha: Portál.
- Hubinák, A. (2011). *Pohybová aktivita a jej vplyv na držanie tela detí*. Ružomberok: Katolícka univerzita v Ružomberku. <https://doi.org/10.54937/ssf.2022.21.1.79-92>
- Jedlička, J. (2009). *Zdravý životný štýl*. Nitra: Slovenská poľnohospodárska univerzita v Nitre.
- Kratochvílová, E. (2010). *Pedagogika voľného času*. Trnava: Trnavská univerzita v Trnave.
- Krška, P. (2008). *Dynamika telesného vývinu a pohybovej výkonnosti detí v období mladšieho školského veku*. Ružomberok: Katolícka univerzita v Ružomberku.
- Krystoň, M. 2003. *Edukácia detí a mládeže vo voľnom čase*. Banská Bystrica: Acta Universitatis Mathiae Belii.
- Mackett, R., & Paskins, J. (2008). Children's Physical Activity. *Children and Society*, 22(1) 345-357.
- Marcinčin, A. (2018). 3 Slovenská. Euroactiv. Retrieved from: <https://dennikn.sk/blog/1300099/tri-slovenska>
- Michal, J. (2010). Voľnočasové pohybové aktivity a ich vplyv na zdravotný štýl žiakov základných škôl. *Pohyb a zdravie* 1(1), 97-108. <https://doi.org/10.32725/sk.2016.088>
- Mitchell, A., Russell, P., Dowda, M., Mattocks, C., Riddoch, C., & Ness, A. (2012). Prospective Study of Sedentary Behaviour in Large Cohort of Youth. *Medicine and Science in Sports and Exercise*, 4(1), 81-87. <https://doi.org/10.1249/mss.0b013e3182446c65>
- National Action Plan (2017). Public Health Authority of the Slovak Republic. Retrieved from: <https://www.opengovpartnership.org/documents/slovak-republic-national-action-plan-2017-2019-english-slovak/>

- Nemec, M., & Adamčák, Š. (2013). Pohybové hry a školská telesná a športová výchova. Banská Bystrica: Univerzita Mateja Bela v Banskej Bystrici. <https://doi.org/10.15584/di.2016.11.12>
- Nowák, M. (1997). Chosen Aspects of Health Related Behaviour of Women Retained Physical Fitness in Past. *Women and Sport*, 1(1), 131-138.
- Shin, K., & You, S. (2013). Leisure Type, Leisure Satisfaction and Adolescents' Psychological Wellbeing. *Journal of Pacific Rim Psychology*, 7(2), 53-62. <https://doi.org/10.1017/prp.2013.6>
- Slepičková, I. (2005). Sport a volný čas. Praha: Karolinum.
- Slovíková, M. (2010). Násilné televízne obsahy a potreba mediálnej výchovy. *Prevencia*, 4(1), 1-12.
- Soares, J., Antunnes, H., & Van Den Tillaar, R. (2013). A comparison between boys and girls about the motives for the participation in school sport. *Journal of Physical Education and Sport*, 13 (3), 303-307.
- Teplý, Z. (1995). Zdraví, zdatnost, pohybový režim. Praha : Česká asociace sportu.
- Uherová, Z. (2012). Modernizačné aspekty didaktických štýlov v telovýchovnom procese. Prešov: Prešovská univerzita v Prešove.
- Vašíčková, J. (2016). Pohybová gramotnosť v Českej republike. Olomouc: Univerzita Palackého v Olomouci. <https://doi.org/10.5507/ftk.16.24448831>
- Vašíčková, J., Hřebíčková, H., & Groffik, D. (2014). Gender, Age and Body Mass Differences Influencing the Motivation for Physical Activity among Polish Youths. *Journal of Sport Science*, 2(1), 1-12.
- Wiley, M., & Blackwell, B. (2010). Regular Exercise Reduces in Large Number Health Risks Including Dementia and Some Cancers. *Science Daily*, 1(1), 20-30.
- World Health Organization. (2010). Global Recommendations on Physical Activity for Health. Geneva: World Health Organization.
- Youth Council of Slovakia. (2018). Trávenie voľného času. Bratislava: Iuventa.
- Zrnzević, N., & Arsić, R. (2013). Motivation of Students for Physical Education Classes. *Activities in Physical Education and Sports*, 3(2), 215-220.



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Graduateness and sports coaching: A preliminary study of coaches' behaviour using the revised Arizona State University Observation Instrument

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ABSTRACT

This project aimed to identify if there were differences in coaching behaviours between coaches trained and educated in less-academic, traditional, governing body of sport approaches ($n = 6$) and those who were educated and trained through Higher Education routes ($n = 6$). Data were gathered from twelve coaches by videoing and audio-recording coaching sessions. The data were analysed using the REVISED ASUOI observation tool, employing an independent-samples t-test to establish differences between the graduate coaches and non-graduate coaches across each of the behaviour categories. Differences were identified in five categories – Learning Intention, Closed Questioning, Open Questioning, Coaches' Model, and Observation. Graduateness as outlined by Coetzee (2014), was proffered as an explanation of differences. Further work is suggested using conversational analyses to provide a more subtle and nuanced examination of the coaches' vocabularies and judgements as they communicate.

Keywords: Physical education, Coach behaviour, Coach education, Graduate, Football, Higher education.

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INTRODUCTION

Sports coaching is a process that has evolved from a sport specific competitively focussed functional duty to a more holistic construct that reflects a coach's role of facilitating the development of people of all ages and abilities across a width of physical activities. This definition was encapsulated in Sport England's (2016) mission of "*improving a person's experience of sport and physical activity by providing specialised support and guidance aligned to their individual needs and aspirations*" (p7).

For some time, it has been promulgated that successful sports coaching revolves around the social interactions between the coach and her/his athlete(s) (Groom, Cushion & Nelson, 2012). These interactions provide both opportunities and constraints for athlete development. To meet the need for greater insight of the coaching, we are seeing increased prominence of investigations of coaching activities in the literature (e.g. Vinson, Brady, Moreland & Judge, 2016).

The progress or change in coach education in the last 10 years has begun to influence course structures of National Governing Bodies of Sport (NGBs). National Agencies including NGBs have revisited the structure of coaching courses, developing modular content to accommodate contemporary coaching practice (e.g. The UK coaching Certificate – UKCC). This on-going review is arguably in response to criticism of coach education courses for their failure to put holistic knowledge into practice within the natural coaching setting (Cronin & Lowes, 2016). For example, the Football Association have recently introduced two *in-situ* club visits into its assessments for the Level 2 in Coaching Football qualification. The awarding bodies' acknowledgement of the impact of enculturation in the working environment is welcomed by some coach educators, but remains an area for further research (Cushion, Griffiths & Armour, 2017).

As with coach education courses, the traditional three-year undergraduate degree coaching programmes, delivered in many of the United Kingdom's Higher Education Institutions (HEIs), are built on contemporary knowledge. Where undergraduate degrees have been criticised, it is for their contextually immaterial setting and failing to embed sufficient experiential learning opportunities to allow students to put their theoretical knowledge into practice (Morgan, Jones, Gilbourne & Llewellyn, 2013). In recent years there has been a shift toward increasing experiential learning opportunities in undergraduate degree programmes. Thus, arguably, the gap between coach education and professional practice has narrowed.

Advocates of a holistic approach to coach education distinguish between formal, non-formal and informal opportunities for education and learning (Cushion, Nelson, Armour *et al*, 2010; Mallett, Trudel, Lyle & Rynne, 2009). Formal opportunities represent institutionally structured delivery that includes higher education courses, albeit that NGB based education courses have also been considered formal coach education (Stodter & Cushion, 2019). Informal situations promote learning in a manner that is not structured, typically underpinned by the coach's autonomy. Non-formal coach education is "*organised learning opportunities outside the formal educational system*", tending to be short-term and voluntary such as attendance at conferences or workshops (Mallett, Trudel, Lyle & Rynne, 2009; p328). It can be argued that failure to engage in all three opportunities creates a gap in a coach's development.

Historically, in the UK coach education was undertaken almost solely by NGBs of sport (Coaching Review Panel, 1991). However, the last thirty years has witnessed a burgeoning of tertiary courses in coaching. For the year 2019-20, there were some 187 degree-level courses being offered across the United Kingdom with "*(sport) coaching*" in their titles (UCAS, 2019). To better themselves, students on those courses are paying for University level studies with University level fees of up to £9500 *per annum*. This study route is being

followed in an area in which there is also a “fast-track” cheaper route to coaching, namely through national governing body of sport (NGB) courses and awards. It could be argued that the vocationally relevant courses of the NGBs will prepare students in the same way as degree courses that follow a more academic form of delivery and assessment. If such was the case, students could become sports coaches through NGB awards for substantially less cost than the University route. However, conversely, it must be argued that degree level experiences provide substantially more than NGB courses. The additional skills, attributes, experiences and capacities have been located under an umbrella term of “graduateness”.

Graduateness was initially viewed as the distinguishing factor between those who were not university graduates and those who were (Wheelahan, 2003). Simply put, if a person had gone to university, the knowledge, skills and attributes that they exhibited were recognised as an attestation of their graduateness. Later, Booth, McLean, and Walker (2009) voiced concerns that the intellectual growth of students, which they saw as a measure of graduateness, was being overtaken by short term focus on economic factors. This then led to an increased perception that employability was being conflated with graduateness (Steuer, Janssen & Hofman, 2012; Brunton *et al*, 2020). With mixed views of what graduateness was and how it could be measured, Coetzee (2014) developed a scale through which graduateness could be measured and which reflected multiple factors and attributes:

The quality of personal growth and intellectual development of the graduates produced by higher education institutions, and the relevance of the graduateness skills and attributes they bring to the workplace (Coetzee, 2014, p.888)

Coetzee contended that graduates possess knowledge and the ability to apply it (scholarship), that they are capable of leadership while being comfortable empowering others (global and moral citizenship), and that graduates are committed to their continued professional development (lifelong learning). Further, central to a graduate's success is contextual learning experiences that narrow the gap between course content and on the job experiences. Coetzee's instrument was developed as a generic scale. Given that our literature search found no similar sports related measure, and having considered fully the scale's development, we felt that it suited the needs of this project.

This study set out to investigate whether coaching behaviours differed according to whether a coach possessed a higher education qualification or had undertaken formal coach education only in the context of a NGB coach education course. This is an important area for research, not least because it has been suggested that educational background might substantively impact on coaching practice through greater knowledge around instruction, albeit that this was with qualified teachers (Cope, Partington, Cushion and Harvey, 2014). Despite this assertion, there is little evidence that graduateness impacts positively on coaching practice due to a paucity of research in the area. A recent study by Stonebridge and Cushion (2018) has undertaken to fill what has been perceived as a gap in coach knowledge: to identify if higher/tertiary education impacts on coaching behaviour. However, their work, albeit a strong contribution to the field, has not addressed the issues of “graduateness” *per se* but solely some context dependant indications of whether differences could be identified and explained by a coach's educational background.

In this paper graduateness will be investigated/established as an independent variable linked to contextual coaching education. The epistemological supposition suggests that the rigour of undergraduate coaching degree expands the tool kit of coaches.

Coaching literature suggests that there are two discrete coaching contexts, namely performance coaching (developmental & elite) and, recreational /participative coaching (Trudel & Gilbert, 2006). Within both

contexts, outcomes may vary with pre-existent factors such as the architecture of the coaching body, the personality traits of the coach, and the accompanying socio-economic environment. Also worthy of consideration is the graduate coach which remains an opaque area of investigation but is nonetheless worthy of study due to the number of students who are undertaking formal tertiary-based coach education courses.

To report on coach behaviour, an observation study is a useful tool for acquiring objective data from within the field (Smith, Quested, Appleton & Duda, 2016). Observation studies allow collection of both quantitative and qualitative data pertaining to coaching behaviour. In turn, conclusions can be drawn from the data that offer explanation of both meaning and context. An observation study enables the researcher to draw conclusions from discernible behaviours rather than from a research methodology utilising, for example, a questionnaire that must draw its conclusions from reported behaviours (Rosenbaum, 2009).

Observation of coaching behaviours involves trained individuals observing and recording behaviours as they occur in the coach's natural environment. Ideally, each coaching session would be video recorded, and the footage analysed to ensure reliability of the results through an inter-rater reliability check (see Smith & McGannon, 2018; Cope *et al.*, 2017 for recommendations). When video recording is not possible, reliability can be determined by comparing the observations of two or more trained observers, who undertake the task in real time independently of one another. Their findings are then compared. This process of direct observation of coaching activity is strengthened using a systematic observation instrument against which observations can be standardised (Allan *et al.*, 2016).

ASUOI CATEGORIES	DESCRIPTION	RASUOI CATEGORIES
Use of first name	Using the first name or nickname when speaking directly to a player	
Post-instruction	Correction, re-explanation, or instructional feedback given after the execution of the skill or play	
Physical assistance	Physically moving the player's body to the proper position or through the correct range of a motion of a skill	
Silence	Periods of time when the coach is not talking.	
Pre-instruction	Directional information given to player(s) preceding the desired action	Pre-instruction
Concurrent instruction	Cues, reminders, or instructions given during players' actual performance of a drill, skill or play as play develops.	Concurrent instruction
Negative modelling	A physical or enacted demonstration by the coach of the incorrect performance or technique.	Negative model
Hustle	Verbal (or non-verbal) actions or statements that are intended to intensify effort	Hustle
Management	Verbal (or non-verbal) statements or actions related to the organisation of the practice session, which do not relate to the technical details of the practice.	Management
Other	Any behaviour that does not fit into the above categories.	Uncodable
Questioning	Question to player(s) that instigates and yes, no or simple answer Questions that instigate a more detailed and analytical answer	Closed Questioning Open Questioning
Positive modelling	A demonstration of the correct performance of a skill or technique. A model, whether correct or not, that is demonstrated by the player(s).	Coach's model Learner's model
Praise	Non-specific verbal or non-verbal feedback given at the conclusion of the skill or exercise The coach demonstrates general satisfaction or pleasure at general practice behaviours	Praise at skill attempt Praise (general)
Scold	Verbal or non-verbal behaviours demonstrating displeasure at the player's skill or practice attempts: Verbal or non-verbal behaviours demonstrating displeasure at players' social behaviours in the training session The coach explains why he/she is doing a particular practice. The learning outcome is explained.	Scold at skill attempt Scold (general) Learning intention
	Positive feedback given to the player(s) during the actual performance of a drill, game, or skill	Concurrent feedback
	Information or re-explanation that is given during an actual performance of skill, game, or drill, which informs the player of how the performance should be altered in order to improve	Concurrent feedforward
	Positive feedback of a specific nature given to player(s) following the execution of a specific skill or task	Post-feedback
	Information or re-explanation given after the execution of a skill or play informing player how the performance would need to alter to improve	Post-feedforward
	Verbal remarks and the use of humour.	Use of humour
	Periods of diagnostic observation when the coach is not talking but observing	Observation
	Speaking to individuals not directly involved in the practice	Conferring with Assistants

Figure 1. A comparison between the Arizona State University Observation Instrument (ASUOI) and the Revised Arizona State University Observation Instrument (RASUOI).

Two of the most widely used sports coaching observation instruments are the Coaching Behavioural Assessment System (CBAS: Smith, Smoll & Hunt, 1977) and the Arizona State University Observational Instrument (ASUOI: Tharp & Gallimore, 1976; Lacy & Darst, 1984). Both instruments have been used to

identify and define working behaviours of a teacher or coach in training and match day settings. Research has shown that use of both instruments has added greatly to the spectrum of knowledge and to the advances in coaching science (Partington & Harvey, 2016).

The CBAS consists of 12 categories divided into two main coaching behaviours: reactive and spontaneous. Reactive behaviours relate to a coach's response to identifiable situations, whereas spontaneous behaviours focus on general actions surrounding instruction, encouragement, organisation, and communication. The original ASUOI (Tharp & Gallimore, 1976) consisted of 10 categories but is most used as a 14-category system after revisions by Lacy and Darst in 1984 (see Table 1). In 2011, Sutcliffe and Toms renewed interest in the behavioural categories of the ASUOI by validating a 22-category system (see Figure 1).

The REVISED ASUOI is based on the Arizona State University Observation Instrument (ASUOI: Lacy and Darst, 1984). It was developed in response to Brewer and Jones' (2002) criticism of the ASUOI. They questioned the validity of the instrument as a systematic observation tool in contemporary coaching. Criticisms were levied around the ASUOI's validity in the wake of the evolution of coaching science and athlete centred coaching methods. With coaching science continuing to evolve, there is a strong tenet that the pursuit of coaching excellence must remain open to contemporary approaches (Sutcliffe & Toms, 2011). The same must therefore apply to a sports coaching observation instrument where the aim is to accurately capture interaction between coaches and their athletes.

The REVISED ASUOI has several categorisation changes and additions for which both content and face validity were achieved (see Sutcliffe & Toms, 2011). "*Learning intention*" was added to represent the coach's description of why a practice was being undertaken. "*Concurrent feedback*", "*concurrent feedforward*", "*post-feedback*", and "*post feedforward*" were added to provide greater insight into a coach's input. Questioning was split into "*open*" and "*closed*" questioning catering for a more athlete centred approach. Similarly, an increase in coaches' uses of reciprocal teaching/learning methods (see Mosston & Ashworth, 2008) supported the addition of the "*learner model*" alongside the "*coaches' model*" and the "*negative model*", to illustrate when a coach may choose to have a player(s) deliver a demonstration. The original categories of "*praise*" and "*scold*" were expanded to include general use of praise and scold, in addition to positive or negative recognition of a player's skill or practice attempts. The term "*observation*" replaced "*silence*" to reflect a more facilitative period of reflection that the coach is likely to act upon. Two additional categories were added with "*use of humour*" and "*conferring with assistant*" depicting when a coach may use humour to motivate or engage his/her player(s) and/or seek the opinions of others to endorse or discard their ideas. Finally, the category of "*use of first name*" was removed as it was no longer considered by the authors to hold relevance. To the best of the authors' knowledge the REVISED ASUOI has not been used in published studies since its development and validation. For example, it did not show in Cope *et al's* (2017) review of systematic observations, yet it meets many of their recommendations for use.

The aim of this study is to use the REVISED ASUOI to determine whether the coaching behaviours of graduate coaches differ from those of non-graduate coaches.

MATERIALS AND METHODS

A mixed methods approach was employed to obtain systematic observation data of working behaviours of sports coaches during training sessions. The REVISED ASUOI's authors (Sutcliffe & Toms, 2011) promoted the use of a mixed methods approach for categorising initial coach behaviours within an applied setting (see Cope *et al.*, 2017 for details of this approach).

Design

Data was collected using systematic observations (see Stodter & Cushion, 2014; Vinson *et al.*, 2016). The REVISED Arizona State University Observation Instrument (REVISED ASUOI) (Sutcliffe & Toms, 2011) was used to identify the instructional behaviours of individual coaches.

Ethical approval to conduct the study was granted by the University of Sunderland Ethics Committee (006587). Prior to commencement, all coach participants were informed that their coaching behaviours would be the main object of the study. The players with whom they were working were advised that they would not be specifically observed but would be in shot due to their playing and training roles. Participating coaches provided written consent which included the right to be video and audio recorded. Participating coaches whose athletes were under 18 years of age were accepted onto the study with the *proviso* that written permission from their sports club was provided allied with evidence of the club's safeguarding policy. Parental consent had previously been granted to the club for such work and this was identified in the club's safeguarding policy. In addition, the players completed informed consent forms and for those who were under the age of 18, assent forms were completed. This gives the younger players control of their participation and the option to withdraw at any point.

Participants and Procedures

Following recommendations from McKenzie & Van Der Mars (2015), four researchers were trained in how to use the REVISED ASUOI and code resultant data, before observing the two coaches who each delivered a 45-minute session. All of this was reinforced by video and audio recording of the sessions. The observers were randomly allocated into two teams of two (P1 & P2 and P3 & P4), with each observer taking responsibility for approximately half of the REVISED ASUOI's 22 behavioural categories. In addition, inter-rater reliability checks were undertaken by anonymously providing each observer with an additional three behaviour categories that appeared on their partner's observers list. The cross-over categories were: "Hustle", "Closed Questioning", "Open Questioning", "Concurrent Feedback", "Post Feedback", and "Pre-Instruction". After each observer had consulted the video footage, Cronbach's alpha coefficient was calculated on the cross-over categories resulting in an acceptable level of agreement: P1-P2: $\alpha = .82$, P3-P4: $\alpha = .79$.

The target group of coaches for the main study all coached in the North East of England and had a minimum of two years coaching across a range of four sports. All were handed a letter of invitation to participate, an information sheet, and a copy of the REVISED ASUOI (Sutcliffe & Toms, 2011) before being asked to read and sign the participant consent form. Participants were also asked to provide information on: (a) their sex and age, (b) their highest level of educational qualification, (c) the main sport in which they coached, (d) what level of coaching award they held in the aforementioned sport, (e) whether they were an employed or volunteer coach, (f) their approximate number of years coaching, (g) at what level they coached, and, (h) the profile of the bulk of the participants whom they coached (e.g. were they adults or children and males or females?).

A total of 12 coaches were recruited into the study (10 males, 2 females) aged 23-55 years $M = 36.6$ years, $SD 9.21$; one coach did not provide their age). Sampling was purposive with inclusion into the study being determined by the lead researcher, based on the coaches' responses to the demographic questioning (see Table 1).

Coaches were observed twice when dealing with the same participants within a two-week period. This is less than the recommended three observations suggested by Brewer & Jones (2002) but within the highest

frequency range reported by Cope *et al.* (2017). The fact that this current study was exploratory allows for such frequencies.

Table 1. Personal characteristics of participants (n = 12).

Coach Name (pseudonym)	Sex	Age (years)	Main Sport	Coach Level	Employed/ Voluntary	Years Coaching	Participant Level	Profile of Participants	Education
A	Male	41	Rugby Union	2	Voluntary	6	Recreational/ Club Competitive	Adults Male	GCSE
B	Male	34	Rugby Union	2	Employed Part-Time	8	Recreational/ School Based/ Club Competitive	Children Male	A-Level
C	Male	55	Football	1	Voluntary	3.5	Recreational/ Club Competitive	Children Male	GCSE
D	Male	49	Football	1	Voluntary	8	Club Competitive	Children Male	A-Level
E	Male	40	Football	1	Voluntary	5	Club Competitive	Children Male	GCSE
F	Female	29	Gymnastics	1	Voluntary	2	Recreational	Children Female	A-Level
G	Male	39	Football	3	Employed Part-Time	10	Club Competitive	Adults Male	UG Degree
H	Male	23	Rugby Union/ Rugby League	2	Employed Part-Time	7	Recreational/ School Based	Adults & Children, Males & Females	PG Degree
I	Female	26	Gymnastics/ Trampoline	1	Employed Part-Time	1	School Based	Children Female	PG Degree
J	Male	37	Gymnastics/ Trampoline	3	Employed Full-Time	15	School Based	Children Male	UG Degree
K	Male	--	Gymnastics/ Trampoline	4	Employed Full-Time	--	School Based/ National/ Club Competitive	Adults & Children, Males & Females	UG Degree
L	Male	39	Football	3	Voluntary	9	Club Competitive	Children Male	PG Degree

Each observation lasted between 45-60 minutes and involved video recording the coach in action. Similar to a study of handball coaching (Guzmán & Calpe-Gómez, 2012), the observed coach was required to wear a wireless microphone to ensure that all verbal communications were captured. Two researchers independently used the video and audio footage to undertake a systematic categorisation of the coach's behaviour against the REVISED ASUOI behaviour categories. Each observer took responsibility for approximately half of the 22 REVISED ASUOI behavioural categories and were given responsibility for observing the same coaches. In addition, inter-rater reliability checks were undertaken, anonymously, providing each observer with an additional three behaviour categories that appeared on their partner's observers list. The cross-over categories remained the same as in the pilot study. Cronbach's alpha coefficient was calculated on the cross-over categories resulting in high levels of agreement: P1-P2: $\alpha = .81$, P3-P4: $\alpha = .84$. Subsequently, the average of both observers recorded observations was taken for the cross-over categories.

Measures

The REVISED Arizona State University Observation Instrument (Sutcliffe & Toms, 2011) was employed for data collection.

A pilot study was first carried out to check for suitability of the data collection procedure with two coaches of an equivalent level and background to those intended for the main study. Following this process, in accordance with the views of Brewer and Jones (2002) and Sutcliffe & Toms (2011) two steps were taken to ensure maximum consistency in the application of the REVISED ASUOI. First, the 22 behavioural categories were broken down into two sections with a single observer being responsible for each section, with a cross-over of three categories. Secondly, the researchers were trained in the use of the REVISED ASUOI prior to engaging in the pilot study that was used to assure the reliability of observations.

Data analysis

Data produced by the REVISED ASUOI coding process was collated into a total number of coaching behaviours for each of the instrument's categories. An independent-samples t-test was then conducted to establish differences between graduate coaches and non-graduate coaches across each of the behaviour categories. The term "graduate coach" is used to differentiate sports coaches who possessed an undergraduate and/or postgraduate coaching degree from those who did not. Finally, Levene's test was used to assess the assumption of homogeneity of variance and appropriate corrections applied where this was not the case. In addition, due to the small sample size and its effect on the assumption of normal distribution of data, a Mann Whitney U test was run in parallel with the t-test to assess for any similarities or differences.

RESULTS

An independent-samples t-test was conducted to compare the mean scores of each of the REVISED ASUOI's categories between graduate and non-graduate coaches across two observations. Participants were divided into two groups according to whether they did or did not possess an undergraduate degree qualification or higher (Group 1: Graduate coaches, $N = 6$; Group 2: non-graduate coaches, $N = 6$).

Table 2. Categories in which significant differences in coaching behaviours were found between graduate and non-graduate coaches using an independent-samples t-test.

Category Heading	Combined observation			Observation 1			Observation 2		
	Mean	SD	Sig (two-tailed)	Mean	SD	Sig (two-tailed)	Mean	SD	Sig (two-tailed)
Learning Intention									
Graduate Coaches	12.16	3.09	.001	13.83	5.23	.004	10.50	2.07	.000
Non-Graduate Coaches	4.25	2.27		4.33	3.44		4.16	2.04	
Closed Questioning									
Graduate Coaches	13.33	4.14	.000	16	5.93	.000	10.66	3.55	.000
Non-Graduate Coaches	1.83	2.11		2.16	2.63		1.50	1.64	
Open Questioning									
Graduate Coaches	15.16	3.23	.000	15	3.03	.000	15.33	5.35	.000
Non-Graduate Coaches	1.25	1.66		1.50	2.07		1.00	2.00	
Coaches' Model									
Graduate Coaches	16.16	4.64	.002	14.66	3.66	.000	17.66	5.88	.000
Non-Graduate Coaches	5.25	0.52		5.16	0.75		5.33	0.81	
Observation									
Graduate Coaches	13.83	2.92	.002	15.16	3.92	.002	12.50	2.81	.005
Non-Graduate Coaches	7.16	2.46		7.33	2.42		7	2.52	

Of the 22 ASUOI categories recorded across both observations, there was a significant difference ($p < .005$) in graduate and non-graduate coaches' scores for five of the categories – Learning Intention, Closed

Questioning, Open Questioning, Coaches' Model and Observation. Similarly, there was a significant difference for the same five categories when looking at observations one and two in isolation (see Table 2). A Mann Whitney U test confirmed similar findings with only Observation revealing a non-significant difference ($p > .005$) between Graduates and non-graduates when considered across both observations $p = .008$ and on taking the results in isolation, Observation 1, $p = .006$ and Observation 2, $p = .015$. The remaining four categories – Learning Intention, Closed Questioning, Open Questioning and Coaches' Model – remained significantly different in all cases (see Table 3).

Table 3. Categories in which significant differences in coaching behaviours were found between graduate and non-graduate coaches using a Mann Whitney U.

Category Heading	Combined observation				Observation 1				Observation 2			
	Median	U	z	Sig (two-tailed)	Median	U	z	Sig (two-tailed)	Median	U	z	Sig (two-tailed)
Learning Intention												
Graduate Coaches	12.5	.500	-2.812	.005	14.5	2.5	-2.491	.005	10.5	.500	-2.832	.005
Non-Graduate Coaches	3.5				3				4			
Closed Questioning												
Graduate Coaches	15	.000	-2.898	.004	18	.500	-2.822	.005	11.5	.000	-2.898	.004
Non-Graduate Coaches	1				1				1			
Open Questioning												
Graduate Coaches	16	.000	-2.908	.004	14.5	.000	-2.903	.004	13.5	.000	-2.939	.003
Non-Graduate Coaches	0.5				.5				.0			
Coaches' Model												
Graduate Coaches	15.5	.000	-2.892	.004	13.5	.000	-2.913	.004	16	.000	-2.989	.003
Non-Graduate Coaches	5.3				5				5			
Observation												
Graduate Coaches	14.5	1.50	-2.651	.008	15.5	1.00	-2.746	.006	13	3.00	-2.436	.015
Non-Graduate Coaches	6.5				7				6			

DISCUSSION

This study provided insight into the coaching behaviour of graduate and non-graduate coaches. Overall, despite similarities in the behaviours observed, graduate coaches were found to engage in five of the 22 REVISED ASUOI categories significantly more so than non-graduate coaches. We suggest that possession of an undergraduate degree or higher qualification, resulted in greater engagement in the following coaching behaviours: Learning Intention, Closed Questioning, Open Questioning, Coaches' Model and Observation, which are considered important in contemporary coaching practice.

Graduateness is a term that incorporates both skills and attributes that contribute to personal and intellectual development. Coetzee's (2014) three holistic domains of graduateness provided an explanation for the findings of this study. Four of the five coaching behaviours ("*Learning Intention*", "*Coaches' Model*", "*Closed Questioning*" and "*Open Questioning*") in which graduate coaches engaged more so than non-graduate coaches, demonstrated evidence of Coetzee's *scholarship* and *global and moral citizenship* domains. All four behaviours were evident in the scholarship domain involving the ability of the coach to communicate their knowledge confidently and effectively. Within the *global and moral citizenship* domain, "*Learning Intention*",

“Coaches Model” and “Closed Questioning” show graduate coaches to utilise their own leadership skills, providing direction to others, while also being comfortable empowering others to make decision for themselves (“Open Questioning”). The formal education opportunities afforded to these students have arguably resulted in an increase in the coaching behaviours observed.

The remaining category, “Observation” demonstrated the coach’s ability to reflect on their work and that of the participants’ progress. Coetzee (2014) argued that reflection is evidence of having developed a higher-level set of critical thinking skills that coaches use to better themselves and their participants as part of the *lifelong learning* domain. A coach’s ability to reflect is central to the coaching process, and within Further and Higher Education Institutions, reflection is becoming an increasingly important assessment method to aid students’ understanding, informing their future practice (Gregson *et al*, 2015). Dowson and Robinson (2009) and Kuklick, Gearity and Thompson (2015) emphasised the role of higher education in coaching education proclaiming that, at its heart, a focus on personal development is underpinned by critical reflection through conversation. The authors argue that the formal education received by graduate coaches developed their ability to be reflective practitioners and this in turn may have led to the increase in some of the graduate coaches’ behaviours. Within this cohort, it was identified through informal discussion (anecdotal evidence), that graduates were exposed to models of reflection and were therefore prone to repetition of the same material so that learning became embedded. Thus, reflection becomes not just second nature but evolves to be instinctively hardwired in the graduate.

Additionally, the staff in the participants’ institution follow the models of Gibbs (1988) and Rolfe (1993) which champion the use of five repetitions of the same material, thus critical reflection is ingrained, not only in a theoretical context, but also as a matter of sound practice. A HEI’s curriculum and course design seems central to the way that formal learning opportunities contribute to a coach’s behaviour.

CONCLUSION

Several reports have shown that higher education programmes lack contextual relevance and holistic learning opportunities for their students, compared with coaches from an informal or non-formal coach education background (see Morgan, Jones, Gilbourne and Llewellyn, 2013). However, the findings of the current study challenge the stance that coaches in possession of an undergraduate or higher degree, fail to embed theoretical knowledge in their practices. In particular, the rise of experiential learning opportunities embedded within HEI courses could be a significant factor in the observed increase of aspects of coaching behaviour witnessed in this study. Thus, we can argue that coaches having undertaken a formal education in HE are increasingly offered opportunities for hands on experience. The narrowing of this gap, coupled with institutionally structured delivery, may be responsible for coaches with HE coach education experiences engaging more in some coaching behaviours.

In the past, HEI’s failure to award significant time to helping students gain hands on experience, left a gap in their skill set. However, formal education is increasingly offering experiential opportunities where graduate coaches are awarded the opportunity to put theoretical content into practice (Cronin & Lowes, 2016). This process is arguably an important factor in producing knowledgeable and confident coaches who through their HE degree have learned to value lifelong learning, valuing the role of continued learning in their future practice. This work suggests that skills and attributes of graduates develop beyond specific knowledge as they seem to employ softer skills as well as more holistic skills. This sits well with Stodter & Cushion’s (2019) assertion that the impact of formal education and the consequent adoption of deeper learning through reflective practice are stimulated by the educational process.

While this work uses a more recent approach to identify coaches' behaviours, there is much to do. Despite the rigorous way in which the instrument was developed and validated, there is much sitting "*below the surface*" that needs to be considered also. One possible avenue for future work would be to attempt, not only to look at behaviour and type of language involved, but to also conduct conversational analyses as outlined by Faulkner & Finlay (2002) and Evan (2017). This would provide a more subtle and nuanced observation of how communication takes place in a coaching field. Further enhancement could be offered if theory was considered, such as in the work of Groom, Cushion and Nelson (2012).

AUTHOR CONTRIBUTIONS

Conceptualisation: Dr Steven Anderson & Ms Marina Georgakopoulou. Collecting and analysing of pilot data: Ms Marina Georgakopoulou. Collecting and analysing data: Dr Steven Anderson & Mr Ivor Harkin. Writing of the paper: Dr Steven Anderson & Dr Ian Whyte. All authors editing of the paper.

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REFERENCES

- Allan, V., Turnnidge, J., Vierimaa, M., Davis, P. & Côté, J. (2016). Development of the assessment of coach emotions systematic observation instrument: A tool to evaluate coaches' emotions in the youth sport context. *International Journal of Sports Science and Coaching*, 11(6), 859-871. <https://doi.org/10.1177/1747954116676113>
- Booth, A. McLean, M. & Walker, M. (2009). Self, others and society: A case study of university integrative learning. *Studies in Higher Education*, 34(8), 929-939. <https://doi.org/10.1080/03075070902773818>
- Brewer, C. J. & Jones, R. L. (2002). A five-stage process for establishing contextually valid systematic observation instruments: The case of rugby union. *The Sport Psychologist*, 16(2), 139-161. <https://doi.org/10.1123/tsp.16.2.138>
- Brunton, J.A., Cánovas-Álvarez, F.J., Meroño, L., Leiva-Arcas, A., Arias-Estero, J.L., Conde, E., Isidori, E., Decelis, A., Samantzis, C., Yildiz, A., Doğan, Y.I., Fazio, A., Mallia, O., Koustelios, A., & Sánchez-Pato, A. (2020). Implementing the European Sports Leadership Programme: A vehicle to help development graduate workplace competencies. *Journal of Human Sport and Exercise*, *in press*. <https://doi.org/10.14198/jhse.2022.173.07>
- Coaching Review Panel (1991). *Coaching matters: A review of coaching and coach education in the United Kingdom*. London: Sports Council.
- Coetzee, M. (2014). Measuring student graduateness: Reliability and construct validity of the graduate skills and attributes scale. *Higher Education Research & Development*, 33(5) 887-902. <https://doi.org/10.1080/07294360.2014.890572>
- Cope, E., Partington, M. & Harvey, S. (2017). A review of the use of a systematic observation method in coaching research between 1997 and 2016. *Journal of Sports Sciences*, 35(20) 2042-2050. <https://doi.org/10.1080/02640414.2016.1252463>

- Cope, E., Partington, M., Cushion, C.J. & Harvey, S. (2016). An investigation of professional top-level youth football coaches' questioning practice. *Qualitative Research in Sport, Exercise and Health*, 8(4), 380-393. <https://doi.org/10.1080/2159676x.2016.1157829>
- Cronin, C. J. & Lowes, J. (2016). Embedding experiential learning in HE sport coaching courses: An action research study. *Journal of Hospitality, Leisure, Sport & Tourism Education*, 18, 1-8. <https://doi.org/10.1016/j.jhlste.2016.02.001>
- Cushion, C. J., Griffiths, M. & Armour, K. (2017). Professional coach educators in-situ: A social analysis of practice. *Sport, Education and Society*, 1-14. <https://doi.org/10.1080/13573322.2017.1411795>
- Cushion, C. J., Nelson, L., Armour, K., Lyle, J., Jones, R., Sandford, R., O'Callaghan, C. (2010). *Coach learning & development: A review of literature*. Leeds: sportscoachUK.
- Dowson, P. & Robinson, S. (2009). Higher education, personal development & coaching. *Annual Review of High Performance Coaching & Consulting*, 157-173.
- Evans, B. (2017). Sports coaching as action-in-context: using ethnomethodological conversation analysis to understand the coaching process. *Qualitative Research in Sport, Exercise and Health*, 9(1), 111-132. <https://doi.org/10.1080/2159676x.2016.1246473>
- Faulkner, G. & Finlay, S.-J. (2002). It's not what you say, it's the way you say it! Conversation analysis: A discursive methodology for sport, exercise, and physical education. *Quest*, 54(1), 49-66. <https://doi.org/10.1080/00336297.2002.10491766>
- Gibbs, G. (1988). *Learning by doing: A guide to teaching and learning methods*. Oxford: Further Educational Unit, Oxford Polytechnic.
- Gregson, M., Hillier, Y., Biesta, G., Duncan, S., Nixon, L., Spedding, T., & Wakeling, P. (2015). *Reflective teaching in further, adult and vocational education*. London: Bloomsbury. <https://doi.org/10.1177/1045159516659036>
- Groom, R., Cushion, C. J., & Nelson, L. J. (2012). Analysing coach-athlete 'talk in interaction' within the delivery of video-based performance feedback in elite youth soccer. *Qualitative Research in Sport, Exercise and Health*, 4(3), 439-458. <https://doi.org/10.1080/2159676x.2012.693525>
- Guzmán J.F. & Calpe-Gómez, V. (2012). Preliminary study of coach verbal behaviour according to game actions. *Journal of Human Sport and Exercise*, 7(2), pp. 376-382. <https://doi.org/10.4100/jhse.2012.72.04>
- Kuklick, C. R., Gearity, B. T. & Thompson, M. (2015). Reflective practice in a university-based coach education programme. *International Sport Coaching Journal*, 2, 248-260.
- Lacy, A. C., & Darst, P. (1984). Evolution of a systematic observation instrument: The A.S.U. observation instrument. *Journal of Teaching in Physical Education*, 3(3), 59-66. <https://doi.org/10.1123/jtpe.3.3.59>
- Mallett, C.J., Trudel, P., Lyle, J. & Rynne, S.B. (2009). Formal vs. informal coach education. *International Journal of Sports Science & Coaching*, 4(3), 325-364. <https://doi.org/10.1260/174795409789623883>
- McKenzie, T.L., & Van Der Mars, H. (2015). Top 10 research questions related to assessing physical activity and its contexts using systematic observation. *Research Quarterly for Sport and Exercise*, 86(1), 13-29. <https://doi.org/10.1080/02701367.2015.991264>
- Morgan, K., Jones, R.L., Gilbourne, D. & Llewellyn, D. (2013). Changing the face of coach education: Using ethno-drama to depict lived realities. *Physical Education and Sport Pedagogy*, 18(5), 520-533. <https://doi.org/10.1080/17408989.2012.690863>
- Mosston, M., & Ashworth, S. (2008). *Teaching physical education* (Fifth edition). New York: Merrill Publishing Co.
- Partington, M. & Harvey, S. (2016). A review of the use of a systematic observation method in coaching research between 1997 and 2016. *Journal of Sports Science*, 35(2), 2042-2050. <https://doi.org/10.1080/02640414.2016.1252463>

- Reade, I., Rodgers, W. & Hall, N. (2008). Knowledge transfer: How do high performance coaches access the knowledge of sport scientists? *International Journal of Sports Science & Coaching*, 3(3), 319-334. <https://doi.org/10.1260/174795408786238470>
- Rolfe, G. (1993). Closing the theory–practice gap: A model of nursing praxis. *Journal of Clinical Nursing* 2, 173–177. <https://doi.org/10.1111/j.1365-2702.1993.tb00157.x>
- Rosenbaum, P. (2009). *Design of observational studies*. New York: Springer.
- Smith, B. & McGannon, K. R. (2018). Developing rigor in qualitative research: Problems and opportunities within sport and exercise psychology. *International Review of Sport and Exercise Psychology*, 11(1), 101-121. <https://doi.org/10.1080/1750984x.2017.1317357>
- Smith, N., Quested, E., Appleton, P., & Duda, J. (2016). A review of observational instruments to assess the motivational environment in sport and physical education settings. *International Review of Sport and Exercise Psychology*, 9(1), 134-159. <https://doi.org/10.1080/1750984x.2015.1132334>
- Smith, R. E., Smoll, F. L., & Hunt, E. B. (1977). A system for the behavioral assessment of athletic coaches. *Research Quarterly*, 48(4), 401-406. <https://doi.org/10.1080/10671315.1977.10615438>
- Sport England (2016). Coaching in an active nation: The coaching plan for England 2017-21. Available at https://www.sportengland.org/media/11317/coaching-in-an-active-nation_the-coaching-plan-for-england.pdf (Accessed 29 October 2018).
- Steur, J.M., Jansen, E.P.W.A. & Hofman, W.H.A. (2012). Graduateness: an empirical examination of the formative function of university education. *Higher Education*, 64, 861-874. <https://doi.org/10.1007/s10734-012-9533-4>
- Stodter, A. & Cushion, C. J. (2014). Coaches' learning and education: a case study of cultures in conflict. *Sports Coaching Review*, 3(1), 63-79. <https://doi.org/10.1080/21640629.2014.958306>
- Stodter, A. & Cushion, C. J. (2019). Evidencing the impact of coaches' learning: Changes in coaching knowledge and practice over time. *Journal of Sports Sciences*, 37(18), 2086-2093. <https://doi.org/10.1080/02640414.2019.1621045>
- Stonebridge, I. & Cushion, C. J. (2018). An exploration of the relationship between educational background and the coaching behaviours and practice activities of professional youth soccer coaches. *Education and Sport Pedagogy*, 23(6), 636-656. <https://doi.org/10.1080/17408989.2018.1485143>
- Sutcliffe, G. & Toms, M. (2011). A preliminary investigation into the coaching behaviours of English independent school team sport coaches. Dissertation Thesis. University of Birmingham. Available at: <http://etheses.bham.ac.uk/3022/1/Sutcliffe11MPhil.pdf> (Accessed: 23 October 2017).
- Tharp, R. G. & Gallimore, R. (1976). What a coach can teach a teacher. *Psychology Today*, 9(8), 75-78.
- Trudel, P. & Gilbert, W. (2006). Coaching and coach education. In D Kirk, D. MacDonald, & M. O'Sullivan (Eds.). *Handbook of physical education*, (516-539). London: Sage Publications. <https://doi.org/10.4135/9781848608009.n29>
- UCAS(2019). Available at: <https://digital.ucas.com/coursedisplay/results/providers?studyYear=2020&destination=Undergraduate&postcodeDistanceSystem=imperial&pageNumber=1&sort=MostRelevant&searchTerm=Sports%20Coaching> (Accessed 20th July 2020).
- Vinson, D., Brady, A., Moreland, B., & Judge, N. (2016). Exploring coach behaviours, session contexts and key stakeholder perceptions of non-linear coaching approaches in youth sport. *International Journal of Sports Science and Coaching*, 11(1), 54-68. <https://doi.org/10.1177/1747954115624824>
- Wheelahan, L. (2003). Recognition of prior learning and the problem of 'graduateness'. Paper presented at the sixth Australian VET Research Association Conference, Sydney, Australia, 9-11 April 2003.



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Special training of highway cyclists considering energy metabolism types

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ABSTRACT

The competitive activity of racers on the highway makes high demands on the level of their physical fitness, since the competition can be held in the form of a multi-day race. The training of road racers is based on the development of physical qualities, among which the most important for them are different types of endurance. The development of these qualities is possible only with a purposeful impact on their physiological systems and, in particular, on the mechanisms of energy supply of muscle activity. Studies have shown that the success in preparing athletes for competitions largely depends on taking into account the individual characteristics of the mechanism of energy supply of muscle activity. For the training of racers on the highway, the solution of special tasks for the development of tempo and speed endurance is characteristic. Pace endurance is necessary for athletes to maintain high speed during the race on the highway, and speed endurance is necessary for them to build up speed at the finish line of the race. And the longer this finishing spurt is, the higher the athlete's final result will be. Studies have shown that special tasks during such training should be solved taking into account the type of energy metabolism in road racers. The article presents the results of studies on the development of the content of a model of training for road racers, taking into account the type of their energy metabolism.

Keywords: Performance analysis of sport, Physical conditioning, Road racers, Training model, Energy metabolism, Training process, Competition.

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INTRODUCTION

Competition activity of highway cyclists is highly demanding in terms of the level of their physical fitness (Kumstát et al., 2019; Novak & Dascombe, 2014; Maciejczyk et al., 2015). Specialized preparation for the multi-day race is based on development of special endurance for covering the race distance at unstable ambient temperatures (Spierer et al., 2004; Dushanin, 1986; Costa et al., 2012). The effective development of this physical quality is achieved through applying special loads to the athlete's organism considering the type of energy metabolism (Bakayev & Bolotin, 2020; Ganapolsky et al., 2019; Bolotin & Bakayev, 2017).

Quite many studies on this subject only indirectly mention special features of energy supply to the muscular activity of highway cyclists (Bakayev et al., 2018; Spencer et al., 2005; Porter et al., 2019; Prieur & Mucci, 2013; Sousa et al., 2013). This contradiction limits the possibilities for differentiated use of means and methods for the development of special endurance in highway cyclists. There is only limited use of methods for the development of special endurance in highway cyclists, differentiated by energy metabolism typology in athletes.

The objective of the study was to identify the effectiveness of methods for specialized training of highway cyclists, considering energy metabolism types.

MATERIAL AND METHODS

Twenty eight highway cyclists preparing to a multi-day race took part in the study. The subjects' age ranged from 17 to 20. To test the developed training options, 4 groups of athletes were formed depending on the type of energy metabolism: aerobic type, anaerobic type, mixed type, and regardless of the type of energy supply to muscle activity. The duration of the experiment was 6 weeks of a special preliminary training period. Means and methods of specialized training for each athlete group were developed taking into account the peculiarities of the mechanism of energy supply to muscle activity. To substantiate a training model of highway cyclists, we performed a comparative analysis of functional organism capabilities of athletes from various groups differentiated by the type of energy metabolism.

The study used D&K-Test, which is a method for rapid diagnosis of the functional state and reserve capabilities of athlete organism developed by S.A. Dushanin (1986). The program algorithms helped identify athletes belonging to one of energy metabolism types based on the analysis of the nature and height of the R- and S-wave of the electrocardiogram recorded in 3 standards, 3 augmented and 6 chest leads. The obtained data was used to calculate the following parameters:

1. Capacity of anaerobic energy supply (CANSE), which characterizes the ability to fulfil the load in the 3rd, 4th and 5th intensity zones.
2. Capacity of aerobic energy supply source (CASE), which characterizes the ability to fulfil the load in the 1st and 2nd intensity zones.
3. Total metabolic capacity (TMC) characterizing the total organism performance.
4. Power of creatine phosphate energy supply (PCPES), which characterizes the speed qualities of cyclists.
5. Power of glycolytic energy supply (GPS) characterizing the high-speed endurance of cyclists.
6. Power of aerobic energy supply (PAE) which characterizes the ability to show general endurance, as well as to recover after anaerobic work.

The effectiveness of training process management was achieved by differentiating the special training methods of cyclists depending on the peculiarities of energy supply to their muscular activity. The pace endurance of cyclists, mainly of aerobic energy metabolism type was developed using the method of continuous long-term exercise, and speed endurance – using repeated training method. In athletes with anaerobic energy metabolism type, pace endurance was developed by method of interval exercise, and speed endurance – by method of submaximal loads with fixed number of repetitions.

Cyclists with a mixed energy metabolism type developed pace endurance through a variable training method, and speed endurance – through combining the repeated training method with the method of sublimit efforts with a fixed number of repetitions of distance sections. For the control cyclist group, standard means and methods for the development of pace and speed endurance were used. The load for cyclists was selected on the basis of the current result in the individual 10 km (Table 1) and 25 km (Table 2) race. The number of repetitions and the weekly volume of training load were selected depending on the level of athletes' functional state. To manage specialized training, the training process control system was used. It included power testing on a special bench, lactate profile determination, skin fold test, and blood profile analysis. The system was used to plan a training program for cyclists taking into account heart rate and energy metabolism type.

Table 1. Basic parameters of the load of cyclists at the special preliminary stage of preparation for the competition (6 weeks).

Load parameters	Subject groups by the type of energy metabolism			
	Aerobic type	Anaerobic type	Mixed type	Regardless of metabolism type
Daily distance, km.	90-120	70-100	80-110	80-110
Weekly distance, km.	560-840	490-700	560-770	560-770
Number of training sessions per week	12	12	12	12
Basic training task.	8 x 5 km; 2 x 25 km	5 x 4 km; 5 x 10 km	2 x 10 km 3 x 20 km	3 x 10 km; 2 x 25 km
Training method.	Uniform, repeated	Interval, submaximal loads	Variable, sublimit loads	Uniform, repeated, interval

RESULTS AND DISCUSSION

The study identified differences in the dynamics of specialized test parameters depending on the energy metabolism types of cyclists (Tables 2, 3).

Table 2. Dynamics of results in the 10 km race for cyclists of various energy metabolism types (min).

