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PEDAGOGICS PSYCHOLOGY medical-biological problems of physical training and sports

The expression of emotional skills among individual and team sports male athletes

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: Athlete must recognize and manage one's emotions, as well as their opponents and teammates emotions, in order to perform well in sports. For athletes, higher emotional skills have been linked to higher performance in sports.
Purpose: to reveal the peculiarities of the expression of emotional skills among individual and team sports male athletes.

Material: the participants comprised of 204 individual sports (track and field athletes, gymnasts, swimmers, badminton players, table tennis players, bodybuilders, and cyclists) and 212 team sports (basketball, football, volleyball, handball, and rugby players) male athletes from Lithuanian sport clubs/schools, age ranged 15 to 18 years old. The measures of emotional skills were evaluated using Social Emotional School Readiness Scale (BUSSE-SR), Rosenberg Self-Esteem Scale, and Emotional Intelligence Questionnaire – Short Form (TEIQue - SF). In order to analyse data, descriptive statistics (mean, standard deviation), Student's t test, and Cohen's d were utilized.

Results: the comparison of the expression of emotional skills among individual and team sports male athletes revealed that team sports male athletes have higher rate of self-awareness and self-regulation skills than individual sports male athletes ($p < .05$). Meanwhile, Student's t test for independent samples showed that there no significant differences between individual and team sports male athletes in terms of their abilities to express emotions, and self-esteem skills ($p > .05$).

Conclusions: the findings of the quantitative study confirmed our research hypothesis that male athletes who compete in team sports will have more developed emotional skills than those in individual sports: team sports male athletes have more developed self-awareness and self-regulation skills than individual sports male athletes.

Keywords: emotional skills, self-awareness, self-regulation, self-esteem, ability to express emotions, individual sports athletes, team sports athletes.

Introduction

In today's sport world, physical exercise is not regarded as the main factor to achieve success. Sport is an environment where individuals have to motivate themselves to achieve long-term goals through hard training. Athletes are required to consistently cope with the stress of hard training and competitive pressure, and this includes understanding and regulating their emotions and those of other individuals (e.g., opponents, teammates, coaches, referees, and spectators) [1, 2].

The researchers within the field of sport and exercise psychology have demonstrated that athletes scoring higher on emotional intelligence tests are more successful [3-5]. It was found that emotional intelligence relates to more successful athletic performance [6]; to physiological stress responses [7]; to psychological skill usage [8]; a greater occurrence of pleasant emotions [9]; a lower reported intensity of anxiety (an unpleasant emotion) before a competition [10]; a greater athletic success motivation (the ability to motivate oneself efficiently toward sport achievement) [11]; to a more frequent use of self-talk, imagery, emotional control, goal setting, activation, and relaxation techniques in practice and competition [8]. Skills such as relaxation, imagery, mindfulness, energy control, reframing, and goal setting have all been found to play an important role in athletes' performance across a variety of individual and team sports [12]. According to D. Singh and colleagues, athletes with higher emotional intelligence are able to pay attention to the worries and concerns of others, can listen to someone without the urge to say something, can stay focused under pressure, are able to handle multiple demands and able to identify and separate their emotions [13]. S. Laborde and colleagues indicated that athletes with higher emotional intelligence might perform better because they appraise competitions as a challenge and use more effective coping strategies in response to competition stress [5].

In the past two decades, the concept of emotional intelligence – popularized by D. Goleman [14] – has gained a great deal of attention and popularity among different disciplines, largely because of its potential to influence human performance, relationships, and well-being [15]. Emotional intelligence refers to individual responses to intrapersonal or interpersonal emotional information and encompasses the identification, expression, understanding and regulation of personal or others' emotions [16, 17].

Overall, research in sport settings has provided evidence that emotional skills facilitate athletic performance with both team and individual athletes [1].

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For individual sports athletes, is very important to be able to recognize their own optimal performance states especially under stressful and pressure situations. In order to achieve their individual zone of functioning, they need to develop skills to manage their emotions and control their energy levels [18]. Team sports demand athletes in a group to communicate, collaborate, and work as a unit towards common goals. As such, it is important to be mindful and aware of the other players' thoughts and emotions in order to react appropriately to a given situation [19]. According to N. Stambulova [20], individual sports athletes are more independent, more introverted, have more individual goals, and competition between the individual athletes is more common. These athletes have the possibility to control different situations, for example, trainings and competitions and they have higher responsibility over the results. Team sports athletes goals are both individual and team goals and they also have less control over sport when situations because one athlete can't determine the outcome of trainings or competitions, it's a result of the whole teams effort [20]. P. Totterdell [21] noted that teammates can influence another player's emotional state, e.g., one player's mistake may place another player in a situation where he could fail. Indeed, interactions with others can reduce a player's control of a situation [22].