Test period at the special preliminary stage of preparation	Subject groups by energy metabolism type			
	Aerobic type	Anaerobic type	Mixed type	Regardless of metabolism type
Stage beginning	11.8 ± 1.4	11.4 ± 1.8	11.7 ± 1.7	11.8 ± 1.6
Stage end	10.8 ± 3.5	10.3 ± 1.3	10.4 ± 1.3	11.1 ± 1.8

In the individual 10 km race, athletes of the aerobic energy metabolism type group showed an improvement in time by 60 s, the increase in results was 9.8% ($p < .05$). Cyclists of the mixed energy metabolism type group improved the result by 78 s, the increase was 10.4% ($p < .05$). Cyclists of the anaerobic energy metabolism type group showed an improvement of the time parameter by 66 s, the increase was 10.1% ($p < .05$).

.05). The average improvement in time in this test in cyclists of the group regardless of the type of energy metabolism was 42 s, which corresponds to an increase by 6.9% ($p < .01$).

Table 3. Dynamics of results in the 25 km race for cyclists of various energy metabolism types (min).

Test period at the special preliminary stage of preparation	Subject groups by energy metabolism type			
	Aerobic type	Anaerobic type	Mixed type	Regardless of metabolism type
Stage beginning	29.4 ± 2.4	29.6 ± 2.8	29.3 ± 2.8	29.7 ± 2.2
Stage end	28.4 ± 1.6	28.9 ± 2.2	28.8 ± 14.5	29.3 ± 2.4

Table 4. Dynamics of parameters of functional and reserve capabilities of the cyclists' organism as a result of the special preliminary stage of preparation.

Test period	Subject groups by energy metabolism type			
	Aerobic type	Mixed type	Anaerobic type	Regardless of metabolism type
<i>Anaerobic metabolic capacity (CANSE), conventional units</i>				
Before	45.42 ± 13.68	71.07 ± 6.9	124.65 ± 8.96	76.12 ± 34.63
After	48.96 ± 11.23	76.9 ± 4.89	136.1 ± 11.32	82.52 ± 9.15
t	0.62	2.19*	2.44*	0.84
<i>Aerobic metabolic capacity (CASE), conventional units.</i>				
Before	240.1 ± 21.36	229.5 ± 17.63	204.41 ± 21.69	226.65 ± 29.49
After	260 ± 18.13	249.5 ± 13.68	218.92 ± 18.67	244.85 ± 16.83
t	2.22*	2.89*	1.38	2.50*
<i>Total metabolic capacity (TMC), conventional units.</i>				
Before	285.5 ± 12.3	300.6 ± 21.42	329.06 ± 22.18	302.78 ± 34.07
After	308.52 ± 14.38	326.4 ± 19.22	355 ± 23.01	327.65 ± 18.87
t	4.10**	2.98**	2.34*	2.98**
<i>Power of creatine phosphate energy supply (PCPES), conventional units.</i>				
Before	31.54 ± 2.35	29.55 ± 1.95	38.75 ± 2.26	32.64 ± 5.93
After	34.79 ± 2.167	32.03 ± 2.19	41.93 ± 2.12	35.57 ± 2.16
t	3.23**	2.96**	2.86*	2.17*
<i>Power of glycolytic energy supply (GPS), conventional units.</i>				
Before	31.60 ± 2.65	29.52 ± 2.47	33.5 ± 2.03	31.28 ± 3.19
After	34.35 ± 2.76	31.94 ± 2.03	35.77 ± 1.58	33.75 ± 2.12
t	2.35*	2.47*	2.35*	3.00**
<i>Power of aerobic energy supply (PAE), conventional units.</i>				
Before	57.48 ± 4.43	52.12 ± 5.80	46.39 ± 4.03	51.62 ± 10.60
After	62.25 ± 3.22	56.03 ± 6.13	51.63 ± 4.34	56.28 ± 8.96
t	2.63*	1.60	2.57*	1.56

Note: **- $p < .01$; *- $p < .05$.

In the individual 25 km race, athletes of the aerobic energy metabolism type group showed an improvement in time by 60 s, the increase in results amounted to 6.9% ($p < .05$). Cyclists of the mixed energy metabolism type group improved the result by 42 s, the increase was 4.7% ($p < .05$). Cyclists of the anaerobic energy metabolism type group showed an improvement of average result by 30 s, the increase was 3.4%. The average improvement in time in this test in cyclists of the group regardless of energy metabolism type was 24 s, which corresponds to an increase of 3.1% ($p < .01$). Table 4 presents the assessment results of

functional and reserve capabilities of the athletes' organism before and after the special preliminary stage of preparation.

CANSE increase in aerobic type cyclists was 3.54 c.u. (7.8%), athletes of the mixed energy metabolism type group showed an increase by 5.83 c.u. or 8.2% ($p < .05$), athletes of the anaerobic energy metabolism type group showed an increase by 11.45 c.u. (9.2%) ($p < .05$). The average increase in CANSE in cyclists of the group regardless of energy metabolism type was 6.4 c.u. (8.4 %). The increase in CASE in athletes of the aerobic energy metabolism type group was 19.9 c.u. or 8.3% ($p < .05$), athletes of the mixed energy metabolism type group showed an increase by 20 c.u. or 8.7% ($p < .05$), athletes of the anaerobic energy metabolism type group showed an increase by 14.51 c.u. or 7.1%. The average increase in CASE in athletes regardless of the type of energy metabolism was 18.2 c.u. or 8.03% ($p < .05$).

Assessment of TMC dynamics in athletes of aerobic energy metabolism type group showed an increase by 23.02 c.u. or 8.0 5% ($p < .01$), athletes of the mixed energy metabolism type group showed an increase by 25.8 c.u. or 8.45% ($p < .01$), athletes of the anaerobic energy metabolism type group showed an increase by 25.94 c.u. or 8.2% ($p < .05$). The average increase in TMC in athletes of the group regardless of energy metabolism type was 24.87 c.u. or 8.22% ($p < .01$).

The increase in PCPES in athletes of the aerobic energy metabolism type group showed an increase by 3.25 c.u. or 10.3% ($p < .01$), athletes of the mixed energy metabolism type group showed an increase by 2.48 c.u. or 8.4% ($p < .01$), athletes of the anaerobic energy metabolism type group showed an increase by 3.18 c.u. or 8.2% ($p < .05$). The average PCPES increase in group of athletes regardless of energy metabolism type was 2.93 c.u. or 8.9% ($p < .05$).

The assessment of GPS dynamics according to the results of the experiment showed an increase by 2.75 c.u. in athletes of the aerobic energy metabolism type group or 8.7% ($p < .05$), athletes of the mixed energy metabolism type group showed an increase by 2.42 c.u. or 8.2% ($p < .05$), athletes of the anaerobic energy metabolism type group showed an increase by 2.27 c.u. or 6.8% ($p < .05$). The average increase in GPS in athletes of the group regardless of energy metabolism type was 2.47 c.u. or 7.9% ($p < .01$).

The increase in PAE in athletes of the aerobic energy metabolism type group was 4.77 c.u. or 8.3% ($p < .05$), athletes of the mixed energy metabolism type group showed an increase by 3.91 c.u. or 7.5%, athletes of the anaerobic energy metabolism type group showed an increase by 5.24 c.u. or 11.3% ($p < .05$). The average increase in PAE in cyclists of the group regardless of energy metabolism type was 4.66 c.u. or 9.03%.

Thus, as a result of the application of a differentiated training method, highway cyclists showed a significant increase in the functional and reserve capabilities of their organism. It is also noteworthy that in the absence of a significant increase in CANSE and PAE in the group of athletes regardless of energy metabolism type, there was a significant increase in these parameter values in mixed and anaerobic energy metabolism type groups. The obtained data suggests effectiveness of a differentiated method for training highway cyclists, considering energy metabolism types.

CONCLUSION

As a result of the implementation of the special preliminary stage of preparation of cyclists for the competitions with different energy metabolism types, a different reaction of the organism to the training load was recorded.

Athletes with anaerobic and mixed energy metabolism type adapt faster to speed and power work, and cyclists with aerobic energy metabolism type adapt to long-term endurance work. This indicates that the energy metabolism typology of cyclists can be the basis for determining the means and methods of training athletes in preparation for a multi-day race.

AUTHOR CONTRIBUTIONS

Conceptualization, A.B. and V.B.; methodology, A.B.; software, V.B; data analysis, A.B., V.B.; investigation, V.B. and A.B.; data curation, A.B; writing-original draft preparation, V.B.; writing-review and editing, V.B. All authors have read and agreed to the published version of the manuscript.

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No potential conflict of interest was reported by the authors.

REFERENCES

- Bakayev, V., & Bolotin, A. (2020). Differentiated Training Model for Marathon Runners on Building Tempo and Speed Endurance Based on the Types of Energy Metabolism. *Sport Mont*, 18(3), 31-34. <https://doi.org/10.26773/smj.201011>
- Bakayev, V., Bolotin, A., & You, C. (2018). Reaction of vegetative nervous system to loads in female long-distance runners with different fitness level. *Journal of Human Sport and Exercise*, 13(2proc), S245-S252. <https://doi.org/10.14198/jhse.2018.13.proc2.09>
- Bolotin A. and Bakayev V. (2017). Method for Training of Long Distance Runners Taking into Account Bioenergetic Types of Energy Provision for Muscular Activity. In *Proceedings of the 5th International Congress on Sport Sciences Research and Technology Support*, pp. 126-131. <https://doi.org/10.5220/0006516101260131>
- Costa, M.J., Bragada, J.A., Mejias, J.E., Louro, H., Marinho, D.A., Silva, A.J., & Barbosa, T.M. (2012). Tracking the performance, energetics and biomechanics of international versus national level swimmers during a competitive season. *European Journal of Applied Physiology*, 112, 811–820. <https://doi.org/10.1007/s00421-011-2037-6>
- Dushanin, S. A. (1986). System of multi-factor Express diagnostics of functional readiness of athletes at current and operational medical and pedagogical control: *Physical Culture and sport*.
- Ganapolsky, V.P., Matytsin, V.O., & Rodichkin, P.V. (2019). Complex use of hypoxic training and pharmacological corrections to improve performance of mountaineers. *Teoriya i Praktika Fizicheskoy Kultury*, (3), p. 34.
- Kumstát, M., Struhár, I., Hlinský, T., & Thomas, A. (2019). Effects of immediate post-exercise recovery after a high intensity exercise on subsequent cycling performance. *Journal of Human Sport and Exercise*, 14(2), 399-410. <https://doi.org/10.14198/jhse.2019.142.12>
- Maciejczyk, M., Wiecek, M., Szymura, J., Szygula, Z., & Brown, L.E. (2015). Influence of Increased Body Mass and Body Composition on Cycling Anaerobic Power. *The Journal of Strength and Conditioning Research*, 29(1), 58–65. <https://doi.org/10.1519/jsc.0000000000000727>

- Novak, A.R., & Dascombe, B.J. (2014). Physiological and performance characteristics of road, mountain bike and BMX cyclists. *Journal of Science and Cycling*, 3(3), 9–16.
- Porter, Fenton, and Reed. (2019). The effects of hyperoxia on repeated sprint cycling performance & muscle fatigue. *Journal of Science and Medicine in Sport*, 22(12), 1344-1348. <https://doi.org/10.1016/j.jsams.2019.07.001>
- Prieur, and Mucci. (2013). Effect of high-intensity interval training on the profile of muscle deoxygenation heterogeneity during incremental exercise. *European Journal of Applied Physiology*, 113(1), 249–257. <https://doi.org/10.1007/s00421-012-2430-9>
- Spencer, M., Bishop, D., Dawson, B., & Goodman, C. (2005). Physiological and Metabolic Responses of Repeated-Sprint Activities: Specific to Field-Based Team Sports. *Sports Med*, 35(12), 1025–1044. <https://doi.org/10.2165/00007256-200535120-00003>
- Spierer, D. K., Goldsmith, R., Baran, D. A., Hryniewicz, K., & Katz, S. D. (2004). Effects of active vs. passive recovery on work performed during serial supramaximal exercise tests. *Int J Sports Med*, 25(2), 109–114. <https://doi.org/10.1055/s-2004-819954>
- Sousa, A., Figueiredo, P., Zamparo, P., Vilas-Boas, J.P., & Fernandes, R.J. (2013). Anaerobic alactic energy assessment in middle distance swimming. *European Journal of Applied Physiology*, 113(8), 2153–2158. <https://doi.org/10.1007/s00421-013-2646-3>



Practices of pedagogical skills in the implementation of courses in the field of physical education and sports in a distance format

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ABSTRACT

In modern conditions, no one doubts that physical culture and sports are useful and necessary for every person. A team of SPbPU authors have developed and introduced into the educational process of MOOC courses "Physical culture" in 2016, "Fundamentals of the training process of cybersports men" in 2020, posted on the National portal "Open Education". The Physical Education online course can be one example of organizing such resources. Today (and especially during a pandemic) this is one of the most popular courses with a massive audience. At the Polytechnic University, it is involved in all curricula and is compulsory for all students. Our research is devoted to further prospects for the development of the resource. Of course, it is very difficult to define the concept of "pedagogical skill" in the context of this article. However, we tried to do this, highlighting the main, from our point of view, the criteria of pedagogical excellence, which are necessary for the high-quality implementation of courses in a distance format. The online resources we have created allow us to stimulate and motivate students for personal development, organize their educational activities, including building a training system, organize pedagogical activities, monitor the success of students' development of resources, and structure classes. The implemented system made it possible to organize training during the COVID-19 pandemic without interruptions and without reducing the quality of education.

Keywords: Performance analysis of sport, Physical conditioning, Teaching skills, Online courses, Physical education, Distance learning.

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INTRODUCTION

Universal digitalization brings change to many aspects of our daily lives, including the educational process. However, its implementation should be justified, phased and gradual; qualitative changes should have no sudden “leaps” that disrupt the progress in the training process (Bespalko, 1995; Bakayev et al., 2018; Kerry, 2021; Littlejohn & Milligan, 2015; Makarova & Makarova, 2018; Garavan et al., 2020; Olesov et al., 2020; Bolotin, & Bakayev, 2017).

The spring-autumn period of 2020 (lockdown) required urgent and disruptive decisions in order to keep the educational process going. Unfortunately, not all universities were prepared to make this transition. Implementation of Emergency Remote Teaching required involvement of additional human and information resources (Figure 1).

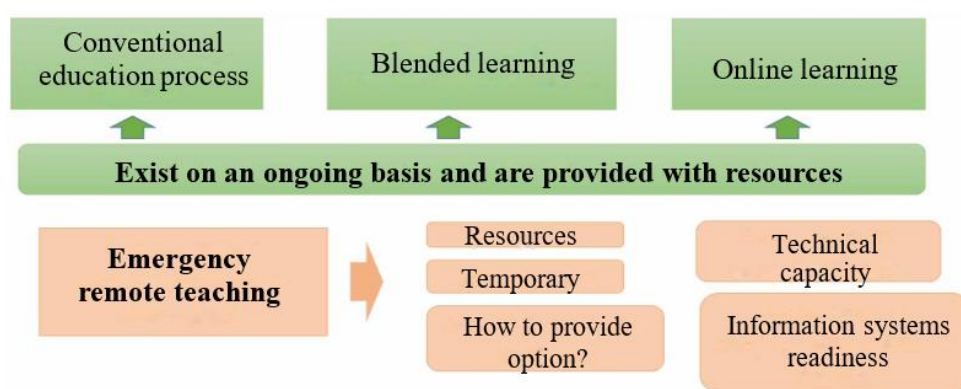


Figure 1. Key differences in organization of conventional and emergency training.

Despite all challenges of the pandemic, it was necessary to ensure both quality of the educational process and its full implementation in accordance with the curricula. Teaching Physical Education online raised many questions that had to be resolved in an unusual format of training. Based on the available experience, teachers of our University have implemented the educational process at due level of quality during this difficult period. However, any information technology or online resource would be of limited use, were it not for the pedagogical excellence of the faculty.

MATERIAL AND METHODS

Analysis of literature showed that many famous teachers and psychologists had delved into the topic of pedagogical excellence. V.A. Slasterin (2002) wrote that... *“among teachers, the opinion was firmly established that the pedagogical excellence is purely individual, so it cannot be directly transferred. However, from balance between technology and mastery, it is apparent that pedagogical technology can indeed be mastered; like any other, is not only mediated, but also determined by the personal parameters of the teacher. One and the same technology can be implemented by different teachers showing their professionalism and pedagogical excellence”*.

Other researchers argue that pedagogical excellence is the highest level of mastery of pedagogical technology; however, *“it is not limited solely to the operational component but is a synthesis of personal and*

professional qualities and properties that determine high efficiency of the pedagogical process” (Bolotin, & Bakayev, 2018).

The team of authors from Peter the Great St. Petersburg Polytechnic University has developed and implemented Massive Open Online Courses published at Open Education National Portal (<https://openedu.ru/>). Implementation of online courses prompted a conclusion that a teacher of higher education should seek to combine scientific and educational activities and possess a whole range of digital competencies that he or she can use in constructing an educational process in digital environment. In the course of our study, we have established the main qualities and skills that a physical education teacher should possess in order to deliver an online training course. Those were:

- Excellence in organizing group work of students;
- Excellence in organizing individual work of students;
- Excellence in transfer of knowledge and skills on organization of physical education and sports classes;
- Excellence in involving students in educational and sports activities.

Pedagogical excellence is closely interlinked with pedagogical technology. Perfect knowledge of pedagogical technology is the definition of excellence. Thus, it can be concluded that pedagogical excellence in the digital environment is additionally measured by the digital competencies of teachers in delivering their disciplines. Despite the fact that in the digital environment the problem of upbringing is understudied, in physical education this aspect of pedagogical technology is quite relevant.

Pedagogical technologies are usually represented by didactic technologies and upbringing technologies, namely:

- Technology for transfer of knowledge and technology for personality development;
- The technology chain of the actions sequence arranged in accordance with target assumptions having the form of a specific expected result;
- Technologies implementing the principles of individualization and differentiation, enabling optimal fulfilment of human and technical capabilities and dialogue;
- An integral part of pedagogical technology consists in diagnostic procedures containing criteria, parameters and tools for measuring performance (Pikan, 2005; Toni Mohr, et al., 2012; Suárez-Llorca, et al., 2010; Bakayev, 2015; Obidallah et al., 2019; Popovic, et al., 2021; Yan, et al., 2021).

RESULTS AND DISCUSSION

Pedagogical technologies implemented during organization and delivery of the Physical Education discipline in the digital environment suggest a fairly high level of pedagogical excellence of the teaching staff. As a result of the introduction and integration of online courses into the curriculum, the team of authors gained an invaluable experience.

For the first time, the course was launched in 2016. It was a highly non-typical course due to its subject matter. However, the authors of the course seriously worked through the material to create suitable content, including video and tests. At the initial stage in 2016, the authors of the course did not aim at practicing hands-on skills; it was solely devoted to the theory of physical education.

Today, the total number of students on the course exceeded 63,000; the course is included in Top 3 at the platform by the number of students attending it Figure 2. During the pandemic (spring semester of 2020), more than 15 Russian universities included this course in their educational process.

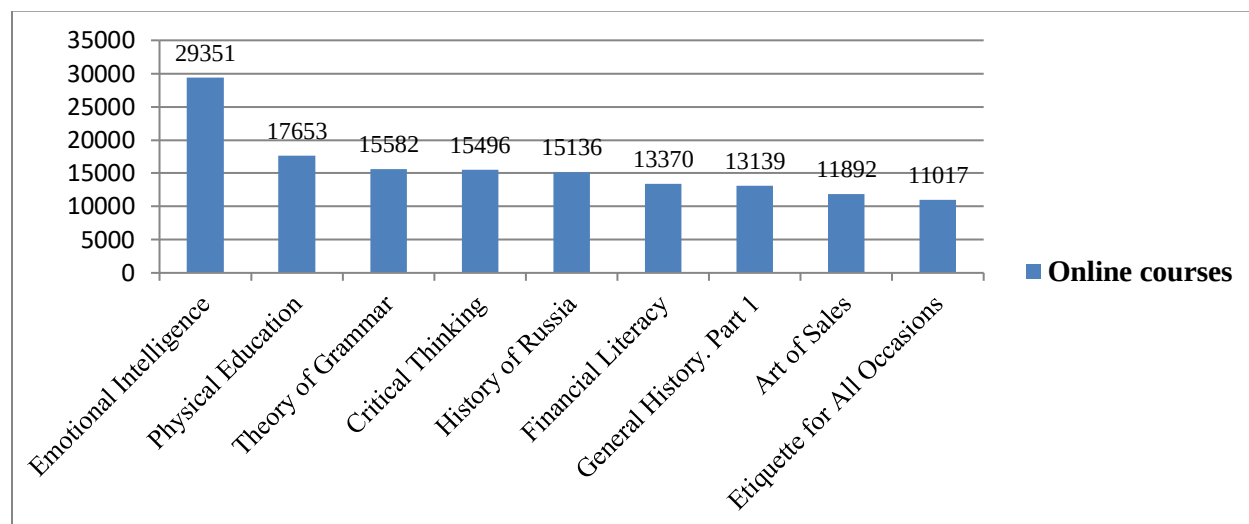


Figure. 2 Number of students in the Open Education National Portal courses in spring 2020.

Table 1. Procedural and descriptive aspect of online course design.

Planned result	Course organization	Methodological requirements
Forming the knowledge competencies of students in the field of theoretical and methodological practical principles of physical education and healthy living	The theoretical material including videos (duration – up to 10 minutes) delivering theory and case studies, summaries and presentations	<i>Systematic arrangement.</i> Clear learning plan. Transparent grading system. Available deadlines and explained consequences of failure to meet them.
Development of personal healthcare and physical self-improvement skills	Material for self-development. Training process arrangement rules. Training load control rules.	<i>Manageability.</i> Diagnostic targeting of the material. Possibility to plan the educational trajectory in order to correct the results.
Improvement and development of skills of independent use of methodological principles of physical education	Material for self-development and self-testing, including tasks on developing a training schedule and self-check plan.	<i>Reproducibility.</i> The used pedagogical technologies and recommendations on the organization of the course (methodological recommendations for teachers) help conduct classes at various universities of the Russian Federation, apart from the developer university.
	Theoretical knowledge check-up tests	

The course owes its success, among other things, to its good selection of pedagogical technologies. Distinguished researcher V.P. Bespalko defined pedagogical technology as “*a meaningful technique for implementing the educational process*”. Pedagogical technology has a procedural and descriptive aspect which is closely related to the design of the online course (Table 1).

During the pandemic period, methodological recommendations were developed for personal physical training in a variety of sports, as it was necessary to organize practical classes. The principles laid down in the theoretical material helped students build the correct training system, and the practical part was therefore implemented quite quickly.

Practicing teachers who conducted physical education classes recorded video content demonstrating the exercising process. In the case of team sports, those were individual trainings of players. According to the methodology set out in the theoretical part, students were asked to prepare a schedule of trainings and also schedules for recording their achievements and general health status.

The Institute of Physical Education, Sports and Tourism of Peter the Great St. Petersburg Polytechnic University (IFKST SPbPU) is registered within the remote training system of SPbPU on a separate portal <https://dl-ifkst.spbstu.ru/> posting videos of practical exercises, webinar rooms (for teacher and student meetings if necessary), and additional methodological recommendations (Figure 3).



Figure 3. IFKST portal in SPbPU remote training system.

CONCLUSION

The practice of implementing the discipline in “*full online*” format or “*emergency remote learning*” format in spring 2020 showed that despite the quite high level of educational process organization and almost complete absence of negative feedback from students, improvement of the following is required:

- Enhancing the digital competencies of all teachers involved in the implementation of the discipline. This will make training more effective and introduce a competitive component even between students who are far away from each other;
- Redesigning the main theoretical course, supplementing it with interactive elements that allow to carry out the corrective effect of the training trajectory (self-training) depending on the obtained results (interactive feedback);
- Supplementing and revising the course on the IFKST portal, matching the monitoring of successful completion of the practical part of the discipline with the sections of the main theoretical course. This will enable implementation of the pedagogical mono technology and the unity of information

environments for organizing and managing the educational process using various types of diagnostics and monitoring.

AUTHOR CONTRIBUTIONS

Conceptualization, V.B. and S.K.; methodology, S.K.; software, V.V.; data analysis, S.K., V.B. and V.V.; investigation, SK., V.B. and V.V.; data curation, S.K., V.B.; writing-original draft preparation, V.B.; writing-review and editing, V.B. and V.V. All authors have read and agreed to the published version of the manuscript.

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REFERENCES

- Bakayev, V. (2015). Determining the significance of practical military skills applied by the special purpose regiments of the Internal Troops of the Russian Ministry of Internal Affairs to deliver combat objectives. *Journal of Physical Education and Sport*, 15(4), pp. 615-618.
- Bakayev, V., Vasilyeva, V., Kalmykova, S., & Razinkina, E. (2018). Theory of physical culture - a massive open online course in educational process. *Journal of Physical Education and Sport*, 18(1), 293- 297. DOI: 10.7752/jpes.2018.01039
- Bespalko V.P. (1995). Pedagogy and progressive teaching technologies. Moscow, p412.
- Bolotin, A., & Bakayev, V. (2017). Success criteria of the pedagogical pattern of physical training on self-guide basis with individual assignments among futsal referees. *Journal of Human Sport and Exercise*, 12(3), 607-615. <https://doi.org/10.14198/jhse.2017.123.05>
- Bolotin, A., & Bakayev, V. (2018). Scientific and Theoretical Prerequisites for Improvement of Modern Pedagogical Technologies, In N. Llevot-Calvet & O. Bernad (Eds.) *Advanced Learning and Teaching Environments* Núria Llevot, IntechOpen (pp. 195-221). Cervera: IntechOpen. <https://doi.org/10.5772/intechopen.72342>
- Garavan, T., O'Brien, F., Duggan, J., Gubbins, C., Lai, Y., Carbery, R., Heneghan, S., Lannon, R., Sheehan, M. & Grant, K. (2020). Learning and Development Effectiveness in Organisations: An Integrated Systems-Informed Model of Effectiveness. <https://doi.org/10.1007/978-3-030-48900-7>
- Kerry, T. (2021). *Ethics for Teachers and Middle Leaders: A Practical Guide* (1st ed.). Routledge. <https://doi.org/10.4324/9781003136606>
- Littlejohn, A. and Milligan, C. (2015). Employers are becoming aware of the potential of Massive Open Online Courses (MOOCs) as a significant form of learning for work. *eLearning Papers* 42.
- Makarova E. and Makarova E. (2018). "Blending pedagogy and digital technology to transform educational environment." *International Journal of Cognitive Research in Science Engineering and Education*, vol. 6, no. 2, pp. 57–65. <https://doi.org/10.5937/ijcrsee1802057m>
- Obidallah, W.J., Raahemi, B. and Ruhi, U. (2019). Clustering and association rules for web service discovery and recommendation: a systematic literature review. *SN Comput. Sci.* 1(1), 1–33. <https://doi.org/10.1007/s42979-019-0026-8>

- Olesov, N. P., Sergin, A. A., Alekseev, V. N., Nikiforov, N. V., & Baishev, I. I. (2020). Preparing Students of the Institute of Physical Education and Sport to Use Distant Learning Technologies in the Course of Pandemic. *Journal of Educational Psychology - Propósitos y Representaciones*, 8(S3), e709. <https://doi.org/10.20511/pyr2020.v8nspe3.709>
- Open Education – Retrieved from: <https://openedu.ru/>
- Pikan B.V. (2005). *Management of Variative Education in School*. Monograph. - Moscow, - 270 p.
- Popovic, S., Zarubica, M., Vukovic, J., & Matic, R. M. (2021). Attitudes and Preferences of Students in Sports Science Concerning the Use of E-Learning and Social Media at the University of Novi Sad. *Sport Mont*, 19(2), 11-15. <https://doi.org/10.26773/smj.210616>
- Slastenin V.A., Isaev, E.N. & Shiyanov; Ed. (2002). *Pedagogy*. Textbook for students of higher educational institutions. – Moscow. Publishing Center "Academy", - 380 c.
- Suárez-Llorca C, Carrasco-Embuena V, Fourcade-López A, Chinchilla-Mira JJ, & Andreu-Cabrera E. (2010). The effects of the use of blogs on the learning process of sea sports in the framework of higher education. *J. Hum. Sport Exerc.*, 5(2):288-294. <https://doi.org/10.4100/jhse.2010.52.16>
- Toni Mohr, A., Holtbrugge, D., & Berg, N. (2012). Learning style preferences and the perceived usefulness of eLearning. *Teaching in Higher Education*, 17(3), 309-322. <https://doi.org/10.1080/13562517.2011.640999>
- Yan L., Yin C., Chen H., Rong W., Xiong Z. & David B. (2021) Learning Resource Recommendation in E-Learning Systems Based on Online Learning Style. In: Qiu H., Zhang C., Fei Z., Qiu M., Kung SY. (eds) *Knowledge Science, Engineering and Management. KSEM 2021. Lecture Notes in Computer Science*, vol 12817. Springer, Cham. https://doi.org/10.1007/978-3-030-82153-1_31



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Development of a scale to measure moral disengagement for occupational gains to enhance our understanding of the use of Performance and Image Enhancing Drugs (PIEDs) in the workplace

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ABSTRACT

Performance and Image Enhancing Drugs (PIEDs) are a cause of concern for those seeking to reduce health harms and associated transgressive behaviour. This form of behaviour is associated with moral disengagement and is collectively used to refer to acts that can have negative interpersonal consequences (Kavussanu, 2019). Moral disengagement (Bandura 1991) refers to cognitive mechanisms that separate our moral values from our actions, resulting in behaviour that conflicts with our moral values. This model has been used to theorise the use of PIEDs for occupational performance gains - for instance, in the police or in private security- with the development of the psychometric Moral Disengagement for Occupational Gains Scale. In this investigation, 84 participants (34 PIED and 50 Non-PIED users) from 10 occupations completed an online questionnaire, shared via social media. The questionnaire was based on an 8-factor model proposed by Bandura et al. (1996), with items adapted from validated scales investigating doping in sport. Twenty items measured the following factors: Moral Justification, Euphemistic Labelling, Advantageous Comparison, Diffusion of Responsibility, Distortion of Consequences and Displacement of Responsibility. Participants completed the questionnaire using a 7-point scale (1 = strongly disagree to 7 = strongly agree). The Moral Disengagement for Occupational Gains Scale (MDOGS) has demonstrated initial psychometric properties that support the use as a valid and reliable measure of moral disengagement for research into the use of PIEDs in an occupational context.

Keywords: Sport medicine, Moral behaviour, Workforce behaviour, Occupation.

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INTRODUCTION

This study provides an original approach towards moral disengagement and the use of Performance and Image Enhancing Drugs (PIEDs) from an occupational perspective. The mechanism of moral disengagement has been a fertile base for research across many disciplines when analysing transgressive behaviour (Moore, 2015). The notion of transgressive behaviour has been a focus in the context of 'doping' in sport. This term is used to reflect the use of prohibited substances or methods to enhance performance (Nolte, Krüger and Fletcher, 2014). This directed a 'narrative of worry' over concerns (Ljungqvist, 2016) over doping substances (e.g., PIEDs) transitioning from sport into the public domain. Our study proposes an alternative narrative, in which sport is viewed as an occupation, and one of several where PIEDs are used for occupational gains. In the same way that an athlete is an employee in their sport uses PIEDs to improve performance above their normal ability (Ahmadi & Svedsäter, 2016), then some employees in public service roles (e.g., police, military, and private security) use PIEDs to similarly improve their occupational performance (O'Hagan & Walton, 2015).

The use of PIEDs outside of sport in occupations include private security (Monaghan, 2002), police (Turvey & Crowder, 2015) and military occupations (Bray et al, 2009; Goldman et al, 2019). These occupations commonly have extreme fitness and physical strength as desirable job characteristics (Fogel, 2012, Wicks, 2017). We believe that the narrative should be driven towards a focus on employment-related PIED use, as there is evidence that the workplace is a source of PIEDs (Santos and Coombe, 2017) and that work colleagues contribute to relationships that encourage their use (Rowe et al., 2016). If the narrative is changed to focus on the occupational use of PIEDs, then it can be used to understand moral disengagement that encourages transgressive behaviour in the workplace more broadly (e.g., workplace misconduct behaviours). In this study, we examine this using Bandura's (1991) Social Cognitive Theory of Moral Thought and Action theory.

There are various reasons proposed for why certain occupations are at a greater risk of using PIEDs. Firstly, these occupations could be seen to operate within the social ecology of hypermasculinity. This has been attributed to occupations such as the police and private security, in which a hypermasculine physique is desirable to enhance ability to intimidate (Higate, 2013). In these occupations there is emphasis on masculinity with femininity devalued (Southern, 2018). This is seen through the valuing of traits such as fearlessness, heroic demeanour, physical strength, emotional strength, assertiveness, and intelligence (Kurtz, 2008).

Secondly, readiness for conflict and threat to life motivate PIEDs-use in some occupations. This has been referred to as the 'functional argument'. Hoberman (2017) suggests this argument can apply to a variety of male action-dominated occupational roles. The functional user believes that their 'survival' depends on their physical ability, as they are liable to hostility and threats to their safety (Matthews, 2001). This preparation rationale is seen in other roles such as the military in which PIED use is not exclusive to deployment but also with training (Casey et al, 2014). Yet in all these occupations the social assumptions associated with PIEDs (Salasuo & Piispa, 2012) could undermine their professionalism regardless of the justification for using PIEDs.

The link between moral disengagement and workplace behaviours in different occupations highlights the need to develop a measure of moral disengagement that is indexed to the use of PIEDs in specific occupations. Within these occupations each employee has the right to choose and make potentially harmful decisions; that using these drugs does not make one 'vulnerable' (Harvey, 2018). Employees also rationalise

their PIED use (Petróczi, 2013) even if doing so can result in violating their employment contract. Instead of seeing PIEDs-using employees as vulnerable or deviant and apt for regular drug-testing (which might not be cost efficient), they can be identified and supported. If those more likely to morally disengage and take risks to meet the demands of their profession can be identified, they can be supported in a way that maintains their moral agency.

This research is guided by the Social Cognitive Theory of Moral Thought and Action (Bandura, 1991). This theory refers to how moral disengagement can reduce the inhibitive aspect of morality and affect how we regulate behaviour, resulting in transgressive behaviour (Boardley & Kavussanu, 2011).

Under the collective term of 'moral disengagement' Bandura (1991) outlines that there are eight mechanisms that can change how we behave. These are separated into four different aspects of harmful conduct. The first domain refers to reprehensible behaviour proposed by Bandura that includes moral justification (MJ), euphemistic labelling (EL) and advantageous comparison (AC). This mechanism for moral disengagement is associated with the unacceptable behaviour that is rationalised as socially acceptable (MJ), where language can be used to present reprehensible behaviour as respectable (EL) and where the behaviour is compared to other behaviours, so that they show the advantage or negligible consequences (AC). Secondly Bandura (1991) outlines the next domain as agents of responsibility. This contains two mechanisms, which are displacement (DoR)- and diffusion- of responsibility (DloR). This domain allows a chain of command (DoR) or group decisions (DloR) to be blamed for the behaviour.

Bandura (1991) outlines the third and fourth domains as the victim and the effect of the behaviour. The domain of detrimental effects includes two mechanisms: Distortion of Consequences (DoC) and Dehumanisation (DH). When a behaviour has an outcome that harms another, then the perpetrator denies or minimises the consequences (DoC). Another way to rationalise the behaviour is to remove the human qualities of the victim (DH). Finally, the victim domain consists of one mechanism referred to as Attribution of Blame. This mechanism allows the perpetrator to cast punitive conduct as a justified response to provocation.

The aim of this study was to develop a valid and reliable instrument for PIEDs in occupational environments that reflects the multidimensional nature of moral disengagement. This study examined the internal reliability and construct-, concurrent- and convergent- validity of the conceptualised scale and tested the pattern and structure coefficients of the final scale.

MATERIAL AND METHODS

Participants

The participants from this study were recruited through social media platforms Facebook and Reddit. On Facebook the focus was Sport and Exercise social media groups while the focus on Reddit was community groups that were set up to discuss PIED use. The approach for the distinct social media allowed for the appropriate population to take part in the study. The total number of respondents was 148 but once the data were screened with non-completion responses removed this resulted in 84 participants. This sample consisted of both PIED users ($n = 34$) and non-PIED users ($n = 50$). The sample consisted of 33 females (39.3%) and 47 males (56.0%) with 3 individuals not disclosing their sex (3.6%). The age characteristics provided a wide range of participants with 26-30 years and 31-35 years consisting of 38% of the sample followed by 36-40 and 41-50 years representing 28.6%. The sample consisted of 10 identified occupations with education representing the largest reported occupation of the sample ($n = 23$, 27.4%). As well as the

occupations identified within the sample the option for 'other' as a choice means that there were more than 10 occupations but that this option was deemed as non-identifiable ($n = 39$, 46.4%) since participants did not disclose their occupation title.

Measures

Items were adapted from existing scales investigating moral disengagement and doping in sport: Mechanisms of Moral Disengagement (Bandura et al, 1996), the Moral Disengagement in Sport Scale (Boardley and Kavussanu, 2007) and the Moral Disengagement in Doping Scale (Kavussanu et al, 2016). This resulted in a total of 58 preliminary items. These were shared with an experienced sport and exercise psychologist to select the most appropriate items for the final questionnaire. This selection was based on the relevance and wording of each item proposed checking for any duplication. Lastly, the items selected were based on how each item was representative of the moral disengagement mechanisms. The outcome was a 20-items questionnaire that incorporated six of the eight factors from the Bandura et al. (1996) model. Although there are eight mechanisms of moral disengagement proposed by Bandura (1991) research associated with doping has shown that attribution to blame and dehumanisation to not emerge from qualitative studies, demonstrating less importance compared to the remaining six mechanisms (Kavussanu et al, 2016). These mechanisms are moral justification (four items), euphemistic labelling (four items), advantageous comparison (four items), displacement of responsibility (two items), diffusion of responsibility (three items) and distortion of consequences (three items). The questionnaire adopted a 7-point Likert scale and was based on the study by Jackson & Sparr (2005). The choice of this numbered Likert scale is due to its higher internal consistency (Preston & Colman, 2000). The negative pole is to the left and the positive to the right, with available responses ranging from 1 (Strongly Disagree) to 7 (Strongly Agree).

Procedures

This study used the Internet-mediated research approach, complying with the British Psychological Society's (2017) ethical requirements for remote acquisition of data from humans. Ethical approval was provided by the University of Sunderland Research Ethics Group. Participants were required to be 18+ years and have at least six months' job experience. Qualtrics (Provo, UT) software was used to allow the format of the instrument to be shared electronically as an aid to recruitment. When the instrument was finalised in Qualtrics, the link to the instrument was shared via Facebook and Reddit to encourage recruitment. This link was open for prospective participants for six weeks. Data collected via the instrument were then downloaded as a SPSS file and transferred to the IBM Statistical Package for Social Sciences (version 26.0 for Windows, SPSS Inc., Chicago IL) for statistical analysis.

Data analysis

Prior to item analysis, content analysis was conducted. This involved the use of previously published instruments and the expert opinion of a sport and exercise psychology professional to refine the items originally proposed (from 58 to 20). Psychometric properties of item reliability and measurement of error were determined using Cronbach's alpha score and Item total statistics for each scale. Cronbach's alpha scores were determined using the recommended maximum alpha value of 0.90 (Tavakol & Dennick, 2011), with reliability of item inclusion following Field's (2012) guidance of $< .3$ for corrected Item-Total Correlation scores.

Upon confirmation of item inclusion, Principal Component Analysis (PCA) was used to test the fit of a series of models of the inventory. All statistical assumptions were tested. For acceptance or rejection of the model, fit indices were used: Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy for the overall data set and Bartlett's test of sphericity. The latter was tested using the significance level ($< .05$) to confirm if there was an identity matrix. Factor extraction was used to identify the appropriate number of Eigenvalues to be used in

the PCA process along with two processes associated with Scree analysis. The first method was the Guttman (1954) rule in which all factors of Eigenvalues greater than 1.0 are retained (Warne and Larsen, 2014). The next was Cattell (1966) Scree plot approach. This consisted of producing a heuristic graph representation consisting of the Eigenvalues (y-axis) and components (x-axis) and inspecting the Scree plot for the last significant drop in the line plot (Ledesma et al, 2015).

A Direct Oblimin oblique rotation with Kaiser Normalization was used to produce the pattern and structure coefficients. This rotation is based on the correlation between the extracted factors and provides a pattern-, structural- and component correlation matrix (Hadi et al, 2016). Factor scores screened for minimum factor loadings and possible cross-loading based. This was based on Worthington and Whittaker's (2006) recommendations of minimum factor loading (.32) and cross loadings (less than .15 from the item's highest factor loading). The loading of these factors was used to assess the construct and discriminatory validity of this instrument. IBM SPSS (version 26.0 for Windows, SPSS Inc., Chicago IL) was used for all statistical analysis outlined above.

RESULTS

Descriptive statistics

Table 1. Descriptive statistics for each scale in sample.

Moral disengagement mechanism	Item	M (SD)
Moral justification	It is all right to use drugs when the environment that you work in is hostile	2.04 (1.54)
	Using PIEDs is all right because it helps you cope with work	2.45 (1.68)
	When you feel threatened at work it is ok to use drugs that can help achieve a positive outcome	2.26 (1.72)
Euphemistic labelling	Using PIEDs to help with job performance is not cheating but an 'aid' to help achieve a means	3.38 (2.11)
	Using PIEDs is a way to 'maximize potential'	4.40 (2.19)
	Using PIEDs is just a 'little helper'	2.98 (1.98)
	There are worse drugs to use than PIEDs that are more addictive	5.27 (1.90)
Advantageous comparison	Compared to the illegal things people do in everyday life, using PIEDs is not very serious	4.00 (2.02)
	PIED use will not hinder fellow employees, they just enhance that person	3.46 (1.96)
	They are not as harmful as other substances, such as tobacco and alcohol	3.89 (1.96)
Displacement of responsibility	If a manager does not discourage PIED use, then those using these drugs should not be disciplined	2.76 (2.00)
	People cannot be blamed for using PIEDs at work if they feel pressure to do it	2.20 (1.56)
Diffusion of responsibility	It is unfair to blame the person using PIEDs if they feel that they have been pressurised by other to do so	2.54 (1.69)
	If a manager encourages breaking rules at work, then using drugs to achieve these outcomes is not an individual's responsibility	2.19 (1.60)
	Users cannot be blamed for using PIEDs if everyone at work is doing it	2.24 (1.67)
Distortion of consequences	The negative side effects are exaggerated by the employer	3.30 (2.02)
	Using PIEDs does not really harm anyone	3.46 (2.20)
	The risks associated with using PIEDs are exaggerated	3.68 (2.15)

Table 1 outlines the mean scores and accompanying standard deviation for the occupational PIED inventory. These have been separated into the moral disengagement mechanisms for each associated item. For each item, the mean score has been provided with the standard deviation in parenthesis.

Item analysis of moral disengagement (occupational) scale

Cronbach's alpha score was computed to determine item reliability and measurement of error. Initial case processing for Cronbach's alpha was $\alpha = .950$ based on 20 items. As the inventory is based on six moral disengagement constructs, the alpha level was calculated for each construct individually (Tavakol & Dennick, 2011). The resulting alpha scores are present in Table 2.

Table 2. Item analysis summary.

Moral disengagement mechanism	α	Index of measurement error	N of items
1. Moral disengagement (items 01-04)	.832	0.32	4
2. Advantageous comparison (items 09-12)	.893	0.21	4
3. Diffusion of responsibility (items 15-17)	.802	0.32	3
4. Euphemistic labelling (items 05-08)	.779	0.41	4
5. Displacement of responsibility (items 13-14)	.596	0.36	2
6. Distortion of consequences (items 18-20)	.891	0.21	3

Note. The sample size ($n = 84$) and Cronbach alpha is denoted by the α symbol. Index of measurement error was calculated by squaring the correlation and subtracting from 1.00.

Cronbach alpha scores for moral disengagement, euphemistic labelling, advantageous comparison, diffusion of responsibility and distortion of consequences demonstrated excellent internal reliability with α scores that do not surpass the recommended maximum alpha value of 0.90 (Tavakol & Dennick, 2011). Displacement of responsibility had an α score ($\alpha = .596$) that warranted further investigation as to whether there was a need to remove this construct from the final scale. Four of these subscales (Advantageous Comparison, Displacement of Responsibility, Diffusion of Responsibility and Distortion of Consequences) had acceptable correlations. Deleting any items for these subscales would have no significant impact on the corresponding alpha scores to warrant item removal. Scale analysis for Moral Justification and Euphemistic Labelling resulted in item adjustment, which improved Cronbach's alpha scores. The removal of the Moral justification item '*Using PIEDs would help to provide for one's family*' increased the Cronbach's alpha score from .832 to .869. The removal of the Euphemistic labelling item '*Describing it as using 'roids', 'gear' and 'juice' makes it sound acceptable*' increased the Cronbach's alpha score from .779 to .835.

Principal Component Analysis results

A Scree plot analysis was completed, confirming that there were two Eigenvalues. The total variance achieved from the two factors equals 68.37%. The first Eigenvalue is equal to 9.774 and explained 54.29% of the variance in the original data. The second Eigenvalue is equal to 2.535 and explained 14.08% of the variance in this data set. Although there is potentially a third Eigenvalue, this equates to only .975 and explains only 5.41% of the variance; in this instance the acceptance of two Eigenvalues confirms the original notion of the Guttman (1954) rule (Larsen and Warne, 2010) and reinforces the Scree plot assessment associated with the Cattell (1966) Scree plot approach. However, as the Guttman (1954) rule of Eigenvalues needing to be > 1.0 is an arbitrary value (Larsen and Warne, 2010), the PCA was repeated as three Eigenvalues instead of two, to see if there was any difference in the loading against the factors. The result was that there was no significant loading to the third factor, so the data forthcoming refers to the 2-factor analysis.

A Direct Oblimin oblique rotation was applied to produce the pattern and structure coefficients. The resulting communalities were confirmed to all be above .3 (Table 3). This confirms that each item shared some common variance with other items. The result was that factorial analysis was appropriate for the 18 items.

Due to the loading of the items, the pattern matrix results confirmed construct validity. Also, discriminatory validity was achieved as the relationship between items and the rest of the factors was low. This meant that items loaded highly to either factor 1 or 2 rather than highly on both factors.

Table 3. Pattern and structure matrix for vocational inventory.

Items	Pattern coefficients		Structure coefficients		Communalities
	Component		Component		
	1	2	1	2	
It is all right to use drugs when the environment that you work in is hostile	.952	-.239	.927	.383	.674
Using PIEDs is all right because it helps you cope with work	.949	-.049	.877	.318	.624
When you feel threatened at work it is ok to use drugs that can help achieve a positive outcome	.923	-.102	.855	.486	.580
Using PIEDs to help with job performance is not cheating but an 'aid' to help achieve a means	.799	.122	.846	.493	.730
Using PIEDs is a way to 'maximize potential'	.784	.136	.843	.194	.756
Using PIEDs is just a 'little helper'	.780	.060	.840	.493	.597
There are worse drugs to use than PIEDs that are more addictive	.777	.140	.807	.415	.556
Compared to the illegal things people do in everyday life, using PIEDs is not very serious	.772	-.063	.777	.492	.861
PIED use won't hinder fellow employees, they just enhance that person	.698	.175	.744	.288	.722
They are not as harmful as other substances, such as tobacco and alcohol	.592	.295	.733	.644	.654
If a manager does not discourage PIED use, then those using these drugs should not be disciplined	.555	.391	.727	.565	.659
People cannot be blamed for using PIEDs at work if they feel pressure to do it	-.162	.957	.274	.883	.801
It is unfair to blame the person using PIEDs if they feel that they have been pressurised by other to do so	-.170	.858	.466	.817	.633
If a manager encourages breaking rules at work, then using drugs to achieve these outcomes is not an individual's responsibility	.112	.764	.460	.815	.634
Users cannot be blamed for using PIEDs if everyone at work is doing it	.119	.763	.476	.785	.679
The negative side effects are exaggerated by the employer	.150	.716	.221	.781	.628
Using PIEDs does not really harm anyone	.266	.632	.554	.753	.743
The risks associated with using PIEDs are exaggerated	.295	.580	.560	.715	.777

Note. Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization. Bold items indicate major factor loadings.

Factor scores (Table 4) were screened for minimum factor loadings (.32) and possible cross-loading ($< .15$), based on the suggestions of Worthington and Whittaker (2006). Four items were removed resulting in a decrease from 18-items to 14-items due to cross loadings above the .15 threshold. The four items removed were *'They are not as harmful as other substances, such as tobacco and alcohol'*, *'If a manager does not discourage PIED use, then those using these drugs should not be disciplined'*, *'Using PIEDs does not really harm anyone'* and *'The risks associated with using PIEDs are exaggerated'*.

Table 4. Factor labelling.

Factor 1: Social normalisation of PIED use	Factor loading	Mechanism
It is all right to use drugs when the environment that you work in is hostile	.952	Moral justification
Using PIEDs is all right because it helps you cope with work	.949	
When you feel threatened at work it is ok to use drugs that can help achieve a positive outcome	.923	
Using PIEDs to help with job performance is not cheating but an 'aid' to help achieve a means	.799	Euphemistic labelling
Using PIEDs is a way to 'maximize potential'	.784	
Using PIEDs is just a 'little helper'	.780	
There are worse drugs to use than PIEDs that are more addictive	.777	Advantageous comparison
Compared to the illegal things people do in everyday life, using PIEDs is not very serious	.772	
PIED use won't hinder fellow employees, they just enhance that person	.698	
Factor 2: Responsibility and consequences		
People cannot be blamed for using PIEDs at work if they feel pressure to do it	.957	Displacement of responsibility
It is unfair to blame the person using PIEDs if they feel that they have been pressurised by other to do so	.858	Diffusion of responsibility
If a manager encourages breaking rules at work, then using drugs to achieve these outcomes is not an individual's responsibility	.764	
Users cannot be blamed for using PIEDs if everyone at work is doing it	.763	
The negative side effects are exaggerated by the employer	.716	Distortion of consequences

We termed Factor 1 'social normalisation of PIED use', based on the developing social norms and occupational use of these substances. This factor consists of the items that represent moral disengagement (items 1-3), euphemistic labelling (items 6-8), and advantageous comparison mechanisms (items 9-11). For Factor 1 the factor loading ranged from .952 to .698. We termed Factor 2 'Responsibility and Consequences', as this cluster represents the mechanism of displacement of responsibility, diffusion of responsibility and distortion of consequences. This cluster is represented by items 14-20. Within factor 2 the factor loading range was .957 to .716. Within this factor there was more emphasis on diffusion of responsibility when compared to displacement or distortion of consequences. However, the item *'People cannot be blamed for using PIEDs at work if they feel pressure to do it'* is associated with the original mechanism of displacement of responsibility and this achieved the highest factor loading of .957 for factor 2.