After the theoretical substantiation of the assumptions for the emotional skills of individual and team sports male athletes it appeared that the following emotional skills components are most important to the emotional development of athletes: self-awareness, self-regulation, self-esteem, and ability to express emotions.

Self-awareness – the ability to accurately recognize one's own emotions, thoughts, and values and how they influence behaviour. The ability to accurately assess one's strengths and limitations, with a well-grounded sense of confidence, optimism, and a "growth mindset" [23].

Self-regulation – the ability to successfully regulate one's emotions, thoughts, and behaviours in different situations – effectively managing stress, controlling impulses, and motivating oneself. The ability to set and work toward personal and academic goals [23].

Self-esteem – is totality of the individual's thoughts and feelings with reference to himself as an object [24].

Ability to express emotions – the ability to express emotions in one's and other people physical states, feelings, and thoughts [25].

Taking into account these things, *a hypothesis is raised* in the work that those who compete in team sports will have more developed emotional skills than those in individual sports. This expectation builds upon the assumption that team sports provide athletes more opportunities to interact (e.g., communicate, collaborate) with others, and that helps support athlete's social and emotional development [1, 26].

The purpose of the research – to reveal the peculiarities of the expression of emotional skills among individual and team sports male athletes.

Material and methods

Participants:

When the population size is known, the following formula is used to determine the sample size [27]:

$$n = \frac{N \cdot 1.96^2 \cdot p \cdot q}{\varepsilon^2 \cdot (N-1) + 1{,}96^2 \cdot p \cdot q}$$

N – the population size; the value 1.96 corresponds to 95 % confidence level of the standard normal distribution; p is the predicted result probability that the analysed attribute will be evident in the surveyed population (usually, the worst scenario probability – the attribute is typical for the half of the population, i.e. 50 % - is taken and then p = 0.5); q is the probability that the analysed attribute will not be evident in the surveyed population (q = 1–p = 0.5); ε is the required accuracy, usually ε =0.05. Whereas the population size male athletes is approximately N = 5,000 persons, hence, the sample size calculated according to this formula is n = 357. Therefore, it can be stated that the sample of 357 respondents is a representative one.

Participants of this study include 416 male athletes, aged between 15 and 18 years (M = 16.42, SD = 1.63), who are member of one of the sport clubs/schools and regularly participate in team practice at least three sessions per week and in the last year have been place on the competition conditions. The study employed a random (probability) sampling method, i.e., the athletes (15–18 years old) from Lithuanian sport clubs/schools should have equal opportunities to be included into the sample. Researchers selected 204 athletes of individual sports including: *track and field* (n=79), *gymnastics* (n=21), *swimming* (n=24), *badminton* (n=27), *cycling* (n=12), *body building* (n=9), *table tennis* (n=32), and 212 athletes of team sports including: *basketball* (n=87), *football* (n=51), *volleyball* (n=30), *handball* (n=25), and *rugby* (n=19) from Kaunas, Vilnius, Klaipeda, Siauliai, Panevezys, and Alytus cities sport clubs/schools.

Instruments:

To determine emotional skills of individual and team sports male athletes, we used following questionnaires:

Social Emotional School Readiness Scale (BUSSE-SR), developed by C. Bustin [28]. The questionnaire was developed for assessment of students' self-awareness, self-regulation, social relationships, empathy, and coping skills. The BUSSE-SR comprises 50 statements (in our case 25 statements). In this study, we used only the self-awareness (11 statements, e.g., „*I can tell others what I would like to do*") and self-regulation (14 statements, e.g., „*I am able to wait turn to speak in a group*") skills assigned parts of the questionnaire. Answering to each statement, the respondents had to choose the variants of their answer by using a 4 - point Likert rating scale with the following categories: „*Never*"; „*Sometimes*"; „*Mostly*", and „*Always*". In the current study a Cronbach alpha of .89 was found for the BUSSE-SR total score (self-awareness subscale – .88, self-regulation subscale –

.87), indicating high internal reliability.

The Rosenberg Self-Esteem Scale (RSES) [24] is widely used in social science research and is a global measure of self-esteem. It consists of 10 items to which responses are given using a four-point Likert scale ranging from 1 – „*strongly disagree*" to 4 – „*strongly agree*". The Lithuanian version of the RSES has a reported internal consistency of .73 [29]. In the current study a Cronbach's alpha of .72 was found for the RSES total score, indicating acceptable internal reliability.