DISCUSSION

Moral disengagement has been used to study transgressive behaviour in various disciplines, including Sport (Kavussanu & Ring, 2017), Business (Moore et al, 2012), Military psychology (Stephens, 2014), Law (Osofsky et al, 2005) and Criminology (Fagan et al, 2011). We expanded these disciplines and generated data on occupational use of PIEDs. The occupations in this study contrast with the occupations listed by Fogel (2012) of Police, Military, Fireman, Door supervisor and Personal security. However, the occupation in this study that reflects highest use of PIEDs from the participants recruited through Facebook and Reddit groups was education. This seems to contrast markedly with previous research on PIEDs use. While previous research has concluded that police and other public service employees are far more likely to use PIEDS, this research concluded that 46% of users in this study were from other occupations meaning we should expand our knowledge of occupations that use PIEDs.

As well as providing evidence of occupational PIED use, we confirmed that there were six distinct mechanisms associated with moral disengagement in the context of occupational PIED use. The instrument conceptualized in this research, the Moral Disengagement for Occupational Gains Scale (MDOGS) demonstrated appropriate item validity as well as pattern and structure coefficients of the final instrument model. Construct validity of this instrument was demonstrated by the concurrent and convergent validity of the scale and the discriminatory validity of both sub-scales. These sub-scales were based on the two factors that were formed in the pattern and structure matrix for the inventory, 'Social Normalisation of PIED Use' and 'Responsibility and Consequences'. These two factors incorporated all six mechanisms confirmed in other inventory conceptualisation studies (e.g., Boardley and Kavussanu, 2007). The first factor was a combination of moral justification, euphemistic labelling, and advantageous comparison. The second factor was a combination of displacement- and diffusion- of responsibility and distortion of consequences. As the relationship between the items and the rest of the factors was low, they were associated with only one of the two factors, confirming that the inventory achieved discriminatory validity.

A limitation of this study was attributed to occupational coverage. Due to the complexity of providing all occupations as options in the questionnaire shared with participants there was an option to disclose their occupation as 'Other' and not divulge the title. Due to this then these occupations were classified as unidentifiable occupations. Due to this, occupational performance cannot be identified uncritically as the motive for PIEDs use in unidentified occupations within this study. This is because users associated with unidentifiable occupation could be involved in other activities (e.g., gym or body building activities) that motivate use rather than their employment being the motivating reason for PIED use. However, this study has highlighted that the range of occupations that use PIEDs is wider than first suggested and warrants wider investigation.

CONCLUSION

This study was able to produce a 14-item, 2-factor model outperforming the alternative 3-factor model. This instrument developed in this study incorporates six of the eight proposed mechanisms of moral disengagement proposed by Bandura (1991). The resulting outcome was an instrument entitled The Moral Disengagement for Occupational Gains Scale (MDOGS) consisting of the following subscales: Moral justification (3 items), Euphemistic labelling (3 items), Advantageous comparison (3 items), Displacement of responsibility (1 item), Diffusion of responsibility (3 items) and Distortion of consequences (1 item). The implication of this study is that this context specific instrument, the MDOG instrument has the potential to develop our understanding of which occupations are susceptible to PIED use for job performance. Also, this

instrument is proposed to be used to forge employee-supportive ways to influence health promotion work associated with workplace drug use in occupations where PIED use is associated with job performance motivations.

AUTHOR CONTRIBUTIONS

Data for this study was collected by the first author while all co-authors contributed to the development of this manuscript from the inception to the publication stage.

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REFERENCES

- Ahmadi, N., & Svedsäter, G. (2016). "The winner takes it all"- individualization and performance and image enhancing in sport and in society. In Ahmadi, N., Ljungqvist, A., and Svedsäter, G. (Editors). *Doping and Public Health*. Routledge. Oxford, United Kingdom. pp 38-48. <https://doi.org/10.4324/9781315688428>
- Bandura, A. (1991). Social cognitive theory of moral thought and action. In Kurtines, W. M., & Gewirtz, J. L. (Editors). *Handbook of moral behaviour and development: Theory, research and applications*. Lawrence Erlbaum Associates. Hillsdale, NJ. pp. 71-129.
- Bandura, A., Barbaranelli, C., Caprara, G., & Pastorelli, C. (1996). Mechanisms of Moral Disengagement in the Exercise of Moral Agency. *J Pers Soc Psychol*, 71 (2): 364-374. <https://doi.org/10.1037/0022-3514.71.2.364>
- Boardley, I. D., & Kavussanu, M. (2007). Development and validation of the Moral Disengagement in Sport Scale. *J Sport Exerc Psychol*, 29: 608-628. <https://doi.org/10.1123/jsep.29.5.608>
- Boardley, I. & Kavussanu, M. (2011). Moral disengagement in sport. *Int Rev Sport Exerc Psychol*, 4:2, 93-108. <https://doi.org/10.1080/1750984x.2011.570361>
- Bray, R., Pemberton, M., Hourani, L., Witt, M., Olmsted, K., Brown, J., Weimer, B., Lane, M., Marsden, M., Scheffler, S., Vandermaas-Peeler, R., Aspinwall, K., Anderson, E., Spagnola, K., Close, K., Gratton, J., Calvin, S., & Bradshaw, M. (2009). Department of Defense survey of health related behaviours among active duty military personnel. RTI International. <https://doi.org/10.1037/e645362011-001>
- British Psychological Society. (2017). *Ethics guidelines for internet-mediated research*. Leicester, UK.
- Casey, A., Hughes, J., Izard, R., & Greaves, J. (2014). Supplement use by UK-based British Army Soldiers in training. *Br. J. Nutr*, 112: 1175-1184. <https://doi.org/10.1017/s0007114514001597>
- Cattell, R. (1966). The Scree test for the number of factors. *Multivar. Behav. Res*, 1: 245-276.
- Fagan, J., Shulman, E., Cauffman, E., & Piquero, A. (2011). Moral disengagement among serious juvenile offenders: a longitudinal study of the relations between morally disengaged attitudes and offending. *Dev. Psychol.*, 47: 1-14. <https://doi.org/10.2139/ssrn.1934939>
- Field, A. (2012). *Discovering statistics using IBM SPSS statistics (4th Ed.)*. Sage Publications. London, UK.
- Fogel, C. (2012). Vocational Steroid Use: Reconsidering the Effectiveness of a Prohibition Approach. *Socialinių tyrimų žurnalas*, 3 (1): 25-36.

- Goldman, A., Pope, H., and Bhasin, S. (2019). The Health Threat Posed by the Hidden Epidemic of Anabolic Steroid Use and Body Image Disorders Among Young Men. *J Clin Endocrinol Metab*, 104 (4) :1069-1074. <https://doi.org/10.1210/jc.2018-01706>
- Guttman, L. (1954). Some necessary conditions for common-factor analysis. *Psychometrika*, 19: 149-161. <https://doi.org/10.1007/bf02289162>
- Hadia, N., Abdullaha, N., & Sentosa, I. (2016). An easy approach to exploratory factor analysis: marketing Perspective. *J. Educ. Soc. Res.*, 6 (1): 215-223. <https://doi.org/10.5901/jesr.2016.v6n1p215>
- Harvey, O. (2018). 'Shades of Grey': The Ethics of Social Work Practice in Relation to Unprescribed Anabolic Androgenic Steroid Use. *Practice*, 31 (4): 239-258. <https://doi.org/10.1080/09503153.2018.1510480>
- Higate, P. (2013). Critical impact report: the politics of profile and the private military and security contractor. Bristol: University of Bristol, Global Insecurities Centre.
- Hoberman, J. (2017). Dopers in uniform: police officers' use of anabolic steroids in the United States. From Møller, V., Waddington, I., & Hoberman, J., (Eds.). *Routledge handbook of drugs and sport*. Routledge, NY. <https://doi.org/10.4324/9780203795347-35>
- Jackson, L.E., & Sparr, J.L. (2005). Introducing a new scale for the measurement of moral disengagement in peace and conflict research. *Conflict & Communication Online*, 4 (2): 1-16.
- Kavussanu, M., Hatzigeorgiadis, A., Elbe, A.-M., Ring, C. (2016). The Moral Disengagement in Doping Scale, *Psychol Sport Exerc.*, 24: 188-198. <https://doi.org/10.1016/j.psychsport.2016.02.003>
- Kavussanu, M and Ring, C. (2017). Moral Identity Predicts Doping Likelihood via Moral Disengagement and Anticipated Guilt. *Sport Exerc Psychol*, 39 (4): 293-301. <https://doi.org/10.1123/jsep.2016-0333>
- Kavussanu, M. (2019). Toward an understanding of transgressive behaviour in sport: progress and prospects. *Psychol Sport Exerc*, 42: 33-39. <https://doi.org/10.1016/j.psychsport.2019.01.009>
- Kurtz, D. (2008). Controlled burn: The gendering of stress and burnout in modern policing. *Fem. Criminol.*, 3 (3): 216-238. <https://doi.org/10.1177/1557085108321672>
- Larsen, R., & Warne, R. (2010). Estimating confidence intervals for eigenvalues in exploratory factor analysis. *Behav. Res. Methods*, 42 (3): 871-876. <https://doi.org/10.3758/brm.42.3.871>
- Ledesma, R., Valero-Mora, P., & Macbeth, G. (2015). The Scree test and the number of factors: a dynamic graphics approach. *Span. J. Psychol*, 18 (e11): 1-10. <https://doi.org/10.1017/sjp.2015.13>
- Ljungqvist, A. (2016). Doping and public health- Historical background. In Ahmadi, N., Ljungqvist, A., and Svedsäter, G. (Editors). *Doping and Public Health*. Routledge. Oxford, United Kingdom. pp 11-21. <https://doi.org/10.4324/9781315688428>
- Monaghan, L. (2002). Hard men, shop boys and others: embodying competence in a masculinist occupation. *Sociol Rev.*, 50 (3): 334-355. <https://doi.org/10.1111/1467-954x.00386>
- Matthews, L. (2001). Doors of opportunity: Security staff at risk. *DrugLink*, pp. 14-17.
- Moore, C., Detert, J.R., Trevino, L.K., Baker, V.L., & Mayer D.M. (2012) Why employees do bad things: moral disengagement and unethical organisational behaviour. *Pers Psychol*, 65:1, 1-48. <https://doi.org/10.1111/j.1744-6570.2011.01237.x>
- Moore, C. (2015). Moral disengagement. *Curr Opin Psychol*, 6: 199-204.
- Nolte, K., Krüger, P., and Fletcher, L. (2014). Doping in sport: attitudes, beliefs and knowledge of competitive high-school athletes in Gauteng Province. *S. Afr. J. Sports Med.*, 26 (3): 81-86. <https://doi.org/10.17159/2413-3108/2014/v26i3a103>
- O'Hagan, A., & Walton, H. (2015). Bigger, faster, stronger! an overview of anabolic androgenic steroids and their use and impact on the sport industry. *Forensic Research & Criminology International Journal*, 1 (3): 104-115. <https://doi.org/10.15406/frcij.2015.01.00018>
- Osofsky, M., Bandura, A., & Zimbardo, P. (2005). The role of moral disengagement in the execution process. *Law Hum Behav*, 29 (4): 371-393. <https://doi.org/10.1007/s10979-005-4930-1>

- Petróczi, A. (2013). The doping mindset- Part 1: Implications of the functional use theory on mental representations of doping. *Perform. Enhanc. Health*, 2: 153-163. <https://doi.org/10.1016/j.peh.2014.06.001>
- Preston, C., & Colman, A. (2000). Optimal Number of Response Categories in Rating Scales: Reliability, Validity, Discriminating Power, and Respondent Preferences. *Acta Psychologica*. 104: 1-15. [https://doi.org/10.1016/s0001-6918\(99\)00050-5](https://doi.org/10.1016/s0001-6918(99)00050-5)
- Rowe, R., Berger, I., & Copeland, J. (2016). "No pain, no gainz"? Performance and image-enhancing drugs, health effects and information seeking. *Drug. Educ. Prev. Polic.* <https://doi.org/10.1080/09687637.2016.1207752>
- Salasuo, M., & Piispa, M. (2012). Perspectives to doping substance use outside elite sports in Finland. Finnish Youth Research Network and Finnish Youth Research Society Internet Publications, 123 (52).
- Santos, G., & Coomber, R. (2017). The risk environment of anabolic-androgenic steroid users in the UK: examining motivations, practices and accounts of use. *Int. J. Drug Policy*, 40: 35-43. <https://doi.org/10.1016/j.drugpo.2016.11.005>
- Southern, N. (2018). Political conflict, policing and the challenges of masculinity: The experiences of women officers in the Royal Ulster Constabulary GC. *The Police Journal: Theory, Practice and Principles*, 91 (1): 44-63. <https://doi.org/10.1177/0032258x16687165>
- Stephens, D. (2014). Behaviour in war: the place of law, moral inquiry and self-identity. *Int. Rev. Red Cross*, 96 (895/896): 751-773. <https://doi.org/10.1017/s1816383115000235>
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *Int. J. Med. Educ*, 2: 53-55.
- Turvey, B., & Crowder, S. (2015). Anabolic steroid abuse in public safety personnel: a forensic manual. Elsevier, London. United Kingdom. <https://doi.org/10.1016/b978-0-12-802825-4.00001-4>
- Warne, R., & Larsen, R. (2014). Evaluating a proposed modification of the Guttman rule for determining the number of factors in an exploratory factor analysis. *Psychol Test Assess Model*, 56 (1):104-123.
- Wicks, J. (2017). UK steroid use is on the rise: what does it mean for the legal sector, family law and employers? Retrieved 19th January 2020 at <https://blog.cansfordlabs.co.uk/steroid-testing-the-lowdown>
- Worthington, R., & Whittaker, T. (2006). Scale development research: a content analysis and recommendations for best practices. *Couns Psychol*, 34 (6): 806-838. <https://doi.org/10.1177/0011000006288127>



The relationship of resilience and anxiety in volleyball

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ABSTRACT

The purpose of this study was to investigate the relationship between resilience levels and anxiety of volleyball players and to find possible differences that exist between the two genders. Participants included 195 volleyball players (37 male and 158 female), with the Self Evaluation Resilience test and the CSAI-2 test (Greek version) used as evaluation instruments. The data was analysed with SPSS 21.0 using Pearson's *r* and t-test for independent samples. Results of Pearson's *r* test showed positive intercorrelations between all the resilience variables and between resilience and self-confidence. The t-test showed statistically significant differences between male and female volleyball players in "forming relationships" and "self-efficacy" variables, with no other statistically significant differences observed for the rest of the resilience variables. Additionally, statistically significant differences were observed for "cognitive", "somatic" anxiety and "self-confidence" between the two genders of volleyball players. Future research should further investigate the relationship between resilience and self-confidence and how it affects the resilience level of volleyball players.

Keywords: Physical activity, Sport psychology, Volleyball, Gender differences, Resilience, Anxiety.

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INTRODUCTION

Mental resilience as a general term refers to the positive adjustment of an individual following a traumatic event as well as their ability to recover. According to many authors (Masten & Wright, 2010; Zautra, 2014; Luthar, Crossman, & Small, 2015), recovery, positive adaptation to adversity, and balanced sustainability (physical, emotional, and systemic) are elements of the resilience concept. This, in turn, means that two critical conditions are indirectly related to the concept of resilience; a) exposure to adversity (threat / danger or positive event); and b) achieving a positive adjustment, since the display of resilience primarily requires an athlete to face their difficulty or achieve a positive adjustment (Charney, 2004; Masten & Wright, 2010; Sarkar, Fletcher, & Brown, 2015).

A definition of resilience closely related to sports settings is defined as *“the role of mental processes and behaviour in promoting personal assets and protecting an individual from the potential effect of negative stressors”* (Fletcher & Sarkar, 2012, p. 675, 2013, p. 16). This definition recognizes the support of trait-like protective factors and (mental) processes which define how one adapts to adversity (Fletcher & Sarkar, 2012, 2013; Galli & Gonzalez, 2015).

Research studies show that resilience is strongly associated with the requirements of the adverse event status (Fletcher & Sarkar, 2013; Rutter, 1981) and the interaction of the athlete with the environment (Luthar, Cicchetti, & Becker, 2000; Fletcher & Sarkar, 2012, 2013, Sarkar, & Fletcher, 2014; Sarkar, Fletcher, & Brown, 2015). These distinct, social, cultural and environmental factors affect an individual's overall ability to recover. According to Masten and Wright (2010), although the study of human resilience focuses specifically on understanding these differences due to adverse experiences, resilience should not be assumed as a static characteristic of an individual, as it derives from various processes and interactions that far exceed the human body and include interpersonal relationships and social settings to achieve positive adjustment.

Understanding how an individual acquires the characteristics or properties that make both the process and the result feasible (resilience) (Luthar, Cicchetti, & Becker, 2000), primarily requires the simultaneous study of these elements that allow the appearance and degree of resilience through the perspective of a dynamic process that takes into account the effect of positive adjustment and / or overcoming - which occurs after exposing an athlete to adversity (Waller, 2001).

Relevant research clearly states that internal resilience factors include personality traits, emotion regulation, assessment and problem-solving skills, self-awareness, and various aspects of positive well-being (Smith, Hayslip, Jr., 2012). In addition, positive traits such as forgiveness, optimism, a sense of purpose, and dominance have been identified as important internal aspects of resilience (Masten & Wright, 2010; Zautra, 2014).

Many studies also show that resilience seems to be associated with experiencing positive emotions, optimism and humour. People who have these characteristics possess the ability to observe difficulties from a different perspective than others and to exhibit a positive attitude (Seery, Holman, & Silver, 2010; Seery, 2011). A positive self-image is also a protective factor that plays a very important role in creating resilience, especially when a person recognizes their positive features and has the feeling that they can control their life and future and recover easier from any encountered difficulty. This positive attitude helps an athlete to deal more effectively with difficult situations such as defeat after a game of significant interest for the team and continue with their efforts (Gould, Finch, & Jackson, 1993; Van Geert, 2009).

An external factor possibly related to resilience is the existence of a supportive social network such as the environment of a volleyball team. When an athlete is surrounded by people with mutual understanding, he has the opportunity to express his feelings and receive the appropriate support and acceptance. However, so far no social factor or set of factors have yet been identified that create resilience in highly competitive sports environments such as those within volleyball teams (Rutter, 1981; Galli & Gonzalez, 2015; Patsiaouras 2020a).

Some studies have even reported contradictory results. As an example, Fletcher and Sarkar (2012) noted that high levels of perceived social support were positively associated with resilience, while Mummery, Schofield, and Perry (2004), observed that resilient athletes exhibited lower levels of perceived social support as compared to their non-resilient teammates. Furthermore, not all professionals experience such negative effects. In fact, many of them are particularly resilient even under stressful working conditions (Masten & Wright, 2010). Possibly, setting goals for the athlete and the volleyball team prior and during the season will help players to recover more easily after a negative game result.

In conclusion, resilience is a complicated process and not just an ability that depends exclusively on the athlete, but results from the continuous interactions of different factors related to the individual and his environment over time (Fletcher & Sarkar, 2013; Sarkar, Fletcher, & Brown, 2015). This complex process of resilience is very likely to occur in volleyball during different games or difficult sets.

In volleyball, players are always interacting with each other, with the opponents, the ball, the referees and so on. These actions of the players and their opponents constantly affect each other as they adapt to the continuous scoring changes of the game. Currently, research on resilience has shown that some athletes are able to cope with negative performance and return to a successful one, while others do not deal effectively with such negative transitions that in turn leads to lower performance levels (Kelso, 1995; Scheffer et al., 2012; Schöner & Kelso, 1988; Van de Leemput, et al. 2014).

According to several researchers (Bonanno, 2004; Van de Leemput, et al., 2014), following such transitions it is usually difficult for the athlete to fully regain his previous level of performance. Sarkar and Fletcher (2014) stated that resilience also appears whilst a player attempts to find functional balance when facing difficulty (Bonanno, 2004; Mancini & Bonanno, 2009) and taking necessary actions to protect themselves from possible negative effects or stressors (Fletcher & Sarkar, 2012; 2013). Anxiety although extensively researched as a term, has not yet been examined in interaction with the resilience of volleyball players (Patsiaouras 2021a).

Anxiety is a very common condition that most athletes experience before, during and after training or competitions. In sports, anxiety is separated into trait anxiety and state anxiety, as well as, into cognitive and somatic anxiety (Martens, & Gill, 1976). Trait anxiety, a stable characteristic of personality, is an important factor in the sports domain. It is a fact and often obvious in everyday practice, when male and female athletes doubt themselves, their ability level, and succession in a game. According to many researchers, anxiety influences the performance of an athlete during the game in a negative way (Maynard, Hemmings, Warwick-Evans, 1995). Theodorakis, Goudas, and Papaioannou (2001) states that two factors are responsible for the presence of anxiety in sports; a) uncertainty regarding the outcome. and b) the importance of the outcome as perceived by the athlete (Maynard, Hemmings, Warwick-Evans, 1995). Many studies found that there is an interactive negative relationship between self-confidence and cognitive and somatic anxiety prior games (Yan Lan, and Gill 1984; Krane, Williams, and Feltz, 1992).

As Samulski (1987) noted, athletes feel anxiety due to inadequate preparation, expected anticipations, presence of a strong opponent, disappointment after defeat, danger of injury, new and unfamiliar circumstances, and the relationships developed between players as well as their effect on the team (Patsiaouras, et al. 2017).

Also, many players feel anxious and stressed by the presence of spectators and even more so by the presence of parents, siblings and friends, possibly due to the expectations of “*significant others*” (Patsiaouras, 2020b). In general, anxiety results from the negative thoughts of the players and their attention on possible negative results that in turn leads to self-esteem and performance issues. On the other hand, complete apathy also has negative effects on the performance of the players (Vallerand, Colavecchio, & Pelletier, 1988).

However, until now very little is known about the different expressions of anxiety during a volleyball game such as anxiety control, aggression, vulnerability and impulsiveness etc. As Patsiaouras (2021a) pointed out, there is an obvious need to investigate the effect of anxiety of volleyball players and its relationship with their resilience level.

Based on what has previously been discussed, the purpose of this study was to assess the effect of anxiety on volleyball players’ resilience. In particular, to examine how each athlete experiences a stressful situation individually and the impact that anxiety has on resilience depending on the participants’ gender.

On reviewing the content, it seems that this study is one of the first ever conducted having such a purpose within volleyball context, supporting the necessity and novelty of this research. Considering the heterogeneous findings on the effect of gender on anxiety–resilience relationship as well as the absence of relative studies (Englert & Seiler, 2020; Patsiaouras. 2021a,b), this study has been treated as exploratory.

MATERIALS AND METHODS

A non-probability sample of 195 Greek volleyball players was collected online through snowball sampling (exponential Non-Discriminative Snowball Sampling), using questionnaires with the help of Google Docs due to Covid- 19 restrictions. All athletes had to be active volleyball players prior to the Covid-19 pandemic, as a participation criterion of this study.

Participants

This study involved 195 participants aged 14-52 years ($M = 21.55$, $SD = 6.29$), all volleyball players participating prior to the Covid-19 restrictions, were participants in official championships organized by the Greek Volleyball Federation. An overrepresentation of women (81%) was observed in the sample and a mean age of 20.60 years was reported ($M = 20.60$, $SD = 6.04$) compared to men volleyball players (19%) with a mean age of 24.49 ($M = 24.49$, $SD = 8.29$). All volleyball players had spent sufficient years of training and/or playing volleyball and participated in teams of several volleyball categories from regional teams up to First League category teams and the National team (Table 1). Prior to the online completion of study questionnaires, all participants were informed about their research participation and were assured that the completion of the questionnaires were anonymous and confidential. The completion time of the online questionnaire using Googles Forms lasted approximately 10 minutes. All participants were informed that their participation was voluntary and they were free to withdraw from the research procedure any time they wanted. The study was approved by the Ethical Committee of the University of Thessaly /DPESS.

Table 1. Demographic data of the volleyball players participating to the study.

Gender	N	Mean age	SD	Mean experience*	SD	Mean playing years	SD
Males	37	24.49	8.29	11.57	5.88	10.38	5.54
Females	158	20.87	5.53	9.42	6.39	7.139	5.26

Note. * training experience in years.

Statistical analysis

Statistical analysis was carried out using SPSS v21.0. Data analysis included the use of t-test for independent samples to examine any possible differences according to gender (male-female volleyball players) for each factor tested. Descriptive statistics were also included and Cronbach's coefficient alpha was used to examine the internal consistency of each factor, along with Pearson's (r) to test the inter-correlations between factors. The alpha level for statistical significance was set at $p < .05$ for all tests.

Measuring instrument

Resilience was measured using the Self Evaluation Resilience test (<http://www.resilience-project.eu/>), which is an approved valid and reliable questionnaire used in many relevant studies [Leontopoulou, 2008; Patsiaouras, 2020; Patsiaouras & Stirbu, 2020; Patsiaouras, 2021a; b). The self-evaluation questionnaire consists of 21 questions – 3 for each of the seven categories (variables). The seven variables are: a) “*perception*” of how a person focuses on the present making the best for here and now and finding the balance between the past- the present- and the future-oriented thinking (e.g. Q1: I believe that my life is meaningful and worth living), b) “*getting a grip of one's life*”, that is, how to manage one's life and how to find own coping strategies to master stress, obstacles and problems and become aware of positive aspects (e.g. Q2: I approach things (pleasant and unpleasant) and take action), c) “*forming relationships*”, referring to resilience and wellbeing as a result of sharing with others (e.g. Q3: I have faith in others and I can rely on their support when I need it), d) “*acceptance and optimistic thinking*” (confidence in future), related to thinking skills that foster resilience in daily life (e.g. Q2: I evaluate my experiences and learn from mistakes as well as successes), e) “*orientation on solution and aims*”, to get away from problem thinking and developing thinking skills that enable solutions (e.g. Q3: I have goals for my life and they are consistent with my values), f) “*healthy lifestyle*”, related to the approach which keeps one physically and mentally healthy to empower one's resilience (e.g. Q3: In a difficult situation, I put my own health before the expectations of others), and g) “*self-efficacy*”, of getting to know one's strengths and using one's own resources in everyday life (e.g. Q3: I believe in myself). Answers were given at a 10-point Likert rating scale (1: total disagree-10: total agree).

The Greek version of CSAI-2 (Tsorbatzoudis, Barkoukis, Sideridis, & Grouios, 2002) proved to be a valid measurement tool in testing anxiety in Greek athletes, which was also used to test the anxiety of the volleyball players. The CSAI-2 Greek version measures cognitive anxiety (8 items), somatic anxiety (8 items) and self-confidence (5 items). Previous factor analyses confirmed that the Greek version of the questionnaire demonstrates very good psychometric characteristics regarding cognitive and somatic anxiety and pointed out the difficulties in measuring self-confidence. Nevertheless, many studies have confirmed a high internal consistency of the questionnaire the alpha values varying between $\alpha = .74$ and $\alpha = .91$ (Tsorbatzoudis, Barkoukis, Sideridis, & Grouios, 2002). Participants respond on a 4-point scale that ranges from 1 (“*not at all*”) to 4 (“*very much*”).

RESULTS

Reliability analysis was conducted using Cronbach's coefficient alpha, revealing an internal consistency ranging from moderate-good ($\alpha = .61$) to high ($\alpha = .88$) for “*forming relationship*” and “*self-efficacy*” variables

respectively for the resilience questionnaire, as well as a high internal consistency for all variables of the CSAI-2 Greek version (Table 2).

Table 2. Reliability analysis of the factors.

Variables	Cronbach's α
Perception	.703
Getting a grip of one's life	.737
Forming relationships	.607
Acceptance and optimistic thinking	.726
Orientation on solution and aims	.793
Healthy lifestyle	.730
Self-efficacy	.883
Cognitive anxiety	.870
Somatic anxiety	.809
Self-confidence	.873

Correlation analysis (Pearson's r) revealed moderate positive and negative intercorrelations up to weak inter-correlation between variables (Table 3). All resilience variables intercorrelated positively between each other as expected. Note that the volleyball players were not aware of somatic anxiety, an expected outcome due to the characteristic of volleyball with no physical contact between the opponents. Interestingly enough, self-confidence correlates positively with all resilience variables, a finding that should be further investigated in the future (Table 3).

Table 3. Intercorrelation of the resilience variables and CSAI-2 Greek version variables.

Variables	1	2	3	4	5	6	7	8	9	10
1. Perception	-	.665**	.229**	.584**	.550**	.515**	.504**	-.234**	-.086	.295**
2. Getting a grip of one's life		-	.218**	.627**	.632**	.490**	.505**	-.135	-.022	.360**
3. Forming relationships			-	.356**	.198**	.332**	.219**	-.116	-.052	.168*
4. Acceptance and optimistic thinking				-	.640**	.558**	.580**	-.086	-.001	.311**
5. Orientation on solution and aims					-	.547**	.543**	-.102	-.030	.344**
6. Healthy lifestyle						-	.581**	-.120	-.082	.289**
7. Self-efficacy							-	-.324**	-.267**	.487**
8. Cognitive anxiety								-	.728**	-.343**
9. Somatic anxiety									-	-.136
10. Self-confidence										-

Note. * $p < .050$, ** $p < .010$.

Descriptive statistics of the resilience and CSAI-2 variables and t-test results between male and female volleyball players are shown in Table 4.

The results of t-test procedure showed statistically significant differences between the groups in "forming relationships" variable in favour of female ($p \leq .002$) volleyball players and self-efficacy in favour of male volleyball players ($p \leq .024$). It seems that female volleyball players focus more on the wellbeing of the team and sharing with the teammates compared to male volleyball players, but on the other hand male volleyball players exhibited higher levels of self-efficacy compared to females, indicating that male athletes seem to

know their strengths and ways to use their own resources in everyday life better, compared to female volleyball players. No other statistically significant gender differences were observed in the rest resilience factors.

In addition, statistically significant differences were observed between the two genders in cognitive anxiety ($p \leq .011$), somatic anxiety ($p \leq .005$) and self-confidence ($p \leq .004$) in favour of the male volleyball players (Table 4). It seems that female volleyball players are less effective in coping with situations in volleyball that produce anxiety compared to males.

Table 4. t-test between the two genders (females N = 158, and males N = 37) for resilience and CSAI-2 variables of study participants.

Variables	Gender	Mean	SD	t	df	p
Perception	Males	23.92	4.67	-4.37	193	.662
	Females	24.27	4.26			
Getting a grip of one's life	Males	24.38	4.41	-4.20	193	.675
	Females	24.70	4.08			
Forming relationships	Males	25.62	4.03	-3.05	41.12	.002
	Females	27.71	2.19			
Acceptance and optimistic thinking (confidence in future)	Males	24.51	3.30	-7.02	193	.483
	Females	24.97	3.60			
Orientation on solution and aims	Males	25.27	3.80	-.002	193	.998
	Females	25.27	4.21			
Healthy lifestyle	Males	25.05	3.46	-5.71	193	.569
	Females	25.48	4.15			
Self-efficacy	Males	27.24	2.90	1.98	193	.024
	Females	25.88	3.92			
Cognitive anxiety	Males	8.81	4.62	-2.32	193	.011
	Females	10.68	4.36			
Somatic anxiety	Males	7.16	2.93	-2.56	193	.005
	Females	8.94	3.96			
Self-confidence	Males	16.32	3.10	2.65	193	.004
	Females	14.49	3.22			

Note. * $p < .050$.

DISCUSSION

The purpose of the study was to examine the relationship between the resilience and anxiety of volleyball players and detect possible differences existing between the two genders.

Results showed that all resilience variables intercorrelate positively, with a medium or high positive linear relationship noticed between those variables as expected. This finding is in line with Patsiaouras study (2021a) reporting a similar positive strong relationship between resilience variables. Cognitive anxiety had a significant positive linear relationship with somatic anxiety and both variables correlated negatively with a medium to small linear relationship with self-confidence. In addition, all resilience variables correlated positively and similarly with self-confidence, all findings should be further investigated in future studies.

Statistically significant differences were observed between males and females for “*forming relationships*” variable in favour of female volleyball players, an interesting finding that shows females focusing not only on relationships formed among teammates as the right choice, but they are willing to further make this choice work and seek for their teammates support more, as compared to male volleyball players. This finding is in line with the results of Patsiaouras (2020a). Interestingly enough, no statistically significant differences were observed in other tested variables, whereas other previous studies found statistically significant differences existing between the two genders “*orientation on solution*” (Patsiaouras, 2021a, b), and “*healthy lifestyle*” variables (Patsiaouras, 2021b). Possible reasons could be looking on the methodology for the selection of study sample, the age of the participants and maybe the nature of the resilience questionnaire that assess resilience as a state characteristic.

As for “*self-efficacy*” finding suggested strongly that it is affected by gender as Patsiaouras and Stirbu (2020), Patsiaouras (2020a) and Patsiaouras (2021a,b) highlighted in their studies too. It seems that male volleyball players are able to develop and use effective strategies not only in volleyball but in everyday life too, compared to female volleyball players. Findings suggest that the contribution of age maturation (age levels), team category, training experiences and the differentiation of resilience factors should be further investigated.

As for anxiety, results revealed statistically significant differences observed between the two genders in favour of male volleyball players. Data findings are in line with the study of Englert and Seiler (2020) suggesting that male volleyball players can cope better with perceived anxiety (cognitive and somatic anxiety) than female volleyball players as well as exhibit higher self-confidence in their abilities.

CONCLUSION

The results of this study shows that volleyball coaches should focus more on gender differences in the resilience level without, however, overlooking the anxiety levels of the players.

Female volleyball players are more oriented to forming relationships with teammates which may contribute to a better cohesion in the team but they are less able to develop effective self-efficacy strategies and achieve their self-efficacy goals compared to males. Furthermore, it appears that it was easier for male volleyball players to deal with cognitive and somatic anxiety compared to female volleyball players and appeared more self-confident compared to females. Volleyball coaches should take into account these findings and further adopt, develop and practice elements that can help volleyball players to increase resilience levels and, for females, to cope better with anxiety and in turn to additionally optimize the technical and tactical capacity of their team.

Limitations of the study

The participants and sample size that included only volleyball players along with the relatively small number of studies investigating resilience and anxiety in volleyball were the major limitations of the present study.

Although the findings should be interpreted with caution, this study has several strengths. One of the strengths of this study is that it represents a comprehensive examination of the resilience level and its relationship with anxiety among a large number of volleyball players. The study provides an in-depth view of the topic of resilience and anxiety and the differences existing between the two genders in volleyball that can be generalized in volleyball teams. Another strength of the present study is that the data can relatively be easily analysed by the coaches who might want to evaluate resilience and anxiety levels of their volleyball players.

AUTHOR CONTRIBUTIONS

Patsiaouras A.: writing whole sections of the paper, design of the study, material collection, statistical analysis, results, discussion and conclusions. Boziou E.: contribution to literature research -introduction, material collection, contribution to discussion and conclusions. Kontonasiou D.: literature research, material collection.

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REFERENCES

- Bonanno, G. A. (2004). Loss, Trauma, and Human Resilience: Have We Underestimated the Human Capacity to Thrive After Extremely Aversive Events? *American Psychologist*, 59(1), 20–28. <https://doi.org/10.1037/0003-066X.59.1.20>
- Charney, D.S. (2004). Psychobiological mechanisms of resilience and vulnerability: implications for successful adaptation to extreme stress. *American Journal of Psychiatry*, 161(2), 195-216. <https://doi.org/10.1176/appi.ajp.161.2.195>
- Englert, C., & Roland Seiler, R. (2020). Anxiety and volleyball performance in a real testing situation: gender differences in competitive environments. *Educational Psychology*, 40(6), 735-749. <https://doi.org/10.1080/01443410.2019.1706723>
- Fletcher, D., & Sarkar, M. (2012). A grounded theory of psychological resilience in Olympic champions. *Psychology of Sport and Exercise*, 13(5), 669–678. <https://doi.org/10.1016/j.psychsport.2012.04.007>
- Fletcher, D., & Sarkar, M. (2013). Psychological resilience: A review and critique of definitions, concepts, and theory. *European Psychologist*, 18(1), 12–23. <https://doi.org/10.1027/1016-9040/a000124>
- Galli, N., & Gonzalez, S. P. (2015). Psychological resilience in sport: A review of the literature and implications for research and practice. *International Journal of Sport and Exercise Psychology*, 13(3), 243–257. <https://doi.org/10.1080/1612197X.2014.946947>
- Gould, D., Finch, L. M., & Jackson, S. A. (1993). Coping strategies used by national champion figure skaters. *Research Quarterly for Exercise and Sport*, 64, 453-468. <https://doi.org/10.1080/02701367.1993.10607599>
- Kelso, J. A. S. (1995). *Dynamic patterns: The self-organization of brain and behavior*. Cambridge, MA: MIT Press.
- Krane, V., Williams, J., Feltz, D. (1992). Path analysis examining relationships among competitive anxiety, somatic anxiety, state confidence, performance expectations, and golf performance. *Journal of Sport Behavior*, 15, 279-295.
- Leontopoulou, (2008) A cross – cultural study of resilience in young people, in P. Roussi, E., Vassilaki, & K. Kaniasty, (Eds.). *Stress and psychosocial resources: Coping with life changes, occupational demands, educational challenges, and threats to physical and emotional well-being* (p. 31-44). Berlin: Logos Verlag.

- Luthar, S. S., Cicchetti, D., & Becker, B. (2000). The construct of resilience: A critical evaluation and guidelines for future work. *Child Development*, 71, 543-562. <https://doi.org/10.1111/1467-8624.00164>
- Luthar, S. S., Crossman, E. J., & Small, P. J. (2015). Resilience and adversity. In R.M. Lerner and M. E. Lamb (Eds.). *Handbook of Child Psychology and Developmental Science* (7th Edition, Vol. III, pp. 247- 286). New York: Wiley. <https://doi.org/10.1002/9781118963418.childpsy307>
- Mancini, A. D., & Bonanno, G. A. (2009). Predictors and parameters of resilience to loss: Toward an individual differences model. *Journal of Personality*, 77, 1805-1832. <https://doi.org/10.1111/j.1467-6494.2009.00601.x>
- Martens, R., Gill, D.L. (1976). State anxiety among successful and unsuccessful competitors who differ in competitive trait anxiety. *Research Quarterly*, 47, 698-708. <https://doi.org/10.1080/10671315.1976.10616731>
- Masten, A. S., & Wright, M. O. (2010). Resilience over the lifespan: Developmental perspectives on resistance, recovery, and transformation. In J. W. Reich, A. J. Zautra, & J. S. Hall (Eds.), *Handbook of adult resilience* (p. 213–237). The Guilford Press.
- Maynard, I.W., Hemmings, B., Warwick-Evans, L. (1995). The effects of a somatic intervention strategy on competitive state anxiety and performance in semiprofessional soccer players. *The Sport Psychologist*, 9, 51-64. <https://doi.org/10.1123/tsp.9.1.51>
- Mummary, W. K., Schofield, G., & Perry, C. (2004). Bouncing back: The role of coping style, social support and self-concept in resilience of sport performance. *Athletic Insight*, 6, 1-15.
- Patsiaouras, A. (2020a). The Relationship between Resilience and the Perceived Importance of Match Outcome for Volleyball Player. *Journal of Sports and Games*, 2(2), 20-26.
- Patsiaouras, A. (2020b). Relations of Parents, Coaches and Players in Volleyball: Expectations, Values and Guidelines. In Schwartz, M. (Ed.), *Essential Topics in Tennis and Volleyball*. Nova Science Publishers. ISBN: 978-1-53618-200-2.
- Patsiaouras, A. (2021a). The Impact of Coach Leadership Style on Resilience of Volleyball Players. *International Journal of Physical Education, Fitness and Sports*, 10(1), 16-23. <https://doi.org/10.34256/ijpefs2113>
- Patsiaouras, A. (2021b). Team category and gender differences of resilience among high-level volleyball players. *Journal of Physical Education and Human Movement*, 3(1), 1-9. <https://doi.org/10.24310/ipehmjpehmjpehm.v3i110436>
- Patsiaouras, A., & Stirbu, C. (2020). Assessing Resilience in Youth (U16) Volleyball National Teams. *International Journal of Physical Education, Fitness and Sports*, 9(3), 39-45. <https://doi.org/10.34256/ijpefs2036>
- Patsiaouras, A., Chatzidimitriou, M., Charitonidis, K., Giota, A., Kokaridas, D. (2017). The Relationship of Personality and Trait Anxiety between Male and Female Volleyball Players. *Annals of Applied Sport Science*, 5(3), 39 – 47. <https://doi.org/10.29252/acadpub.aassjournal.5.3.39>
- Rutter, M. (1981). Stress, coping and development: Some issues and some questions. *Journal of Child Psychology and Psychiatry*, 22, 323-356. <https://doi.org/10.1111/j.1469-7610.1981.tb00560.x>
- Samulski, D. (1987). Wie motivieren sich Leistungssportler selbst? In Münster: Leistungspsychologie, 1, 7 – 11.
- Sarkar, M., & Fletcher, D. (2013). How should we measure psychological resilience in sport performers?. *Measurement in Physical Education and Exercise Science*, 17, 264-280. <https://doi.org/10.1080/1091367x.2013.805141>
- Sarkar, M., & Fletcher, D. (2014). Psychological resilience in sport performers: a review of stressors and protective factors. *Journal of Sports Sciences*, 32, 1419-1434. <https://doi.org/10.1080/02640414.2014.901551>

- Sarkar, M., Fletcher, D., & Brown, D. J. (2015). What doesn't kill me...: adversity-related experiences are vital in the development of superior Olympic performance. *Journal of Science and Medicine in Sport*, 18, 475-479. <https://doi.org/10.1016/j.jsams.2014.06.010>
- Scheffer, M., Carpenter, S. R., Lenton, T. M., Bascompte, J., Brock, W., Dakos, V., ... Vandermeer, J. (2012). Anticipating Critical Transitions. *Science*, 338(6105), 344-348. <https://doi.org/10.1126/science.1225244>
- Schöner, G., & Kelso, J. S. (1988). Dynamic pattern generation in behavioral and neural systems. *Science*, 1513-1520. <https://doi.org/10.1126/science.3281253>
- Seery, M. D. (2011). Resilience: A silver lining to experiencing adverse life events. *Current Directions in Psychological Science*, 20, 390-394. <https://doi.org/10.1177/0963721411424740>
- Seery, M. D., Holman, E. A., & Silver, R. S. (2010). Whatever does not kill us: Cumulative lifetime adversity, vulnerability and resilience. *Journal of Personality and Social Psychology*, 99, 1025-1041. <https://doi.org/10.1037/a0021344>
- Smith, G. C., & Hayslip, B., Jr. (2012). Resilience in adulthood and later life: What does it mean and where are we heading? In B. Hayslip, Jr. & G. C. Smith (Eds.), *Annual review of gerontology and geriatrics: Vol. 32. Annual review of gerontology and geriatrics, Vol. 32. Emerging perspectives on resilience in adulthood and later life* (p. 3-28). Springer Publishing Company. <https://doi.org/10.1891/0198-8794.32.3>
- Theodorakis, Y., Goudas, M., Papaioannou, A. (2001). Psychological superiority in sports. (Ψυχολογική υπεροχή στον αθλητισμό. Θεσσαλονίκη: Εκδόσεις Χριστοδουλίδης) [inGreek].
- Tsorbatzoudis, H., Barkoukis, V., Sideridis, G., & Grouios, G. (2002). Confirmatory factor analysis of the Greek version of the Competitive State Anxiety Inventory-2 (CSAI-2). *International Journal of Sport Psychology*, 33(2), 182-194.
- Vallerand, R. J., Colavecchio, P. G., & Pelletier, L. G. (1988). Psychological momentum and performance inferences: A preliminary test of the antecedents-consequences psychological momentum model. *Journal of Sport & Exercise Psychology*, 10, 92-108. <https://doi.org/10.1123/jsep.10.1.92>
- Van de Leemput, I. A., Wichers, M., Cramer, A. O., Borsboom, D., Tuerlinckx, F., Kuppens, P., ... & Derom, C. (2014). Critical slowing down as early warning for the onset and termination of depression. *Proceedings of the National Academy of Sciences*, 111, 87-92. <https://doi.org/10.1073/pnas.1312114110>
- Van Geert, P. (2009). Nonlinear complex dynamical systems in developmental psychology. In S. J. Guastello, M. Koopmans, & D. Pincus (Eds.), *Chaos and complexity in psychology: The theory of nonlinear dynamical systems* (pp. 242-281). New York, NY: Cambridge University Press. <https://doi.org/10.1017/cbo9781139058544.009>
- Waller, M. A. (2001). Resilience in ecosystemic context: Evolution of the concept. *American Journal of Orthopsychiatry*, 71(3), 290-297. <https://doi.org/10.1037/0002-9432.71.3.290>
- Yan Lan, L., Gill, D.L. (1984). The relationships among self-efficacy, stress responses, and a cognitive feedback manipulation. *Journal of Sport Psychology*, 6, 227-238. <https://doi.org/10.1123/jsp.6.2.227>
- Zautra, A. J. (2014). Resilience is social, after all. In M. Kent, M. C. Davis, & J. W. Reich (Eds.), *The resilience handbook: Approaches to stress and trauma* (pp. 185-196). New York, NY: Routledge.



Health in digital environment: Challenges and solutions

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ABSTRACT

Office work is associated with movement restrictions, muscle stress, burnout and other risk factors that negatively affect the health of working - age people. The coronavirus epidemic has changed the labour market: neither employers nor employees were prepared to tackle the challenges of moving to remote work. Therefore, search for solutions to preserve health of remote workers in the context of self-isolation and digital transformation is a priority medical and social task. Pilot research for examination of the office-workers state included interviews, psychological, neurological tests and methods of instrumental visualization. The aim of the study was to identify the signs of the emotional impact of remote work and develop exercises to prevent physical inactivity, as well as technologies for monitoring of individuals' health. The survey revealed that 80% of office workers have stress and burnout in an epidemic situation, as well as a loss of interest in work and professional achievements. Burnout was accompanied with increased irritability, sleep disorders. Neurological examination revealed muscle spasms and "tunnel" neurovascular disorders in the cervical spine and postural displacement in all persons. Electrophysiological research indicated cerebral acidosis and brain hypoxia in 50% of examined individuals. The programs for postural correction and cerebral metabolism included special coordination and breathing exercises. Recommendations to healthy lifestyle and workplace reorganization were given to all persons. Digital transformation is a challenge that requires changes in legal, organizational, psychological and infrastructural approaches to preserve the health of remote workers in the new environment.

Keywords: Sport medicine, Digital transformation, Office work, Postural stress, Coordination gymnastics, Breathing gymnastics, Remote workers.

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INTRODUCTION

The beginning of the 21st century was marked by the rapid development of information and communication technologies (ICT), labour automation, which changed all spheres of the economics and led to creation of new digital professions. Office workers had become in demand at every enterprise, due to the introduction of electronic document management and big data processing. Business centres and offices were opened everywhere, often in unsuitable premises, in place of “repurposed” industrial facilities, with large non-segmented spaces (open space), or, conversely, with “closed” spaces without natural light, ventilation and other violations of occupational health / technique of industrial safety.

Office work became attractive and prestigious, but, from the other side, it was associated with certain health affected risk factors. Staying at the computer for 8 hours and more, physical inactivity at the working place (postural stress), discrepancy of the ergonomic parameters of the workplace with the expected norms, emotional burnout; sleep and eating behaviour disturbances: irregular schedule, many allergens - this is not a complete list of risk factors that negatively affect labour productivity and professional longevity in general.

Psychologists, neurologists and psychiatrists sounded the alarm because they identified a kind of professional stress in office workers, which was characterized by a triad of manifestations. This complex of psychological, psychosomatic and behavioural disorders, which has developed in office workers due to the impact of various factors of the working environment, has received the definition of “office syndrome” (Danilov et al., 2011; Dontsov et al., 2016). Psychological manifestations included emotional outbursts, impaired concentration, loss of self-esteem and self-confidence, feelings of inadequacy, helplessness and guilt, and anxiety) (Baksansky et al, 2021). Physical manifestations of office syndrome included back pain, muscle tension, stiffness in the body, headaches, insomnia, chronic fatigue, increased blood pressure, the development of varicose veins. Behavioural manifestations were characterized by a loss of interest in work, decreased in labour activity and criticality, loss of punctuality and neglect of duties, eating disorders - switching to fast food, constant increasing use of coffee and alcohol (Janwantanakul et al., 2011).

The term “burnout”, coined by H. Freudenberger (Freudenberger et al., 1974) and K. Maslach in the 1980-90s (Maslach et al., 1996; Maslach et al., 2001), also proved to be very appropriate in the “office context”. This term was suitable to describe certain psychological states observed in people working both in the system of helping professions “person-person” (Vlakh et al., 2015) and in the system of digital technologies “person-computer”. The risk group began to include office workers: digital specialists, managers, dispatchers, bank employees, accountants, whose work is associated with labour automation, physical inactivity, stereotyped movements and at the same time, with great responsibility. The COVID-19 epidemic affected not only the population’ health, but also had a significant impact on the labour market: in the face of an unexpected and emergency epidemic situation, young and middle-aged office workers were transferred to remote work. In general, 2020 saw a surge in international activity on remote work issues as a timely, natural response of governments and international organizations to the coronavirus epidemic. The conditions of self-isolation became a real challenge for both employers and employees, who were not ready to solve all the problems associated with organizing “home offices”, both in legal, organizational and psychological terms.

According to a survey, conducted by the Society for Human Resource Management (SHRM), 71% of employers experienced difficulties switching to remote work; 65% of them noted that it was difficult to maintain the morale of their team, and more than a third have faced the difficulties associated with the corporate culture and productivity of employees and the regulation of vacation time (SHRM, 2021).

In the Russian Federation, a sharp jump in the volume of remote work in 2020 was also due to the spread of coronavirus infection. Since the prevalence of COVID-19 was the highest in Moscow, strict requirements were introduced for the transfer of employees to remote work. Moscow employers were obliged to transfer at least 30% of employees to a remote work format. About 40% of employers practiced remote work in their team in October 2020, and already 51% of employees worked remotely in December (Kotyakov, 2020; Bill No 973264-7, 2020). By May 2021, most enterprises retained a “*hybrid*” work format.

Therefore, study of psychological stress impact and search for solutions to preserve health of remote workers in the context of self-isolation and digital transformation is a priority medical and social task of our days.

Aim of the study

To study the impact of remote work on health, identify the signs of the emotional burnout and develop solutions for the prevention of physical inactivity as well as technologies for monitoring of individuals' health in digital environment.

MATERIALS AND METHODS

52 patients (35 women and 17 men, age of 42 ± 8 years, (office staff, remote workers) with combined myofascial pain in the cervical part of the vertebral column and burnout were examined. Idea of the pilot project was to create new protocol, including screening technologies (Safonicheva et al., 2015; Janda, 1983).

Methods of investigation of the remote office-workers state included interviews, psychological, neurological tests and methods of instrumental visualization. Clinical neurological study was performed, according to the generally accepted scheme and principles of functional medicine, systematized at the Departments of Sports Medicine and Medical Rehabilitation (Safonicheva, 2020). Pilot research was organized in I.M. Sechenov Moscow State Medical University (Sechenov University of Life Sciences).

1) The neuropsychological study was carried out to examine the cognitive sphere, emotional stability of patients.

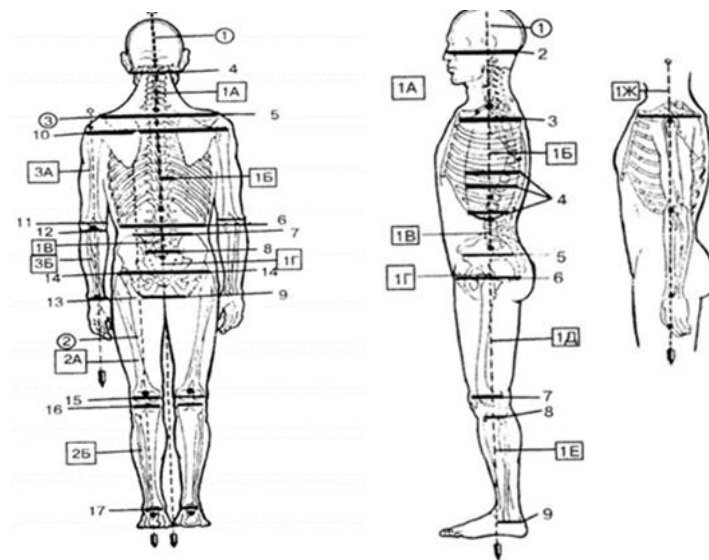


Figure 1. “Norm model of optimal body posture”.

2) Visual diagnostics and kinesiological testing were performed on the basis of the three-dimensional coordinate axis method (Kogan et al., 1991) to compare the body position of patient in the “*initial state*” with the “*Normative model of optimal body posture*” (Figure 1).

Method of visualisation allowed to assess the condition of all vertebral regions, symmetry of the shoulder girdle line for revealing a violation of posture, postural muscle imbalance, and pelvic dysfunction. Optimal body posture is an important condition for global circulation in blood system (“*closed loop*” system) and in lymphatic system (“*open loop*” system) to keep homeostasis and mechanisms of self-regulation at the optimal level. Cerebral metabolism, brain plasticity, neurogenesis and brain development are depended on blood circulation (supply of oxygen, plastic substances) and venous, cerebrospinal and glymphatic fluids timely outflow, which is especially important to the brain (Safonicheva et al., 2015). Optimal body posture - “*corridor of norm*” is important condition for health protection (Safonicheva, 2000; Ivanichev, 2011).

3) Clinical neurological examination was conducted to identify the role of myotonic “*compression-tunnel*” syndromes in the cranial-vertebral region and biomechanically significant disturbances in the cervical spine for affecting the cerebral blood flow (Kipervas, 1991). Kinaesthetic diagnostics was carried out using the methods of palpation to assess the level of sensitivity, skin turgor, kinetics of superficial and deep fasciae of the neck, state of tone and local tension (Janda, 1985).

4) The purpose of the neurophysiological examination of the patients by the neuro-energo-cartography (NEC) method was to assess the cerebral metabolism, adaptive capabilities of the brain, as well as interhemispheric interactions in the initial state and after the rehabilitation measures. The check was carried out on a computer software system NEC, created in the laboratory of age physiology of the brain Research Centre of Neurology (under the guidance of professors V. F. Fokin and N.V. Ponomareva, patent № 2135077 A61B5 / 04, 08.27.1999).

It is known that one of the main links in the development of pathological processes can be a deficit in the delivery of energy substrates and violation of the oxygen supply of brain structures, as well as a change in the acid-base balance at the border of the blood-brain barrier. NEC-method was registered the constant potential level (CPL) — the slow electrical activity, reflecting the integrated metabolism of various brain zones (Fokin et al., 1999). The detector of material energy processes in the brain was considered to be the CPL - the magnitude of the stable difference in the mV range, which is recorded between the brain and the referred area. According to CPL – amplitude, we could measure the degree of acidosis in the brain tissues. Sources of CPL were the potentials of the blood-brain barrier and vascular potentials in referred area. The registration was carried out at the NEC computer - software complex.

CPL of the brain is a type (variability) of slow electrical processes, it integrally reflects the membrane potentials of neurons, glia and blood-brain barrier. The main potential-organizing ions for CPL - are the ions of Hydrogen (Fokin et al., 2002). CPL registration was carried out in five leads: frontal, central, occipital, and two temporal – right and left (Fz, Cz, Oz, Td, Ts), according to the 10-20 scheme. The projections of the CPL-recording areas correspond to the main cerebral arteries: the anterior cerebral (two), middle cerebral (two) and vertebral basilar (Figure 2).

The process of venous blood and cerebrospinal liquor outflow restriction lead to changes in acid-based balance in the brain tissues – to brain hypoxia and acidosis (oxygen and glucose insufficiency).

THE NEURO-ENERGO-CARTOGRAPHY (NEC) method

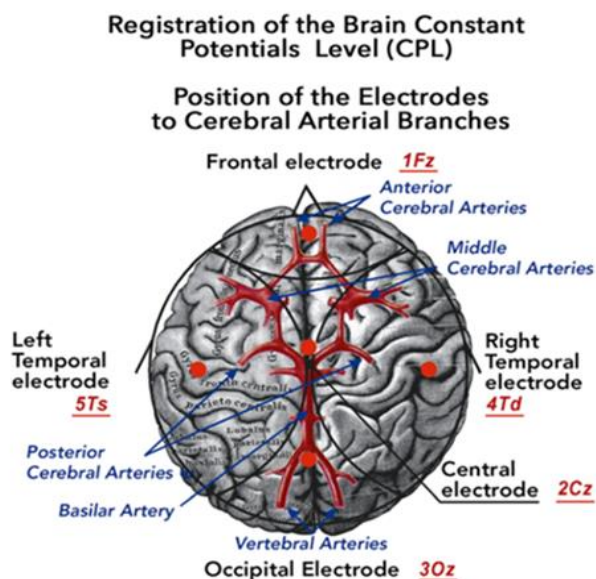


Figure 2. CPL scheme registration.

RESULTS

The survey revealed that 80% of office workers have stress and “burnout” in an epidemic situation, as well as a loss of interest in work and professional achievements. Burnout was accompanied with increased irritability, sleep disorders. Main complains in patients were: headache, fatigue, memory, eating behavioural disorders. All patients had impairments in cognitive, emotional, and personal status; violation of the motivational sphere, decreased concentration of attention and loss of interest (this even related to taking care of their own health). Somatic disorders were revealed in all patients: persistent muscle pain, a sense of “stiffness”, frequent pain (thorax, cervical, lumbar spine), various joint pain (without redness), shortness of breath.

Clinical neurological examination has revealed biomechanical markers – muscular hypertension, rigidity in the shoulder girdle, elevation of the upper aperture structures, chest kyphosis, as well as multilevel myotonic and neurovascular “tunnel” syndromes in the cranial-vertebral zone and cervical spine. Muscle spasms, the fascia and cranial membranes kinetics restriction contributed to slowing down the cerebral blood flow and obstruction of venous outflow. Thus, the connection between burnout, pain syndrome, vascular insufficiency in the vertebral-basilar area and biomechanical changes (postural stress) in cervical spine was detected.

According to the results of NEC-method in 52 patients (age of 42 ± 8 years), changes in cerebral metabolism were detected with manifestations of brain hypoxia on the background of varying degrees of acidosis.

The digital indicators of the acid-base balance in the NEC- method were translated into colour. The acid-base balance shift in the direction of acidosis (lowering the pH and increasing the CPL) was painted in a yellow-red-brown range of colours. When the brain used more reserve mechanism of energy exchange, the redder it was painted on the picture, the higher the CPL was registered (Figures 3, 4).

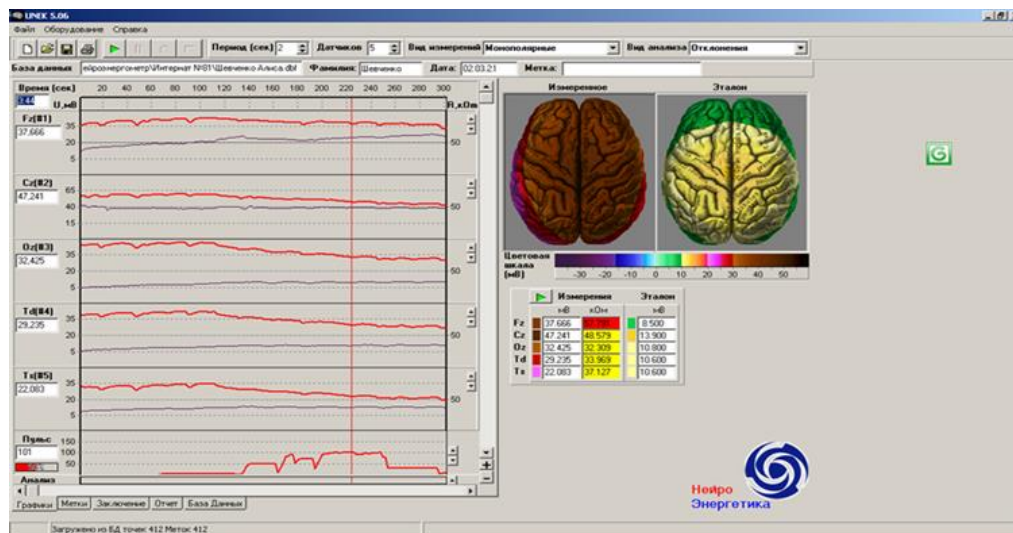


Figure 3. High level of cerebral acidosis in patient of 45 aged.

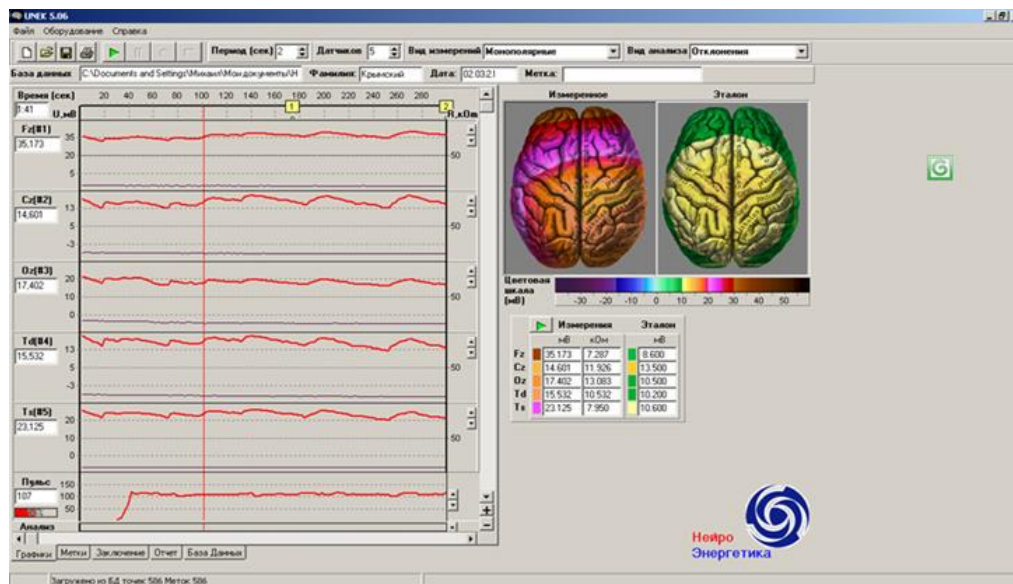


Figure 4. Middle level of cerebral acidosis in patient of 42 aged.

Electrophysiological research indicated cerebral acidosis and brain hypoxia in 50% of examined individuals. According to the study, there was the direct connection between disorders in cerebral metabolism with the state of tone of the shoulder girdle muscles. We suggested that the cause of the development of the brain hypoxia and cerebral acidosis could be “tunnel” muscle-tonic syndromes leading to compression of the main vessels of the neck (Kipervass, 1991). The analysis of risk factors and indicators of functional disorders – muscle imbalance, postural stress damage in the cranio-vertebral region and neurological syndromes indicated the common mechanisms of their formation (Safonicheva, 2006).

Thus, in the examined patients, the manifestations of the “office syndrome” were revealed. These disorders affected the psychological, psychosomatic and behavioural levels, which required an integrated approach to rehabilitation.

Methods of non-drug rehabilitation

People can maintain their emotional and cognitive well-being in the face of acute or chronic challenges, and this ability is defined as resilience (Davydov et al., 2010).

Methods of resilience management were: 1) physical (strength- and endurance-based) activity, 2) cognitive training, 3) postural and coordination gymnastics, 4) breathing and yoga techniques, 5) soft-tissue manual therapy.

The scheme of non-specific correction of muscle disturbances, restoration of the optimal body posture using soft-tissue techniques was worked out in Sechenov University at the Department of Sports Medicine and Medical Rehabilitation (Shimarova et al., 2020).

Stages of the soft-tissue therapy were:

- 1) Unloading the main collectors of lymph system in subclavicular area. Soft-tissue technique was devoted to structuring tissues, removing fixation between superficial and deep fascia for decompression of subcutaneous vessels.
- 2) Relaxation of pectoralis major, minor muscles and adductors of the shoulder.
- 3) Myofascial technique was devoted to remove the compression of the jugular veins and lymph duct in the place of their flowing into subclavicular veins.
- 4) Relaxation of the respiratory diaphragm.
- 5) Restoration of the neck muscles tone for normalizing of blood circulation and brain hypoxia removing. Duration of the procedure – 35-40 min, number of procedures was 7 – 9.

Treatment had an impact for all mechanisms of office – syndrome and burnout formation in remote workers, due to changes in the quality of the afferent flow and positive effect to the patient's mental sphere. After the rehabilitation course we receive positive results: postural muscle balance was restored, the “tunnel” neurovascular syndromes in patients were removed, state of the cerebral metabolism was normalized, emotional background and cognitive functions were improved (Figures 6, 7).

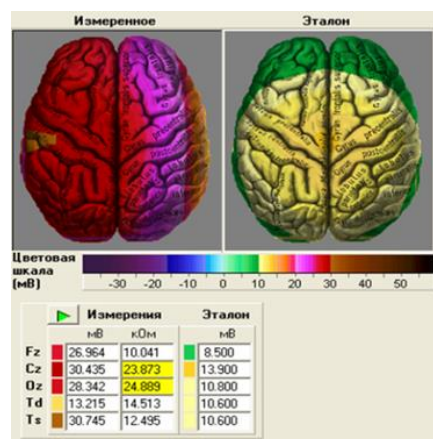


Figure 5. Dynamics in cerebral acidosis in patient aged 45 years.

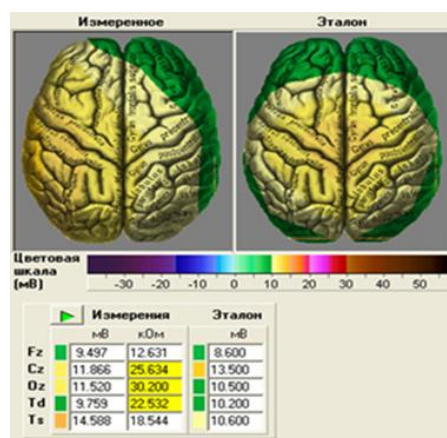


Figure 6. Dynamics in cerebral acidosis in patient aged 42 years.

All the observed patients were given recommendations on adherence to a healthy lifestyle and arrangement of the workplace in compliance with ergonomic parameters. It was recommended to get up from the table every 45 minutes and do midline crossover and breathing exercises. All the observed patients were given recommendations on adherence to a healthy lifestyle and arrangement of the workplace in compliance with ergonomic parameters. They were instructed to get up from the table every 45 minutes and do special gymnastics with movements, crossing the midline, as well as breathing exercises aimed at relaxing the muscles of the neck, shoulders, chest, and diaphragm. During the course of rehabilitation, the patients studied a set of balancing exercises to maintain an optimal body posture.

Telemedicine technologies were used to monitor personal health - Skype sessions once a week.

DISCUSSION

It is known that the structure of health is made up of several factors - genetics, ecology and environment, lifestyle and health care system. The contribution of these factors is distributed in different ways: the leading role is played by lifestyle - 55%, genetic factors - 15-20%, ecology and environment - 15-20%, and the healthcare system - 10-15%. Although office syndrome and burnout are not medical diagnoses, these generalized definitions have come to indicate both occupational risk factors and unhealthy office worker' lifestyle that generally led to chronic diseases.

In 2010-2015 the World Health Organization (WHO) announced the beginning of an epidemic of noncommunicable diseases (NCDs) or an epidemic of "lifestyle diseases", since by this time the number of annual deaths due to four classes of diseases (cardiovascular, bronchopulmonary, cancer and diabetes mellitus) exceeded 36 million people (WHO, 2015).

At first, this term "Epidemic of Chronic NCDs" caused controversy, since earlier epidemics were associated only with infections.

However, the losses from NCDs, which accounted for about 75% of the total morbidity and about 86% of the total mortality, were so significant that WHO suggested to use this very term (Golubnitschaja et al., 2020).

Over the past 10 years, WHO has announced several “*epidemics*” among residents of cities and megalopolises - an epidemic of obesity, an epidemic of neurodegenerative diseases, an epidemic of mental disorders and depression.

The mentally exhausted person has become the personification of the appearance of modern cities, where modern infrastructure and business centres have replaced factories and plants. However, office jobs have led not to an increase in the quality of life, but, on the contrary, to its decrease.

Epidemics of chronic non-communicable disease turned out to become challenges to health systems, employers and workers who had to find solutions (Golubnitschaja et al., 2016).

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Epidemics of chronic non-communicable disease turned out to become challenges to health systems, employers and workers who had to find solutions.

WHO has developed a number of programs to coordinate healthy lifestyle. One such program is the WHO “*Global Action Plan to increase the level of physical activity 2018–2030*”. This program includes several initiatives (WHO, 2014).

1. An active society: the implementation of information campaigns to change the lifestyle, awareness-raising work, the introduction of IT systems and innovation technologies.
2. An active, healthy and accessible environment: integrating urban and transport planning strategies, ensuring equitable access to places for walking, cycling and other physical activity.
3. Active systems: optimizing development institutions and governance, multisectoral partnerships, and workforce capacity to drive research.
4. Active people: making programs and services available in a variety of ways that encourage people of all ages to engage in regular physical activity.
5. Preventive health aspects: introduction of systems for examining and counselling patients on the issues of increasing physical activity in primary and secondary medical and social care facilities. Health systems were encouraged to develop programs for increasing the level of physical activity in workplaces, sports and religious institutions, and in open public places.

Large companies and organizations such as Tesla, Apple, Microsoft, Google, Facebook, Amazon, Beeline began to make efforts to create an optimal “*psychological climate*”, a health-saving ecosystem for office workers, and the formation of a “*corporate culture*”. The most important conditions for team building were thinking through the company's mission, positioning it in the market, building internal and external communications. Stress management programs were prepared, motivational trainings were carried out to increase employee commitment, and collaborations with fitness centres were created, which contributed to an increase in labour productivity and preservation of employee health.

Gradually, from 2015 to 2017, the same companies began to practice the remote work format.

For example, Beeline company in 2016 developed the BeeFree Strategic Remote Work Project, which was implemented for strengthen an open corporate culture, transform internal processes and infrastructure. The Charter and the BeeFree program for remote workers were developed and posted on the website. The Program prescribed the rules and step-by-step instructions for remote work (arrangement of the workplace, weekly planning and coordination of the work schedule with the management and team members) to create a common information space on the Skype, Zoom or Google Meet sites. Also, the program includes recommendations for maintaining health (pauses for a break, doing gymnastics, adhering to a diet, etc.).

An employment contract for remote work is signed with the employee. The contract includes the clause "*Working conditions and working hours*". A working day is set for an employee in accordance with an individual schedule.

But majority of the office workers continued to work in their traditional offices, where ergonomics, overcrowding, physical inactivity and other working conditions did not correspond to the parameters of health savings conditions.

The situation has deteriorated significantly since mid-March 2020, when WHO declared a real epidemic - the COVID-19 epidemic, which was added to the epidemic of "*lifestyle diseases*".

The situation has deteriorated significantly since mid-March 2020, when WHO declared a real epidemic - COVID-19 epidemic.

With the announcement of the COVID-19 epidemic in March 2020, the whole world was placed in difficult working conditions: working people faced an unusual way of life, almost every person of working age, in one way or another, was forced to work from home.

A feature of remote format working is that the usual work regime is disrupted, the boundaries of working hours in the "*home office*" are blurred, physical inactivity is aggravated in the absence of the need and the ability to leave the house (when organizing a courier service for the delivery of products). In the epidemic conditions, a working person, being at the same time at home and in the office, was forced to solve both household and industrial affairs. At the same time, other family members, who were also in self-isolation, faced the same problems. Big Data analysts from MTS found that the working day of residents of the capital on a remote basis increased to ten hours on average, remote workers began to "*linger after work*" more (Starodubov, 2021).

The International Labour Organization (ILO) analysed the current situation and, in May 2020, prepared a guide for employers: "*Remote work in the context of the COVID-19 pandemic*" (ILO, 2020).

The ILO recalled that the health and safety risks associated with teleworking could increase amid the COVID-19 pandemic. These can be increased psychosocial risks in "*fit office*" settings, including a potential increase in occupational stress levels. Employers need to keep in touch with their employees on a regular basis and keep them informed of all available opportunities. For example, some employers have employee assistance programs that provide workers with confidential counselling and psychological assistance (ILO, 2020).

CONCLUSIONS

Preserving the health of the working population in the context of digital transformation is a global challenge of our time and requires decisions at the legal, organizational, psychological, and infrastructural levels:

1. Health systems should adhere to WHO recommendations for developing health interventions to combat both coronavirus and lifestyle diseases.
2. Labour legislation should make additions to regulate industrial relations in the new conditions of the remote format (working hours, vacations, working conditions, possibly telemonitoring of lunch breaks and industrial gymnastics).
3. Preventive measures of the “office syndrome” and “burnout” among specialists in digital professions are: the formation of a corporate culture in teams, the creation of conditions for employees’ professional growth, a literate motivational policy, which includes social guarantees and social support, information activities aimed at the development of a pleasant social and psychological climate in co-operation, as well as an increase in emotional intelligence.
4. Correction of the “office syndrome” and “emotional burn out” requires a personalized approach with the use of modern restorative technologies (Krutko et al., 2017), an increase in stress resistance of specialists, a culture of health and trust in teams. In the context of the forced digital transformation, it will be necessary to look for an emotional balance, set up the main channel of working communications in the form of online meetings, and possibly transfer events and projects to digital rails. Understanding the risks will help identify early signs of burnout and create a conducive environment for health savings and professional longevity.

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AUTHOR CONTRIBUTIONS

All authors contributed to the study conception and design.

SUPPORTING AGENCIES

No funding agencies were reported by the authors.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

REFERENCES

- Analytical report: Development of remote (remote) forms of labor activity in health care / Under the scientific editorship of Academician of the Russian Academy of Sciences V.I. Starodubov. Federal State Budgetary Institution “Central Research Institute for Organization and Informatization of Health Care” of the Ministry of Health of the Russian Federation. Moscow 2021. Retrieved from: https://mednet.ru/images/materials/news/doklad_o_distanc_trude.pdf
- Baksansky OE, Safonicheva OG. Syndrome of emotional burn out. The view of a psychologist and a neurologist (literature review)]. Journal of New Medical Technologies. 2021;2:45-57. <https://doi.org/10.24412/1609-2163-2021-2-45-57>

- Danilov A.B., Kurganova Yu. M. Office Syndrome is a reality. JMR. Neurology and Psychiatry. No. 30, 2011. P.2-7. Retrieved from: https://www.rmj.ru/articles/nevrologiya/Ofisnyy_sindrom/
- Davydov D.M., Stewart R., Ritchie K., Chaudieu I. Resilience and mental health. Clinical Psychology Review. 2010. T. 30. № 5. C. 479-495. <https://doi.org/10.1016/j.cpr.2010.03.003>
- Dontsov V.I., Krutko V.N. Health - saving as a modern direction of preventive medicine (review). Bulletin of rehabilitation medicine. 2016. No. 1 (71). P. 2-9.
- Explanatory note to the draft of Federal law "On Amendments to the Labor Code of the Russian Federation regarding the regulation of remote work". Retrieved from: <https://sozd.duma.gov.ru/bill/973264-7>
- Fokin V.F.; Ponomareva N.V. "A method for assessing the energy state of the brain." The patent of the Russian Federation № 2135077 A61B5 / 04, 08.27.1999. Retrieved from: <https://elibrary.ru/item.asp?id=38130764>
- Fokin V.V., Ponomareva N.V. Energetic physiology of the brain. - Moscow, 2002. Retrieved from: <https://elibrary.ru/item.asp?id=26409935>
- Freudenberger, H. J. Staff Burn-Out / H. J. Freudenberger // Journal of Social Issues. 1974. Vol. 30, № 1. P. 159-165. <https://doi.org/10.1111/j.1540-4560.1974.tb00706.x>
- Golubnitschaja O, Baban B, Boniolo G, Wang W, Bubnov R, Kapalla M, Krapfenbauer K, Mozaffari M, Costigliola V. Medicine in the early twenty-first century: paradigm and anticipation – EPMA position paper 2016. EPMA J. 2016;7:23. <https://doi.org/10.1186/s13167-016-0072-4>
- Golubnitschaja O, Topolcan O, Kucera R, Costigliola V and EPMA. 10th Anniversary of the European Association for Predictive, Preventive and Personalised (3P) Medicine - EPMA World Congress Supplement 2020. EPMA J. 2020 Aug; 11(Suppl 1): 1–133. <https://doi.org/10.1007/s13167-020-00206-1>
- Ivanichev G.A. Clinical muscular pain syndromes. Kazan Medical Journal. 2011. Vol. 92. P.244-248. Retrieved from: <https://elibrary.ru/item.asp?id=16219782>
- Janda V. Muskelfunktions Diagnostik // 2 Aufl. - Berlin: Volk U. Ges., 1985.- 160 s.
- Janda V. On the concept of postural muscles and posture in men // Aus. J. Physiother. 1983. 29. - P. 83-84. [https://doi.org/10.1016/s0004-9514\(14\)60665-6](https://doi.org/10.1016/s0004-9514(14)60665-6)
- Janwantanakul P., Pensri P. et al. Development of a risk score for low back pain in office workers—a cross-sectional study, BMC Musculoskeletal Disorders. 2011. <https://doi.org/10.1186/1471-2474-12-23>
- Kipervas I.P. Peripheral tunnel syndromes. - M., MMA them. THEM. Sechenov, 1991, - 32s.
- Kogan O.G., Schmidt I.R., Vasilyeva L.F. Visual diagnostics of non-optimal statics and dynamics. Manual medicine. 1991. No. 3. P. 8-10.
- Krutko V.N., Dontsov V.I., Molodchenkov A.I., Potemkina N.S., Smirnov I.V.. Internet - technology for personalized support for health savings. Bulletin of rehabilitation medicine. 2017. No. 1 (77). P. 90-95.
- Letter of the Ministry of Labor of Russia by April 23, 2020 No. 14-2 / 10 / P-3710. "On the direction of Recommendations for the use of flexible forms of employment in the context of preventing the spread of a new coronavirus infection in the Russian Federation". Retrieved from: <https://base.garant.ru/73961439/>
- Maslach C., Jackson S.E., Leiter M.P. Burnout inventory manual (3rd ed.). – Palo Alto, California: Consulting Psychological Press, Inc., 1996. 52 p.
- Maslach C., Schaufeli W.B., Leiter M.P. Job Burnout. Annual Review of Psychology. 2001; 52:397–422. <https://doi.org/10.1146/annurev.psych.52.1.397>
- Remote Operations in the COVID-19 Pandemic: A Guide for Employers / Geneva: International Labour Office, 2020.
- Safonicheva O. G., Kuznetsova O. V. Lymphatic drainage. Tutorial. Recommended for publication by the problem commission "Rehabilitation of patients with diseases of the nervous system and

- musculoskeletal system". December 16, 2000. / Novokuznetsk, 2000. Retrieved from: <https://elibrary.ru/item.asp?id=21364830>
- Safonicheva O. G., Martynchik S. A. A comprehensive screening program in the neurology platform based on innovative technologies of personalized medicine. International Journal of Applied and Basic Research. 2015. No. 2-2. P. 246-250. Retrieved from: <https://applied-research.ru/en/article/view?id=6444>
- Safonicheva O. Syndrome of upper aperture of the chest (New look at pathogenesis and treatment). Doctor. 2006. No. 13. S. 68-70. Retrieved from: <https://elibrary.ru/item.asp?id=12936662>
- Safonicheva O.G. Method for correction of the functional state of the human body. Patent for invention RU 2163795 C1, 10.03.2001. Application No. 2000105235/14. March 2, 2000.
- Shimarova O. V., Malakhovsky V. V., Zilov V. G. The value of methods of neuromuscular activation of the postural muscles of the neck in the rehabilitation of patients with cervical pain syndrome. Bulletin of rehabilitation medicine. 2020; 96 (2); 49-53. <https://doi.org/10.38025/2078-1962-2020-96-2-49-53>
- Society for Human Resource Management: Difficulties in the transition to remote operation. Research results. Retrieved from: <http://www.shrm.org/resourcesandtools/pages/remote-work.aspx>
- Vlakh N.I. Model of psychological help to presenters of "helping" professions with emotional burnout // Vestnik SUSU. Series: Psychology. 2015. No. 4. P.24-30.
- World Health Organization. Retrieved from: <https://who.int/ru>



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School social climate and personal and social responsibility of high school students in secondary school according to their motivational profile

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ABSTRACT

The aim of the present study was to analyse the motivational profile of high school students and how it was related to responsibility, basic psychological needs and school social climate, as well as to assess gender differences. For this purpose, a total sample of 302 students ($M = 14.48$; $SD = 1.40$) participated and were administered a multiple-choice questionnaire, where, in turn, gender and date of birth were asked. A profile analysis was performed using Ward's method and k-means using the motivation scale (intrinsic motivation, identified, introjected and external regulation, amotivation) as variables for its elaboration. Two cluster profiles were finally created and named: a) "high motivation and low amotivation" ($n = 212$); b) "low motivation and high amotivation" ($n = 95$). Next, a multivariate analysis was performed, which showed that high motivation profile had statistically significant results at $p < .001$, higher in the satisfaction of the basic psychological needs of autonomy, competence and relatedness, personal and social responsibility and school social climate. On the other hand, attending to gender, no significant differences were found in the number of students in the profiles after analysing the standardized residuals. It is concluded that an increase in self-determined motivation can be associated to an improvement in basic psychological needs, responsibility and school social climate, regardless of the student's gender.

Keywords: Physical activity psychology, Basic psychological needs, Gender, School, Self-determination theory.

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INTRODUCTION

In the educational field, motivation is considered one of the personal variables most associated with students' learning and academic performance (Rodríguez & Rosquete, 2018), arousing great research interest among the educational scientific community (Navarro-Patón et al., 2019; Sandin & Curione, 2021; Vázquez-Toledo et al., 2021). Within the academic context, school motivation is understood as the set of beliefs held by students in relation to their final goals and that allow us to know the main reasons for students to adopt behaviours of greater persistence towards the task (Gaeta et al., 2015; Usán Supervía & Salavera Bordás, 2018).

This variable is a fundamental element for achieving meaningful learning in students, as it is directly related to their interests and contributes to the comprehensive development of their abilities, overcoming their own limitations (Sellan Naula, 2017). Thus, a student with a high degree of motivation will have a greater predisposition to learn and to show positive behaviour towards the learning process (Navarro-Patón et al., 2019; Rodríguez & Rosquete, 2018; Sellan Naula, 2017).

Among the frameworks used to study students' motivational processes, the Self-Determination Theory (SDT, Deci & Ryan, 1985, 2000) stands out. This macro-theory studies and analyses the degree to which human behaviours are performed in a self-determined or voluntary manner (Granero-Gallegos et al., 2014). Within this theoretical framework, motivation is conceived as a continuum comprising different degrees or levels of self-determination of behaviour, from self-determined to non-self-determined, distinguishing between the two, 3 large blocks ordered from greater to lesser degree of self-determination: intrinsic motivation, extrinsic motivation and amotivation (Granero-Gallegos et al., 2014; Trigueros et al., 2020). Intrinsic motivation constitutes the highest degree of self-determination, which is characterised by the student's commitment to an activity that brings pleasure and enjoyment (Trigueros et al., 2020). The second block corresponds to extrinsic motivation, which establishes that a person's behaviour is influenced by external factors (Menéndez-Santurio & Fernández-Río, 2017). Within this construct, we find other types of regulation (Granero-Gallegos et al., 2014; Ryan & Deci, 2014), also ordered from greater to lesser self-determination: (1) integrated regulation, when a student performs activities because it relates to a lifestyle of his or her own, (2) identified regulation, when the student performs a task because he or she considers it important for him or herself, (3) introjected regulation, when the student participates in class out of guilt, and (4) external regulation, when the student participates in tasks out of obligation and seeks the attainment of rewards or recognition by others. The last construct refers to amotivation, which is associated with an absence of motivation and feelings related to frustration or incompetence (Sánchez et al., 2011).

In this line of argument, SDT establishes the existence of 3 basic psychological needs that must be met in the social context of the individual and that can influence the different types of motivation (Deci & Ryan, 2002). These needs are considered psychological mediators of motivation (Sánchez et al., 2011) and are: (1) autonomy, the student's need to feel like a guide and regulator of his or her own learning and behaviour, (2) relatedness, referring to the need to feel satisfied by relating to others and participating in a group (affiliation), and (3) competence, associated with the student's need to feel able to overcome the proposed tasks and activities effectively. Thus, the degree of self-determination achieved by the individual will depend on whether or not these basic psychological needs are satisfied, i.e., the greater the satisfaction of students' needs, the higher levels of self-determination and intrinsic motivation will be achieved (Deci & Ryan, 2000; Menéndez-Santurio & Fernández-Río, 2017).

In this way, it can be observed that the most self-determined motivation is the most relevant (Menéndez-Santurio & Fernández-Río, 2017) since, according to scientific evidence, this motivation is directly related to adaptive behaviours such as satisfaction and enjoyment (Méndez-Giménez et al., 2017), prosocial behaviours (Manzano-Sánchez et al., 2021b) or the intention to be physically active (Granero-Gallegos et al., 2014); and social factors such as personal and social responsibility (Fernández-Hernández et al., 2021; Manzano-Sánchez et al., 2021a, 2021b) or school social climate (Manzano-Sánchez et al., 2021a, 2021b).

On the other hand, there are numerous scientific investigations that have studied academic motivation as a function of gender (Delgado et al., 2010; Gómez & Riccetti, 2016; Granero-Gallegos et al., 2014; Granero-Gallegos & Gómez-López, 2020), mostly finding that males present higher values in self-determined motivation than females. The studies by Granero-Gallegos et al. (2014) and Granero-Gallegos and Gómez-López (2020) show that boys are more associated with the "*high motivation*" profile, while the "*low motivation*" profile is mostly associated with girls.

Taking into account the above theoretical background, the main objective of the present study was to analyse the motivational profile of secondary school students and its relationship with responsibility, basic psychological needs and school social climate, as well as to assess gender differences. Therefore, it is hypothesized that there are two different motivational profiles, the more self-determined motivational profile being positively related to higher values in responsibility, the satisfaction of basic psychological needs and the social climate of the classroom. Regarding gender, there will be differences in the number of members in the different motivational profiles, with men having a greater participation in the more self-determined profile.

MATERIAL AND METHODS

Design

A descriptive, correlational and analytical observational cross-sectional study design has been used, following the quantitative methodology.

Participants

The sample of this study was initially composed of 327 secondary school students, who, after following the inclusion and exclusion criteria, were a total of 307, being 149 men (48.5%) and 158 women (51.5%) with a mean age $M = 14.48$; $SD = 1.40$. The inclusion criteria were: completing all the items in the questionnaire, doing it with the researcher and the teacher in class, and meeting the legitimacy criteria of the statistical analysis to detect atypical cases.

Instruments

Questionnaire for the analysis of basic psychological needs (PNSE, Vlachopoulos & Michailidou, 2006)

To measure the satisfaction of the needs of competence, autonomy and social relationship adapted to Spanish by Moreno et al., (2008). The scale is made up of 18 items, six to assess each of the needs: competence (e.g., "*I am confident to do the most challenging exercises*"), autonomy (e.g., "*I think I can make decisions in my workouts*"), and relationship with others (e.g., "*I feel close to my training partners because they accept me as I am*"). The previous sentence is "*In my trainings...*" and the answers are collected on a Likert-type scale, whose score ranges from 1 (totally disagree) to 5 (totally agree). The reliability values were .855 (autonomy), .882 (competence) and .872 (relationship).

Questionnaire for the analysis of the levels of personal and social responsibility (PSRQ, Li et al., 2008)

To measure the levels of personal responsibility and social responsibility adapted to Spanish by Escartí et al. (2011). The scale is made up of 14 items, seven for evaluating social responsibility (e.g., "I help others") and seven for personal responsibility (e.g., "I propose goals for myself") and the answers are collected on a Likert-type scale whose score range oscillates between 1 (strongly disagree) and 6 (strongly agree). Reliability was .938 (social responsibility) and .859 (personal responsibility).

Academic Motivation Scale (EME, Vallerand et al., 1989)

To measure motivation from the most self-determined forms to the most external causes and amotivation. The questionnaire is made up of 7 subscales, called; intrinsic motivation towards knowledge (e.g., "because I feel pleasure and satisfaction when I learn new things") towards achievement (e.g., "because of the pleasure I feel when I excel in studies") and towards stimulating experiences (e.g., "because reading stimulates me on the issues that interest me"), identified regulation (e.g., "because it will allow me to access the labour market in the field that I like the most"), introjected regulation (e.g., "to show me that I am an intelligent person"), external regulation (e.g., "To get a more prestigious job") and amotivation (e.g., "I don't know, I don't understand what I'm doing in high school"). Adapted to the context of Secondary Education by Nuñez et al. (2010). The instrument is made up of 28 items, preceded by the sentence "I go to school / institute because ..." with a Likert-type scale of five points, from 1 (does not correspond at all) to 7 (corresponds totally) and distributed in seven subscales, five of them with four items and the remaining two with three. Reliability was .959 (intrinsic motivation), .846 (identified regulation), .891 (introjected regulation), .885 (external regulation) and .879 (amotivation).

School Social Climate Scale (CECSCE, Trianes et al., 2006)

Originally designed by the California School Climate and Safety Survey questionnaire (Furlong et al., 1991; Rosenblatt & Furlong, 1997) to measure the centre climate. The questionnaire is made up of 2 subscales called: "centre climate" (e.g., "Students really want to learn"), composed of 8 items and "teachers climate" (e.g., "The teachers of this centre are nice with the students") With a five-point Likert-type scale, from 1 (does not correspond at all) to 5 (fully corresponds). The reliability was .881 (school social climate) and .853 (teacher climate).

Procedure

The design was approved by the Research Ethics Commission of the University of Murcia, code 1685/2017. The data were collected for convenience and accessibility in two Secondary Education centres in the autonomous community of the Region of Murcia. The management team was contacted to inform them of the objectives and request their collaboration, and informed consent was given to all students. Next, information was given on how to fill in the instruments and solve all the doubts that may arise during the process, the questionnaires were administered with the researcher present to make a brief explanation of the objective of the study, administering trying to create a calm environment relaxed during the 5 minutes prior to the performance. The time required to complete the questionnaire was approximately 20 minutes, and it varied slightly according to the age of the students.

Statistical analysis

A profile analysis was performed using student motivation as independent variables (intrinsic motivation, identified regulation, introjected regulation, external regulation and amotivation). To determine the number of profiles, a dendrogram analysis was first performed using the hierarchical method using Ward's method and the most distant neighbour method, obtaining similar results, suggesting the elaboration of two to four sets.

Next, a two-stage cluster corroborated a silhouette measure of cohesion and cluster separation considered good ($> .5$) for two sets. Finally, the K-means method was used to make the final clusters with 2 clusters.

Each profile was examined by means of a multivariate analysis (MANOVA) taking into account the differences found in each of the variables under investigation. Additionally, the clusters were analysed according to gender through an analysis of the chi-square value with 2x2 contingency tables. Statistical analysis was performed using the IBM SPSS 23.0 package.

RESULTS

Descriptive analysis and bivariate correlations

Table 1 shows the descriptive analysis of the different variables under study. It is worth noting practically all the variables had a correlation with each other at $p < .01$ or $.05$, except for amotivation, especially that it had only negative correlation with the rest of the motivational variables (less external regulation), with competition and the climate of the teaching staff. The highest values were for the motivation scale, in external regulation ($M = 5.68$), for basic psychological needs, in the relationship ($M = 3.93$), for the school social climate, the teacher's climate was higher ($M = 3.71$) and in responsibility, social responsibility ($M = 4.69$). Finally, the correlations were significant at $p < .001$ except for competition and fear of angering others, which was at $p < .05$.

Cluster analysis

The cluster analysis was carried out according to the considerations of Hair et al. (1999). The dendrogram obtained suggested the existence of two clusters that were formed by two continuous lines following the Z values (Figure 1). The clusters were grouped into "high motivation" ($n = 212$) and "low motivation" ($n = 95$), with statistically significant higher values in intrinsic, identified, introjected and external motivation for the first profile and in amotivation for the second. The level of significance was $p < .01$ in all cases.



Figure 1. Cluster Z values for the different variables.

Differences in the variables under study

A multivariate analysis (MANOVA) was performed using the clusters as independent variables and the rest of the study variables as dependent variables (Table 2). Significant differences were found at the multivariate level (Wilks's Lambda = .670; $F = 28.628$, $p < .001$). The univariate ANOVAs showed statistically significant differences in all variables, in favour of the cluster with high motivation compared to the cluster with low motivation, as shown in Table 2.

Table 1. Descriptive and correlations values among different variables.

	<i>R</i>	<i>M</i>	<i>SD</i>	<i>A</i>	<i>K</i>	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Intrinsic motivation	1-7	4,70	1,54	-0,535	-0,583	.786**	.874**	.667**	-.155**	.760**	.688**	.688**	.546**	.729**	.537**	.612**	.608**	.516**	.568**
2 Identified regulation	1-7	5.43	1.44	-1.006	0.296	1	.758**	.793**	-.213**	.720**	.516**	.596**	.478**	.602**	.468**	.558**	.543**	.605**	.578**
3 Introjected regulation	1-7	5.03	1.61	-0.683	-0.475		1	.696**	-.174**	.651**	.590**	.599**	.464**	.627**	.466**	.515**	.519**	.486**	.551**
4 External regulation	1-7	5.68	1.41	-1.170	0.567			1	-.083	.474**	.452**	.556**	.498**	.571**	.381**	.418**	.422**	.623**	.613**
5 Amotivation	1-7	2.03	1.38	1.607	2.058				1	-.736**	-.040	-.144*	-.053	-.089	-.050	-.140*	-.102	-.027	-.030
6 SDI	1-7	5.42	4.55	-0.747	0.500					1	.478**	.548**	.393**	.538**	.400**	.519**	.487**	.374**	.392**
7 Autonomy	1-5	3.19	1.00	-0.295	-0.542						1	.731**	.583**	.879**	.672**	.698**	.724**	.357**	.392**
8 Competence	1-5	3.70	0.98	-0.825	0.219							1	.664**	.907**	.609**	.699**	.692**	.428**	.493**
9 Relation	1-5	3.93	0.99	-0.980	0.320								1	.851**	.653**	.599**	.660**	.477**	.411**
10 BPI	1-5	3.61	0.87	-0.752	0.322									1	.734**	.757**	.787**	.478**	.491**
11 School climate	1-5	3.56	0.84	-0.603	-0.064										1	.793**	.944**	.382**	.348**
12 Teacher climate	1-5	3.71	0.88	-0.699	0.026											1	.949**	.364**	.360**
13 Total climate	1-5	3.64	0.82	-0.676	0.114												1	.394**	.374**
14 Social responsibility	1-6	4.69	1.12	-1.088	0.339													1	.851**
15 Personal responsibility	1-6	4.21	1.05	-0.847	-0.273														1

Note. SDI = Self Determination Index; BPI = Basic Psychological Index; R = range; M = Mean; SD = standard deviation; A = Asymmetry; K = kurtosis; ** $p < .01$; * $p < .05$.

Table 2. Multivariate analysis of profiles.

	Cluster “High motivation”			Cluster “Low motivation”			F	p	eta
	R	M	SD	M	SD				
Autonomy	1-53.54		0.82	2.43	0.96	107.781	< .001	0.261	
Competence	1-54.06		0.68	2.90	1.07	129.362	< .001	0.298	
Relation	1-54.21		0.78	3.31	1.12	65.485	< .001	0.177	
BPI	1-53.93		0.61	2.88	0.92	139.435	< .001	0.314	
School climate	1-53.79		0.72	3.05	0.88	60.391	< .001	0.165	
Teacher climate	1-54.00		0.67	3.07	0.97	92.935	< .001	0.234	
Total climate	1-53.90		0.64	3.06	0.89	86.878	< .001	0.222	
Social responsibility	1-65.05		0.90	3.89	1.17	90.320	< .001	0.228	
Personal responsibility	1-64.54		0.86	3.47	1.08	87.501	< .001	0.223	

Wilks' Lambda (λ) = .670 ($f = 28.627$) $p < .001$

Note. BPI = Basic Psychological Index; R = range; M = Mean; SD = standard deviation.

Differences in profiles according to gender and age of the sample

Next, an analysis was carried out using contingency tables to check the differences according to the gender of the participants (Table 3). The analysis did not show statistically significant differences, although the value of $p = .069$ shows a high tendency to statistical significance in favour of the girls who predominated in the high motivation cluster.

Cluster 1 was positively associated with women, 53.7%, compared to 46.3% in men, and cluster 2 with men in 53.7%, compared to 46.3% in women, suggesting that men obtained a higher profile. related to amotivation, and women with higher motivation.

Table 3. Differences in motivational profiles by gender.

		Cluster “High motivation”		Cluster “Low motivation”	
		n	%	n	%
Gender	Men	98	46.3%	51	53.7
	Women	114	53.7%	44	46.3
	eta				.266
	Chi ²				0.069

DISCUSSION

The present study aimed to examine the motivational profile of adolescent students, as well as its link with responsibility, basic psychological needs and classroom social climate, and to review gender differences. The satisfaction of students' basic psychological needs is reflected in more self-determined levels of motivation that generate behaviours based on personal and social responsibility (Manzano-Sánchez et al., 2021). Thus, a classroom social climate focused on the teaching-learning process of students favours the acquisition of knowledge (Cid et al., 2019), promotes the development of personal skills (Alevriadou & Pavlidou, 2016; Hidalgo-Rasmusen et al., 2013), generates a greater intention to practice physical activity (Taylor et al., 2010) and reinforces young students' social satisfaction in the classroom (Baena-Extremera et al., 2013; Garn et al., 2014; Vallerand, 1997).

The results of the study show the fulfilment of the research hypothesis in relation to the existence of motivational profiles with two different degrees of self-determined motivation. The variables under study show

a correlation with each other, with the exception of demotivation, which showed a negative association with the rest of the variables of the TAD self-determination continuum (Vasconcellos et al., 2020) (except for external regulation), with competence and with teacher climate. External regulation as a form of motivation was the highest rated. This relates to Iso-Ahola and St. Clair's (2000) definition of motivation as "*the most important and immediate factor in human behaviour*", because it stimulates, energizes, directs and regulates it. Moreover, motivation provides the force that drives and orients the activity of individuals to achieve a goal (Sanpascual, 2007, retrieved from Cuenca-Ruano et al., 2021).

As for the existence of different motivational profiles, the cluster analysis yielded a "*high motivation*" profile ($n = 212$) and a "*low motivation*" profile ($n = 95$), with statistically significant higher values for intrinsic, identified, introjected and external motivation for the first profile and for demotivation for the second. Significant differences were also obtained of the cluster with high motivation with respect to the cluster with low motivation. These results are related to those obtained by Cid et al. (2019) who tested a structural regression model in which a learning-oriented climate had a positive impact on the satisfaction of students' basic psychological needs. However, only competence satisfaction had a positive and significant relationship with students' autonomous motivation, which in turn had a positive and significant relationship with the physical education grade, as well as with intentions to engage in sport/physical activity in leisure time. In the same line of study, Moreno-Murcia et al. (2013) found the existence of two motivational profiles among physical education students: a "*self-determined*" profile with higher scores for the four types of intrinsic motivations (general, knowledge, stimulation and achievement) and identified regulation, compared to introjected and external regulation; and a second "*non-self-determined*" profile with higher scores for external regulation, introjected and amotivation than for the four types of intrinsic motivation (general, knowledge, stimulation and achievement).