Emotional Intelligence Questionnaire – Short Form (TEIQue - SF), developed by K.V. Petrides and A. Furnham [17]. The TEIQue-SF consists of 15 subscales (including ability to express emotions), organized under four factors: well-being, self-control, emotionality, and sociability. The questionnaire consists of 30 items (two items from each of the 15 subscales). Participants indicate their responses on a 7 - point Likert scale, ranging from 1 – „*completely disagree*", to 7 – „*completely agree*". High scores on ability to express emotions subscale mean people are fluent in communicating their emotions to others, they know what the best words are for expressing their feelings accurately and unambiguously. Low scores on this subscale indicate a difficulty in communicating emotion related thoughts, even in situations when this is necessary. People with low scores find it difficult to let others know how they feel [30]. In the current study a Cronbach alpha coefficient for the TEIQue – SF total score was .84 (ability to express emotions subscale – .89).

Procedures:

The quantitative study was carried out during the period from March, 2017 to May, 2017. The authors were present during the meetings with the athletes and informed them about the study and related ethical issues. The athletes were informed that the obtained data would be used for scientific goals only and provided in a general way in order not to identify any concrete persons. The data of these persons chosen for the statistical analysis of results complied with all the requirements for the research because the principles of the voluntary basis and anonymity were observed. The permission was obtained from sport clubs/schools administrators to conduct the study. Prior to collecting data from the minor athletes, parental informed consent forms were completed. The duration of the survey was 20 minutes.

Statistical analysis:

The statistical research data analysis was performed by using the SPSS (*Statistical Package for Social Sciences*, version 22.0) programme package. Descriptive statistics, means (*M*) and standard deviation (*SD*) were calculated for each of the items of the tests. We calculated the reliability of each dimension given by the index of Cronbach alpha internal consistence. Student's *t test* for independent samples was chosen for the evaluation of statistical significance between two groups: individual sports group and team sports group. Effect sizes for mean differences were expressed as *Cohen's d*, which are generally defined as follows: small ($d = .2$), medium ($d = .5$), and large ($d = .8$). Statistical significance was set at $p < .05$.

Results

The goal of the research was to identify and compare the results of the expression of emotional skills among individual and team sports male athletes. Student's *t* test for independed samples showed that team sports male athletes have more developed self-awareness skills than individual sports male athletes: (t (414) = -1.99; $p < .05$; $d = .20$). The analysis of self-awareness skills resulted in the following averages: individual sports male athletes – 30.24 ± 2.09, and team sports male athletes – 30.66 ± 2.21. The comparison of the expression of emotional skills among individual and team sports male athletes also revealed that team sports male athletes (39.97 ± 4.94) have higher rate of self-regulation skills than individual sports (39.03 ± 4.79) male athletes: (t (414) = -1.97; $p < .05$; d = .19). The obtained results are summarized in Table 1.

Table 1. The statistical indicators of emotional skills among individual and team sports male athletes (n=416)

Emotional skills	Sport	N	M	SD	Scores of Student's *t* - test	*Cohen's d*
Self-awareness	Individual	204	30.24	2.09	-1.99*	.20
	Team	212	30.66	2.21		
Self-esteem	Individual	204	17.08	2.46	-.77	.08
	Team	212	17.26	2.33		
Self-regulation	Individual	204	39.03	4.79	-1.97*	.19
	Team	212	39.97	4.94		
Ability to express emotions	Individual	204	9.14	2.69	-1.20	.12
	Team	212	9.45	2.57		

Note: N – number of participants; M – mean; SD – standard deviation; *Cohen's d* – effect size; * – $p < .05$.

Meanwhile, Student's *t* test for independent samples showed that there no significant differences between individual and team sports male athletes in terms of their abilities to express emotions, and self-esteem skills ($p > .05$).