Regarding the levels of motivation according to gender, the analysis using contingency tables showed a greater number of girls in the "*high motivation*" cluster. These results contrast with those found in other studies that show that boys are more associated with the "*high motivation*" profile, while the "*low motivation*" profile is mostly associated with girls (Granero-Gallegos et al., 2014; Granero-Gallegos & Gómez-López, 2020). The fact that girls present more self-determined levels of motivation in the PE classroom could be attributed to the importance that teachers attach to variables such as personal and social responsibility and the satisfaction of the BPNs in the classroom, compared to contexts of achievement-oriented goals such as performance, traditionally more linked to the male gender (Ruiz-Juan & Baena-Extremuera, 2015).

Regarding the variables of responsibility and classroom or school social climate, a positive and significant association of responsibility with school social climate, basic psychological needs (autonomy, competence and relatedness), the self-determination index and prosocial behaviour was observed (Manzano-Sánchez et al., 2021).

In relation to the limitations of the study, the sample size should be increased and longitudinal design studies should be carried out to establish comparisons over time and in a completely randomised way between motivational profiles at different educational stages (e.g., in primary school). Future research is needed to further analyse different educational contexts in European, American, etc. educational settings. Furthermore, it is necessary to analyse variables related to emotional intelligence and levels of self-determination due to their correlation demonstrated in the studies reviewed and the relevance of these variables on cognitive performance, academic performance and positive emotional conditions.

IMPLICATIONS PRACTISES

The social climate fostered in the classroom plays an important role in students' perception of learning-oriented climates, which might be different, depending on the teaching style. Thus, teachers who encourage students to experience a "*personal and social learning*" oriented climate might have a positive and significant relationship with the satisfaction of basic psychological needs that might be positively linked to physical education grades, i.e.: academic performance. Even providing the opportunity for students to intervene in class through different psychological classroom climates guided by teachers could represent a boost for students in the pedagogical and socio-cultural characteristics of physical education. Teachers have a responsibility to promote task and learning environments in which students experience positive outcomes (Rodriguez et al., 2020).

The level of motivation in physical education classes in adolescent students can be used as a starting point for self-reflection and for designing proactive learning environments, personal development and personal and socio-cultural transferability of competences acquired in the classroom. This would lead to the development of effective didactic interventions, built between teaching competences and skills and the importance of students' cognitive and practical input and feedback. To this end, teachers' own motivation is of great importance, as it correlates significantly with the way they interact with their students.

CONCLUSIONS

The results obtained indicate that the participants who obtained higher levels of self-determined motivation are those who, in turn, have higher values of satisfaction with the BNPs, a better school social climate and higher levels of personal and social responsibility. In turn, girls are those with a higher number of participants in the more self-determined profile, with corresponding benefits in the psychosocial variables studied in this study.

AUTHOR CONTRIBUTIONS

NB-P: Idea, concept, and design. DM-S: Data collection, analysis and interpretation. JFJ-P: Writing article. AV-V: Literature review and supervision.

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No potential conflict of interest was reported by the authors.

REFERENCES

- Alevriadou, A., & Pavlidou, K. (2016). Teachers' interpersonal style and its relationship to emotions, causal attributions, and type of challenging behaviors displayed by students with intellectual disabilities. *Journal of Intellectual Disabilities*, 20(3), 213-227. <https://doi.org/10.1177/1744629515599108>
- Baena-Extremera, A., Granero-Gallegos, A., Pérez-Quero, F. J., Bracho-Amador, C., & Sánchez-Fuentes, J. A. (2013). Motivation and motivational climate as predictors of perceived importance of Physical

- Education in Spain. South African. Physical Education and Recreation, 35(2), 1-13. <https://doi.org/10.21909/sp.2015.03.695>
- Chen, R., Wang, L., Wang, B., & Zhou, Y. (2020). Motivational climate, need satisfaction, self-determined motivation, and physical activity of students in secondary school physical education in China. BMC Public Health, 20(1), 1-14. <https://doi.org/10.1186/s12889-020-09750-x>
- Cid, L., Pires, A., Borrego, C., Duarte-Mendes, P., Teixeira, D. S., Moutão, J. M., & Monteiro, D. (2019). Motivational determinants of physical education grades and the intention to practice sport in the future. PLoS One, 14(5), e0217218. <https://doi.org/10.1371/journal.pone.0217218>
- Cuenca-Ruano, P., Salvador García Martínez, A., Ferriz-Valero, A., & Tortosa-Martínez, J. (2021). Comparative analysis of motivational profiles and flow status between a traditional methodology and the Flipped Classroom methodology in Physical Education students. Retos, 39, 338-344. <https://doi.org/10.47197/retos.v0i39.78574>
- Delgado, B., Inglés, C. J., García-Fernández, M., Castejón, J. L., & Valle, A. (2010). Diferencias de género y curso en metas académicas en alumnos de Educación Secundaria Obligatoria. Revista Española de Pedagogía, 67-83. <https://doi.org/10.6018/analesps.30.2.148331>
- Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and selfdetermination in human behaviour. Plenum Press. <https://doi.org/10.1007/978-1-4899-2271-7>
- Deci, E. L., & Ryan R. M. (2000). Target Article: The “What” and “Why” of Goal Pursuits: Human Needs and the Self-Determination of Behavior. Psychological Inquiry, 11(4), 227-268. https://doi.org/10.1207/s15327965pli1104_01
- Deci, E. L., & Ryan, R. M. (2002). Overview of self-determination theory: An organismic dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), Handbook of self-determination research (pp, 3-36). University of Rochester Press. https://doi.org/10.1007/978-1-4899-2271-7_5
- Fernández-Hernández, A., Manzano-Sánchez, D., Jiménez-Parra, J. F., & Valero-Valenzuela, A. (2021). Analysis of differences according to gender in the level of physical activity, motivation, psychological needs and responsibility in Primary Education. Journal of Human Sport and Exercise, 16(2proc), S580-S589. <https://doi.org/10.14198/jhse.2021.16.proc2.42>
- Field, A. (2017). Discoring statistics using IBM SPSS Statistics (5th ed.). SAGE Publications.
- Gaeta, M. L., Cavazos, J., Sánchez, A. P., Rosário, P., & Högemann, J. (2015). Propiedades psicométricas de la versión mexicana del Cuestionario para la Evaluación de Metas Académicas (CEMA). Revista Latinoamericana de Psicología, 47(1), 16-24. [https://doi.org/10.1016/s0120-0534\(15\)30002-9](https://doi.org/10.1016/s0120-0534(15)30002-9)
- Garn, A. C., & Wallhead, T. (2015). Social goals and basic psychological needs in high school physical education. Sport, Exercise, and Performance Psychology, 4(2), 88. <https://doi.org/10.1037/spy0000029>
- Gómez, V. M., & Riccetti, A. E. (2016). Perfiles motivacionales y diferencias en función del género en clases de educación física. In VIII Congreso Internacional de Investigación y Práctica Profesional en Psicología XXIII Jornadas de Investigación XII Encuentro de Investigadores en Psicología del MERCOSUR. Facultad de Psicología-Universidad de Buenos Aires.
- Granero Gallegos, A., Baena Extremera, A., Sánchez Fuentes, J. A., & Martínez Molina, M. (2014). Perfiles motivacionales de apoyo a la autonomía, autodeterminación, satisfacción, importancia de la educación física e intención de práctica física en tiempo libre. Cuadernos de Psicología del Deporte, 14(2), 59-70. <https://doi.org/10.4321/s1578-84232014000200007>
- Granero-Gallegos, A. G., & Gómez-López, M. (2020). La motivación y la inteligencia emocional en secundaria. Diferencias por género. International Journal of Developmental and Educational Psychology, 1(1), 101-110. <https://doi.org/10.17060/ijodaep.2020.n1.v1.1766>
- Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1999). Análisis multivariante (Vol. 491). Prentice Hall.

- Hidalgo-Rasmussen, A., Ramírez-López, G., & Hidalgo-San Martín, A. (2013). Actividad física, conductas sedentarias y calidad de vida en adolescentes universitarios de Ciudad Guzmán, Jalisco, México. *Ciência & Saúde Coletiva*, 18(7), 1943-1952. <https://doi.org/10.1590/s1413-81232013000700009>
- Iso-Ahola, S. E., & St.Clair, B. (2000). Toward a theory of exercise motivation. *Quest*, 52, 131-147. <https://doi.org/10.1080/00336297.2000.10491706>
- Manzano-Sánchez, D., Gómez-Mármol, A., Conte-Marín, L., Jiménez-Parra, J. F., & Valero-Valenzuela, A. (2021a). Future Academic Expectations and Their Relationship with Motivation, Satisfaction of Psychological Needs, Responsibility, and School Social Climate: Gender and Educational Stage. *International Journal of Environmental Research and Public Health*, 18(9), 4558. <https://doi.org/10.3390/ijerph18094558>
- Manzano-Sánchez, D., Gómez-Mármol, A., Valero-Valenzuela, A., & Jiménez-Parra, J. F. (2021b). School climate and responsibility as predictors of antisocial and prosocial behaviors and violence: a study towards self-determination theory. *Behavioral Sciences*, 11(3), 36. <https://doi.org/10.3390/bs11030036>
- Menéndez-Santurio, J. I., & Fernández-Río, J. (2017). Responsabilidad social, necesidades psicológicas básicas, motivación intrínseca y metas de amistad en educación física. *Retos*, 32, 134-139. <https://doi.org/10.47197/retos.v0i32.52385>
- Moreno-Murcia, J. A., Cervelló-Gimeno, E., Huéscar-Hernández, E., Belando-Pedreño, N., & Rodríguez-Martínez, J. (2013). Motivational Profiles in Physical Education and Their Relation to the Theory of Planned Behavior. *Journal of Sports Science and Medicine*, 12, 551-558.
- Navarro-Patón, R., Lago-Ballesteros, J., Basanta-Camiño, S., & Arufe-Giraldez, V. (2019). Relation between motivation and enjoyment in physical education classes in children from 10 to 12 years old. *Journal of Human Sport and Exercise*, 14(3), 527-537. <https://doi.org/10.14198/jhse.2019.143.04>
- Rodríguez, F., Monteiro, D., Teixeira, D. S., & Cid, L. (2020). La relación entre los climas motivacionales de maestros y compañeros, la satisfacción de las necesidades y las calificaciones de educación física: un enfoque AGT y SDT. *Revista Internacional de Investigación Ambiental y Salud Pública*, 17 (17), 6145. <https://doi.org/10.33776/remo.v0i9.3196>
- Rodríguez, D. R., & Rosquete, R. G. (2018). Relación entre perfil motivacional y rendimiento académico en Educación Secundaria Obligatoria. *Estudios sobre Educación*, 34, 199-217. <https://doi.org/10.15581/004.34.199-217>
- Ruiz-Juan, F., & Baena-Extremera, A. (2015). Predicción de las metas de logro en educación física a partir de la satisfacción, la motivación y las creencias de éxito en el deporte. *Revista Iberoamericana de Psicología del Ejercicio y el Deporte*, 10(2), 193-203. <https://doi.org/10.30827/digibug.54004>
- Ryan, R. M., & Deci, E. (2014). Self-determination theory. In *Encyclopedia of Quality of Life and Well-Being Research* (pp. 5755-5760). Springer Netherlands. https://doi.org/10.1007/978-94-007-0753-5_2630
- Sánchez, D., Leo, F. M., Sánchez, P. A., Gómez, F. R., & García, T. (2011). Teoría de la autodeterminación y comportamientos prosociales en jóvenes jugadores de fútbol. *Apunts. Educación Física y Deportes*, 103, 31-37.
- Sandin, F., & Curione, K. (2021). Motivación en la escuela: una revisión sistemática desde la perspectiva teórica de Susan Harter. *Contextos de Educación*, 30(21), 8-22.
- Sanpascual, G. (2007) *Psicología de la educación*. ECU.
- Sellan Naula, M. E. (2017). Importancia de la motivación en el aprendizaje. *Sinergias Educativas*, 2(1), 13-19. <https://doi.org/10.31876/s.e.v2i1.20>
- Taylor, I. M., Ntoumanis, N., Standage, M., & Spray, C. M. (2010). Motivational Predictors of Physical Education Students' Effort, Exercise Intentions, and Leisure-Time Physical Activity: A Multilevel Linear Growth Analysis. *Journal Sport Exercise Psychology*, 32(1), 99-120. <https://doi.org/10.1123/jsep.32.1.99>

- Trigueros, R., Aguilar-Parra, J. M., Álvarez, J. F., Cangas, A. J., & López-Liria, R. (2020). El efecto de la motivación sobre la resiliencia y la ansiedad del deportista. *Revista Internacional de Medicina y Ciencias de la Actividad Física y del Deporte*, 20(77), 73-86. <https://doi.org/10.15366/rimcafd2020.77.005>
- Usán Supervía, P., & Salavera Bordás, C. (2018). Motivación escolar, inteligencia emocional y rendimiento académico en estudiantes de educación secundaria obligatoria. *Actualidades en Psicología*, 32(125), 95-112. <https://doi.org/10.15517/ap.v32i125.32123>
- Vasconcellos, D., Parker, P. D., Hilland, T., Cinelli, R., Owen, K. B., Kapsal, N., et al. (2020). Self-Determination Theory Applied to Physical Education: A Systematic Review and Meta-Analysis. *Journal Education Psychology*, 112, 1444-1469. <https://doi.org/10.1037/edu0000420>
- Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. *Advances Experimental Social. Psychology.*, 29, 271-360. [https://doi.org/10.1016/s0065-2601\(08\)60019-2](https://doi.org/10.1016/s0065-2601(08)60019-2)
- Vázquez-Toledo, S., Latorre-Coscolluela, C., & Liesa-Orús, M. (2021). Un análisis cualitativo de la motivación ante el aprendizaje de estudiantes de educación secundaria. *REOP-Revista Española de Orientación y Psicopedagogía*, 32(1), 116-131. <https://doi.org/10.5944/reop.vol.32.num.1.2021.30743>



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Formation of a healthy lifestyle in a younger schooler with the means of physical education

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ABSTRACT

Comparison of the effectiveness of general educational and specially directed methods of physical education in relation to a healthy lifestyle is carried out. During the study, it was proved that pedagogical activity, specially organized for the formation of a healthy lifestyle among junior schoolchildren of physical culture, increasing students' interest in their health; forms an emotionally positive attitude towards one's health; will contribute to the assimilation of knowledge about a healthy lifestyle and their application in practice.

Keywords: Physical education, Children, Motivation, Exercises, Sport.

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INTRODUCTION

According to WHO experts, health depends 50-55% on a person's lifestyle, 20-23% on heredity, 20-25% on the state of the environment (ecology) and 12% on the work of the national health system. So, to the greatest extent, human health depends on the way of life, which means that it can be considered that the general line of formation and strengthening of health is a healthy lifestyle (HLS). The foundation for health and a positive attitude towards exercise is laid during childhood. Every year the health of the younger generation is gradually deteriorating, which indicates the need to take urgent measures to improve the health of children and adolescents.

Childhood is the time when tendencies of human physical development are laid, it is at this time that environmental factors have the greatest influence on the body. The main goal of the work is to determine the effectiveness of general educational and specially targeted methods of physical education in relation to a healthy lifestyle.

According to modern concepts, a healthy lifestyle is the typical forms and methods of a person's daily life strengthening and improving the adaptive and reserve capabilities of the body which ensures the successful performance of social and professional functions.

Belov V.I. (2003) considers a healthy lifestyle as a model of life associated with ideas about the personal and social value of health, means, forms and ways of preserving it. The culture of a healthy lifestyle is a person's way of life in relation to his health, determined by the following components: cognition; value and motivation; physical; sociocultural and behavioural; active; strong-willed.

Any way of life is based on principles, that is, the rules of behaviour that a person follows. There are biological and social principles based on which a healthy lifestyle is formed. Biological principles: the lifestyle should be age-related, energetically safe, strengthening, rhythmic, moderate. Social principles: the way of life should be aesthetic, moral, strong-willed, self-limiting.

This classification is based on the principle of the unity of the individual and the general, the unity of the organism and the environment, biological and social. A healthy lifestyle is a rational organization of human life based on biological and social life forms of behaviour - behavioural factors. Let's list the main ones:

- The formation of positive emotions that contribute to mental well-being - the basis of all aspects of life and health;
- Optimal physical activity is the leading innate mechanism of bio progress and health;
- Rational nutrition is the main factor of bio progress and health;
- A rhythmic lifestyle corresponding to biorhythms is the basic principle of the body's life;
- Effective organization of labour activity - the main form of self-realization, formation and reflection of the human essence;
- Rejection of addictions (alcoholism, drug addiction, smoking, etc.) is a decisive factor in maintaining health.

In practice, the implementation of the listed forms of behaviour is extremely difficult.

The fact is that in the hierarchy of needs underlying human behaviour, health is far from being in the first place. This is due to the low individual and general culture of health, which leads to the absence of an attitude towards the primacy (supremacy) of the value of health in the hierarchy of human needs.

Childhood is the greatest age for developing a healthy lifestyle. In childhood, the basic values, habits, life guidelines are laid. A healthy lifestyle, being an individual system of human behaviour, presupposes the implementation of the rules of behaviour: hardening, rational nutrition, adherence to work and rest, personal hygiene, psychological stability, rejection of bad habits, etc.

Systematic sports activities effectively solve the problems of maintaining and strengthening health, preventing diseases, strengthening immunity, and so on. In addition, physical culture and sports are multifunctional means of education. The polyfunctionality of physical education is manifested in the development of physical, aesthetic, moral and volitional qualities of a person.

Physical education, as a means of forming a healthy lifestyle, is used at school throughout the entire period of education and is carried out in various forms. They are interconnected, complement each other and represent a single process of physical education of schoolchildren:

- Lessons are the main form of physical education and can have a direct impact on the process of forming the foundations of a healthy lifestyle for schoolchildren;
- Classes in sections, in groups of general physical training, physiotherapy exercises allow individualizing the process of physical education;
- Musical breaks, short warm-ups, physical exercises during the school day contribute to increased efficiency, improvement of conditions for educational work and rest, the formation of skills and habits of a healthy lifestyle for schoolchildren;
- Mass health-improving, physical culture and sports events contribute to the formation of a positive attitude towards a healthy lifestyle, increase the importance of systematic physical education and sports for schoolchildren.

Formation of healthy lifestyle is a long-term pedagogical process carried out by teachers, parents and a doctor. This process must be systematic and comprehensive. The formation of a healthy lifestyle affects different aspects of personality development.

For a comprehensive assessment of the degree of formation of a healthy lifestyle, we have identified the following criteria:

The cognitive criterion assumes the presence (or absence) of certain knowledge, skills, intellectual functions necessary for the formation of a healthy lifestyle. This criterion includes an understanding of various aspects of knowledge about health: hygienic requirements and norms, the basics of proper nutrition, work and rest, physical activity, etc. In addition, this criterion allows you to assess the degree of awareness of the rules for the use of various methods of maintaining and promoting health.

The motivational criterion assumes a desire to lead a healthy lifestyle, an interest in one's health.

The criterion of activity assumes the presence of measures to maintain a healthy lifestyle. This criterion assesses the degree of implementation of the main provisions of a healthy lifestyle in the behaviour, habits, and actions of children.

The emotional-volitional criterion assumes the degree of intensity of the emotional experiences of schoolchildren, their characteristics, the degree of volitional efforts in the process of assimilating and assimilating the foundations of a healthy lifestyle. It is determined by what volitional efforts the student makes to follow the rules of a healthy lifestyle.

Characteristics of the levels of formation of a healthy lifestyle are presented in Table 1.

Table 1. Characteristics of the levels of formation of a healthy lifestyle.

Criteria	Level		
	High	Average	Low
Cognitive	1. The student has knowledge of the basics of a healthy lifestyle; 2. The student knows the rules for performing physical exercises and complexes of physical exercises; 3. The student has knowledge of safety precautions during physical education.	1. The student partially possesses knowledge of the basics of a healthy lifestyle, understands the basic principles. 2. The student knows some of the rules for performing physical exercises and complexes of physical exercises. 3. The student partially possesses knowledge of safety measures in physical education lessons.	1. The student does not know the basics of a healthy lifestyle, does not understand the basic principles. 2. The student does not know the rules for doing physical exercises. 3. The student does not know safety precautions when doing physical education.
Motivational	1. The student is interested in knowledge about a healthy lifestyle. 2. The student is tempted to take part in wellness activities. 3. Intrinsic motivation is sufficient to fulfil the norms and rules of a healthy lifestyle.	1. The student is sometimes interested in a healthy lifestyle. 2. The student sometimes wants to take part in health-related activities. 3. Intrinsic motivation must be supported by external	1. The student is not interested in knowledge about a healthy lifestyle. 2. The student does not want to engage in health-improving activities. 3. There is no intrinsic motivation
Active	1. The student systematically uses knowledge and practical skills in the field of healthy lifestyle in his life. 2. The student is an active participant in health-related activities. 3. The student introduces other children to health-related activities.	1. The student sometimes uses knowledge and practical skills in the field of a healthy lifestyle in his life. 2. The student participates in most health-related activities.	1. A student rarely uses or does not use knowledge and practical skills in the field of a healthy lifestyle in his life. 2. The student does not participate or rarely participates in health-related activities.
Emotional-volitional	1. Positive emotions prevail among schoolchildren in health improvement classes. 2. In situations of difficulties in the classroom, the student seeks to cope with them, continues to participate, often achieves success. 3. Students view health-related activities as potential situations of their own success. 4. The student can organize himself during the exercise. 5. When retelling a sporting event with his participation, the student demonstrates emotional experiences.	1. At the lessons of health-improving orientation the student has mixed emotions. 2. In difficult situations during the lesson, external support is needed. 3. The student views health-related activities outside the situation of their own success. 4. The student experiences difficulties in self-organization of physical exercises fulfilment. 5. When retelling an event with his participation, he almost does not demonstrate emotional experiences.	1. Negative emotions prevail among schoolchildren in health-improving classes. 2. In situations of difficulties during classes, the student does not seek to cope with them, interrupts participation, 3. The student considers health-improving activity as a situation of his own failure. 4. The student does not know how to organize himself in the process of performing physical exercises. 5. When retelling an event with his participation, the student does not demonstrate emotional experiences.

The main assessment tools for these criteria were: questionnaires, questionnaires, observations, expert assessments. Let's look at these tools in relation to each criterion.

The main tool for assessing the formation of a healthy lifestyle in relation to the cognitive criterion in our study is a questionnaire in the form of a test. The survey reveals the level of students' awareness of a healthy lifestyle. The test questions are selected in such a way that the answers reveal the level of knowledge, considering age characteristics. The content of the questions is directly related to the educational material studied in the process of mastering the physical education program.

To determine the degree of motivation for physical education, we have developed a questionnaire for schoolchildren. The questionnaire contains suggested answers to the questions posed. Each answer is evaluated with a certain number of points.

The level of practical mastering of the fundamentals of a healthy lifestyle is revealed through the observation of the teacher and parents over the child's activities. The purpose of the observation is to determine to what extent the rules of a healthy lifestyle have become the norm of behaviour for the child. The observation results are recorded in the forms, quantitative data processing is carried out and a conclusion is made about the level of development according to this criterion.

To identify the attitude of children to activities related to a healthy lifestyle, students record their emotional attitude to all activities and events related to the formation of a healthy lifestyle within the curriculum.

To identify the peculiarities of the lifestyle of primary schoolchildren, we conducted a diagnostic study based on a state comprehensive school located in St. Petersburg. The study involved third grade students (students aged 8 to 9), their parents, teachers, and school medical staff.

Pupils of 3 "B" grade made up an experimental group of 24 people (12 boys and 12 girls), pupils of 3 "B" grade - a control group of 18 people (10 boys and 8 girls). To determine the level of students' awareness of a healthy lifestyle (cognitive criterion), testing was carried out among students of the experimental and control groups. The test results are presented in Tables 2, 3.

Table 2. Results of quantitative processing of the ascertaining stage of the experiment in the experimental class (n = 24).

Criterion	Level					
	High		Middle		Low	
	Number of students	%	Number of students	%	Number of students	%
Cognitive criterion	5	20.83	9	37.50	10	41.67
Motivational criterion	5	20.83	9	37.50	10	41.67
Activity criterion	2	8.33	6	25.00	16	66.67
Emotional-volitional criterion	3	12.50	8	33.33	13	54.17

Table 3. Results of quantitative processing of the ascertaining stage of the experiment in the experimental class (n = 18).

Criterion	Level					
	High		Middle		Low	
	Number of students	%	Number of students	%	Number of students	%
Cognitive criterion	4	22.22	6	33.33	8	44.44
Motivational criterion	2	11.11	6	33.33	10	55.56
Activity criterion	1	5.56	4	22.22	13	72.22
Emotional-volitional criterion	3	16.67	5	27.78	10	55.56

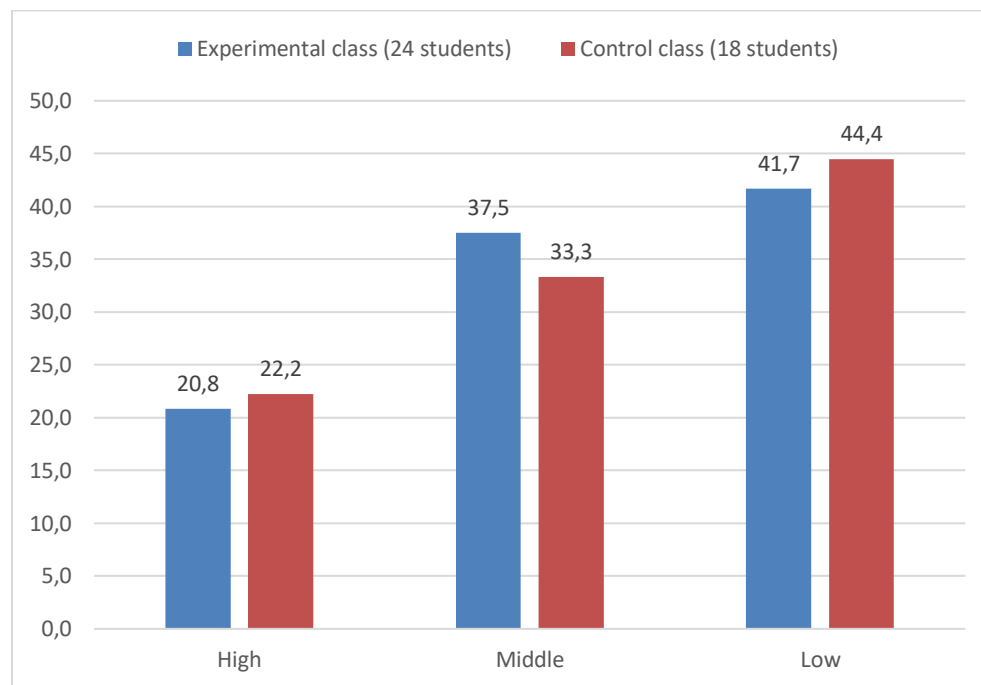


Figure 1. Distribution of schoolchildren by the level of cognitive criterion.

An analysis of the results of the ascertaining experiment regarding the cognitive criterion shows that children have insufficient knowledge of a healthy lifestyle (Figure 1), namely:

- Students do not clearly identify the main factors affecting health, they cannot formulate the rules of a healthy lifestyle;
- Students do not understand the significance and influence of physical culture and sports on their health;
- Students do not differentiate physical exercises, depending on their focus (development of strength, flexibility, relaxation, mobilization of attention, etc.);
- Students do not know how and when to perform health-improving exercises (morning exercises, exercises for the eyes, for the formation of correct posture, etc.).

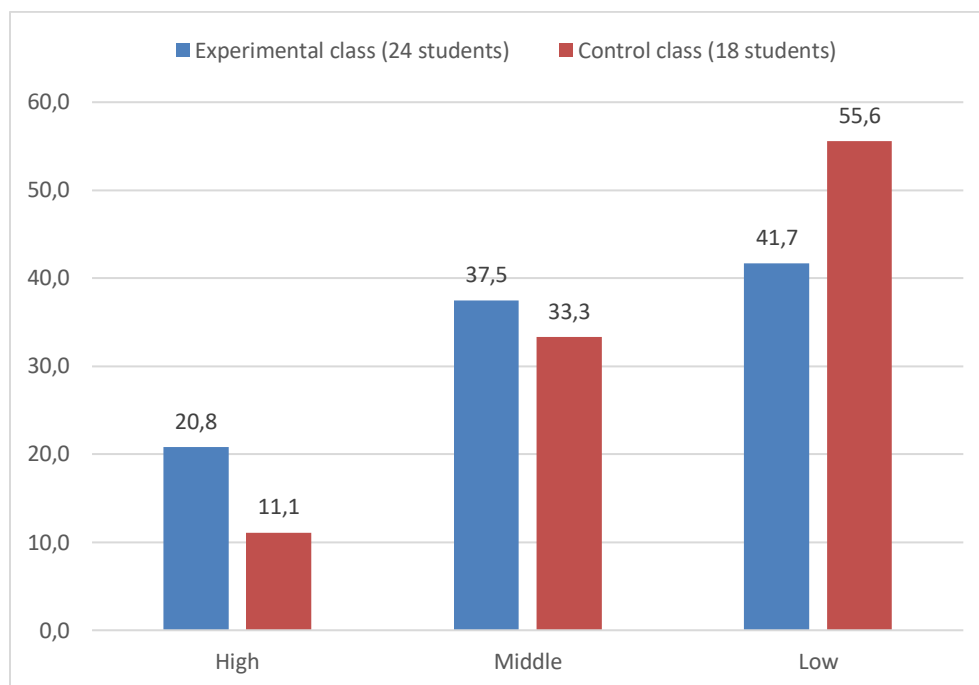


Figure 2. Distribution of schoolchildren by the level of motivational criterion.

Analysis of the results of the ascertaining stage of the experiment according to the motivational criterion revealed insufficient interest of children in activities related to a healthy lifestyle (Figure 2), namely:

- Students do not show initiative in learning the basics of a healthy lifestyle;
- Students do not try to lead a healthy lifestyle on their own initiative;
- Most students do not want to engage in extracurricular sports and physical education.

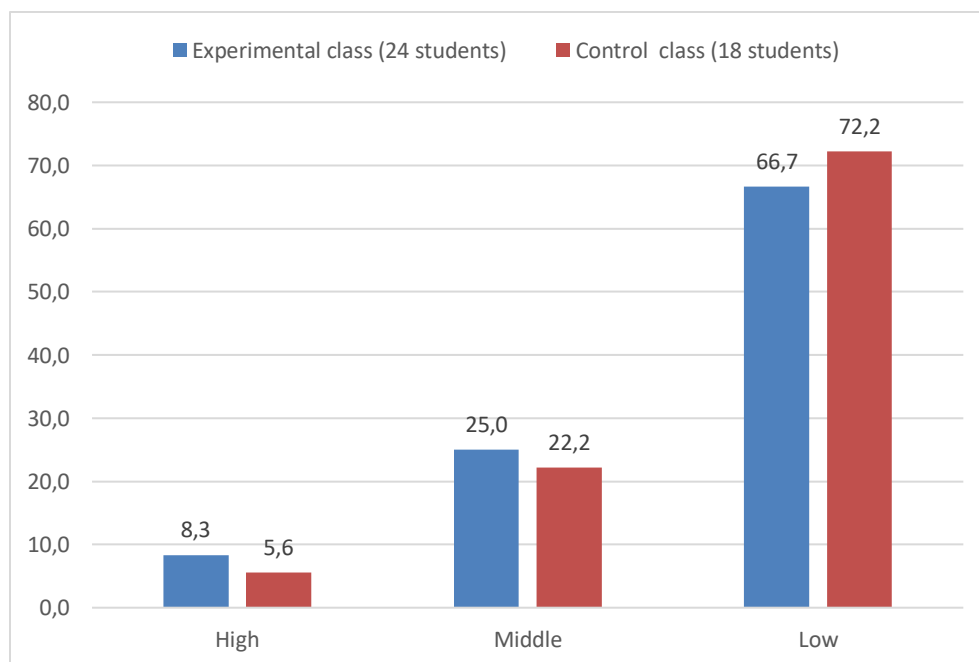


Figure 3. Distribution of schoolchildren by the level of activity criterion.

Analysis of the results of the ascertaining stage of the experiment in relation to the criterion of activity showed that students rarely apply knowledge about a healthy lifestyle in practice (Figure 3);

- Students have bad habits and there are no independent attempts to combat them;
- Students ignore the norms and rules of a healthy lifestyle known to them in practice (biting nails, sitting with a crooked pose, etc.);
- Many students refuse to participate in sports and recreation activities.

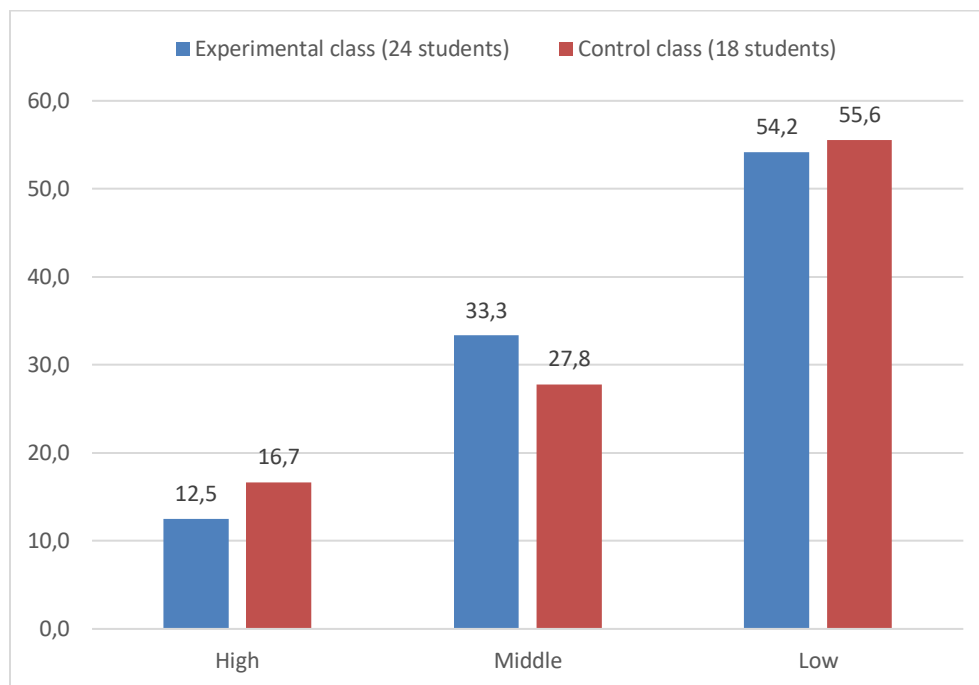


Figure 4. Distribution of schoolchildren by the level of emotional-volitional criterion.

Analysis of the results of the ascertaining experiment according to the emotional-volitional criterion shows that children are not emotionally involved in a healthy lifestyle (Figure 4), namely:

- Students show aversion to health-related activities;
- Students are not emotionally involved in sports games and physical exercises;
- When the difficulty of the exercise increases, students stop trying to complete the exercise.

The results showed that at the initial stage, students in the control and experimental classes have approximately the same degree of formation of a healthy lifestyle.

Thus, it is necessary to purposefully work on the formation of a healthy lifestyle by different means of physical education, which would be of a complex, systemic nature. According to E.A. Zaitseva and E.M. Shishkova (2011) organic inclusion in the educational process of various forms, methods, and techniques for the formation of a healthy lifestyle for teachers and students allows you to optimize the upbringing process, make it fun and effective.

According to Tolibova (2019) restructuring of the pedagogical process in physical education on the way to rationalization and optimization is to increase the motivation for physical education and sports; in the use of active and creative methods and forms of learning.

An experiment was carried out to assess the effectiveness of educational work.

One of the objectives of the physical education program is to form students' conscious attitude to their health. The work on the formation of the values of a healthy lifestyle among younger schoolchildren was carried out mainly in physical education lessons. The work was carried out not only to develop physical qualities, but also to improve health. Particular attention was paid to the prevention of many diseases, such as scoliosis, flat feet, diseases of the organs of vision, gastrointestinal tract.

The work on the formation of the values of a healthy lifestyle among younger schoolchildren was carried out through the development of a theoretical section of the "*Physical Education*" program. The theoretical part of the program included the study of the following topics of physical culture:

- Features of the origin of physical culture, the history of the Olympic Games;
- Human health and physical development;
- work of the respiratory and cardiovascular systems, the role of sight and hearing in human life;
- The impact of physical exercise, hardening procedures, personal hygiene and daily regimen on health promotion;
- Physical qualities and their relationship with physical development;
- Formation of correct posture;
- The terminology of the studied exercises;
- The reasons for getting injured in physical education lessons. Injury prevention.

This material was assimilated both in specially designated additional lessons (4-5 hours per quarter) and in the process of physical education lessons.

Each physical education session necessarily solved a health problem. The age of the students was considered. During the preparatory part of physical education lessons, a game-conversation on the topic of physical education was held with children. New knowledge was mastered with the help of riddles, illustrations, poems. New words were constantly introduced, which were then used during theoretical and practical studies. Unfamiliar words were recorded on cards for better memorization. Much attention was paid to the topics: "*School day regimen*", "*Healthy lifestyle*", "*Body hardening*".

Children were offered creative homework assignments:

- Make your daily routine;
- Draw an illustration (factors that have a negative and positive effect on health);
- Write an essay (on the topic "*My healthy lifestyle*").

In the practical part, students learned to compose and perform complexes of morning gymnastics, complexes of physical exercises for the development of speed, coordination, flexibility according to sensitive periods of age group.

The students were introduced to exercises to improve vision and hearing. They were included both in the general developmental exercises and in the final part of the lesson. General developmental exercises also included breathing exercises, which help prevent acute respiratory illness and improve oxygen supply to the brain.

An important place was taken by the students' acquaintance with exercises aimed at preventing flat feet and strengthening the muscular corset. Particular attention was paid to the formation of the correct posture. Such

exercises were offered with a small dosage for better memorization in the classroom and specially organized health-improving classes.

When conducting lessons, the age characteristics of children were considered. Sports games have been used as a primary means of activating and creating a positive emotional mood.

Extra-curricular work on the formation of a healthy lifestyle consisted of sports days, competitions, and children's holidays ("*Merry starts*", "*Family days*", thematic quizzes). The organization of the events was carried out jointly with the students. For the organization of children's leisure, children's entertainment show programs "*Move, play, rejoice*", "*Funny clowns and kids*" and so on were used. Show programs contained:

- Musical warm-up based on imitation of movements (flashlights, airplanes, penguins, horses, etc.);
- Musical rhythmic games: "*Train*", "*Hitchhiker*", "*Sparrow*";
- Fun, anecdotes, attractions, funny relay races.

Fairy tales were often used in sports scenarios. Characters of children's cartoons and fairy tales (Dr. Aybolit, coach Gantelkin, Sportakus) through games, poems, songs, and riddles formed in children an understanding that health depends on themselves. To preserve it, you need to eat right, exercise, keep yourself clean, tidy, and so on.

Such organization of sports events allowed to achieve complete emancipation of children, the manifestation of their independence, imagination, and creative abilities in the choice of movements.

According to Amitina O.V. and Shaikhullina A. (2020) such a form of work as an interactive game-competition does not provide ready-made knowledge, but encourages schoolchildren to independently search for information, develops the ability to defend their point of view reasonably, makes them learn to lead a discussion, convince, and ask questions.

One of the most important factors in the formation of a careful attitude towards their health in children is communication on this topic with their parents. Therefore, parents systematically participated in the organization and conduct of extracurricular activities. The fun atmosphere of the sporting events helped to introduce parents to a healthy lifestyle and served as an occasion to discuss the benefits of a healthy lifestyle for parents and children.

Also, educational work was carried out with all the teachers who worked with the students of the experimental class. The teachers developed physical education protocols that were then used in each lesson. Particular attention was paid to advice on taking breaks. As a result of joint activities, the breaks turned into interesting activities with outdoor games, which were conducted by high school students, teachers, and the children themselves. Introduced daily morning exercise.

According to Smirnova E.O. (2006) the main goal of teachers is to create conditions that will ensure the upbringing of happy, physically, and mentally formed, healthy children. These goals and objectives cannot be realized without the joint work of teachers and families, and it is also necessary to consider the individuality and interests of children.

In agreement with the doctors, an individual approach to children with various health limitations was carried out. This approach made it possible to create favourable conditions for the involvement of all students, without exception, in the process of adequate physical activity.

During educational events of a non-physical orientation, recreational activities were carried out: morning exercises, minute physical education in the classroom, visual and auditory warm-ups.

Thus, during the experiment, during 2 academic quarters (18 weeks) in the experimental class (n = 24), trainings were conducted aimed at developing the values of a healthy lifestyle in younger schoolchildren. The main tasks of physical education of students of the experimental class were:

- Development of basic physical qualities: strength, speed, endurance, coordination of movements, flexibility;
- Teaching physical exercises from such sports as gymnastics, athletics, ski training, as well as outdoor games and technical actions of sports games (basketball, volleyball) included in the school curriculum;
- Formation of general ideas about physical culture, its importance in human life, health promotion, physical development and physical culture and hygiene;
- Development of interest in independent physical exercises, morning exercises, physical exercises and outdoor games;

The teaching of the students of the control class was carried out in accordance with the normative base of teaching the subject [5]. The main tasks of physical education in the control class were:

- Development of basic physical qualities: strength, speed, endurance, coordination of movements, flexibility;
- Teaching physical exercises from such sports as gymnastics, athletics, ski training, as well as outdoor games and technical actions of sports games (basketball, volleyball) included in the school curriculum;
- Teaching the simplest ways to control physical activity, individual indicators of physical development and physical fitness.

Table 4. Results of quantitative processing of the control stage of the experiment in the experimental class (n = 24).

Criterion	Level					
	High		Middle		Low	
	Number of students	%	Number of students	%	Number of students	%
Cognitive criterion	10	41.67	10	41.67	4	16.67
Motivational criterion	12	50.00	8	33.33	4	16.67
Activity criterion	8	33.33	9	37.50	7	29.17
Emotional-volitional criterion	8	33.33	11	45.83	5	20.83

Table 5. Results of control processing of the ascertaining stage of the experiment in the experimental class (n = 18).

Criterion	Level					
	High		Middle		Low	
	Number of students	%	Number of students	%	Number of students	%
Cognitive criterion	5	26.32	8	42.11	6	31.58
Motivational criterion	2	11.11	8	44.44	8	44.44
Activity criterion	1	5.56	6	33.33	11	61.11
Emotional-volitional criterion	2	11.11	7	38.89	9	50.00

The results of the experiment are presented in Tables 4,5.

The results of a comparative analysis of the ascertaining and control experiments are clearly presented in Figures 5-8.

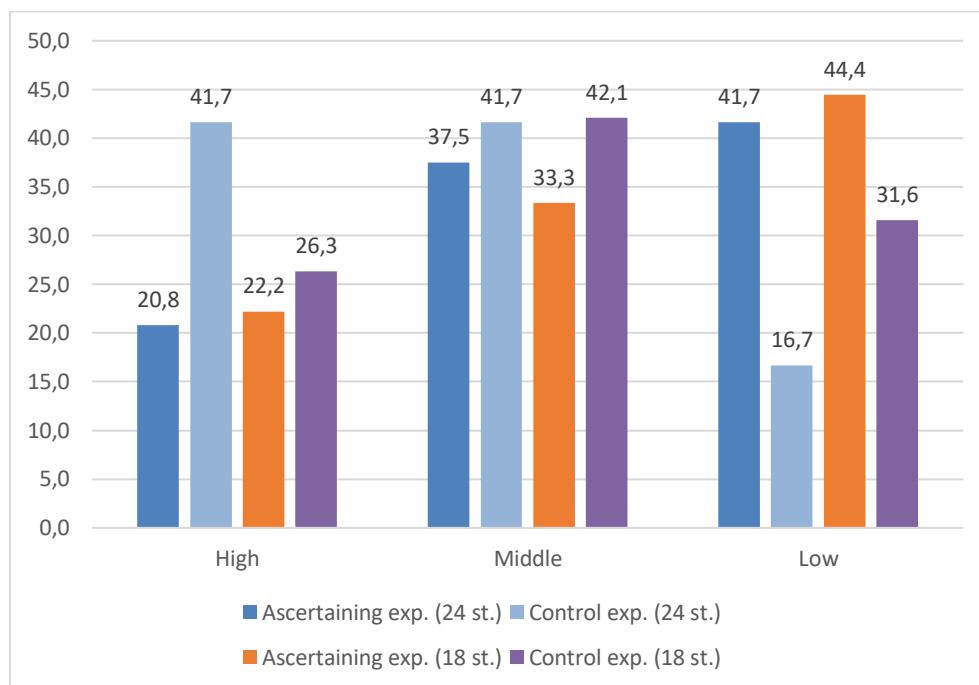


Figure 5. Distribution of schoolchildren by the level of cognitive criterion.

A comparative analysis of the results of the ascertaining and control stages of the experiments shows that the students of the experimental group have significantly expanded their knowledge in the field of a healthy lifestyle. In the control group, the dynamics according to the cognitive criterion was lower.

In the experimental group, the percentage of children with a high level of formation of healthy lifestyle values relative to the cognitive criterion increased by 20.9% (from 20.8% to 41.7%), in the control group the growth was only 4.1%. (from 22.2% to 26.3%).

Thus, the work on the formation of knowledge about a healthy lifestyle among junior schoolchildren was quite effective.

A comparative analysis of the results of the ascertaining and control stages of the experiment showed that the children of the experimental group significantly increased the desire to lead a healthy lifestyle, go in for sports and recreational activities, and increased their interest in their health. The share of students with a high level of motivation for a healthy lifestyle increased by 29.2% (from 20.8% to 50%).

In the control group, the distribution according to the levels of the motivational criterion practically did not change.

The results of the study prove the effectiveness of work on the formation of motivation for a healthy lifestyle.

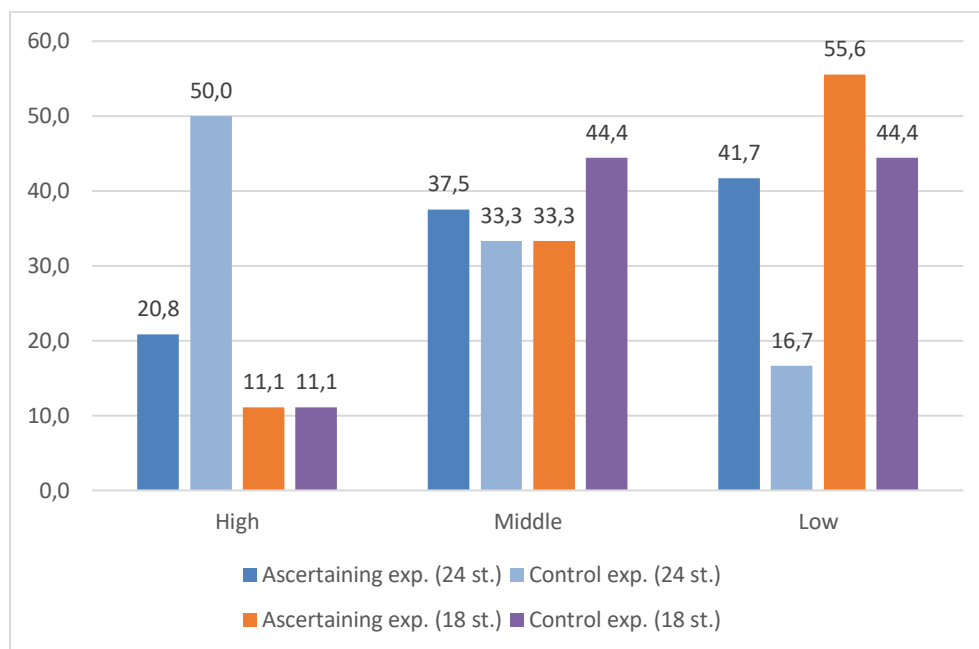


Figure 6. Distribution of schoolchildren by the level of motivational criterion.

A comparative analysis of the results of the ascertaining and control stages of the experiment showed that the students of the experimental group demonstrated a positive dynamic of mastering the foundations of a healthy lifestyle in practice.

The proportion of students in the experimental group who independently and systematically apply knowledge of the norms and rules of a healthy lifestyle increased by 25% (from 8.3% to 33.3%).

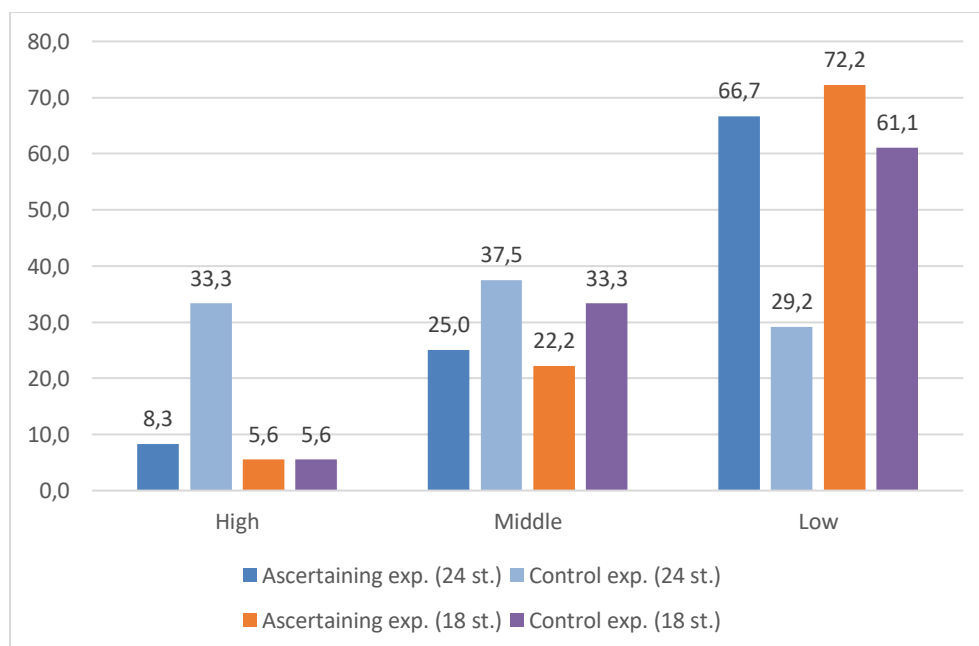


Figure 7. Distribution of schoolchildren by the level of activity criterion

In the control group, according to this criterion, the dynamics is significantly lower.