Discussion

The main purpose of this study was to reveal the peculiarities of the expression of emotional skills among individual and team sports male athletes. The findings of the quantitative study confirmed our research hypothesis that those who compete in team sports will have more developed emotional skills than those in individual sports. It was found that team sports male athletes have higher rate of self-awareness (a small effect, $d = .20$) and self-regulation (a small effect, $d = .19$) skills than individual sports male athletes. G.H. Soflu, N. Esfahani and H. Assadi also observed that there are some differences in emotional intelligence between individual and team sports athletes [31]. Authors found, that there is a significant difference between self-management, self-motivation, and social skills between these two groups, but no significant difference was observed in self-awareness and empathy micro scales. K.R. Singh and A. Mili [32] compared emotional intelligence between individual sports, dual sports and team sports athletes. The following research indicated that team sport athletes have higher self-regulation, motivation, and total emotional intelligence score than individual sports athletes. Dual sports athletes – who are played by two people striving against one another (e.g., tennis and racquetball) – have higher rate of self-regulation, motivation, and social skills, and performed better on total emotional intelligence than individual sports athletes [32]. C. Calmels in a similar research stated that team sports athletes compared to individual sports athletes possessing better communicative skills and have more ability in motivating their teammates but individual sports athletes experience higher levels of self-talk and negative thinking [33]. N. Stambulova evaluated that team sports athletes have a closer relationship to their teammates and the athletes experiences more stress over; fear of making mistakes, conflict between their individual goals and the team goals, higher fear of injuries and conflicts in the team [20]. It has also been shown that team sport athletes have higher self-referenced competency, affiliation with peers, competitive excitement, positive parental involvement and enjoyment compared with individual sport athletes [34].

In contrast, several studies compared emotional skills between team sports and individual sports athletes and found no observable differences [5, 11, 35], but there may be several explanations for this finding. First, previous researches have been related to compare emotional skills between athletes with different levels (e.g., beginner, amateur, sub elite, elite, and non-athletes). According to the earlier research findings carried out by S. Laborde, F. Dosseville, and M.S. Allen [1]; Madzar T. et al. [36]; Znazen H. et al. [37], elite players (professional athletes) apply different types of mental skills in order to control their competitive anxiety; they have higher self-confidence and positive effect on emotions regulation. Second, a subject of previous researches consists of both male and female athletes. S. Laborde, F. Dosseville, and M.S. Allen found that male athletes had higher levels of trait emotional intelligence than female athletes [1]. G.H. Soflu, N. Esfahani, and H. Assadi observed that female athletes have more negative thinking and lower relaxation than male athletes [31]. In contrast, Dunn and colleagues found that women score higher than men on one particular dimension of emotional intelligence – emotion management [38]. Third, this can be interpreted as the emotional skills being equally important in individual and team sports. In general, conducting the research in order to compare emotional skills between team sports and individual sports athletes, the homogeneity of groups should be ensured.

There were several methodological *limitations* of this study. First, the current study analyses only 15 – 18 years old athletes' peculiarities of the expression of emotional skills, although further study is worth to analyse older athletes' emotional skills as well and compare data of these age groups athletes. Research suggests that older adults may obtain higher emotional skills due to increased experience [39], lifelong learning, and accumulating knowledge [40]. Another limitation is that we selected athletes from different types of team sports, e.g., contact team sports, such as basketball or football, are distinctly different from collision sports (e.g., rugby), not only in their rules, but also in the potential emotional experiences elicited through the direct and intense physicality involved in these sports [41].

Conclusions

The present study revealed the expression of emotional skills among individual and team sports male athletes. The results of this study indicate that the significant difference exists in emotional skills among individual sports and team sports male athletes: team sports male athletes have more developed self-awareness and have higher rate of self-regulation skills than individual sports male athletes.

According to the other components of emotional skills (ability to express emotions and self-esteem) between individual sports and team sports male athletes statistically significant difference was not observed.

Conflict of interests:

The authors declare that there is no conflict of interests.

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Selected aspects of biopsychosocial functioning of the senior national team in cycle speedway representing Poland in 2015 at the World Championships in Poole

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Abstract

Purpose: to increase knowledge concerning certain elements of biological and psychological functioning of contestants practising speedway cycling through examining typical health behaviours, the mental approach, and preventive behaviours applied to everyday functioning.

Material: the study sample consisted of 12 cycle speedway competitors (aged between 20 and 37, average 27.42±5.68). The research concerned a group of speedway riders, Polish national senior representatives in speedway cycling at the World Championship. The Standardized Inventory of Health Behaviours and our own questionnaire were applied.

Results: the mean value of the general health behaviour index was 75.50±14.0 (N=12). The value of the coefficient between positive mental approach and satisfaction experienced by the competitors caused by progress within a year was r=0.62; p<0.05. In the group the value of the index of satisfaction caused by obtained progress in improving condition was: median 6.50. Based on the performed analysis, it was found that as for the health behaviour types in the group of cycle speedway competitors there were two smaller groups (p<0.05).