The results of the study prove the effectiveness of introducing knowledge of the fundamentals of a healthy lifestyle into the behaviour and habits of students.

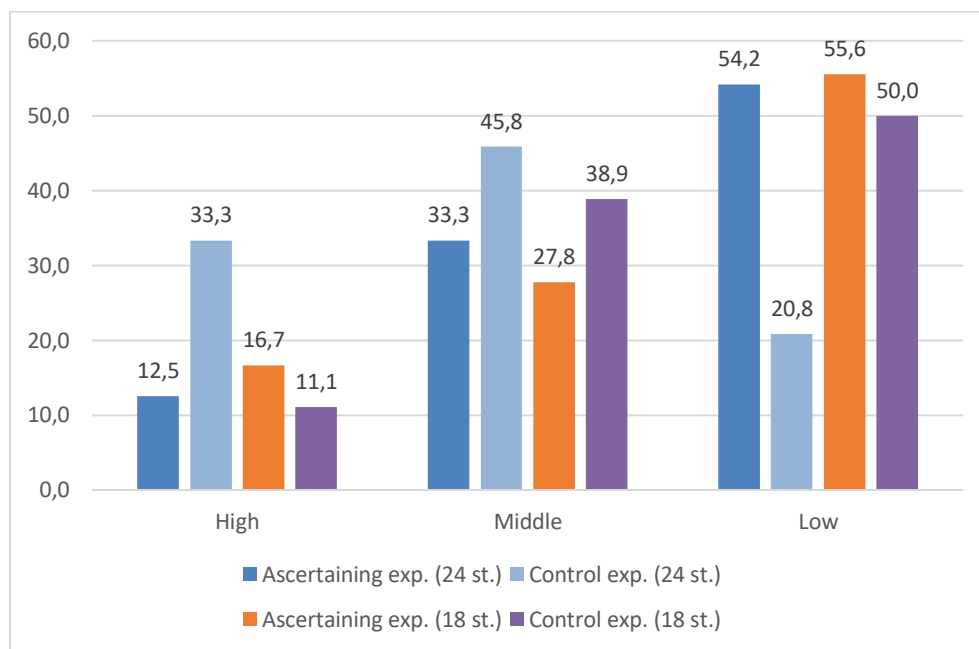


Figure 8. Distribution of schoolchildren by the level of emotional-volitional criterion.

Comparative analysis of the results of the ascertaining and control stages of the experiment showed that the percentage of students in the experimental group with a positive attitude to physical culture and a healthy lifestyle increased by 21.8% (from 12.5 to 33.3%).

In the control group, according to this criterion, there is a slight negative trend. The proportion of students in the control group with a completely positive attitude to physical culture and a healthy lifestyle decreased by 5.2% (from 16.7% to 11.1%).

The results of the study prove the effectiveness of work on the formation of an emotionally positive attitude towards physical education and a healthy lifestyle.

Thus, the results of the experiment show that pedagogical activity aimed at developing a healthy lifestyle among students by means of physical culture contributed to an increase in students' interest in their health, their assimilation of knowledge about maintaining health and their application in practice.

An analysis of the educational work carried out on the formation of the values of a healthy lifestyle for schoolchildren shows that the work of a teacher within the framework of the educational process should be systemic and complex. Such work will be more effective if the teacher not only uses the opportunities of the school curriculum, but also attracts students to extracurricular activities of an optional type, which increases the degree of children's involvement in a healthy lifestyle.

Systematic work (morning exercises, outdoor games during recess, physical education minutes) allows children to master the skills and abilities of a healthy lifestyle. Mass events (holidays, competitions, game programs) create situations of success for students, which becomes a means of developing motivation and desire to continue working in this direction.

An important condition for organizing work on the formation of a healthy lifestyle is the creation of a positive emotional mood, which largely determines the level of work efficiency in this direction.

The experiment showed the need to involve parents, teachers, and doctors in this process in order to observe the unity of educational influences.

CONCLUSION

The study and generalization of the theoretical foundations of the problem of the formation of a healthy lifestyle by means of physical education, as well as the results of the experiment, made it possible to draw the following conclusions:

1. The theoretical essence of a healthy lifestyle is determined by the fact that it is an individual system of human behaviour aimed at maintaining and strengthening one's health and ensuring optimal conditions for physiological and mental processes, reduces the likelihood of illness and increases life expectancy. During the study, it was revealed that childhood is the optimal age for the formation of a healthy lifestyle, since it is in childhood that the basic values, habits, and life guidelines are laid.
2. During the research, the main forms of physical education were identified, which are interconnected, complement each other and represent a single process of forming a healthy lifestyle:
 - Training sessions as the main form of physical education;
 - Classes in sections, in groups of general physical training, physiotherapy exercises as a form of familiarizing with a healthy lifestyle, taking into account the physical fitness of students;
 - Physical exercise in everyday life as a means of forming healthy lifestyle habits in the educational process;
 - Mass health-improving, physical culture, and sports events as a form of attracting students to regular physical culture, the formation of a positive attitude towards a healthy lifestyle.
3. Criteria and indicators of the level of formation of a healthy lifestyle of primary schoolchildren have been determined: cognitive, motivational, activity and emotional-volitional criteria.
4. The ascertaining stage of the experiment confirmed the need for purposeful work on the formation of a healthy lifestyle by means of physical education, which should be systemic and complex.
5. During the study, the pedagogical conditions for the successful formation of a healthy lifestyle by means of physical education were determined:
 - Using the capabilities of the physical education program;
 - The systematic use of physical exercises in the process of educational activities;
 - Creation of conditions for the involvement of schoolchildren and their parents in various extracurricular forms of educational activities aimed at the development of physical culture.

6. During the study, it was proved that pedagogical activity, specially organized for the formation of a healthy lifestyle among younger schoolchildren by means of physical culture, promotes an increase in students' interest in their health, their assimilation of knowledge about maintaining health and their application in practice, the formation of an emotionally positive attitude towards physical education, health-improving and prophylactic orientation.

AUTHOR CONTRIBUTIONS

All authors noted above have contributed to this paper through original research and throughout the writing process.

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REFERENCES

- Amitina, O.V., Shaikhullina, A. (2020). Forming motivation to a healthy lifestyle through interactive cognitive games, Formation of a healthy lifestyle of children and teenagers: traditions and innovations, April, 9-11.
- Belov, V.I. (2003). Encyclopedia of Health. Youth up to one hundred years. Publishing house – Moscow. (In Russian).
- Smirnova, E.O. (2006). Child Psychology textbook for stud. higher. Pedagogical educational institutions. Publishing center «ВЛАДОС». (In Russian).
- Tolibova, M., (2019). Healthy lifestyle: essence, methodology of formation. Pedagogical Sciences. Novaum, January, 313-315. Retrieved from <http://novaum.ru/public/p1159> (In Russian).
- Zaitseva, E.A. Shishkova, E.M. (2011). Pedagogical conditions for the formation of ideas about a healthy lifestyle in younger schoolchildren. Intellectual potential of the XXI century: stages of cognition. (In Russian).



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Estimation of exercise tolerance in bike track racing based on analysis of heart rate variability in athletes of various level of training

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ABSTRACT

Assessment of the tolerance of the training load by cyclists who participate in track races is a significant indicator of the adaptive reactivity of the athletes' bodies. The circulatory system of athletes, during cycling races on the track, is subject to colossal functional loads, both during training work and during competitions. The basis of the training process of female cyclists is adaptation to the effects of physical activity, which has a stimulating effect on the course of adaptive reactions of the organism of female athletes in preparation for the competition. A necessary list of heart rate variability indices has been formed, characterizing the degree of tolerance of the training load by cyclists during preparation for competitions on the track. A procedure has been developed for testing the characteristics of the heart rate variability at rest and during the aftereffect of physical activity on the body of cyclists. The results of the influence of the nervous and hormonal regulation of the heart rate on the fitness state of female cyclists are presented. It has been proven that the main indicator of the fitness level of female cyclists is the synchronization of the influence of the nervous and hormonal components of the regulation of the heart rate. The results obtained allow us to recommend the assessment of the degree of synchronization of the nervous and hormonal components of the regulation of the heart rate as the main indicator of the exercise tolerance of cyclists.

Keywords: Performance analysis of sport, Physical conditioning, Cyclists, Bike races on the track, Indicators of heart rate regulation, Level of fitness, Exercise tolerance.

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INTRODUCTION

The circulatory system of female athletes engaged in track cycling is subject to enormous functional loads, during both training and competition. In this regard, systematic control of training load tolerance in female cyclists is an objective factor in sports training management. The basis of the training process is adaptation to the effects of the optimal amount of physical load, which has a stimulating influence on the course of adaptive reactions in female athletes (Bolotin & Bakayev, 2017a; Cooper, 1989; Bilan et al., 2005; Hopkins et al., 2009; Bakayev, 2015). Adaptive reactivity of female athletes' organism manifests in improvement of trophic, regulatory and transport functions of the circulatory system (Bunevicius et al., 2016; Bolotin & Bakayev, 2017b; Daniel, 2009; Begum, 2016; Barcelos et al., 2015; Bakayev, Bolotin & You, 2018; Flatt & Esco, 2015; Kaikkonen et al., 2012; Manso, 2013; Plews et al., 2012). In assessment of tolerance of the training load for female cyclists, it is advisable to take into account the state of the mechanisms of the nervous and neurohormonal regulation of the circulatory system function (Tiwari et al., 2021; Bunevicius et al., 2016; Reimers et al., 2018; Stanley et al., 2013). The effectiveness of synergy between the nervous and neurohormonal regulation of the circulatory system of female athletes engaged in track cycling can be judged by the results of heart rhythm fractal analysis based on the study of cardiographic signal variability. Studying the interaction between nervous and hormonal regulation of the heart rhythm in female track cycling athletes of different training levels will provide insight into the tolerance of physical loads. The objective of the study was to identify differences in the dynamics of parameter values of sympathetic and parasympathetic heart rhythm regulation in female track cycling athletes of different training levels.

Tasks of the study

1. To compare parameter value dynamics of interaction between fast and slow heart rhythm regulation in female cyclists of different training levels at rest and under the influence of standard training load.
2. To identify differences in the parameter value dynamics of neurohormonal heart rhythm regulation in female cyclists with different training levels under the influence of standard training load.
3. To study the trends in heart rhythm variability in high-skill female track cycling athletes based on the identified differences.

MATERIAL AND METHODS

The study participants were high-skill female athletes A. and B. aged 19, who were trained to participate in the Universiade as members of the Russian national team specializing in track cycling. The study was carried out during the basic mesocycle of the autumn-winter half-cycle after the training done in the orientation mesocycle. The scope of training performed on the track as of the beginning of the mesocycle was 3,800 km for female athlete A. and 3,650 km for female athlete B. During the basic mesocycle, both female athletes performed the same work on the track in terms of volume and intensity of the training load. Cardiogram parameters were recorded three times a day: twice at rest and once immediately after exposure to the training load. The obtained data was analysed using the mathematical statistics methods.

In order to determine the fractal components function effectiveness in the circulatory system, we performed a comparison between the dynamic series of heart intervals in female cyclists by quantitative and qualitative parameters.

The study examined the following characteristics

- Parameters characterizing the actual cardiac function (A1 – total regulation effect; A2 – a parameter of the heart self-regulation);

- Parameters characterizing the nervous and vegetative component (B1 – vegetative homeostasis index of the heart rhythm; B2 – index of cardiac rhythm regulation stability);
- Parameters characterizing the state of the hypothalamic-pituitary system (C1 – hypothalamic-pituitary system regulation level index (nervous component of regulation); C2 – hypothalamic-pituitary system regulation level index (endocrine component of regulation));
- Parameters characterizing the state of the central nervous system (D1 – index of “fast” adaptation to load; D2 – index of “slow” adaptation to load).

The obtained data served as the basis for fractal analysis of the cardiac rhythm in female cyclists, resulting in an energy profile constructed in the form of a content table. The left part of the table reflected assimilation parameters, whereas the right part contained dissimulation parameters. The correlation between parameters in the left and right parts of the table reflected the dynamics of assimilation and dissimulation processes in the organism of female athletes under the influence of training loads. The assimilation parameters characterized the time of energy resources accumulation, whereas dissimulation parameters described the time of energy resources consumption. It was assumed that larger volumes of energy profiles corresponded to more economical energy expenditures of female athletes in performing the same exercise. This ensured minimum energy metabolism in heart rhythm regulation.

Varicard hardware & software system was used to obtain heart rhythm parameters. It helped evaluate the parameters of time and frequency sequence of heart interbit intervals through heart rhythm variability examination methods. The results of the study were provided in form of a detailed report of the following:

- Statistical characteristics of the dynamic series of heart intervals (pulse rate (heart rate-HR), mean square deviation (standard deviation-SD), coefficient of variation (CV));
- Distribution of heart intervals as random variables (variation pulsogram, MO (mode), AM (amplitude of mode), DMM (range – difference between maximal and minimal value);
- Activity degree of the sympathetic division of the autonomic nervous system (rhythmogram of R-R intervals);
- The influence degree of the central control over the autonomic level (autocorrelation function);
- Activity of individual heart rhythm control levels (heart rhythm spectrum).

The statistical characteristic of the dynamic series of heart intervals was estimated by the incremental mean square deviation of the duration of the dynamic series of incremental values of heart intervals (SDSD). SDSD value reflected the total effect of load on the parasympathetic division of the autonomic nervous system in female athletes. SDSD increase indicated the intensified autonomous regulation, whereas its decrease reflected the intensified heart rhythm sympathetic regulation.

Numerical characteristics of the degree of activity of the sympathetic division of the autonomic nervous system were mode (MO), variation span (DMM) and mode amplitude (AM).

AM parameter reflected an increase in centralization of heart rhythm control.

Derivative parameters of variation pulsometry were calculated: regulatory systems' stress index (SI) and vegetative ratio index (VRI).

The stress index characterized the activity of sympathetic heart rhythm regulation mechanisms and was calculated by the formula: $SI = AM / (2 + \Delta X + MO)$.

The vegetative ratio index (VRI) determined the ratio of sympathetic and parasympathetic heart rhythm regulation and was calculated by the formula: $VRI = AM / \Delta X$.

Correlation rhythmography method was used to evaluate the influence degree of central (sympathetic) mechanisms on the process of the heart self-regulation.

Rhythmogram steepness (IK) (the value of the autocorrelation function at the first shift) was studied. Notably, high correlation between central and autonomous regulation mechanisms corresponded to steepness (IK) increase.

Spectrum analysis of heart rhythm variability was performed to assess load tolerance. Use of spectrum analysis enabled to quantify the activity of individual levels of heart rhythm control. Notably, high-frequency components (HF) characterize parasympathetic activity, low-frequency components (LF) – the activity of the sympathetic division of the autonomic nervous system, while very low-frequency components (VLF) describe dissimulation processes.

Statistical data processing included calculating the arithmetic mean ($\bar{x}$); standard square deviation (G); standard error of mean (m); difference significance according to Student's t-test (P).

RESULTS AND DISCUSSION

Dynamics of parameters describing fast and slow heart rhythm regulation at rest and immediately after the training in female athlete A. is shown in Table 1.

The study determined that during the training process, female athlete A. experienced a decrease in sympathetic and an increase in parasympathetic regulation. This indicates neurohormonal regulation component synchronization in the 1st and 2nd microcycles. During intense training, due to the excess load on the organism's adaptational resources in the 3rd training microcycle, the balance between nervous and hormonal regulation is disturbed. So, in the 3rd microcycle, nerve regulation parameter values (A1, B1, B2) increased and hormonal regulation parameter values (C2, D2) considerably decreased, which indicates a predominance of the central circuit of neurohormonal regulation.

Table 1. Dynamics of fast (FHR) and slow (SHR) heart rhythm regulation in female athlete A. during training.

Parameter	FHR (%)					FHR mean (%)	SHR (%)			SHR mean (%)
	A1	B1	B2	C1	D1		A2	C2	D2	
1st microcycle										
At rest										
x ± m	86.8	56.3	62.4	61.9	59.7	69.1	42.7	5.8	12.7	9.5
	6.8	5.3	6.7	4.8	5.8	5.8	3.3	2.8	4.3	3.7
After training										
x ± m	85.7	52.5	63.9	67.7	62.8	70.1	46.7	7.7	17.3	14.7
	2.8	4.3	4.7	5.7	7.4	4.3	4.3	3.8	4.7	4.1
2nd microcycle										
At rest										
x ± m	90.7	62.4	59.2*	62.8	54.2	66.7	46.7	3.9*	15.7	8.9
	5.1	4.8	4.1	3.8	8.5	3.3	2.7	1.3	1.7	2.1
After training										

$x \pm m$	93.7 4.8	40.1 4.3	48.7 3.7	50.7* 3.8	33.9 6.7	51.8 4.8	73.7* 2.3	2.7 0.1	17.7 2.4	10.3 1.5
3rd microcycle										
<i>At rest</i>										
$x \pm m$	97.8 0.6	77.9 3.1	66.4 2.3	64.8* 3.1	58.3 3.7	72.7 1.1	67.7 0.7	4.5* 3.7	13.3 1.3	8.7 2.4
<i>After training</i>										
$x \pm m$	99.8 1.9	69.7 5.7	68.2 4.4	56.9* 3.3	62.8* 8.3	69.3 4.3	65.9 6.8	0.7 2.1	7.5 2.2	7.8 1.2

Note: * $p < .05$.

Dynamics of parameters describing fast and slow heart rhythm regulation at rest and immediately after the training in female athlete B. is shown in Table 2.

Table 2. Dynamics of fast (FHR) and slow (SHR) heart rhythm regulation in female athlete B. during training.

Parameter	FHR (%)					FHR mean (%)	SHR (%)			SHR mean (%)
	A1	B1	B2	C1	D1		A2	C2	D2	
1st microcycle										
At rest										
x ± m	87.4	58.3	62.3	59.7	61.9	65.7	45.9	5.5	11.4	8.3
	7.3	5.7	6.5	3.4	5.9	4.2	5.2	4.9	3.8	2.7
After training										
x ± m	86.5	51.8	66.7	60.9	60.2	67.3	40.5	12.4	13.5	15.9
	2.3	4.3	4.0	5.3	4.1	2.8	3.4	6.7	4.1	4.8
2nd microcycle										
At rest										
x ± m	94.3*	64.8*	53.8	60.7*	47.6	67.1*	75.8	0.8	13.7	7.8
	0.7	6.5	4.1	3.8	8.7	4.4	1.2	0.3	0.8	0.3
After training										
x ± m	85.7	38.7	49.7	51.4	33.9	51.3	70.3	52.3	14.8	10.3
	4.1	3.5	3.8	4.7	6.3	4.1	2.3	3.7	2.4	1.1
3rd microcycle										
At rest										
x ± m	98.5*	75.6	62.9	64.8	59.7	72.3	67.3	0	10.8	8.7
	1.6	3.7	2.2	3.9	3.6	1.2	0.8	0	1.2	2.4
After training										
x ± m	92.7	65.9	67.8	56.6	62.3	69.1	65.5	0	6.5	7.9
	2.3	4.3	4.4	2.7	8.4	4.3	1.9	0	2.1	1.3

Note: * $p < .05$.

The results of comparative analysis show that parameter values of slow heart rhythm regulation in female athlete A. significantly exceed those of female athlete B. Therefore, we may conclude that excessive training work performed by female athlete B. in the process of orientation and medium-load mesocycles negatively affected her functional state. This is confirmed by changes in the ECG in the 2nd standard lead (emergence of a negative T wave, increased QRS complex and a decrease in the S-T segment), indicating the development of myocardial repolarization disturbance due to the excessive physical exertion in female athlete B.

Use of variation pulsometry method enabled to perform comparative analysis by some parameters.

The dynamics of amplitude of mode (AM) is shown in Figure 1.

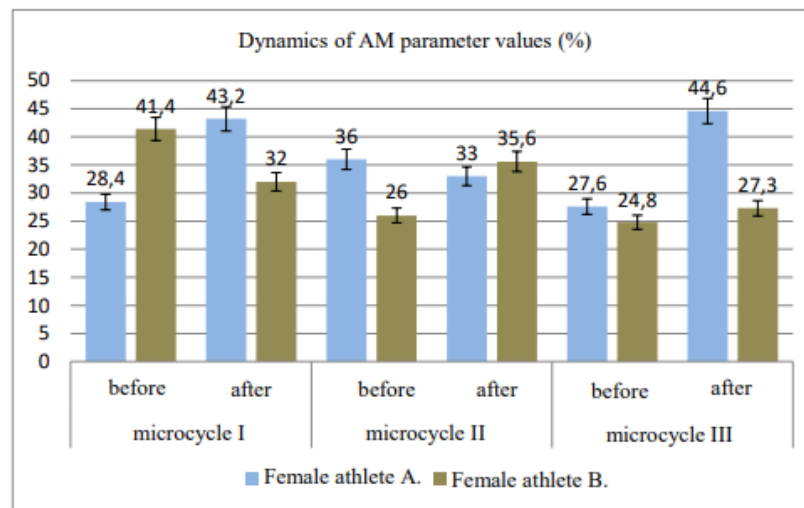


Figure 1. Dynamics of AM (amplitude of mode) of heart interval distribution in female athletes.

The AM parameter characterized the centralization degree of heart rhythm control in female athletes after performing the same amount of exercise on the track. High AM value illustrates the predominance of sympathetic heart rhythm regulation in female athlete B.

The effect of load on the functions of the sympathetic and parasympathetic divisions of the autonomic nervous system in female athletes was examined by the value the mean square deviation of the duration of heart intervals (SDSD). Dynamics of heart interval series in female athletes is shown in Figure 2.

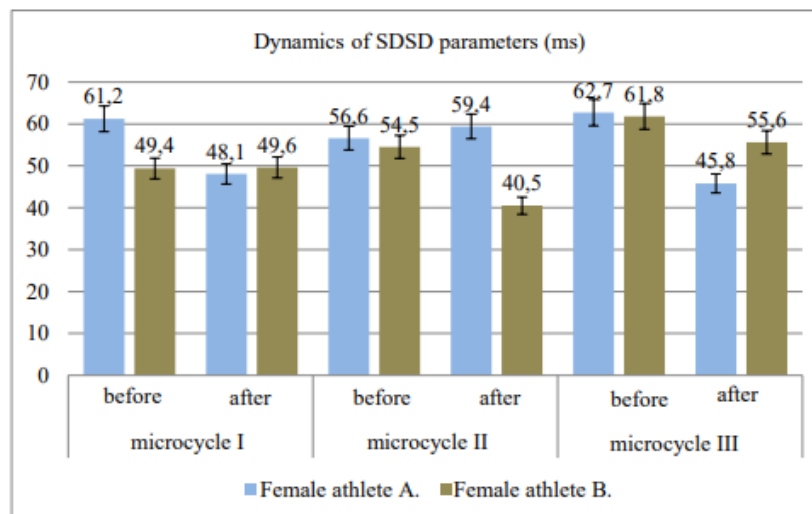


Figure 2. Dynamics of SDNN (square deviation of the duration of heart intervals) parameters in female athletes.

The decrease in SDSD parameter value in female athlete B. illustrates that parasympathetic activity also decreased. This indicates a drop in the training level of the female athlete.

An increase in SDSD value indicated an intensification in autonomous heart rhythm regulation in female athlete A.

The study of stress index of regulatory systems (SI) shows sufficient activity of heart rhythm regulation in both cyclists (Figure 3).

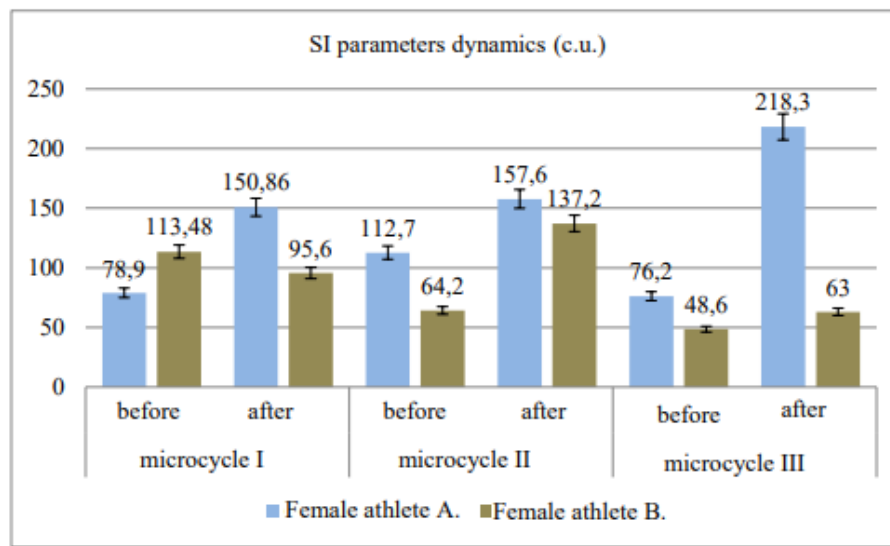


Figure 3. Dynamics of SI (stress index) parameters in female cyclists.

However, the range of changes in SI parameter values in female athlete B. was considerably denser, indicating low adaptation to physical load.

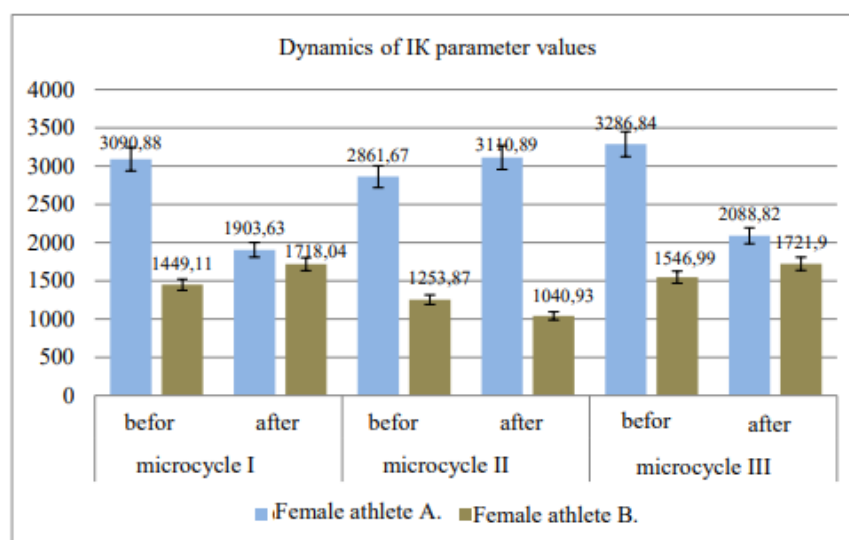


Figure 4. Dynamics of IK (rhythmogram steepness) parameter values in female athletes.

The stress state of the central circuit in female athletes was evaluated by IK parameter (Figure 4).

It was found that in female athlete A., IK parameter value decreased by almost 40% after the training. This suggests activation of the central circuit in cardiac activity regulation.

In female athlete B., IK decreased by 15% only after the training load. This indicates a considerable stress on heart rhythm sympathetic regulation, as well as excessive physical load for this female athlete.

The ratio of central to autonomic heart rhythm regulation was studied on the basis of vegetative balance index (VBI) (Figure 5).

In female athlete A., VBI increased after training. This suggests synchronization of sympathetic and parasympathetic heart rhythm regulation in female athlete A.

In female athlete B., VBI tended to be stable or slightly reduced, indicating an inconsistency in heart rhythm regulation.

Based on the study, female athlete A. showed higher parameter values of fast and slow heart rhythm regulation throughout the basic mesocycle, both before the physical load and after training.

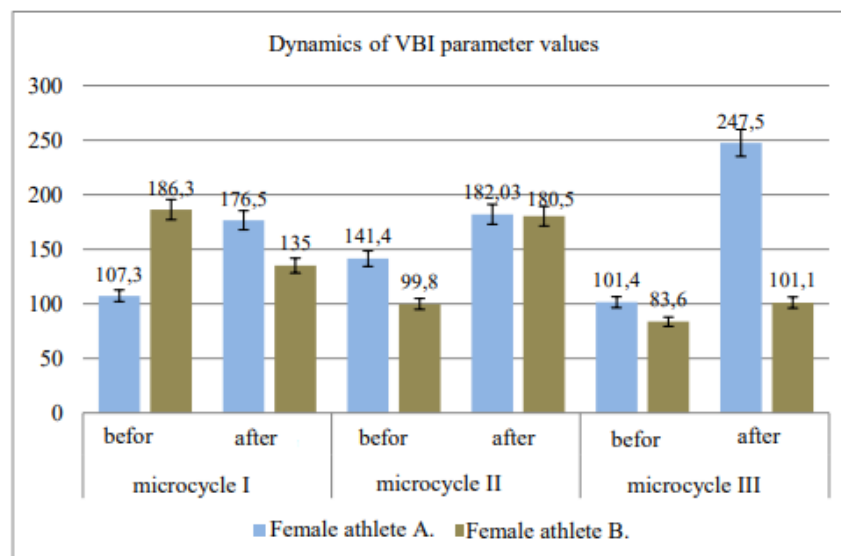


Figure 5. Dynamics of VBI (vegetative balance index) parameter values in female cyclists.

The synchronization of both regulation components in female athlete A. and the mismatch between them in female athlete B. indicate different adaptive reactions of the female athletes' organism to the load. The first one has a higher adaptability, whereas the second one has a considerably lower adaptability. The observed mismatch in the levels of neurohormonal regulation in female athlete B. is the result of chronic fatigue caused by prolonged exposure to excessive physical load that does not correspond to her training level.

CONCLUSION

Apparently, the main criterion for the training level of female cyclists is stable balance between the nervous and hormonal components of heart rhythm regulation. Comparative fractal analysis of heart rhythm variability in high-skill female track cycling athletes allowed to find the following trends in heart rhythm regulation:

- Heart rhythm variability of female athletes depends on coordinated function of nervous and hormonal regulatory systems;
- Decrease in the parameter values of hormonal heart rhythm regulation indicates decreased organism adaptational capabilities;
- Activation of central cardiac regulation under load stress indicates an imbalance between energy assimilation and dissimulation processes;
- Imbalance between nervous and hormonal heart rhythm regulation contributes to the reduction of adaptation resources of the female athletes' organism.

AUTHOR CONTRIBUTIONS

Conceptualization, A.B. and V.B.; methodology, V.B.; software, V.B.; data analysis, A.B., V.B.; investigation, V.B. and A.B.; data curation, A.B.; writing-original draft preparation, V.B.; writing-review and editing, V.B. All authors have read and agreed to the published version of the manuscript.

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REFERENCES

- Bakayev, V., Bolotin, A., & You, C. (2018). Reaction of vegetative nervous system to loads in female long-distance runners with different fitness level. *Journal of Human Sport and Exercise*, 13(2proc), S245-S252. <https://doi.org/10.14198/jhse.2018.13.proc2.09>
- Bakayev, V. (2015). Determining the significance of practical military skills applied by the special purpose regiments of the Internal Troops of the Russian Ministry of Internal Affairs to deliver combat objectives. *Journal of Physical Education and Sport*, 15(4), pp. 615-618.
- Barcelos LC, Nunes PR, de Souza LR, de Oliveira AA, Furlanetto R, Marocolo M, Orsatti FL (2015). Low-load resistance training promotes muscular adaptation regardless of vascular occlusion, load, or volume. *Eur J Appl Physiol.*, 115(7):1559–1568. <https://doi.org/10.1007/s00421-015-3141-9>
- Begum, N. (2016). Analysis of heart rate variability. *Bangabandhu Sheikh Mujib Medical University Journal*, 6(2), 84. <https://doi.org/10.3329/bsmmuj.v6i2.29120>
- Bolotin A, Bakayev V. (2017a). Peripheral circulation indicators in veteran trail runners. *Journal of Physical Therapy Science*, 29: 1092–1094. <https://doi.org/10.1589/jpts.29.1092>
- Bolotin A., Bakayev V. (2017b). The differences in response of the respiratory system of long and middle-distance runners and their influence on recovery rate. *Journal of Physical Education and Sport*, 17(4), pp.2443-2446. <https://doi.org/10.7752/jpes.2017.04272>

- Bunevicius, K, Sujeta A, Poderiene K, et al. (2016). Cardiovascular response to bouts of exercise with blood flow restriction. *Journal of Physical Therapy Science*, 29(12), 3288-3292. <https://doi.org/10.1589/jpts.28.3288>
- Bilan, A.; Witczak, A.; Palusinski, R.; Myslinski, W.; Hanzlik, J. (2005). Circadian rhythm of spectral indices of heart rate variability in healthy subjects. *J. Electrocardiol.*, 38, 239–243. <https://doi.org/10.1016/j.jelectrocard.2005.01.012>
- Cooper, K (1989). The aerobics program for total well-being. Physical Education and Sport, Moscow, 224 p.
- Daniel, S. (2009). Abnormal blood flow in the sublingual microcirculation at high altitude. *Eur. J. Appl. Physiol.*, (106), 473-478. <https://doi.org/10.1007/s00421-009-1023-8>
- Flatt, A.A.; Esco, M.R. (2015). Smartphone-Derived Heart-Rate Variability and Training Load in a Women's Soccer Team. *Int. J. Sports Physiol. Perform.*, 10, 994–1000. <https://doi.org/10.1123/ijspp.2014-0556>
- Hopkins, W.G.; Marshall, S.W.; Batterham, A.M.; Hanin, J. (2009). Progressive statistics for studies in sports medicine and exercise science. *Med. Sci. Sports Exerc.*, 41, 3–13. <https://doi.org/10.1249/mss.0b013e31818cb278>
- Kaikkonen, P.; Hynynen, E.; Mann, T.; Rusko, H.; Nummela, A. (2012). Heart rate variability is related to training load variables in interval running exercises. *Eur. J. Appl. Physiol.*, 112, 829–838. <https://doi.org/10.1007/s00421-011-2031-z>
- Manso, J.M. (2013). Application of Heart Rate Variability in sports training control: Frequency mode analysis. *Archivos de Medicina del Deporte*. 30. 43-51.
- Plews, D.J.; Laursen, P.B.; Kilding, A.E.; Buchheit, M. (2012). Heart rate variability in elite triathletes, is variation in variability the key to effective training? A case comparison. *Eur. J. Appl. Physiol.*, 112, 3729–3741. <https://doi.org/10.1007/s00421-012-2354-4>
- Reena Tiwari, Ravindra Kumar, Sujata Malik, Tilak Raj and Punit Kumar (2021). Analysis of Heart Rate Variability and Implication of Different Factors on Heart Rate Variability. *Current Cardiology Reviews*, 17(5). <https://doi.org/10.2174/1573403x16999201231203854>
- Reimers, A.K.; Knapp, G.; Reimers, C.-D. (2018). Effects of Exercise on the Resting Heart Rate: A Systematic Review and Meta-Analysis of Interventional Studies. *J. Clin. Med.*, 7, 503. <https://doi.org/10.3390/jcm7120503>
- Stanley, J.; Peake, J.M.; Buchheit, M. (2013). Cardiac parasympathetic reactivation following exercise: Implications for training prescription. *Sports Med.*, 43, 1259–1277. <https://doi.org/10.1007/s40279-013-0083-4>



Gym machines for simulating training of technical movements in curling

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ABSTRACT

Curling is a team sports game played on ice. The athletes slide stones one by one toward a marked target area. This is a sport in which the exactness of a throw is the base of technique and one of the main components of a successful play. In sport, technique means the way of making a physical action. Technical preparation is a process of education and improvement of movement skills, serving a mean of sports fighting. For making a throw of a curling stone an athlete has to push himself off a hack and slide in a deep lunge position holding a stone in his hand. In front of the hog line an athlete releases the stone. This paper describes the machines for training the technique of throwing a curling stone. Using empirical research methods we have created and used the machines which were used during the training process at the special preparation stage of the preparation period. A special training roller ground for throwing curling stones was developed. The useful model RU 192760 patent was published on September 30, 2019. The developed equipment allows to do imitative training of movements and technique of curling stones throwing. A training roller ground for a curling player's boot was designed. The useful model RU 193702 patent was published on November 11, 2019. The conditions for simulating training of exactness of take-off force in curling were created.

Keywords: Performance analysis of sport, Physical conditioning, Technical training, Patent, Training roller ground.

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INTRODUCTION

Curling is a team sport played on ice. The athletes, in two teams, slide stones one by one toward the *house*, a 3.66m target just over 45m from the release area (Figure 1).



Figure 1. About curling.

Success in curling is determined by many factors, one of which is technical exactitude (technique) in the throw (release) of the stone. In sport, technique is the means by which a motor action, or a motor skill is executed with technical preparation being the means by which motor skills are developed and improved. In preparation for competitive sport, this preparation involves education and training.

To make throws in curling, an athlete has to push off a hack, which is a backboard against which they can push backwards with one foot to, in turn, propel themselves forward. The curler will then slide in deep lunge positions holding a round granite stone weighing approximately 19 kg before releasing it in front of a line known as the hog line. It can be a physically demanding sport requiring much physical and technical preparation, both on and off the ice. This paper describes a machine that we have developed for 'off-ice' technical training. Its specific aim is to develop technique for throwing a curling stone.

To understand the principle of work of the gym machines it is necessary to regard the elements of curling stone throwing. The first one is getting the starting position before pushing of the hack, which includes the placement of the foot into the hack (crouch and grip of the stone), the second one is pushing oneself off the hack with a stone, the third one is the athlete sliding with the stone inside the allowed borders according to competitions rules (Figure 2). This element also includes the release of the stone and set.

The machines which will be presented in our paper influence two important elements – pushing off the hack and release of the stone with the hand.

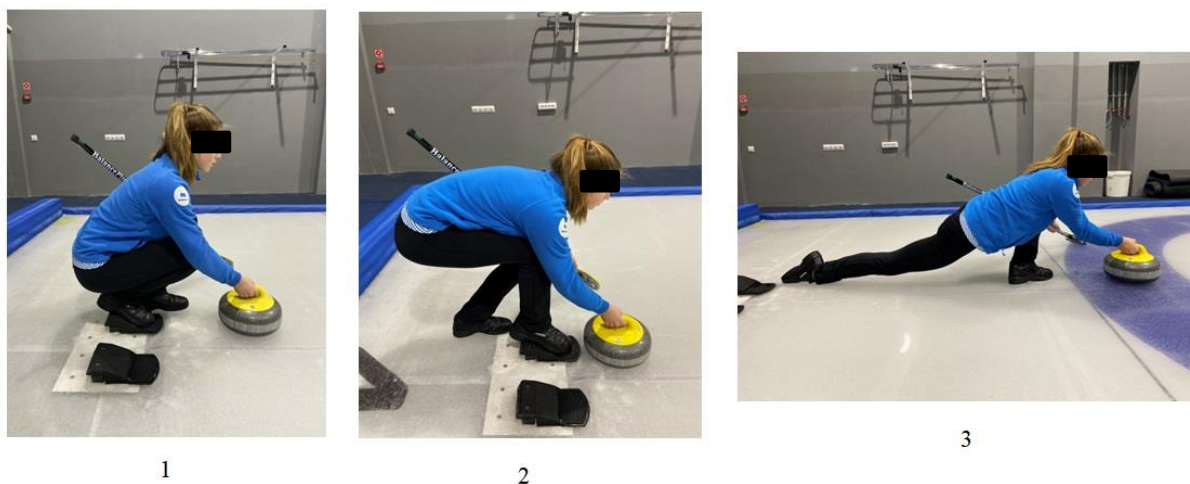


Figure 2. Pushing oneself off the hack with a stone.

METHODS

Taking cognizance of research findings, machines were developed for use during a specific period of the training plan, namely during the (sports) specific preparation period of the preparation phase.

The speed of sliding during the outrun is mainly formed by the muscles of the leg used by the player to push off the hack. The effort, necessary during pushing off the hack, can be practiced until it becomes automatic with the help of our first device (Figure 3).

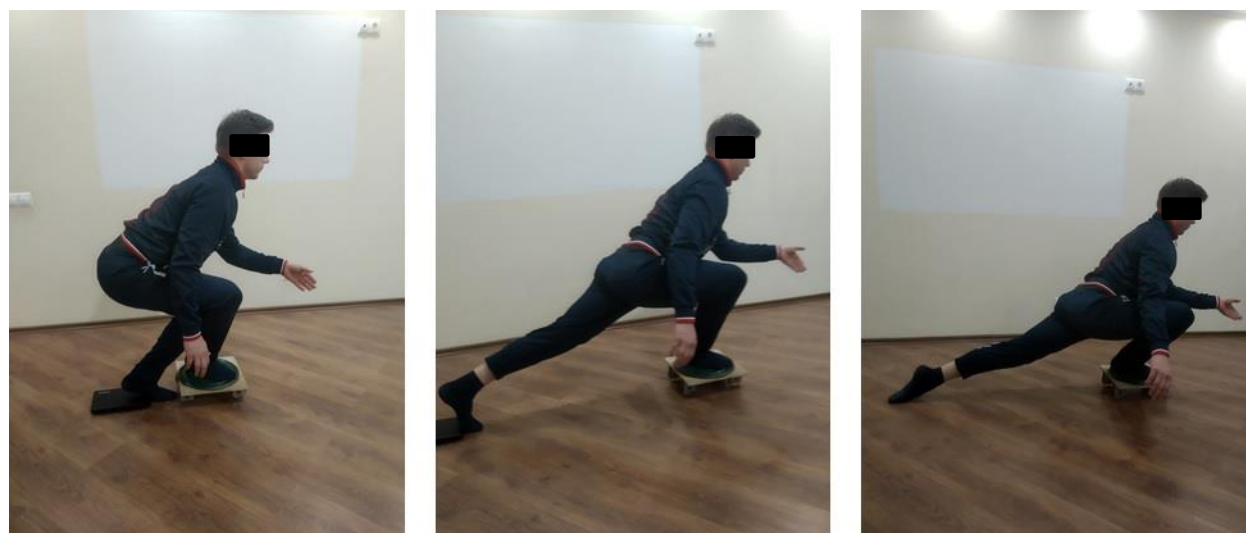


Figure 3. Pushing oneself off the gym machine.

The gym machine consists of a flat platform, two pairs of rollers, and a horizontal bearing. Its special feature is that on its square flat base four rollers are fixed in the corners, on an individual shaft each, with radial

bearings on two parallel lines. In the geometric centre of the platform and between the centres of the vertical shafts of the roller wheels the flat horizontal bearing.

Using the experimental method and scientific statistics method during the simulated training the optimal distances of sliding up to full stop on the rigid floor covered with linoleum with different types of throws were found. For example, if an athlete during competitions must make a draw, he needs to slide with the speed of 7.8 km an hour after pushing off, while during simulating trainings in a gym he must slide 3.6 meters until the full stop to repeat the same effort. And so on. The index numbers for other types of throws are presented in the Table 1.

Table 1. Optimal distances of sliding up to full stop on the rigid floor covered with linoleum with different types of throws.

Type of throw	The speed of the stone sliding during the outrun. km/h (competitions conditions)	The sliding distance in meters during exercise using the training roller platform on a rigid floor covered with linoleum.
Further guard	7	2.8
Middle east guard	7.4	3.2
Draw	7.8	3.6
Slow take out	8.2	4
Middle take out	9.8	5
Hurry take out	10.5	5.5

As a result of the above work, we applied for a patent (Galaiko and Groshev, 2021) (Figure 4).

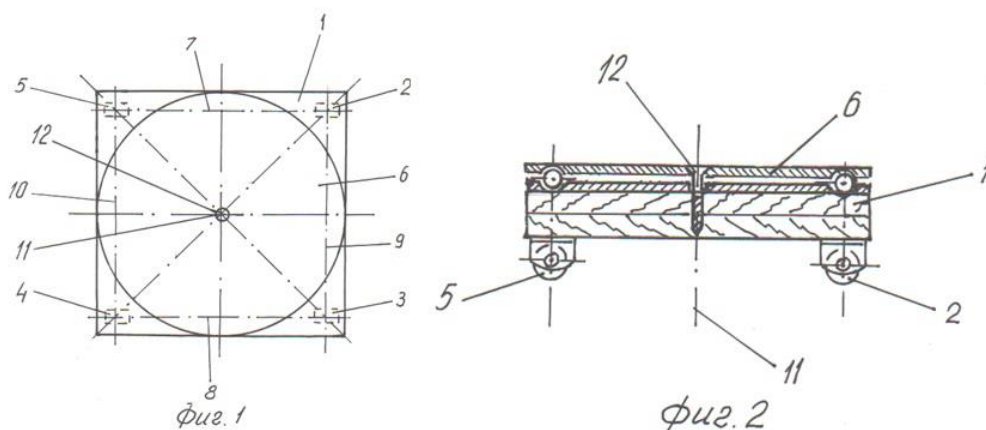


Figure 4. Training roller platform for curlers boot.

The release of the stone by one's hand is also an important element influencing the exactness of a draw. On releasing a stone, it is necessary to make it spin in a clockwise or counter clockwise manner. The intensity of spinning influences the trajectory, so it is important to know how to release the stone with the right number of rotations. On releasing the stone, it is important to correct the trajectory of its movement along the line. It is also possible to correct the speed of the stone releasing it slightly or by giving it an impulse. All these elements of techniques can be improved with the help of the second gym machine.

The training roller platform for curling stones throwing differs from the first one in the fact that the curling stone is placed and fixed in the centre of it. This device can be used during training to improve an athlete's grip of the stone. (See figure 5 for examples of gripping a stone).



Figure 5. Examples of gripping a stone.

This machine is as well used for training and improving the force of stone release and the intensity of its rotation (Figure 6). This equipment enables the repetition of technically appropriate movements that mimic the technique of throwing curling stones.



Figure 6. Training and improving the force of stone release and the intensity of its rotation.

A further patent was applied for and received (Galaiko and Groshev, 2021b). (Figure 7).

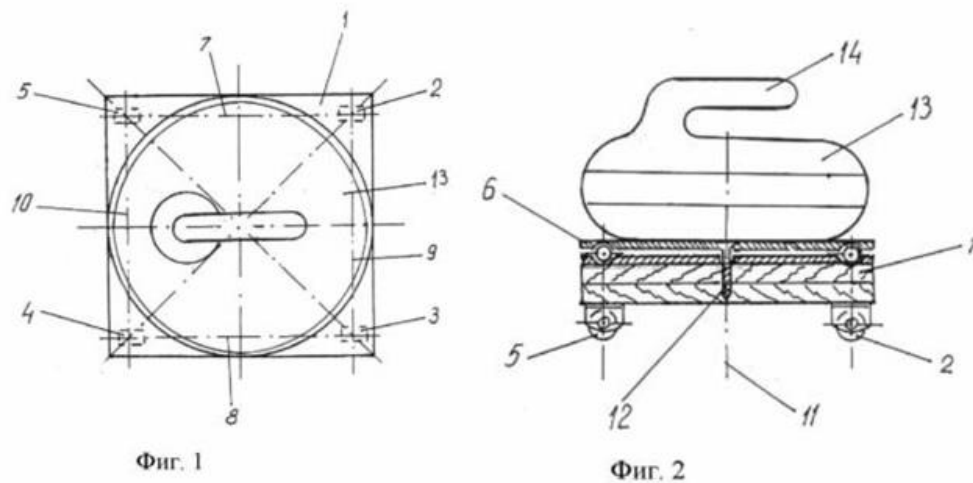


Figure 7. Training roller skate ground for throwing a curling stone.

As a result of both patented developments, conditions were created that enabled athletes to practice technical components of stone delivery, as well as train to improve and control take-off forces.

DISCUSSION

The economical effectiveness of the gym machines usage during the training process is proved by the fact that in the preparation period of the annual cycle before the start of the competitions season (it is July, August, or September) it is possible to have efficient preparation without financial expenses for construction, maintenance and rent of the specialized ice venues. The training process can be organized in a usual fitness gym with linoleum, parquet or laminated flooring. The equipment has aided Krasnoyarsk athletes to improve both the quality and the intensity of their technical preparation. This has been important as the machines have aided efficiency in the use of time, while developing and training technique and competitive actions.

CONCLUSION

We have used the gym machines during the training in the “Ice Sports School” in Krasnoyarsk. They have been used by the players of the Krasnoyarsk Regional team and players of the National team of Russia since 2018.

The award-winning places and victories at regional and Russian competitions of the athletes after using these machines prove the efficiency of this invention.

AUTHOR CONTRIBUTIONS

All authors noted below have contributed to this paper through original research and throughout the writing process. Professor Aleksandr Bliznevskiy. Assistant professor Vasilij Groshev. Assistant professor Natalya Soboleva.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

REFERENCES

- Galaiko V.V. and Groshev V.A. (2021a) Training roller skate ground for throwing a curling stone // Patents.Google.Com: Patents from all over the World. URL: RU192760U1 - Training roller court for throwing a curling stone - Google Patents (date of access 15.07.2021).
- Galaiko V.V. and Groshev V.A. (2021b). Training roller platform for curler's boot // Patents.Google.Com: Patents from all over the World. URL: RU193702U1 - Training roller platform for curler's boot - Google Patents (date of access 15.07.2021).



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Gateways and gatekeepers: Two factors that influence the use of performance and image enhancing drugs (PIEDs) among UK military veterans

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ABSTRACT

Recent reports have identified that PIEDs use is rising within the Armed Forces leading to concerns over health and concomitant operational risks. The aim of this study was to identify the roles of gateways and gatekeepers on PIEDs use among a cohort of UK military veterans. Semi-structured interviews were conducted with 14 ex-Service personnel. Interviews were transcribed verbatim and thematically analysed using NVivo12 software. Common themes were identified around the ways in which the veterans were introduced to PIEDs and how they accessed them. Gateways consisted of two categories of *Circumstances* and *Behaviour*, including excessive gym use, the need to cope with fitness demands of military service, overseas deployment, and previous experiences with nutritional and body-building supplements. Gatekeepers included friends, colleagues, and mentors and their roles were captured in two categories of *Procurement of PIEDs* and *Information Dissemination*. Recommendations include the need for further research on the roles of gatekeepers and gateways as important pathways to PIEDS use. Additionally, there is a need to build on themes suggested by earlier researchers to identify social, cultural, and economic factors that underpin motives for PIEDs use in the uniformed services. These two recommendations would inform the design and evaluation of PIEDS-related interventions.

Keywords: Physical activity psychology, PIEDs, Motivation, Military, Veterans, Armed Forces, Substance abuse.

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INTRODUCTION

Performance and image enhancing drugs (PIEDs) is a collective term that covers substances that affect human performance and that have been highlighted as problematic by many national and international governing bodies of sport (Maughan *et al*, 2018).

Key motivations for the use of PIEDs are to change body shape and appearance and enhance physical performance (Brennan, Wells & Van Hout, 2017; Piacentino *et al*, 2017). However, it is recognised that the use of PIEDs carries health risks (Piacentino *et al*, 2017) from infections to sudden death (Darke, Torok & Dufloy, 2014; Hope *et al*, 2013; van Amsterdam, Opperhuizen & Hartgens, 2010).

Given the above and the fact that drugs use has been associated with criminal behaviour among military veterans (Schultz *et al*, 2015), it is important to gain further knowledge about the use of PIEDs by former military personnel. In particular, we need to identify what influences PIEDs use.

Whyte *et al*'s (2021a) recent review of the literature concerning the use of PIEDs in both serving and retired Armed Forces personnel, highlighted that anabolic steroids (n=10 of 20 papers reviewed), weight loss supplements (n=10) and bodybuilding agents (n=7) were the most mentioned products. They identified that PIEDs were employed variously throughout military careers with use increasing substantively when personnel were deployed compared with before or after operational tours (Lui *et al*, 2018; Paisley, 2015; Varney *et al*, 2017).

Several motivations for PIEDs use among military personnel were highlighted, amongst which image enhancement and coping with the physicality of active service were prevalent (Whyte *et al*, 2021a). Image enhancement was related to weight reduction, muscle development, negative self-image, and body dysmorphia (Campagna & Bowsher, 2016; Carol, 2013; Mattila *et al*, 2010). Keeping up with the physical demands of service was associated with expectations placed upon the Armed Services and the demand for optimal fitness and strength to carry out military duties (Boos *et al*, 2010; Jacobson *et al*, 2012; Herbst, McAslin & Kalapatapu, 2017). Bucher's (2012) investigation noted PIEDs use helped combatants to deal with long foot patrols. This study also noted psychological motives for taking PIEDs to cope with the stresses and strains of combat, holding their nerve, and preparing for the possibility of killing another human being.

Negative physical health outcomes among military users have been reported including severe vascular, organ, muscle, and blood conditions (Mattila *et al*, 2010; Brazeau *et al*, 2015; Harris, Winn & Ableman, 2017; Liane & Magee, 2016; Magee *et al*, 2016; Young *et al*, 2012). Worries around negative mental health have also been reported following PIEDs use, including extreme aggression, and behavioural change (e.g Varney *et al*, 2017; Herbst, McCaslin & Kalapatapu, 2017).

Whyte *et al*'s (2021a) review suggested that PIEDs use often started in basic training or when overseas (Lui *et al*, 2018; Bucher, 2012). Additionally, a number of other factors were also found to be associated with taking PIEDs, including poor educational attainment, heavy alcohol intake, smoking cigarettes, and a history of high intensity physical training (Boos *et al*, 2010; Jacobson *et al*, 2012; Mattila *et al*, 2010). Those factors are viewed as important antecedents to commencing PIEDs use (Coomber *et al*, 2014; van de Ven & Mulrooney, 2017). As such, they are fundamental "gateways" to use. A gateway is a global construct that is used to explain how contextual factor(s) or behaviour(s) influence future lifestyle choices (Wilson, 2020), in this case, PIEDs use.

To counter the lack of research of PIEDs use in the UK military and provide guidance for possible interventions or policy changes, a commissioned study was undertaken by Whyte *et al* (2021b). It aimed to identify motives that underlay PIEDs use among former Service personnel, how they were introduced to PIEDs, and the knowledge base of users around the process of taking PIEDs as well as potential ramifications. However, that study did not specifically focus on the manner of engagement in PIEDS use, nor the roles of others in the process. The present paper aims to rectify this neglect.

Aims

The aims of this study were to investigate what key paths led to PIEDs use among former military personnel, and the roles of other people in the process.

METHOD

Participants

Participants were current PIEDs users who had previously been members of the UK Armed Forces (n = 14; 13 males, 1 female).

Sampling

Purposive sampling (Palinkas *et al*, 2013) was employed to recruit participants with “snowballing” (see Naderifar, Goli. & Ghaljaei, 2017) used to expand the recruitment pool. Recruitment took place in local weight-training gyms that were known to have PIEDs users as clients. Information about the study was supplied to possible participants who met the study’s criteria, following which they completed informed consent forms.

Data collection

The University of Sunderland Research Ethics Sub-Committee granted ethical approval (number 004364), following which participants were recruited. An *aide-memoire* was developed to ensure consistency of data collected, while offering flexibility of approach. The *aide-memoire* was a dynamic document that expanded to address issues raised by participants. Semi-structured interviews were undertaken with each interview lasting between 30 and 80 minutes. Interviews were recorded for later transcription.

Analysis

Following interviews, participants were copies for respondent validations. On return, the recordings were transcribed *verbatim* leading to 184 pages of A4 text (44,360 words) being made available for analysis. Transcripts were uploaded onto NVivo 12 Software (QSR International, London: <https://www.qsrinternational.com/nvivo/nvivo-products/nvivo-12-plus>). Following Mayring’s (2000) approach, transcribed texts were coded for meaning units (MU) that describes or “*means*” something in the context of the study). Next, each MU was ascribed a descriptor(s). Those descriptor headings (embryonic themes) then became “*umbrellas*” below which comparable MUs were apportioned. This was an iterative process as additional themes were developed if MUs did not “*fit*” an existing theme. The final two stages involved the review of themes before clustering them into logical groups (in one case, second order themes were deemed appropriate also), forming categories. These were then appraised, and conceptual topics developed (General Dimensions) into which each category was located. This provided a hierarchical, structured, logically interpretable means of presenting data.

RESULTS

Participants were 32.14 years of age on average (range 26 to 44 years of age) and had been based overseas

in combat zones. Most had enlisted at 18 years of age (mean = 18.6 years, range 18-20 yrs.), and had served in the Armed Forces for a mean average of 7.3 years (range 6 to 10 years). Participants had been retired for between one and seventeen years (mean = 6.28 years). The mean length of time of PIEDs use was 7.93 years, however, the range was large (1 to 22 years of PIEDs use), with ten users reporting that they took PIEDs during their time in the Forces. Inductive analysis resulted in data being placed in two conceptually different areas (termed General Dimensions [GD] in this study). The GDs were designated as **GATEWAYS** and **GATEKEEPERS**. **GATEWAYS** consisted of seven themes which on further analysis were compressed to two categories (Figure 1), while **GATEKEEPERS** comprised of ten 1st order themes. These were further assigned to four 2nd order themes and ultimately to two categories (Figure 2).

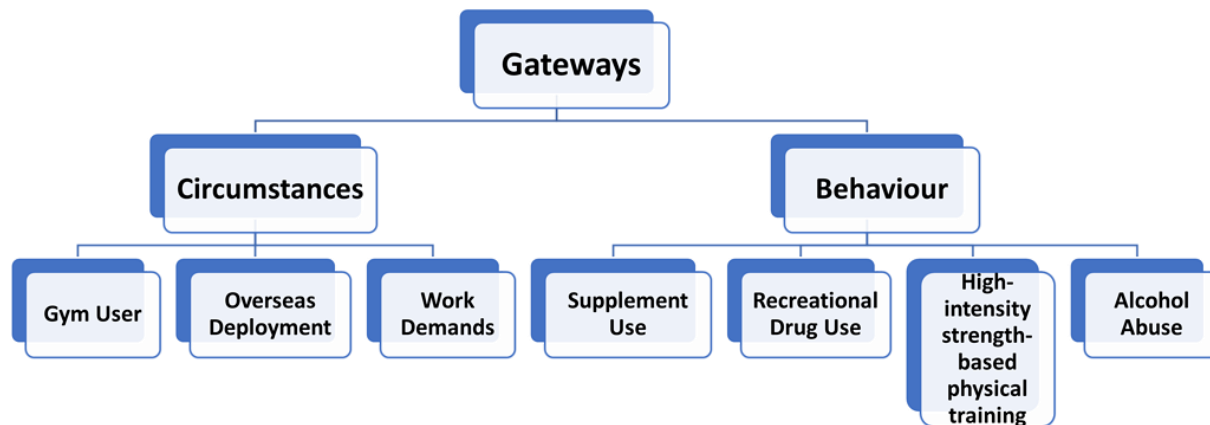


Figure 1. Circumstantial and behavioural aspects of gateways to PIEDs use among Armed Forces veterans.

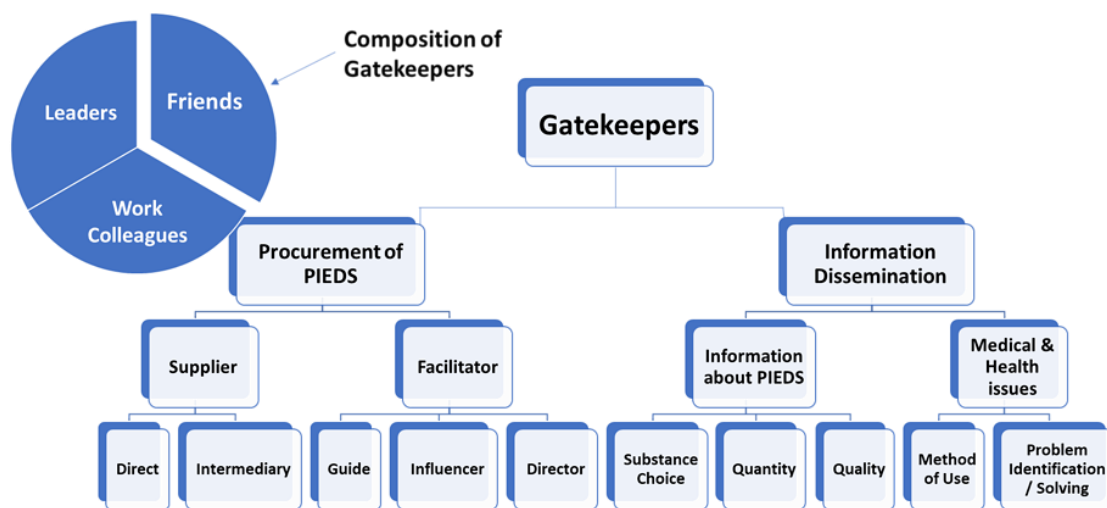


Figure 2. Armed Forces veterans' PIEDs use: composition and functions of gatekeepers.

GATEWAYS: *Circumstances and behaviour were the two categories in this GD.*

Circumstances

This category comprised of three themes: *Gym User*, *Overseas Deployment* and *Work Demands*.

Gym User: One of the least reported themes (seven participant responses) made direct reference to gym usage as a gateway. Comments related to the role of the gym in providing a motivational culture due to the perceived ethos of the gym, and the people that use it:

I went to that gym knowing that most of the members were serious lifters or body builders. Nobody was just a “gym bunny” to keep trim. There were always guys moving around and when they got to trust you, they give plans and help. I wanted to look like them and the culture was to work hard, work often, and take whatever you need. (Male 28 [years]).

Overseas Deployment: Similar to the numbers of responses for *Gym User*, 50% of the participants viewed being deployed overseas as a circumstance that led to PIEDs use, in part due to time to work-out in the gym alongside the need to keep fit for military duties, and mixing with personnel from other countries (mainly USA armed forces):

Before I went out [to Basra] I took supplements. We were stationed near Americans and lifted [weights] with them. We had to be ready physically and mentally in case of trouble from insurgents and keeping fit became more important than ever. I suppose the supplements just became gear [PIEDs] as the Yanks all seemed to take them. (Male, 26).

Work Demands: The final theme reported in this category reflected job related issues that all of the participants vocalised as important. One former soldier noted that even before commencing basic training he felt that he needed to improve his fitness status:

Before I had even signed-on I knew that I wasn't too fit. I had been okay [fit] in junior school but by the time I was ready to leave I was a slob. X-box and takeaways made sure of that. A lad [boy] I knew in school persuaded me to go to the gym and he got a training schedule from his uncle. I started on [legal] supplements then. (Male, 26).

Another factor stated by 12 of the 14 participants as being important in their decision to take supplements and/or PIEDs, was the Army's historically brutal training regime. “*Beasting*” is a squaddie's [new enlistee] term for high intensity, highly demanding, and energy sapping drills as a short-cut to fitness development, or, at times, as a form of punishment. A former infantryman said:

Beasting was the hardest part of it. I've no idea why it needed to be done as most of us were seriously motivated to do well anyway, or at least as well as we could and that's all that should be asked for. There were grown men in tears at times. That starts a culture of doing whatever you need to get through and for me that meant taking supplements and some pills. (Male, 26).

Behaviour

Four themes formed this category: *Recreational Drugs Use*, *Alcohol Misuse*, *Supplement Use*, and *High-Intensity Strength-Based Training*.

Recreational Drugs Use and *Alcohol Misuse:* In the first two themes, nobody thought of themselves as heavy recreational drugs users. Nonetheless, most of the participants had smoked cannabis and been involved in alcohol consumption while under the legal age to take alcohol. One interviewee said:

I never took anything much, not even drinking. I looked young and didn't want to get done [into trouble] for under-age drinking or something. I had some Es [ecstasy] at a music festival; everyone was at it there, so it seemed OK, part of the experience. We knew there was dodgy stuff about, but you still took it (Female, 34).

Supplement Use: Consumption of nutritional supplements had been practiced by all 14 of the participants

prior to or leading to PIEDs use. A veteran provided an insight into behaviour that was not uncommon in the cohort:

Like everyone I know, I have taken supplements almost since I started serious weights [weight-training]. It began with taking shakes [powdered drinks] for recovery and then I experimented with different protein powders, mainly whey, casein, and soy milk, as well as glutamine. After a while, the guy that I got them from in the gym suggested taking gear [PIEDs] (Male, 38).

High-Intensity Strength-Based Physical Training: The final theme in this category reflected the role that intense physical activity had on military veterans. This form of physical training was commented on by almost all interviewees (n=13), highlighting that their desire to do more training at higher intensities was important in their PIEDs journey:

I felt I wanted to do more and more and once I was taking the gear was able to go on for ever. [In] fact I increased my time in the gym from about 70 mins a night to nearer 3 hours but taking them also allowed me to use my time and keep lifting (Male, 26).

GATEKEEPERS

Analysis of data identified that gatekeepers consisted of three key groupings: friends or peers as gatekeepers (n=14); work colleagues (n=14); and leaders or mentors (n=10) (Figure 2). Their influence was strong.

This GD consisted of two categories: Procurement of PIEDs and Information Dissemination

Procurement of PIEDs

This category comprised of two 2nd Order Themes: Supplier of PIEDs (consisting of two 1st Order Themes), and *Facilitator* (consisting of three 1st Order Themes).

Suppliers of PIEDs: Suppliers were categorised in two ways. They were either *Direct* (suppliers) or they worked as *Intermediaries*. This was reflected in the statements with most of the respondents initially getting their supplies from someone, directly connected with them, usually a peer or work colleague, but then often moving on to intermediaries through whom PIEDs could be ordered:

My first lot of PIEDs were bought from one of the guys in the gym that I used. I worked out a bit with him and he told me they were part of his own supply and to try them out. After a bit [some time] of experimenting he told me who he used in Newcastle to get his stuff. That guy got his gear from suppliers in Manchester or Leeds, so I never went direct just through him. It gave me a feeling of security as he knew most of the guys and had been the dealer for ages [years] (Male, 38).

Facilitators: *Guides*, *Influencers*, or *Directors* were the classifications that made up this 2nd Order Theme, with differences being related to roles undertaken. *Guides* provided advice about what might be available and at what cost, while *Directors* indicated who to approach to purchase PIEDs. The roles were closely aligned as this comment from one participant attested: “My mates tell me what I need, how much, what it cost, and who to buy from” (Male, 26). *Influencers’* functions were related to making suggestions and encouraging others to take PIEDs. As with all of the *Facilitators*, *Influencers* came from one of the three groups of gatekeepers, and this is commonly noted in statements offered during interview:

I admired a lot of the more experienced men in the gym. They would help you, even if you didn't ask. They would give tips about technique or help with support, and eventually I got to know them well and trust them and the probably started to trust me. So, they told me how to be able to lift more weight and do it quickly. (Male, 28).

Information Dissemination

This category related to the function of knowledge dissemination that focussed on two key areas, namely those related directly to PIEDs, *Information of PIEDs* and health related topics, *Medical and Health Issues*.

Information of PIEDs: This 2nd Order Theme consisted of three 1st Order Themes focussing on *Substance Choice*, *Quantity* (recommended for use), and *Quality of Substances*.

Substance Choice: All of our military veterans started taking PIEDs as novices and turned to peers, mentors, or work colleagues for information about what substances were needed for best results.

Other gym users and ultimately PIEDs users were the people that I asked for what to take when I was thinking of starting. (Male, 33).

Likewise, as they gained more experience of using PIEDs, our cohort also noted that they used the same people, or an extended network, to gather information about new drugs or trends.

We all talk to each other and when anything new is around we always ask around, in the gym and outside. A real network of knowledge, like a tree with branches everywhere [laughs]. (Male, 38).

Quantity: Similar comments were made with respect to the *Quantities* of PIEDs that should be used, with information again being passed via gatekeepers:

It's not quite hit or miss but it's not as though there are instructions with what I buy. The people I went to for info or listened to most were the lads I was working out with and who were using the same stuff, or who had used it in the past (Male, 33).

Quality: The quality of PIEDs cannot be guaranteed. Our respondents agreed that there was always some sort of risk attached to using PIEDs but acknowledged that they had to trust their gatekeepers and the information offered by them. This faith in a supply chain seemed the norm:

The idea that I am injecting some dodgy gear is always there, but I do my research before I try anything new and take advice from the older and more experienced guys in the gym. That's what we all do, talk to the others, and dig up [gather] whatever info you can about the drug and the supplier...and share it. What else can you do? (Male, 33).

Medical and Health Issues: This was the other 2nd Order Theme that fashioned the *Information* category. This theme consisted of two 1st Order Themes of *Method of Use* and *Problem Identification and Solving*.

Method of Use: The 14 participants were specifically questioned about the manner in which they used PIEDs, with all responding that they injected their drugs. Eleven indicated also that oral ingestion was used at times. However, all referred to initial needs for assistance with injecting. This assistance was usually from peers as opposed to seeking clinical advice or instruction:

My early experiences were by getting help from the lads in the gym. In fact, they injected it for me, showed me how to make it safe until I was ready to try for myself. Even then I had somebody watching me in case I made a mistake. They were as good as any nurse I've known which is just as well as I couldn't see me going to the surgery to ask them to inject me. (Male, 33).

Having been taught how to take their PIEDs, the veterans were given information how best to manage their consumption for best effect, and with a view to ensuring the process was as safe as possible. "Stacking", "pyramiding", "plateauing" and "cycling" are all methods employed regularly by PIEDs users to manage their intake.

One user intimated how he used his PIEDs and what influenced those decisions:

Once I had been taking things for a while, my best mate in the gym suggested that we chat to some of the older lads about how to manage and administer the doses as he read of different ways on the internet to make things safer and healthier. Now I usually stack my juice [PIEDs] taking two or three different types of drugs at a time for different reactions... all at the same time. I then come off that for a few weeks to let my body recover before trying what some lads call cycling where I took one drug, then after about six weeks move on to another, then same again with another drug. To stop the body getting used to it (Male, 33).

Problem Identification and Solving: When issues arise that can be considered as related to health or similar, it is to the same people that they turn:

I've tended to ask the guy that I get my supplies from as he has been there, seen it, done it, got the t-shirt. Like [for instance], when I was on nandrolone [a steroid] I was beginning to look fat and didn't know why or what to do. He told me to change [drugs] as it was water retention (Male, 34).

Similarly, another respondent said:

My first load were orals [steroids] but they were making me feel sick and some of the lads said they were too risky, so I changed to injections. I still take oral supplements even now but not the heavy stuff. (Male, 31).

DISCUSSION

This study identified two key influences associated with PIEDs use in our cohort of ex-Services personnel: *GATEWAYS* and *GATEKEEPERS*. This paper is not the first to identify their roles in multiple settings of substance misuse, however, there are a number of findings that are novel to PIEDs use compared with other areas of abuse (e.g. drugs, alcohol, abusive behaviour) and to military situations in particular. The "*gateway hypothesis*" has developed since the 1970s (Kandel, 2002). This proposes that acquaintance with what have been classed as "*entry*" substances such as alcohol, cigarettes, and cannabis, reliably predicts deeper and more severe drug use.

GATEWAYS seem not to be linked explicitly to psychological construct of motivation in the literature, yet the association seems unequivocal with gateways being cited as (a) occupationally derived, and (b) culturally driven through the environment in which users in are embedded, such as "*body-building gyms*". (Coomber-Moore, 2017). These develop the needs on which PIEDs use is cultivated and fit well with our themes of *Work Demands* and *Gym User*. The third theme of *Overseas Deployment* is a theme that is military specific (Lui et al, 2018; Paisley, 2015; Varney et al, 2017). Ten of our interviewees indicated that they sought to appear tough or mean, to discourage approaches or aggression from others. With many of the respondents working in the security industry, preliminary thoughts were that this was based on participants' post-Services roles. However, further analysis identified a relationship between *Work Demands* and *Deployment*. *Deployment* offers both an access route to PIEDs as well as a rationale for taking the drugs. Access seemed relatively easy when deployed overseas, as UK Forces meet allied personnel, and in our context, work demands involved patrolling hostile environments while on active duty:

We were working and walking among locals not knowing whether you would be attacked by a hostile, so the bigger and meaner and tougher you looked the better it made you feel. Wouldn't have stopped an IED [improvised explosive device] but made me and some of the lads feel better...and anyhow, if not out on patrol, camp was boring, so you are actively encouraged to keep fit and the Yanks [American troops] showed us what to take and where they got it (Male, 44).

The data that contributed to the *Behaviour* category revealed that use of *Recreational Drugs Use* led to PIEDs use, despite all the veterans having previously taken recreational drugs. Despite this, they felt that there was no direct relationship between this and their PIEDs use, although their PIEDs consumption may indicate a broader acceptance of taking some drugs. Bandura's (2002) Theory of Moral Disengagement provides an explanation for this belief. His theory suggests that individuals accept unethical actions to justify other dubious behaviours. Thus, our participants saw no issues with taking recreational drugs, and concomitantly did not consider PIEDs use to be morally unjust (Boardley, Grix & Dewar, 2014).

Supplement Use involved different assumptions to those of recreational drugs users, with the main difference being that they recognised the links between taking legal supplementation and taking PIEDs. All participants stated they took nutritional supplements for training performance or body image benefits and the next stage for them was using PIEDs. This corresponds strongly with the PIEDs literature (e.g. Yager & O'Dea, 2014). It should be noted that the UK Armed Forces is aware of this pathway and takes measures to counter such behaviour (British Army, 2013).

The final *Behaviour* that was thematically defined was that of undertaking *High-Intensity Strength-Based Physical Training*. While this is not an uncommon behaviour among PIEDs users in civilian communities, the military provides other challenges that are related to *Work Demands*. Intense training takes place to prepare the military for combat and failure to cope may have negative consequences for careers. This influences the moves to seek assistance from peers and may lead to PIEDs use as a training aid. Similar findings have been detailed with the US military (Herbst, McAslin and Kalapatapu, 2017; Jacobson *et al* (2010)), highlighting an issue that may be culturally specific to military environments. Further investigation is suggested to ensure that Armed Forces personnel are not (actively or passively) "*encouraged*" to look for support or help outside the boundaries of military norms.

GATEKEEPERS are controversial figures in much of the literature, particularly in medical texts, where general practitioners and primary care specialists prescribe to special services, diagnostic testing, and hospital visits or admissions, and, as such, are acting as gatekeepers (Greenfield, Foley & Majeed, 2016). Gatekeepers also tend to be holders of information, often viewed as experienced persons who can either hold back information or provide it to others with the added value of perceived wisdom (Metoyer-Duran, 1993).

In our study, gatekeepers had strong "*helpful*" roles, rather than acting as blockages. Our analysis identified that gatekeepers were composed of three distinct but often related groups of people: friends or peers, work colleagues, and mentors or leaders (e.g., physical training instructors; fitness leaders). All had a role to play in either the procurement of PIEDs or in providing information about substances, their use, and related medical issues, irrespective of whether the veterans began taking PIEDs as serving or non-serving personnel. This concurs substantively with Coomber & Moyle's (2014) and van de Ven's (2017) research which identified that peers, friends, or other, context specific, individuals (such as other gym users or associates of friends in gyms) are most commonly involved in the acquisition of PIEDs.

GATEKEEPERS as a dimension was derived from two categories of *Procurement of PIEDS* (from 2nd Order Themes of *Supplier* and *Facilitator*) and *Information Dissemination* (from 2nd Order Themes of *Information About PIEDs* and *Medical and Health Issues*).

With new users particularly, the *Procurement of PIEDs* necessitated that gatekeepers took on two distinct roles as either *Facilitators* or *Suppliers*. As stated earlier, *Suppliers* were denoted as being either *Direct* or

Intermediary reflecting the fact that some gatekeepers provided PIEDs to users and were viewed as the “go-to” person in their gyms, whereas intermediaries acted on their behalf, almost as allies or collaborators acting as “go-betweens” in the supply chain. Irrespective, all users put a great deal of faith in their suppliers. This “blind faith” corroborates the findings of van de Ven and Mulrooney (2017; 2020) in Netherlands and Belgium, and Australia respectively, who learned that users of PIEDs implicitly trusted their suppliers.

Facilitators were considered to have one of three distinct functions, namely *Guide*, *Influencer*, and *Director*, a novel attribution. *Guides* were deemed to be gatekeepers who suggested, what PIEDs to take, when to take them, and how to take them. *Influencers* roles generally preceded the decision to take PIEDs, but it was definitely an active role, the purpose of which was to persuasively encourage engagement with PIEDs. Andreasson & Johansson (2014) noted that these influential roles are similar to those undertaken with both recreational and performance and image enhancing drugs users in the general population. The *Director* differentiated from the *Guide* in both focus and control insofar as a *Director* undertook their role once the decision to take PIEDs had been reached, informing the user of who to approach or where to go for their PIEDs. While the people who undertook the roles were at times entwined, their functions seemed to be quite discrete and is a further another novel finding of this study. Further work is needed to consider those roles and their relationships.

The final category reflected the *GATEKEEPERS’* role of *Information Disseminator*. Two distinct areas were developed: *Information about PIEDs* and *Medical and Health Issues*.

The former consisted of three themes: *Substance Choice*, *Quantity (of PIEDs to be taken)*, and *Quality (of PIEDs)*. The three areas were again discreet though closely aligned. What the results indicated is that gatekeepers, be they *Facilitators* or *Suppliers*, were trusted to ensure that the correct substances were being purchased for specific outcomes, that the users were taking them in appropriate quantities, and that the quality was “pure”. Participants trusted that standards were sound, unlaced and free of toxins, and were supplied in appropriate doses. Our veterans were unaware of whether their purchases were safe but simply trusted their supply chains (Coomber *et al*, 2014). Their gatekeepers “led” them through the maze of what drug to take, from among the many available. While there were recognised dangers of acquiring information, knowledge, and practices from non-clinical sources, there was a final thematic area that was drawn from the data, namely *Medical and Health Issues*.

Method of Use (including technique) is an important theme in health terms, recognising that most of the users employed intra-muscular injections to administer their PIEDs, and were taught injection protocols and techniques by friends, peers, or other users.

In terms of managing consumption, participants employed a number of key methods, and again they got the information from other users. These included relatively dangerous behaviours, such as “plateauing” in which doses are increased incrementally over a period of approximately two months with the aim of overcoming the body’s natural adaptation to PIEDs.

Despite the potential for negative health outcomes, they are still employed by our participants, and they gained their knowledge about how to do so from their gatekeepers. Also, in common with PIEDs users from the general population (see Tighe *et al*, 2017; Zahnow *et al*, 2018), general advice from sources such as body-building magazines and internet forums, was used by our participants.

Problem Identification and Solving covered areas of concern and resultant strategies or support to deal with them. Within our cohort, information around medical issues were also garnered for the same sources, instead of accessing suitable medical personnel. The engagement with such sources for medical concerns is normal among PIEDs users (Andreasson and Johansson, 2014; Clement *et al*, 2012). Nonetheless, given the possible negative consequences on health, it is disquieting to realise that they are the principal options followed by PIEDs users when seeking information, advice, possible medical therapies or other interventions.

Responses to our questioning showed that a minority of interviewees (N=5) accessed clinical support, highlighting the normality of PIEDs users to avoid seeking medical opinion whenever possible. It seems that PIEDs users do not trust their Forces medical staff due to an awareness that medical staff are senior figures in the Armed Forces. A comment from one veteran supports this view: "Well you can't really, can you? They're part of the "brass" [senior staff]. They'll shop [inform on] you!" (Male, 26).

GATEKEEPERS were viewed by our participants as being the most important people in their journey of PIEDs use, using them to access the drugs, train them on how to use them, and as sources for knowledge, information, and contacts. In the context of this study, gatekeepers were fundamentally other gym users who introduced and then supported PIEDs users. This was especially so in the early days as users. It was noted that gatekeepers had multiple roles:

My main man [for supply and information] is the guy that I knew in the Forces who was able to get gear from his mates in Liverpool. Anything that I need to know, I go to him. If he doesn't know, he finds out (Male, 44).

In spite of their experiences of negative health consequences, such as injection-site or blood infections, our participants followed the same paths of recreational drug addicts in mainstream society by continuing to use the same suppliers, products, and behaviours (Binswanger *et al.*, 2012).

CONCLUSION

This work amongst former military personnel found similarities with other studies of PIEDs' studies with similar cohorts. There were also similarities found with the results of PIEDs' studies in wider populations. These included the manner in which users were first introduced to performance and image enhancing drugs as well as the gatekeeping roles of "*significant others*" in accessing information. Also noted are features of PIEDs use among Services personnel that require additional exploration. These include factors that might reflect adverse influences by colleagues, the "*masculine*" culture that is inherent within military life, the excessive demands on recruits and regular personnel alike during military physical training sessions, as well as the physical and psychological requirements of active service in foreign lands.

This paper addresses the issues of gateways and gatekeepers in PIEDs use among a small cohort of former military personnel. As such, it is the first paper that has specifically considered the two areas and attempted to map them, albeit independently of each other. Given the apparent importance of both *GATEKEEPERS* and *GATEWAYS* to PIEDs use, further knowledge must be gained. As such, there are two main recommendations that fall out of this work. The first is a call for further research of these topics to build and test a model that identifies where the interactions sit between gatekeepers of varying backgrounds, the roles they undertake, and the relationships with gateways. Secondly, in an effort to inform treatment options and initiatives to promote harm reduction, van den Ven & Mulrooney (2017) argued that the design of interventions to counter PIEDs use should, follow a holistic evaluation of social,

economic, and cultural factors that play a part in the decision to take drugs, as well as the environments and people that facilitate the practice. We support this recommendation as it is of particular significance to the Armed Forces where the values and intense training seems to foster a culture in which the rewards of PIEDs use outweigh the risks.

While much of this study reinforces concepts and practices from other areas of substance abuse or anti-social behaviour, our findings have also identified a number of key issues that have thus far been unrepresented in the literature surrounding the use of PIEDs. The fact that this work has been conducted with a small cohort of ex-military personnel means that it cannot be considered to be representative of PIEDs users generally. This makes the topic one of significance for future research with larger samples in both competitive, vocational, and recreational settings. However, there are issues that are very specific to this present cohort which makes this study an important addition to the literature around the use of PIEDs in the Armed Forces. It supports and reinforces the need for greater knowledge.

AUTHOR CONTRIBUTIONS

Conceptualisation of project: Ian Whyte, Jonathan Ling. Literature review (including write-up): Emily Pattinson, Ian Whyte, Sandra Leyland. Data collection: Ian Whyte. Data analysis: Ian Whyte, Jonathan Ling, Istvan Soos. Write-up: Ian Whyte, Jonathan Ling, Istvan Soos (with Emily Patinson and Sandra Leyland being responsible for the literature review). Editing: all authors.

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REFERENCES

- Andreasson J. & Johansson T. (2014). The fitness revolution: Historical transformations in the global gym and fitness culture. *Sport Science Review*, 23 (3–4), 91–112. <https://doi.org/10.2478/ssr-2014-0006>
- Bandura, A. (2002). Selective moral disengagement in the exercise of moral agency. *Journal of Moral Education*, 31(2), 101-119. <https://doi.org/10.1080/0305724022014322>
- Binswanger, I.A., Nowels, C., Corsi, K.F., Glanz, J, Long, J., Booth, R.E. & Steiner, J.F. (2012). Return to drug use and overdose after release from prison: A qualitative study of risk and protective factors. *Addiction Science and Clinical Practice*, 7(3), 1-9. <https://doi.org/10.1186/1940-0640-7-3>
- Boardley, I.D., Grix, J. & Dewar, A.J. (2014). Moral disengagement and associated processes in performance-enhancing drug use: a national qualitative investigation. *Journal of Sports Sciences*, 32(9), 836-844. <https://doi.org/10.1080/02640414.2013.862842>
- Boos, C., Wheble, G.A.C., Campbell, M.J., Tabner, K.C. & Woods, D.R. (2010). Self-administration of exercise and dietary supplements in deployed British military personnel during Operation TELIC 13. *Journal of the Royal Army Medical Corps*, 156(1), 32-36. <https://doi.org/10.1136/jramc-156-01-07>
- Brazeau, M.J., Castaneda, J.L., Huitron, S.S. & Wang, J. (2015). A case report of supplement-induced hepatitis in an active-duty service member. *Military Medicine*, 180(7), e844-e846. <https://doi.org/10.7205/milmed-d-14-00654>

- Brennan, R., Wells, J.S. & Van Hout, M.C. (2017). The injecting use of image and performance-enhancing drugs (IPED) in the general population: a systematic review. *Health & Social Care in the Community*, 25(5), 1459-1531. <https://doi.org/10.1111/hsc.12326>
- British Army (2013). Army briefing note: Army policy on the use of supplements by soldiers. Serial No: 47/13 Source: DPS(A) PS4 Health Date: 7 Jun 13.
- Bucher, J. (2012). Soldiering with substance: substance and steroid use among military personnel. *Journal of Drug Education*, 42(3), 267-292. <https://doi.org/10.2190/de.42.3.b>
- Campagna, J.D. & Bowsher, B. (2016). Prevalence of body dysmorphic disorder and muscle dysmorphia among entry-level military personnel. *Military Medicine*, 181(5), 494-501. <https://doi.org/10.7205/milmed-d-15-00118>
- Carol, M.L. (2013). Hydroxycut weight loss dietary supplements: a contributing factor in the development of exertional rhabdomyolysis in three U.S. Army soldiers. *Military Medicine*, 178(9), e1039-e1042. <https://doi.org/10.7205/milmed-d-13-00133>
- Clement C.L., Marlowe D.B., Patapis N.S., Festinger D.S. & Forman R.F. (2012). Non-prescription steroids on the internet. *Substance Use & Misuse*, 47 (3), 329-341. <https://doi.org/10.3109/10826084.2011.630225>
- Coomber, R. & Moyle, L. (2014). Beyond drug dealing: Developing and extending the concept of 'social supply' of illicit drugs to 'minimally commercial supply'. *Drugs: Education, Prevention and Policy*, 21(2), 157-164. <https://doi.org/10.3109/09687637.2013.798265>
- Coomber, R., Pavlidis, A., Hanley Santos, G., Wilde, M., Schmidt, W. & Redshaw, C. (2014). The supply of steroids and other performance and image enhancing drugs (PIEDs) in one English city: Fakes, counterfeits, supplier trust, common beliefs and access. *Performance Enhancement & Health*, 3, (3-4), 135-144. <https://doi.org/10.1016/j.peh.2015.10.004>
- Coomber-Moore, J. (2017). An exploration of evolving forms of access to performance and image enhancing drugs (PIED), and body image, on Gold Coast, Australia, with particular emphasis on how users reconcile their drift into criminality (Doctoral dissertation, University of Essex).
- Darke, S., Torok, M. & Dufflou, J. (2014). Sudden or unnatural deaths involving anabolic-androgenic steroids. *Journal of Forensic Sciences*, 59(4), 1025-1028. <https://doi.org/10.1111/1556-4029.12424>
- Ghaljaie, F., Naderifar, M., & Goli, H. (2017). Snowball sampling: A purposeful method of sampling in qualitative research. *Strides in Development of Medical Education*, 14(3).
- Paisley, R.D. (2015). Nutritional and sports supplement use among deployed U.S. Army soldiers in a remote, austere combat outpost in eastern Afghanistan. *Military Medicine*, 180(4), 391-401. <https://doi.org/10.7205/milmed-d-14-00334>
- Greenfield, G., Foley, K., & Majeed, A. (2016). Rethinking primary care's gatekeeper role. *BMJ*, 354, i4803. <https://doi.org/10.1136/bmj.i4803>
- Harris, B.F., Winn, C. & Ableman, T.B. (2017). Hemorrhagic stroke in a young healthy male following use of pre-workout supplement Animal Rage XL. *Military Medicine*, 182(9-10), e2030-e2033. <https://doi.org/10.7205/milmed-d-17-00013>
- Herbst, E., McCaslin, S. & Kalapatapu, R.K. (2017). Use of stimulants and performance enhancers during and after trauma exposure in a combat veteran: A possible risk factor for posttraumatic stress symptoms. *American Journal of Psychiatry*, 174(2), 95-99. <https://doi.org/10.1176/appi.ajp.2016.16010014>
- Hope, V.D., McVeigh, J., Marongiu, A., Evans-Brown, M., Smith, J., Kimergård, A., Croxford, S., Beynon, C.M., Parry, J.V., Bellis, M.A. & Ncube, F. (2013). Prevalence of, and risk factors for, HIV, hepatitis B and C infections among men who inject image and performance enhancing drugs: A cross-sectional study. *BMJ Open*, 3(9), pp1-11, p.e003207. <https://doi.org/10.1136/bmjopen-2013-003207>

- Jacobson, I.G., Horton, J.L., Smith, B., Wells, T.S., Boyko, E.J., Lieberman, H.R., Ryan, M.A., Smith, T.C. & Millennium Cohort Study Team. (2012). Bodybuilding, energy, and weight loss supplements are associated with deployment and physical activity in U.S. military personnel. *Annals of Epidemiology*, 22(5), 318-330. <https://doi.org/10.1016/j.annepidem.2012.02.017>
- Kandel, D. B. (Ed.). (2002). *Stages and pathways of drug involvement: Examining the gateway hypothesis*. Cambridge University Press.
- Liane, B.J. & Magee, C. (2016). Guerilla warfare on the pancreas? A case of acute pancreatitis from a supplement known to contain anabolic-androgenic steroids. *Military Medicine*, 181(10), e1395-e1397. <https://doi.org/10.7205/milmed-d-15-00575>
- Lui, C.W., Waller, M., Bell, A. & van der Pols, J.C. (2018). Retrospective self-reported dietary supplement use by Australian military personnel during deployment to Iraq and Afghanistan: Results from the Middle East Area of Operations Health Study. *Applied Physiology, Nutrition, and Metabolism*. <https://doi.org/10.1139/apnm-2018-0576>
- Magee, C.D., Witte, S., Kwok, R.M. and Deuster, P.A. (2016). Mission compromised? Drug-induced liver injury from prohormone supplements containing anabolic-androgenic steroids in two deployed U.S. service members. *Military Medicine*, 181(9), e1169-e1171. <https://doi.org/10.7205/milmed-d-15-00502>
- Mattila, V.M., Rimpelä, A., Jormanainen, V., Sahi, T. & Pihlajamäki, H. (2010). Anabolic-androgenic steroid use among young Finnish males. *Scandinavian Journal of Medicine & Science in Sports*, 20(2), 330-335. <https://doi.org/10.1111/j.1600-0838.2009.00953.x>
- Maughan R.J., Burke L.M. & Dvorak J., et al. (2018). IOC consensus statement: dietary supplements and the high-performance athlete. *British Journal of Sports Medicine*, 52 439-455. <https://doi.org/10.1136/bjsports-2018-099027>
- Mayring, P. (2000). Qualitative content analysis, *Forum Qualitative Social Research*, 1 (2) <http://www.qualitative-research.net/fqs/> Accessed 14 February 2021.
- Metoyer-Duran, C. (1991). Information seeking behaviour of gatekeepers in ethnolinguistic communities: Overview of a taxonomy. *Library & Information Science Research*, 13, 319-346.
- Palinkas, L., Horwitz, S., Green, C., Wisdom, J., Duan, N & Hoagwood, K. (2013). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and Policy in Mental Health*. 42. <https://doi.org/10.1007/s10488-013-0528-y>
- Piacentino, D., Kotzalidis, G.D., Longo, L., Pavan, A., Stivali, L., Stivali, G., Ferracuti, S., Brugnoli, R., Frati, P., Fineschi, V. & Girardi, P. (2017). Body image and eating disorders are common among professional and amateur athletes using performance and image enhancing drugs: a cross-sectional study. *Journal of Psychoactive Drugs*, 49(5), 373-384. <https://doi.org/10.1080/02791072.2017.1359708>
- Tighe, B., Dunn, M., McKay, F. H., & Piatkowski, T. (2017). Information sought, information shared: exploring performance and image enhancing drug user-facilitated harm reduction information in online forums. *Harm reduction journal*, 14(1), p 48. <https://doi.org/10.1186/s12954-017-0176-8>
- van Amsterdam, J., Opperhuizen, A. & Hartgens, F. (2010). Adverse health effects of anabolic-androgenic steroids. *Regulatory Toxicology and Pharmacology*, 57(1), 117-123. <https://doi.org/10.1016/j.yrtph.2010.02.001>
- van de Ven, K., & Mulrooney, K. J. (2017). Social suppliers: exploring the cultural contours of the performance and image enhancing drug (PIED) market among bodybuilders in the Netherlands and Belgium. *International Journal of Drug Policy*, 40, 6-15. <https://doi.org/10.1016/j.drugpo.2016.07.009>
- van de Ven, K., Dunn, M., & Mulrooney, K. (2020). Performance and image enhancing drug (PIED) producers and suppliers: a retrospective content analysis of PIED-provider cases in Australia from 2010-2016. *Trends in Organized Crime*, 23(2), 143-153. <https://doi.org/10.1007/s12117-018-9348-5>

- Varney, S.M., Ng, P.C., Perez, C.A., Araña, A.A., Austin, E.R., Ramos, R.G. & Bebart, V.S. (2017). Self-reported dietary supplement use in deployed United States service members pre-deployment vs. during deployment, Afghanistan, 2013–2014. *Military Medical Research*, 4(1), p.34. <https://doi.org/10.1186/s40779-017-0141-6>
- Whyte, I., Pattinson, E., Leyland, S., Soos, I., & Ling, J. (2021a). Performance and image enhancing drugs use in active military personnel and veterans: A contemporary review. *Translational Sports Medicine*, 4(1), 72-87. <https://doi.org/10.1002/tsm2.186>
- Whyte, I., Pattinson, E., Leyland, S., Soos, I., & Ling, J. (2021b). Performance and image-enhancing drug use in military veterans. Sunderland: University of Sunderland. Retrieved from: <https://s31949.pcdn.co/wp-content/uploads/20210426-Sunderland-PIEDs-FINAL.pdf>
- Wilson, S. (2020). 'Hard to reach' parents but not hard to research: a critical reflection of gatekeeper positionality using a community-based methodology. *International Journal of Research & Method in Education*, 43(5), 461-477. <https://doi.org/10.1080/1743727x.2019.1626819>
- Young, C., Oladipo, O., Frasier, S., Putko, R., Chronister, S. & Marovich, M. (2012). Hemorrhagic stroke in young healthy male following use of sports supplement Jack3d. *Military Medicine*, 177(12), 1450-1454. <https://doi.org/10.7205/milmed-d-11-00342>
- Zahnow, R., McVeigh, J., Bates, G., Hope, V., Kean, J., Campbell, J. & Smith, J. (2018) Identifying a typology of men who use Anabolic Androgenic Steroids (AAS). *International Journal of Drug Policy*, 55, 105-112. <https://doi.org/10.1016/j.drugpo.2018.02.022>



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The use of the vibroacoustic system for determining the range of a ski jump for training athletes

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ABSTRACT

The principle of vibroacoustic systems operation for determining the distance of a ski jump from a springboard, the possible location of sensors on the springboard and sensor signals that occur when athlete lands are considered. The problems of calculating the jump distance and methods for solving these problems are described. The interrelation of the technique of performing a jump (the spatial position of the skis at the time of landing and the normal component of the landing speed relative to the surface of the springboard) with the form of sensor signals is considered. Real waveforms of signals obtained both during the summer artificial covering of the springboard and in winter, as well as generalized results of experimental operation of the system on springboards with different heights of the acceleration mountain are presented. It is shown that the use of vibroacoustic systems allows achieving the required accuracy of determining the ski jump distance – 0.5 m, and the integration of the system with the general jump monitoring system opens up new opportunities for independent training of athletes and training of a group of athletes under the guidance of a coach.

Keywords: Performance analysis of sport, Physical conditioning, Ski jumping, Jump technique, Jump parameters, Sensor location, Digital signal processing.

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INTRODUCTION

The first attempts to create an automated system for determining the distance of a ski jump from a ski jump were made long before the advent of video recording and video image processing systems. Such systems usually consisted of several sensors located on the landing mount and a signal processing device, in particular, either magnetic or acoustic sensors were used, as, for example, in (Bychkov and Aronov, 1993). When using acoustic sensors, the principle of operation was based on measuring the delay time of the signal that occurs when a skier lands in various acoustic sensors and calculating the distance to the landing point based on their obtained delay time values by analogy with the geodetic triangulation method.

However, in many cases it was not possible to achieve the accuracy required by the International Ski Federation (FIS) (International ski federation, 2018) to determine the jump distance due to the reasons described below.

1. The speed of sound in different materials used in the surface structure of springboard is different. Velocity of acoustic wave propagation depends on the density and humidity of snow and the geometrical form of snowflakes.
2. A skis of an athlete is not a point source of acoustic wave.
3. The strongest acoustic signal is not always corresponding to the position of the foot of a skier.
4. A long and powerful acoustic signal can occur when the end of the ski touches the surface of the springboard before the skier lands.

These reasons are discussed in more detail in (Kiesewetter, Korotkov, Malyugin, 2015 – Kiesewetter et al, 2016).

The problem of determining the speed of sound propagation in the surface of the springboard is partially solved by using a calibration source of an acoustic signal placed under the surface of the springboard (Slavskii, 2011). However, the use of such devices does not eliminate the remaining problems of determining the jump range mentioned above. Therefore, systems with the determination of the skier's landing point by the signal delay in various sensors are first-generation systems. Other technical solutions are also known, for example, the US patent (US Patent 4089057, 1978), in which impact sensors are supplemented with a laser system.

It is possible to achieve the required accuracy of determining the jump distance (0.5 m) by using a large number of sensors located in one line or in the form of several parallel lines from the top of the landing mountain to its bottom. The specified accuracy can be achieved at the distance between the L_d sensors of 1 m or less. The measurement accuracy increases, and the probability of error decreases at the distance L_d equal to 0.5 m. The technical problems of organizing the data collection from sensors and the integration of the vibroacoustic system into the general monitoring system for ski jumping are considered in (Kiesewetter, Korotkov, Malyugin, 2015 –Kiesewetter et al, 2016). There are various technical solutions for the design of such a system, which depend on the type of sensors used. Studies carried out on several trampolines have shown that a good result can be obtained either using accelerometers or fibre-optic sensors installed perpendicular to the direction of movement of athletes when landing with an interval of 0.5 ... 1 m.

METHODS

The method of signal processing in such systems differs significantly from the method used in first-generation systems. The presence of a large number of sensors allows us to base the calculations of the jump range on

the sequence and waveforms that occur in the sensors, and then, if necessary, refine or verify the obtained value using the measured signal delay times.

Typical signals from sensors when skier lands are given, in particular, in (Kiesewetter, Korotkov, Malyugin, 2015). It is obvious that the waveforms of the signals (signal shape, amplitude, etc. parameters) depend on the technique of performing the jump and landing of the athlete. Currently, there is no information in scientific papers about the influence of the technique of performing a ski jump on the signal parameters. Understanding the main trends will improve the quality of signal processing to determine the jump distance, and vice versa – use the calculated parameters of the signals to obtain objective quantitative parameters of the jump technique.