Conclusions: based on the presented research results, we can say that a group of senior competitors representing Poland at the championship in 2015 in cycle speedway is internally divided with respect to the revealed health behaviour type. The findings of the study suggest that there are still potential opportunities to be used by competitors surveyed, which in the future may lead to continued excellent - as at present - and even better performance at competitive events.

Keywords: sports psychology, development, cycle speedway, Poland, psychological, measurement.

Introduction

Obtaining maximum effectiveness in championship competitions in cycle speedway is associated with enormous effort, complex skills, predisposition and other factors, which are the subject of growing scientific knowledge [1, 2].

Successes of the Polish senior national team in cycle speedway are a manifestation of such effectiveness. This has become the inspiration for preparing this paper, which starts by outlining the history of cycle speedway in Poland and achievements of Poles in this discipline at the world championships in the years 1995-2015.

Cycle speedway (bicycle racing on shale tracks) came to Poland from England at the beginning of the 1990s. The first section of this discipline was established at "Union" Leszno. In turn, the first club in Poland which was entered in the register of physical culture associations as a cycle speedway club was Rawicz Sports Club "Pavart", established in 1994 [3]. A year later, also in Rawicz, the Provisional Polish Society of Cycle Speedway was established (since 1997 the Polish Society of Cycle Speedway). Next, on 30 November 2005, the Polish Federation of Cycle Speedway Clubs was registered in court, which replaced the pre-existing Polish Society of Cycle Speedway.

In cycle speedway sport there are two Polish national teams:

- the senior national team with a coach and head of the team and the professional team appointed by name;
- the junior (competitors up to 18 years of age) national team with a coach and head of the team and the professional team appointed by name. In addition, in 2011, for a series of test matches with the United Kingdom, the women's team was appointed.

Poles have been participating in the World Individual and Team Championships since 1995. Since 2003 the World Championships of Pairs have also been held, in which Polish cycle speedway riders have won medals from the very beginning (Table 1).

This paper concerns certain aspects of biopsychosocial functioning of competitors engaged in cycle speedway. Competitors who take part in the championships at the world level, such as the Polish senior national team in cycle speedway, face very high requirements in terms of technical, tactical and physical preparation as well as handling the challenge psychologically.

Some of the challenge that championship competitions consist of is the speed at which the distance is covered, the necessity of full concentration and of no distraction during the competition, and many other factors of biological and psychological nature. In accordance with the biopsychic perspective the process of preparation and performance must be perceived as a whole, while paying attention to the fact that these are processes that are stretched in

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Table 1. Successes of Poles at Individual World Championships (IWC), Team World Championships (TWC) and World Championships of Pairs (WCP) in the years 1995-2015

Year	Venue	IWC Place on the podium	Competitors	TWC Place of Poland on the podium	WCP Place on the podium	Competitors
1995	United Kingdom	-	-	3	-	-
1997	Australia	-	-	-	-	-
1999	Poland	2 3	Damian Woźny Karol Włodarczyk	1	-	-
2001	Australia	-	-	3	-	-
2003	United Kingdom	3	Łukasz Nowacki	2	1	Marcin Szymański Dominik Rycharski Damian Woźny
2005	Australia	-	-	2	1	Łukasz Nowacki K. Szymański P. Kozłowski
2007	Poland	1 2 3	Marcin Szymański Maciej Ganczarek Radosław Handke	1	1	Marcin Szymański, Maciej Ganczarek, Rafał Duliński
2009	Australia	3	Łukasz Nowacki	2	1	Marcin Szymański, Maciej Ganczarek, Łukasz Nowacki
2011	USA	1 2	Łukasz Nowacki Rafał Duliński	3	2	Łukasz Nowacki Przemysław Binkowski Marcin Paradziński
2013	Australia	1	Marcin Szymański	1	1	Marcin Szymański Przemysław Binkowski Łukasz Nowacki
2015	United Kingdom	1	Bartosz Grabowski	1	1	Marcin Szymański Bartosz Grabowski

time, constituting a significant part of everyday life, at the biological, psychological and social level. The biopsychosocial model is a general model or approach stating that biological, psychological and social factors all play a significant role in human functioning in the context of sport and everyday life [4-6].

The essential elements are awareness of the role of nutrition and proper diet, weight control, special attention to one's health, the pursuit of rigorous training objectives, getting enough sleep, maintaining a positive mental attitude despite the hardship of training, and perseverance in an aspiration to improve skills. Under the literature of health psychology, health habits do not constitute a uniform construct of notions.