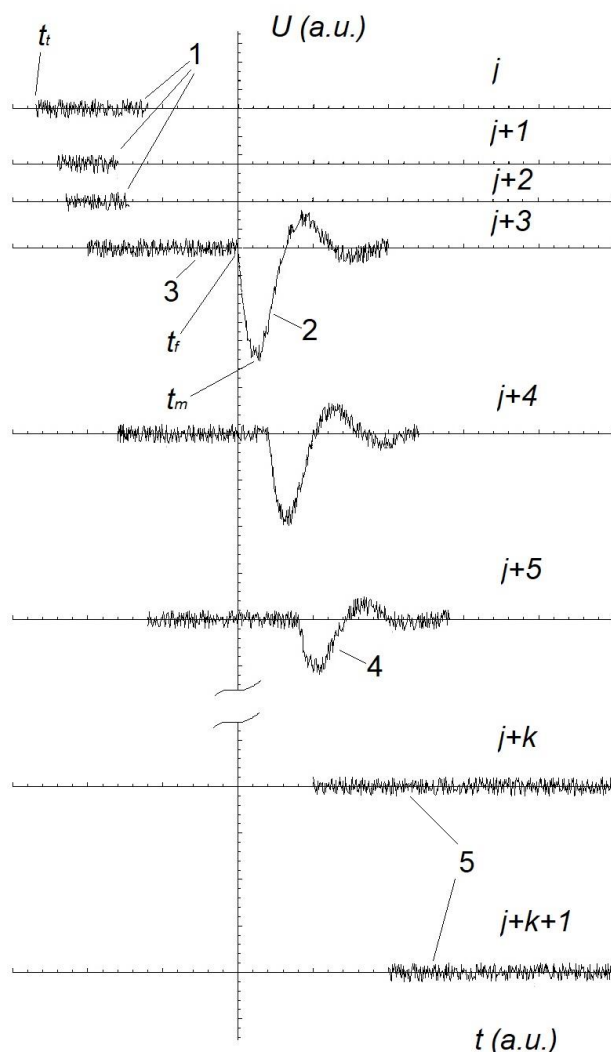


Figure 1. Schematic representation of waveforms, along the abscissa axis-time in relative units, along the ordinate axis-the voltage at the output of the sensors in relative units; types of signals: 1 – noise caused by touching the end of the ski before landing, 2 – signal by elastic deformation of the springboard cover under the action of the athlete's foot, 3 – noise caused by the impact of the ski at the time of landing, 4 – the signal 2 modified during the propagation of an acoustic wave, 5 – noise caused by sliding skis on the springboard cover.

Let us consider the waveforms of sensor signals in more detail, taking into account the main phases of the skier's landing, noted in (Kiesewetter, Korotkov, Malyugin, 2015; Kiesewetter et al, 2016). It is convenient to consider the waveforms in the following form: on one graph there are several waveforms from different sensors, the waveforms on the graph are shifted along the ordinate axis in such a way that the waveform corresponding to the sensor located above all on the landing mountain is also displayed on the graph above all, and the waveforms of signals from sensors located below are shifted down on the graph; along the abscissa – time axis, the beginning of all waveforms corresponds to the same moment in time (i.e. the signals are synchronized).

To explain the main patterns, it is convenient to use schematic, rather than real waveforms of signals that display only the considered patterns and do not take into account secondary effects. An example of schematically depicted waveforms for the case when a skier touches the surface of the springboard with the end of the ski before landing is shown in Figure 1.

In general, we will assume that the first touch was recorded by the sensor with the number j , and we will denote the moment of touch time as t_i . In Figure 1, the areas of the waveforms 1 correspond to the noise that occurs when the end of the ski (or both skis) moves along the surface of the ski jump coating. The standard square amplitude of noise when touching the summer surface of the springboard is significantly greater than when touching the winter surface – i.e. snow, which must be taken into account when implementing the system hardware and in the signal processing software used. The signal corresponding to the moment of landing of the skier, that is, the touch of the athlete's foot on the springboard surface, is indicated in Figure 1 as number 2. The signal appears in the sensor with the number $j+3$; the corresponding moment of time is indicated as t_i . At this point in time, the skier's foot begins to create compression of the ski jump cover, which leads to acceleration of the accelerometer module. Since the springboard coating is springy, i.e. it has the property of elastic deformation, relaxation begins at the time t_m (Figure 1) and vibrations of the springboard coating occur. In some cases, there are also fluctuations in the entire design of the springboard near the landing site of the athlete.

The duration of the athlete's flight Δt_k from the moment the end of the ski touches the landing is equal to the value $t_i - t_i$. The area of overlap of signals 1 in neighbouring sensors, as well as the shape of the envelope of signal 1, depends on the design of the springboard cover. Touching the surface of the springboard with the end of the ski leads to decrease in the longitudinal component of the athlete's flight speed, respectively, to a decrease in the jump range, i.e. to a deterioration in the sports result. The value of Δt_k is an objective quantitative assessment of one of the parameters of the quality of the jump, which can be measured using vibration-acoustic sensors more accurately than using a video fixation system, since at a small distance from the end of the ski to the surface of the springboard (a few centimetres or less), the video fixation system may not be effective. In the case of intermittent touch, an updated value of Δt_k can be used for an objective assessment of the jump quality, taking into account the total touch time, which is difficult to obtain by processing the video image, especially since the existing software does not allow determining this value.

If the athlete's feet touch the surface of the springboard exactly above the sensor (in this example, above the sensor with the number $j+3$), then the jump distance is determined by the position of the corresponding sensor on the landing mountain; no additional adjustment of this value is required. A signal similar to the signal that occurs when a skier lands occurs in the next sensor located below (in this example, in the sensor with the number $j+4$), but the signal amplitude is less than in the sensor $j+3$. This signal is caused by fluctuations in the surface and structures of the springboard, as well as the impact of skis on the surface of the springboard immediately after landing and during the initial phase of sliding. A signal similar to signal 2, but with a

significantly lower amplitude, is also observed in other sensors. The signal is caused by the propagation of an acoustic wave caused by the skier landing. The further away a sensor is located from the sensor over which the skier's foot landed, the greater the signal delay value. Figure 1 shows only the waveform of the sensor signal with the number $j+5$ as an example. Signals similar to signal 2 also occur in sensors located on the landing mountain above the athlete's landing site. In Figure 1, these are sensors with the numbers j , $j+1$ and $j+2$. However, the signals of these sensors are usually significantly weaker than the signals of sensors located below the landing site, since the acoustic compression wave has the direction towards the bottom of the landing mountain along the surface of the springboard. Therefore, these signals are not shown in Figure 1.

If the place of landing of the skier's foot is located between two sensors, then the specified value of the jump distance can be obtained by interpolation-extrapolation of the dependence of the characteristic points of signal 2 (the beginning, maximum and transition through zero of signal 2) on the distance (in fact, the location of the sensors). This approach allows you to determine the distance of an athlete's jump with an accuracy exceeding the distance between the sensors. Theoretically, if the distance between the sensors is 1 m, the estimated jump distance can be determined with an accuracy of better than 0.1 m, which is less than the length of the athlete's shoe. In this case, the obtained value is not related to any area of the athlete's shoe sole but is the result of numerical processing of signals arising from the conditionally integral impact of the athlete's foot.

Signal 2 in the sensor $j+3$, as well as $j+4$, can be preceded by signal 3, similar to signal 1, but more powerful, due to the impact of the entire surface of the athlete's skis when landing. Signal 3 can continue after the termination of signal 2, which is due to a later touch of the front ends of the skis on the springboard surface and their oscillation. The noise signal and some deformation of the springboard surface caused by this reason occur for the sensor located above the sensor $j+3$, i.e. $j+2$. However, such signal does not carry useful information and is not shown in Figure 1.

The maximum signal amplitude 2 ($U_{2\max}$) reached at time t_m (Figure 1), which is the maximum acceleration value of the sensor, depends on the speed of approach of the athlete's foot to the surface of the springboard, the athlete's mass and the duration of the impact associated with the longitudinal speed of the athlete's movement, as well as with the terrain of the landing mountain. The value of $U_{2\max}$ is associated with the technique of performing a jump, but what value is optimal for achieving the best sports result is currently unknown. It can also be assumed that information about the average value of $U_{2\max}$ will help coaches (or referees) make the right choice of the starting point on the acceleration mountain. It should be noted that it is impossible to determine the maximum acceleration of the sensor or the parameters of the deformation of the springboard surface at the moment of landing of the athlete using the video fixation system.

When an athlete's skis slide on the surface of the springboard, a noise signal also occurs, indicated in Figure 1 by the number 5. The sensor signal with the number $j+k+1$ is partially depicted. Using these signals, it is possible to estimate the longitudinal sliding speed of an athlete on a springboard, determine the place of the athlete's fall, if such an event occurs, etc. However, this signal does not carry any useful information about the technique of performing a ski jump, so it is not considered further.

The algorithm for determining the jump distance for the case of different distances of the athlete's legs at the time of landing, including with a certain time delay, is somewhat more complicated. The signal form 2 may differ from the typical signal form shown in Figure 1, and in this case the signals themselves occur in two sensors at once, and these may not be neighbouring sensors. The most difficult case for determining the

jump distance is the case of an athlete landing first on one leg, and then, with a significant delay, on the other leg. Then it is necessary to pre-divide the signals into two time intervals, in each of which the above-mentioned digital signal processing algorithm should be used. Currently, the method of processing such signals is being improved.

The use of sensors located in a line in the middle of the landing mountain may not be enough to achieve the accuracy of determining the jump distance of 0.5 m on trampolines with a wide landing mountain and a high acceleration mountain. In this case, it is advisable to use several sensor lines simultaneously (as, for example, in (Kiesewetter, Korotkov, Malyugin, 2015)) or fibre-optic sensors installed perpendicular to the landing mountain (Kiesewetter et al, 2016). Since the principle of operation of fibre-optic sensors is based on registering the deformation of the fibre, and not measuring acceleration, the signal processing algorithm for determining the jump distance in such system becomes more complicated, but the essence of the method is preserved.

RESULTS

A vibroacoustic system for determining the distance of a ski jump, integrated into the general monitoring system, was installed on the K-40 and K-75 springboards in the village of Toksovo, Leningrad region, Russia. These jumps were not equipped with a permanent video recording system with the ability to determine the distance of the athlete's jump. On each springboard, the monitoring system contained the vibroacoustic system for determining the jump distance, the wind speed and direction sensor, the device for measuring the velocity of an athlete on the acceleration mountain before performing a jump, the synchronization system, the server, the remote start control system, the data collection system from judges' consoles (or computers) and information display devices – a start and information scoreboard. Analog accelerometers with the multi-channel analog-to-digital converter and the data transmission system to the server were used as sensors. The sensors were arranged in the line in the middle of the landing mountain with the interval of 1 m. The interaction of these parts of the system is described in detail in (Kiesewetter, Korotkov, Malyugin, 2015).

As an example, Figure 2 shows real waveforms of signals when an athlete lands on the summer surface of the springboard. The second waveform from above (blue) corresponds to the place of landing of the athlete: it has a typical shape (indicated in Figure 1 as 2) with superimposed noise. The waveform 1 in Figure 2 (red) contains only noise and a signal caused by the waveform of the springboard structure. The waveform 3 (green) has a shape similar to the shape of the waveform 2. The subsequent waveforms 4 and further have a shape different from the typical waveform caused by the skier's foot touching the surface of the springboard. Waveforms 5 and further have a significant delay of the specified signal, as well as a change in its shape due to the high attenuation coefficient of the high-frequency part of the acoustic wave spectrum. The noises caused by the athlete's skis sliding on the surface of the ski jump cover (duration of approximately 0.2 seconds) have a time offset increasing with the sensor number. In the given example, the first waveform was not preceded by signals from sensors located higher on the landing mountain. That is, the given waveforms correspond to the technique of performing a jump, in which the athlete in flight and before landing does not touch the surface of the springboard with the end of the skis. The spread of the U_{2max} value indicated above for various jumps was almost one order of magnitude.

Typical waveforms of sensor signals obtained in winter with snow covering the springboard are shown in the Figure 3. The waveforms presented in Figure 3 are shown on the same scale as in Figure 2 in order to facilitate their comparison. It follows from the data obtained that the signals are significantly weaker. The amplitude of the signals can be increased by increasing the gain of the analog-to-digital converter, performed

using existing software. It can be expected that the amplitude of the signals will depend on the thickness of the snow cover, the density and humidity of the snow, and other factors. However, the general patterns discussed earlier are preserved, which allows using the same algorithm for digital signal processing.

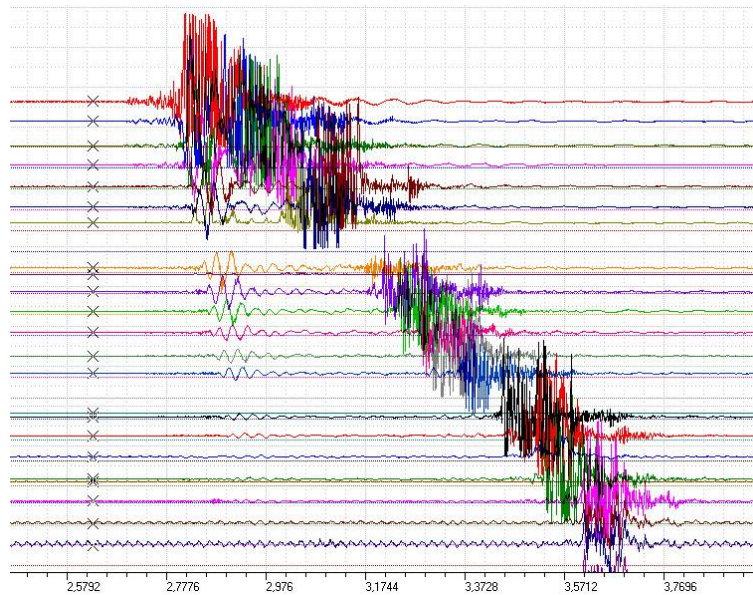


Figure 2. Typical waveforms of sensor signals when a skier lands on the summer artificial surface of the springboard: on the abscissa axis – the time in seconds from the start of the synchronization pulse, on the ordinate axis – the voltage at the output of the accelerometers; the lower the waveform is shifted in the figure, the lower the sensor is located on the landing mountain.

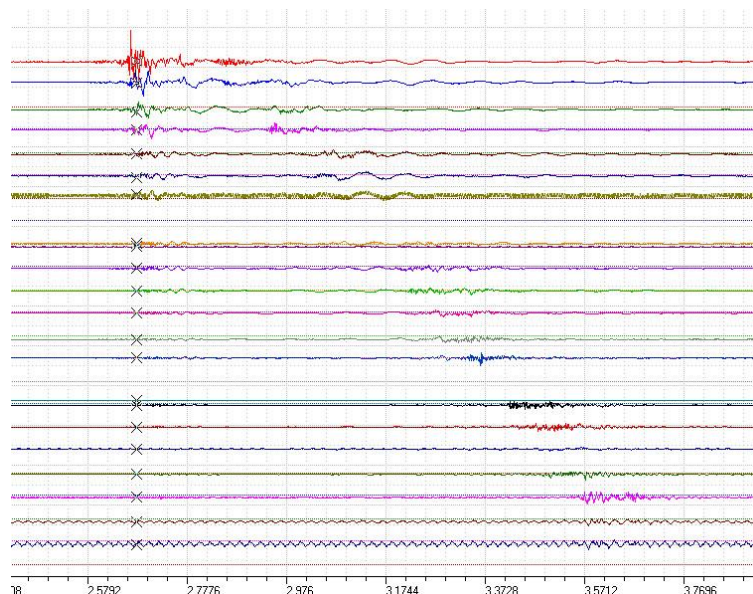


Figure 3. Typical waveforms of sensor signals when a skier lands on the snow surface of one springboard in winter: on the abscissa axis – the time in seconds from the start of the synchronization pulse, on the ordinate axis – the voltage at the output of the accelerometers; the lower the waveform is shifted in the figure, the lower the sensor is located on the landing mountain.

DISCUSSION

The system was tested both during the training of athletes and during competitions. The integration of the vibroacoustic system with the general ski jumping monitoring system allowed athletes to independently obtain data on the jump distance and some other parameters during training, in particular, to assess the quality of skis sliding on the surface of the coating on the acceleration mountain and, if necessary, take appropriate measures (clean the ski jumping coating, choose a suitable lubricant for skis, etc.). The presence of a wind direction and speed sensor in the system made it possible to take into account these parameters for the correct self-assessment of the technique of performing a jump by an athlete. The use of a remote start control device allowed the coach to organize training jumps from a springboard, being in the place most convenient for observing the training process and performing jumps.

CONCLUSION

The use of the vibroacoustic system for determining the distance of a ski jump, integrated into the general jump monitoring system, simplifies the assessment of sports results during the training of athletes both independently and under the guidance of a coach, which allows achieving the best sports results.

AUTHOR CONTRIBUTIONS

D. Kiesewetter has developed the signal processing technique, manufactured the software and hardware of the device. V. Malyugin has performed the experimental study and equipment testing. K. Korotkov has performed the experimental study and processed experimental data. S. Zyryanov has developed the concept of the hardware implementation of the measurement method and performed the installation of sensors.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

REFERENCES

- Bychkov, G.G., Aronov, V.I. (1993): USSR copyright certificate No 1836971, cl. A 63B 5/11. The device for determining the length of the ski jumping (in Russian).
- International ski federation. (2018, June). The international ski competition rules (ICR). Book III. Ski jumping. Retrieved from: https://assets.fis-ski.com/image/upload/v1536927329/fis-prod/assets/International_Competition_Rules_ICR_Ski_Jumping.pdf
- Kiesewetter D., Korotkov K., Malyugin V. (2015). Lecture Notes in Computer Science: Vol. 9247. The Automated System for Collection, Processing and Transmission of Data for Training and Competitive Process in Ski Jumping. Internet of Things, Smart Spaces, and Next Generation Networks and Systems. Springer, Cham. https://doi.org/10.1007/978-3-319-23126-6_41
- Kiesewetter, D., Malyugin, V., Makarov, S., Korotkov, K., Diao Ming and Xue Wei. (2016). Application of the optical fibers in the system of determining the distance of jump at ski springboard. 2016 Advances in Wireless and Optical Communications (RTUWO), 5 – 8, <https://doi.org/10.1109/rtuwo.2016.7821845>

- Slavskii, V.F., Kuramshin, A.M., Kalinin, Y.V., Korotkov, K.G., Sinister, A.A., Zakharov, G.G., Shelkov, O.M., Malyugin, V.I., Kiesewetter, D.V. (2011, March 10): The device for measuring the length of the ski jumping. Patent RF No 102789 U8, G01B7/00 (in Russian).
- US Patent No 4089057-A (1978, May 9): Method and Device for Measuring Jump-lengths on a Ski-jump. Cl. G01B7/00.



Healthy eating behaviours and the role of parents and family in children aged 11, 13 and 15 years

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ABSTRACT

All people acquire healthy or unhealthy habits during family life where the influence of the parental model is decisive. It is precisely the influence of parents at these ages that taken in the study 11, 13 and 15 years based on the European study HBSC. A total of 240 children's were included in the study, as follows: 120 children's from rural areas (40 children's 11 years old, 40 children's 13 years old, 40 children's 15 years old), and from urban areas the same number. In the contemporary literature of dietetics, it is a well-known fact that eating family together plays a decisive role in modelling healthy behaviours in children where the parent plays the main role. The recommendations show that it would be very valuable in many educational aspects for the family to consume most of the three meals, breakfast and dinner together. This lifestyle keeps the family together and children are educated with healthy eating behaviours. Data show that these ages in a large percentage do not consume breakfast (which is considered the most important meal) and this percentage increases with age. A more in-depth study at national level is needed to understand its causes. It is noticed that children consume in many cases an intermediate meal of the fast-food type. These should be followed by specific interventions aimed at raising parents' awareness of their key role in influencing children and creating the basic premise for a healthy lifestyle in their ongoing lives as status changes from child to adult.

Keywords: Physical education, Healthy behaviour, Family importance, Meal consumption, Parental role.

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INTRODUCTION

If we want to have a healthy childhood which is followed by a healthy youth in the future, it is very important to cultivate healthy behaviours towards food and physical activity and sports in early childhood where indisputably the parental role and model is irreplaceable.

Prevention of obesity should commence very early in life. For example, breastfeeding an infant is preferable to the use of a formula and may contribute to the prevention of obesity (M. Paul, I. et al. (2010). Further, young children's food and activity choices can be influenced by early intervention and guidance (Birch and Fisher, (1998) and habits learned early in life are likely to carry through to adulthood (Kelder, S. et al., (1994).

Educating the families of young children concerning nutrition and physical activity may have a powerful positive impact on the obesity risk of children, especially those with obese parents. Obesity prevention programmes should target the whole population, as it is difficult to identify children at risk of developing obesity at a very young age (Hills, P et al., (2007).

The education of eating behaviours is a long process that started in infancy and continues throughout life. Eating behaviours includes food preferences, patterns of food acceptance and rejection, or the types and amounts of food a person eats. Genetic is a key factor that determine the development of eating behaviours.

Risk factors for developing unhealthy behaviour for food and obesity include genetic, social and behavioural factors. Since genetic and social factors cannot be changed, prevention programmes have to focus on behavioural changes including increasing physical activity and reducing energy intake.

Careful parental interventions within the family

Family lifestyles play a central role in the development of children's food preferences and activity choices. Parents in particular have a strong influence on their children's lifestyles through modelling and education (Hodges, 2003).

Parental influences are early determinants of food attitudes and practices in young children (Birch and Davison, (2001) and parenting styles may influence the development of food preferences and the ability of the child to regulate intake. Efforts by parents to control the food intake of children can interfere with children's ability to regulate their own food intake (Birch and Fisher, 1998). Parents have the responsibility to make healthy choices while shopping, to prepare healthy low-fat meals and to make healthy snacks (such as fruits) readily available to children. Parents should also take special care to have meals at regular times with the whole family whenever possible, to be realistic with portion sizes and to limit eating to one place, such as the kitchen or dining table with no eating in front of the television. Most importantly, children should never skip meals or be forced to finish the entire meal (Rolland-Cachera et al., 2002).

Parental support and modelling are strong determinants of children's physical activity level (Fogelholm et al., 1999). When parents are engaged in physical activities and sports, their children are more likely to have a positive attitude towards physical activity.

Of course, the role of the mother is the most important in the family in terms of shopping, cooking, portions and setting the table according to the wishes of each member of the family. In many studies the role of the mother is much more decisive than that of the father.

MATERIAL AND METHODS

This modest study conducted in two rural schools and two 9-year schools in the city aims to assess the healthy behaviours of children on food and the role of parents in creating a correct model for further life. Our study included children aged 11, 13 and 15 years of V, VII, respectively IX grade. A total of 240 children's were included in the study, as follows: 120 children's from rural area (in the school of Kamza and Zall Herri) and 120 urban children's (in the 9-year school 7 Marsi and De Rada).

The questionnaire correctly stood the HBSC standards for these ages. The questions of the questionnaire consisted of:

- Frequency of breakfast and dinner with the family,
- The place where the lunch is taken,
- Frequency of snacks during playtime or computer work,
- Family influence on the consumption of certain unhealthy foods, such as Pepsi, coke or other drinks containing sugar, sweets, chocolate, biscuits and other pastries, chips,
- The frequency of fast-food restaurants attendance and the compliance of family dining rules.

RESULTS AND DISCUSSION

120 students were included in the study, of which 40 students were aged 11 years old (22 girls and 18 boys), 40 students aged 13 years old (19 girls, 21 boys) and 40 students aged 15 years old (24 girls and 16 boys). In the rural areas we studied the eating behaviour in a number of 120 students, of which 40 were aged 11 years old (26 girls and 14 boys) and 40 students were aged 13 years old (20 girls and 20 boys), 40 students aged 15 years old (21 girls and 19 boys).

The recommendations show that it would be very valuable in many educational aspects for the family to consume most of the three meals, breakfast and dinner together. This lifestyle keeps the family together and children are educated with healthy eating behaviours.

Our questionnaire contained these two questions:

1. 1-How often do you have breakfast with your mother or father?
2. 2-How often do you take dinner with your mother or father?

According to the study results presented in the above figure, the reported percentage of students having breakfast with the family, daily or almost daily (5- 6 days/week) decreased from 49.27% in age-group of 11 years to 10.63%, in age group of 15 years. High percentage of students of 13 years old (43.92%) and of 15 years old (38.64%) said they had breakfast with their mother or father, 1-2 days a week, while most of those of 11 years old (38.31%) said they took breakfast at home daily, 13 years old 32.07% and 15 years old 28.65%. We see that we have a difference of 9.66% from the age of 11 to the age of 15.

There are many reasons why a significant percentage do not consume breakfast with parents where one of the main reasons is either they wake up at the "last minute" before leaving for school, or take their bread with them, or parents leave for work too early and do not leave breakfast ready to eat. If we talk about girls, in adolescence they do not eat because they want to maintain the so-called "zero size weight".

We emphasized it above...when the family is united in the consumption of food, the benefits are great because we have the opportunity to look into the eyes of our children and discuss the problems of the day

and especially this close communication allows us to ascertain in time any negative habits such as tobacco, drugs etc, especially with 15-year-olds.

In contrast to the breakfast that appears with the problems addressed above, *dinner is more common to be consumed by the whole family together because we believe that in the evening family members gather at home and this enables dinner together.*

Thus, high percentage of children at all ages said they took dinner with parents daily (71.25% of the students of 11 years old, 59.12% of those of 13 years old and 39.66% of those of 15 years old). Again, the data show that with age, 15-year-olds, in the name of their independence and freedom, move away from sharing dinner with their parents. It is seen that there is a decrease of 31.59% from the age of 11 to 15 years.

Some students declared they consume dinner with parents 1-2 days a week (26.15% students of 11 years old, 23.09% of 13 years old and 18.14% students of 15 years old).

For our study it is important to have data not only what they eat, but also where they eat, which is why we considered useful the question:

- Where do you usually have lunch on school days?

This question did not give us any concrete data because all four schools included in the study, both in rural areas and in the city of Tirana are public schools and do not offer food and study in school. This causes the question to lose relevance and the answer is reduced only to the percentage of children (56%) who take a snack with them and the rest (44%) who state that they consume lunch when they return from school with their parents.

Unfortunately, television viewing promotes both reduced activity and increased food consumption. Many children snack while watching television; in addition, children's food choices are easily influenced by television advertisements such as for soft drinks and energy-dense foods (Kraak and Pelletier, 1998).

Reductions in television viewing time have the potential to decrease the consumption of energy-dense foods and also to increase the likelihood that time will be spent in more energy-intensive activities. Parents should be careful that television viewing does not become integrated into the daily routine of their children.

An average percentage of all children's (29.07% children's of 11 years old, 22.43% children's of 13 years old and 17.18% children's of 15 years old) said they did not ever get snacks while watching TV or playing/working on the computer, which shows that children's and their parents know the negative effects on health. Another situation arises with those who consume snacks while watching TV, computer games or play station. A high percentage of all children's (39.07% children's of 11 years old, 31.43% students of 13 years old and 26.18% children's of 15 years old) state that they almost always consume food during this time. Of course, lack of attention makes you not calculate the amount of consumption, which leads to overweight and obesity.

The world for years is facing a growing trend of fast-food businesses which are very popular, especially for children, although parents do not prefer these foods because it is known that in general these foods contain a lot of calories and saturated fats unhealthy for health. To find out how often children consume such foods, we put this question in our questionnaire:

- How often do you eat at a fast-food business?

11 years old (54.12%), 13 years old (42.17%) and of 15 years old (29.36%) said they go less than once a month at a fast-food business, while 21.12% of the 11 years old children's and 24.4% of the total of 120 students present in our study said they have never been to such a kind of business. It would be highly advisable if most children would frequent fast food occasionally and not often or on a daily basis, because their negative effects on consumer health are well known.

In order to highlight the role of parents in modelling a healthy food behaviour in their children, we address this question included in our questionnaire:

Are you being offered the following things (Cola, Pepsi) from parents if you ask for them?

48.14% of the children of 11 years old, 36.23% of 13 years old and 52.65% of those of 15 years old said they have no problem to consume cola or other soft drinks that contain sugar whenever they want, without any hindrance or penalty from their parents. Another 23.16%, 19.82% and 33.43% of children of 11, 13 and 15 years old said they buy and drink soft drinks every time they want. When you consider that these drinks have industrial sugar, caffeine, aspartame, preservatives, etc., the figures are alarming.

On the contrary, only 34.17%, 39.99% and 43.11% of the 11-, 13- and 15-years old subjects buy and drink rarely or never soft drinks in urban areas. In rural areas, 44.21% of 13 years old children's do not have any hindrance or penalty from their parents about the consumption of such soft drinks, being allowed to consume them any time they want.

We believe that this high percentage in rural areas is related to the lack of information and proper education by parents who, for the sake of truth, have financial problems and work all day in agriculture and livestock to meet the basic needs of the family.

The highest percentage of children of all ages (49.13% of the students of 11 years old, 47.76% of those of 13 years old, respectively 40.31% of those of 15 years old) agreed that every family have certain rules at table and parents expected from their children to follow them. A significant percentage (49.11%) of all children's say do not agree or do not agree at all that the family puts pressure on them to follow the rules of food, meal schedule and anything that goes against their wishes. The children from the urban and rural areas agree or strongly agree that the good manners at table are important. The percentage of those who agree with this statement is higher in the rural areas (65.89% children of 11 years old, respectively 59.74% students of 13 years old) and this is probably because in the urban areas, both the parents and the children are overwhelmed by the disorganized schedule of the family meals, forgetting about the good manners.

We need to be convinced that everything we try to teach children at this age about healthy eating behaviours will provide an adult who has all the right information about what is healthy and unhealthy in life. For this reason, this study shows once again that the role of parents in educating these behaviour's is great and decisive.

CONCLUSIONS

Consumption of breakfast at these ages is problematic and is associated with increasing age. Although parents can leave for work early, before the children go to school, they should leave the breakfast ready for the children. Since public schools in Albania are without food or study hours, it is good for parents to prepare a light snack for children and a bottle of water as a snack before lunch this would be especially true for children who go out without breakfast. Consumption of fast food and Cola or Pepsi is high towards parents

should insist that food be consumed in the family and water or juices from fresh fruits are the healthiest drinks. Parents should try to consume at least breakfast and lunch with the family together. This in today's literature of nutrition is considered a healthy time that greatly affects the education of children. Low level of awareness was observed in parents in relation to consumption of soft drinks, sweets and chips. More than half of the children (all ages) are allowed to consume cola or other soft drinks that contain sugar without any restriction from their parents, the situation being more acute in rural areas. Also, high proportions of children are allowed to eat whenever they want sweets or chips.

AUTHOR CONTRIBUTIONS

Robert Çitozi: Scientific coordinator. Elton Spahiu: Bibliographic research. Benon Paloka: Data preparation, data collection and analysis.

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REFERENCES

- Amador, M., Ramos, L.T., Morono, M. and Hermelo, M.P. (1990) 'Growth rate reduction during energy restriction in obese adolescents', *Experimental and Clinical Endocrinology*, 96: 73-82. <https://doi.org/10.1055/s-0029-1210991>
- Barker, R. and Cooke, B. (1992) 'Diet, obesity and being overweight: a qualitative research study', *Health Education Journal*, 51: 117-21. <https://doi.org/10.1177/001789699205100304>
- Birch, LL, Davison, K (2001) Family environmental factors influencing the developing behavioral controls of food intake and childhood overweight. *Pediatric Clinics of North America* 48: 893-907. [https://doi.org/10.1016/S0031-3955\(05\)70347-3](https://doi.org/10.1016/S0031-3955(05)70347-3)
- Birch, L. and Fisher, J. (1998) 'Development of eating behaviours among children and adolescents' *Pediatrics*. 1998 Mar;101(3 Pt 2):539-49. <https://doi.org/10.1542/peds.101.s2.539>
- Caroli, M. and Burniat, W. (2002) 'Dietary management', in W. Burniat, T. Cole, I. Lissau, E. Poskitt (eds) *Child and Adolescent Obesity. Causes and Consequences, Prevention and Management*, Cambridge: Cambridge University Press, pp. 282-306. <https://doi.org/10.1017/cbo9780511544675.016>
- Craig, S., Goldberg, J. and Dietz, W.H. (1996) 'Psychosocial correlates of physical activity among fifth and eight graders', *Preventative Medicine*, 25: 506-13. <https://doi.org/10.1006/pmed.1996.0083>
- Fisher, J.O., & Birch, L.L. (2002). Eating in the absence of hunger and overweight in girls from 5 to 7 y of age. *American Journal of Clinical Nutrition*, 76, 226-231. <https://doi.org/10.1093/ajcn/76.1.226>
- Fogelholm, M. Nuutinen, O. Pasanen, M. and Myohanen, E. (1999) 'Parent-child relationship of physical activity patterns and obesity' January 2000 *International Journal of Obesity* 23(12):1262-8. <https://doi.org/10.1038/sj.ijo.0801061>
- Hills, P. King, N. and Byrne, N (2007) 'Children, Obesity and Exercise: Prevention, Treatment and Management of Childhood and Adolescent Obesity'. Routledge, United Kingdom, pp. 142-163. <https://doi.org/10.4324/9780203945971>

- Kelder, S. (1994) 'Longitudinal Tracking of Adolescent Smoking, Physical Activity, and Food Choice Behaviors' August 1994 American Journal of Public Health 84(7):1121-6. <https://doi.org/10.2105/ajph.84.7.1121>
- Kraak, V. & Pelletier, DL. (1998) 'The influence of commercialism on the food purchasing behavior of children and teenage youth'. Family Economics and Nutrition Review. 1998, 11: 15-24.
- McLean, N., Griffin, S., Toney, K. and Hardeman, W. (2003) 'Family involvement in weight control, weight maintenance and weight-loss interventions: a systematic review of randomised trials', International Journal of Obesity Related Metabolic Disorders, 27: 987-1005. <https://doi.org/10.1038/sj.ijo.0802383>
- M. Paul, I. et al. (2010), 'Opportunities for the Primary Prevention of Obesity during Infancy', Adv Pediatr. 2009; 56(1): 107-133. <https://doi.org/10.1016/j.yapd.2009.08.012>
- Powell, C.A., Walker, S.P., Chang, S.M., & Grantham-McGregor, S.M. (1998). Nutrition and education: a randomized trial of the effects of breakfast in rural primary school children. American Journal of Clinical Nutrition, 68, 873-879. <https://doi.org/10.1093/ajcn/68.4.873>
- Rolland-Cachera, M-F. Castetbon, K. Arnault, N. Bellisle, F. Romano, M-C. Lehighue, Y. Frelut, M-L & Hercberg, S. (2002). 'Body mass index in 7–9-y-old French children: frequency of obesity, overweight and thinness' International Journal of Obesity volume 26, pages 1610–1616. <https://doi.org/10.1038/sj.ijo.0802146>
- Scaglioni, S., Salvioni, M., & Galimberti, C. (2008). Influence of parental attitudes in the development of children eating behaviour. British Journal of Nutrition, 99, Suppl. 1, S22-S25. <https://doi.org/10.1017/S0007114508892471>
- Schonfeld-Warden, N. and Warden, C.H. (1997) 'Pediatric obesity: an overview of etiology and treatment', Pediatric Clinics of North America, 44: 339-61. [https://doi.org/10.1016/S0031-3955\(05\)70480-6](https://doi.org/10.1016/S0031-3955(05)70480-6)
- Zwiauer, K.F.M. (2000) 'Prevention and treatment of overweight and obesity in children and adolescents', European Journal of Pediatrics, 159(Suppl 1): S56-68. <https://doi.org/10.1007/pl00014367>



Kinematic analysis of “Russian” circles in gymnastics

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ABSTRACT

The kinematic analysis of the Russian wendeswing technique performance in different types of supporting surfaces was undertaken using the 3D Qualisys motion capture system. A high-level qualified gymnast performed 5 routines of three Russian circles on the floor and same on pommel horse. The average performance time of Russian circle on the floor was about 0.3 s less than the same skill performance time on pommel horse. The phase structure of each circle contained 4 hand steps of 0.3-0.4 s duration each. Russian circles control actions are performed through the arms. On floor there was a change of the shoulder joint angle in the range of 4° to 35°, whereas on pommel horse, the performance showed the shoulder joint angle range of 9° to 40°. In our research, the main difference between Russian circles performed on different apparatus was found in the positions and shifting of hip joints and the sacrum attached markers. On floor, the Russian circle performance showed a shift in the vertical sacrum marker in the range of 19 cm compared with 11 cm on pommel horse. The results indicated that floor circles demand higher rotation speed from the athlete and presumes bigger vertical hips shifting. On pommel horse, Russian circles performance registered a lower range of angular velocity and vertical hip shifting but had greater shoulder joint angle.

Keywords: Performance analysis of sport, Physical conditioning, Russian wendeswing, Circle, Pommel horse, Floor exercise, Gymnastics.

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INTRODUCTION

Russian circles otherwise known as Russian "*wendeswing*" (turning swing) is a gymnastic skill that is executed mainly on the pommel horse but also during floor exercises (Figure 1).

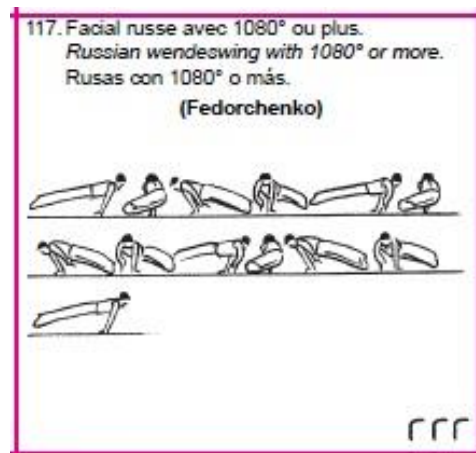


Figure 1. "Russian" circle or Russian wendeswing.

High quality execution of this "*circle*" rewards gymnasts with higher scores and, as such, affects the final outcome of the gymnasts' competitions. Kinematic analysis was employed to identify and log the biomechanical features of the Russian circle on two distinct gymnastics' surfaces, namely the pommel horse and floor.

Many studies have been undertaken to explore pommel horse circles techniques and biomechanics of these skills (Baudry, et al., 2006; 2009 Fujihara, 2006; Grassi et al., 2005; Qian, et al., 2012). However, the main interest of researchers has focused on the most common double leg circles in front and cross support on the pommel horse or gymnastic mushroom, a training aid for pommels so called due to its mushroom-like shape (Fujihara, T., 2006). As Fujihara and Gervais (2010) noted "*the different sets of physical constraints of the apparatus require a gymnast to adapt circles technique*".

Russian circles are more difficult skills compared to normal double leg circles. As such, we hypothesise that the performance of Russian circles in different support conditions should cause a significant adjustment in the way the technique is executed which, accordingly, should be reflected in kinematics parameters. Thus, the purpose of our study was to establish the key differences in the Russian circles performance techniques in different conditions of hand support and to determine the kinematics parameters corresponding to them.

MATERIAL AND METHODS

This case study used one highly qualified adult male gymnast to perform 5 sets of three Russian circles on the floor. Each move in gymnastics is scored for difficulty by the Fédération Internationale de Gymnastique (FIG) with values noted in it Judging Code of Points. On floor, three Russian circles are denoted as a "C" difficulty, while on pommel horse they are valued as a "D".

Fifteen Russian circles were performed on the floor, with the same number being performed on pommel horse with pommels. Additionally, another 15 were performed on pommel horse BUT without pommels.

Data was captured using Qualisys 3-D motion capture system (Qualisys AB, Kvarnbergsgatan 2, 411 05 Göteborg, Sweden), with subsequent analysis being conducted using compatible software, namely *Qualisys Track Manager*. Eight high-speed video cameras were placed around the apparatus to capture the skill movements. Seven reflective markers were fixed on the left and right sides of the gymnast's body to show limb and joint positioning. A further two markers were placed on the sacrum and back of the neck (7 cervical vertebra) (Figure 2), to make a total of 16 markers. The data collected were joint angle dynamics, angular velocity, angular acceleration, duration of the movement and vertical axis shifting of the sacrum.



Figure 2. "Russian" circle kinematics registration procedure.

RESULTS

Following data collection and subsequent kinematic analysis, differences in time and space parameters were identified between Russian circles performed on the floor compared with those performed on pommel horse (Table 1). The average time to execute a single Russian circle on the floor was 0.98 ± 0.09 s, whereas the same skill performed on pommel horse, with or without pommels, was approximately 0.3 s slower (pommel horse without pommels, 1.29 ± 0.07 s; competitive – with pommels - pommel horse was 1.29 ± 0.14 s).

Table 1. The average duration of single Russian circle.

Type of circle	Duration (Mean), s	SD
Russian circle on the floor	0.98	0.09
Russian circle on the horse without pommels	1.29	0.07
Russian circle on the pommel horse	1.29	0.14

The phase structure of each circle contained 4 hand steps of between 0.2-0.4 s duration for each hand step (Table 2). It is noticeable that circles on the floor were faster and smoother than those on pommel horse. Performance of this skill on the floor took almost the same time in each phase of movement which corresponded with a single hand step. Timing parameters of the Russian circle performance on the pommel horse as well as without pommels showed that the 1st and 4th phases distinctly slower than 2nd and 3rd phases duration.

Table 2. The phase structure of Russian circles.

	Russian circle on the floor, M $\pm$ SD	Russian circle on the horse without pommels, M $\pm$ SD	Russian circle on the pommel horse, M $\pm$ SD
Phase 1	0.26 $\pm$ 0.04	0.36 $\pm$ 0.11	0.38 $\pm$ 0.06
Phase 2	0.22 $\pm$ 0.03	0.28 $\pm$ 0.06	0.28 $\pm$ 0.04
Phase 3	0.26 $\pm$ 0.04	0.32 $\pm$ 0.04	0.33 $\pm$ 0.08
Phase 4	0.24 $\pm$ 0.02	0.33 $\pm$ 0.03	0.29 $\pm$ 0.15

The explanation for this fact is the nature of the gymnast's body posture on the apparatus, when at the beginning and the end of the movement legs are lowered below the support level, thereby reducing the speed of their movement (Figure 3).

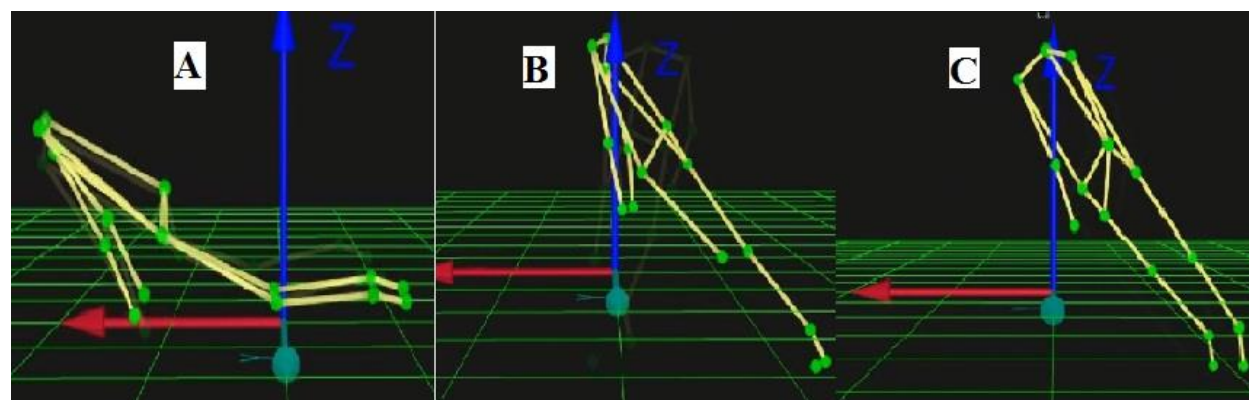


Figure 3. Phase 4-1 transition in different types of Russian circle performance (A – Floor, B – Horse without pommels, C – Pommel horse).

Table 3. The joints angle kinematics of Russian circles performance.

Russian circle on the floor, M $\pm$ SD				
	Left shoulder	Right shoulder	Left hip	Right hip
Phase 1	10.8° $\pm$ 3.2	22.7° $\pm$ 0.7	165.3° $\pm$ 1.7	158.6° $\pm$ 3.4
Phase 2	19.7° $\pm$ 5.2	18.7° $\pm$ 4.3	161.2° $\pm$ 5.2	160.7° $\pm$ 3.3
Phase 3	19.2° $\pm$ 4.2	17.3° $\pm$ 3.7	164.5° $\pm$ 8.2	161.0° $\pm$ 4.9
Phase 4	18.1° $\pm$ 7.4	21.1° $\pm$ 1.6	166.9° $\pm$ 3.3	166.9° $\pm$ 3.3
Russian circle on the horse without pommels, M $\pm$ SD				
	Left shoulder	Right shoulder	Left hip	Right hip
Phase 1	15.4° $\pm$ 1.1	22.5° $\pm$ 2.0	153.3° $\pm$ 2.8	158.6° $\pm$ 0.7
Phase 2	13.9° $\pm$ 1.1	19.9° $\pm$ 1.5	150.5° $\pm$ 4.6	172.3° $\pm$ 5.4
Phase 3	14.7° $\pm$ 0.5	18.1° $\pm$ 0.7	171.3° $\pm$ 2.4	165.5° $\pm$ 0.6
Phase 4	15.0° $\pm$ 3.3	21.2° $\pm$ 4.9	147.6° $\pm$ 0.7	164.3° $\pm$ 2.5
Russian circle on the pommel horse, M $\pm$ SD				
	Left shoulder	Right shoulder	Left hip	Right hip
Phase 1	17.8° $\pm$ 4.3	21.7° $\pm$ 2.8	151.2° $\pm$ 2.8	154.4° $\pm$ 2.7
Phase 2	16.7° $\pm$ 0.8	19.1° $\pm$ 1.5	153.9° $\pm$ 3.2	174.0° $\pm$ 2.8
Phase 3	13.2° $\pm$ 1.7	17.2° $\pm$ 2.5	169.7° $\pm$ 2.9	167.6° $\pm$ 4.4
Phase 4	21.7° $\pm$ 3.5	20.0° $\pm$ 5.8	145.7° $\pm$ 1.6	161.6° $\pm$ 4.8

Control of Russian circles is substantively performed through dynamic arm and shoulder movements with shoulder joint angle changes being in the range of 4° to 35° on floor execution. The gymnast's body posture is mainly dependent of the hip joints angle. Thus, Table 3 represents the shoulder and hip joints kinematics of circles performance in this research.

Shoulder joint angles ranged from 9° to 40° and from 10.8° to 22.7° on average during the Russian circle performance on pommel horse. Irrespective of apparatus on which the circles were conducted, body positions were quite similar with hip angles ranging from 140° - 179° .

The main differences between the Russian circles performed on the three different types of surfaces were the level of vertical axis shifting of hip joints and the sacrum attached marker. Large differences were noted between floor performances in which the vertical sacrum marker shifted on average, and the performances on pommel horse in which there was only an 11 cm shift. Additionally, angular velocity and angular acceleration showed substantial differences between floor and pommel horse performances (respectively 1.4 m/s floor versus 0.68 m/s pommels; 40.4 m/s^2 on floor versus 27.2 m/s^2 on pommel horse).

DISCUSSION

A comparison of the three presented varieties of Russian circles shows the presence of some differences in the technique of its execution. So Russian circles on the floor are performed more quickly and smoothly compared to the pommel horse technique performance. At the same time, due to the more intense nature of pushing with the hands, the gymnast's body jumps slightly, as evidenced by the vertical movement of the sacrum attached marker, and with it the pelvis of the gymnast, which is more significant compared to the circles on the pommel horse.

When Russian circles were performed on a pommel horse, in terms of movement, the gymnast can lower his legs below the level of the hands support, which is accompanied by a slight decrease in the speed of the legs swing movement and a change in the hip angle. But further on gymnast needs to accelerate the movement and make great efforts with his hands to lift his legs above the apparatus. This is also reflected in the kinematics of the gymnast's body. This feature is especially well traced in Russian circles performance on a horse with pommels as the gymnast needs to keep his body high enough above the horse and increase the range of his shoulder angles to produce proper body position compared to performing Russian circles on the floor.

CONCLUSIONS

The results indicate kinematic differences between Russian circles performed on floor compared with those executed on pommel horse. On floor, Russian circles require higher rotation speed and greater vertical hips shift to maintain body position clear of the floor and ensure no or fewer points deductions. By contrast, Russian circles executed on pommel horse showed lower ranges of angular velocity and vertical hip shifting, as the body can drop below the horizontal plane without contacting the horse, but concomitantly, the shoulder joint angle found was bigger.

AUTHOR CONTRIBUTIONS

Vyacheslav Shlyakhtov directed the project, Denis Semenov and Aleksandr Rumyantsev organized the research and data processing. All authors discussed the results and contributed to the final manuscript.

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REFERENCES

- Baudry, L., Sfirza, C., Leroy, D., Lovecchio, N., Gautier, G., and Thouvarecq, R. (2009). Amplitude variables of circle on the pedagogic pommel horse in gymnastics. *Journal of Strength and Conditioning Research*. 23 (3), 705-711. <https://doi.org/10.1519/jsc.0b013e3181a00be8>
- Baudry, L., Leroy, D., and Chollet, D. (2006) The effect of combined self- and expert-modelling on the performance of the double leg circle on the pommel horse. *Journal of Sport Sciences*. 24 (10), 1055-1063. <https://doi.org/10.1080/02640410500432243>
- Fujihara, T., and Gervais, P. (2010). Kinematics of side and cross circles on pommel horse. *European Journal of Sport Science*. 10 (1), 21-30. <https://doi.org/10.1080/17461390903108133>
- Fujihara, T. (2006). Mechanical analysis in mechanism and technique of double leg circles on the pommel horse. *Japanese Journal of Biomechanics in Sport and Exercise*. 10, 27-41.
- Fujihara, T., Fuchimoto, T., and Gervais, P. (2009). Biomechanical analysis of circles on pommel horse. *Sports Biomechanics*. 8 (1), 22-38. <https://doi.org/10.1080/14763140802629974>
- Grassi, G., Turci, M., Shirai, Y. F., Lovecchio, N., Sforza, C., and Ferrario, V. F. (2005). Body movements on the men's competition mushroom: a three-dimensional analysis of circular swings. *British Journal of Sport Medicine*. 39 (8), 489-492. <https://doi.org/10.1136/bjism.2003.010256>
- Qian, J., Su, Y., Song, Y., Qiang, Y., and Zhang, S. (2012). A comparison of a multi-body model and 3D kinematics and EMG of double leg circle on pommel horse. *Journal of Human Kinetics*. 31, 45-53. <https://doi.org/10.2478/v10078-012-0005-9>



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