The aim of this study is to increase knowledge concerning certain elements of biological and psychological functioning of contestants practising speedway cycling through examining typical health behaviours, the mental approach, and preventive behaviours applied to everyday functioning.

The focus of the deliberations has been the area of functioning, approached from the biopsychic perspective with the following research questions asked:

- How are individual manifestations of health behaviour shaped in day-to-day functioning?
- Is there a relationship between mental attitude and the satisfaction with training progress?
- Do top competitors, representing the highest level in cycle speedway, constitute a homogeneous group in terms of health behaviour showed and a sense of personal competence?
- How is a sense of personal competence of the senior

team in cycle speedway shaped?

Material and Method

Participants. The research concerned a group of 12 cycle speedway riders, male, Polish national senior representatives in speedway cycling in 2015 at the World Championship, aged between 20 and 37 (average 27.42±5.68). The conducted research has a self-descriptive character. The presented questionnaires are completely voluntary and anonymous.

Research tools:

Questionnaires of an accepted psychometric value, used in health psychology, were applied in the research: the Inventory of Health Behaviours and the Sense of Personal Competence Scale.

The Inventory of Health Behaviours contains statements describing different types of behaviour connected with health. Considering the frequency of behaviours indicated in the research, the general intensity of health behaviours is established, i.e. proper eating habits, preventive behaviours, health practices and positive mental attitude. This inventory may help in creating preventive programmes establishing the directions of behaviour modification that influences the general functioning and monitoring changes in health practices.

Questionnaires of an accepted psychometric value, used in health psychology, were applied in the research [7, 8]. Additionally, in the presented research the data were gathered using a self-designed questionnaire including open and closed questions. Open questions concerned the motives of undertaking this sport discipline, subjective assessment of progress with condition, and satisfaction of successes in a particular year.

Statistical analysis

Statistical analysis was used. Due to the fact that the obtained data are of a self-descriptive character (they derive from surveys and questionnaires), the analysis was performed using methods that are recommended for processing "non-acute", imprecise data that frequently occur in the humanities and health sciences. The data were subjected to statistical analysis for the purpose of interpretation. Descriptive statistics such as mean, standard deviation, lower and upper quartiles and others were computed to analyse the interdependence between the variables [9, 10]. In order to assess the empirical data in a taxonomical way, the classification algorithm, belonging to the group of algorithms known under the common name cluster analysis, was applied.

Results

The obtained results are presented in tables 2-5. Table 2 contains descriptive statistics concerning the types of behaviour associated with health that often appear in the case of a particular person. Table 3 presents the values of a positive mental approach index and the value of the index of satisfaction caused by progress obtained in the last year. Table 4 presents the results that are the effect of cluster analysis, aimed at evaluating the homogeneity of the group of competitors with respect to the revealed types of health behaviour and the feeling of personal competence (N=12) ($p<0.05$). Table 5 presents the results indicating the feeling of personal competence among cycle speedway competitors.

The correlation between positive mental attitude and satisfaction with the degree of the growth of one's fitness as a result of systematic training was: $r=0.62$; $p<0.05$; N=12 (Figure 2).

Based on the calculations, it was found that the indicator of median satisfaction with the progress made during a given year was 6.50 (Table 2).

On the basis of the study, it was found that in the group surveyed there are relatively high values of positive mental attitude indicators. A correlation was found between a positive mental attitude and satisfaction with the progress made in training within a year.

Table 2. The health-related behaviour, usually in everyday functioning, descriptive analysis.

N =12	Median	Min	max	Lower quartile	Upper quartile	Range	Interquartile range	Skewness
Age	26.50	20.00	37.00	22.50	31.50	17.00	9.00	0.30
Proper feeding habits	18.50	8.00	27.00	16.00	25.00	19.00	9.00	-0.26
Preventive behaviours	21.50	14.00	26.00	18.00	22.00	12.00	4.00	-0.38
Positive mental attitude	18.00	13.00	23.00	15.00	20.50	10.00	5.50	0.03
Health habits	17.00	11.00	25.00	14.50	23.00	14.00	8.50	0.17

Table 3. Positive attitude and satisfaction with the degree of the growth of one's fitness as a result of systematic trainings, descriptive analysis.

N =12	Median	Min	Max	Lower quartile	Upper quartile	Range	Interquartile range	Skewness
Positive mental attitude	18.00	13.00	23.00	15.00	20.50	10.00	5.50	0.03
Satisfaction with training progress	6.50	2.00	10.00	5.50	8.50	8.00	3.00	-0.49

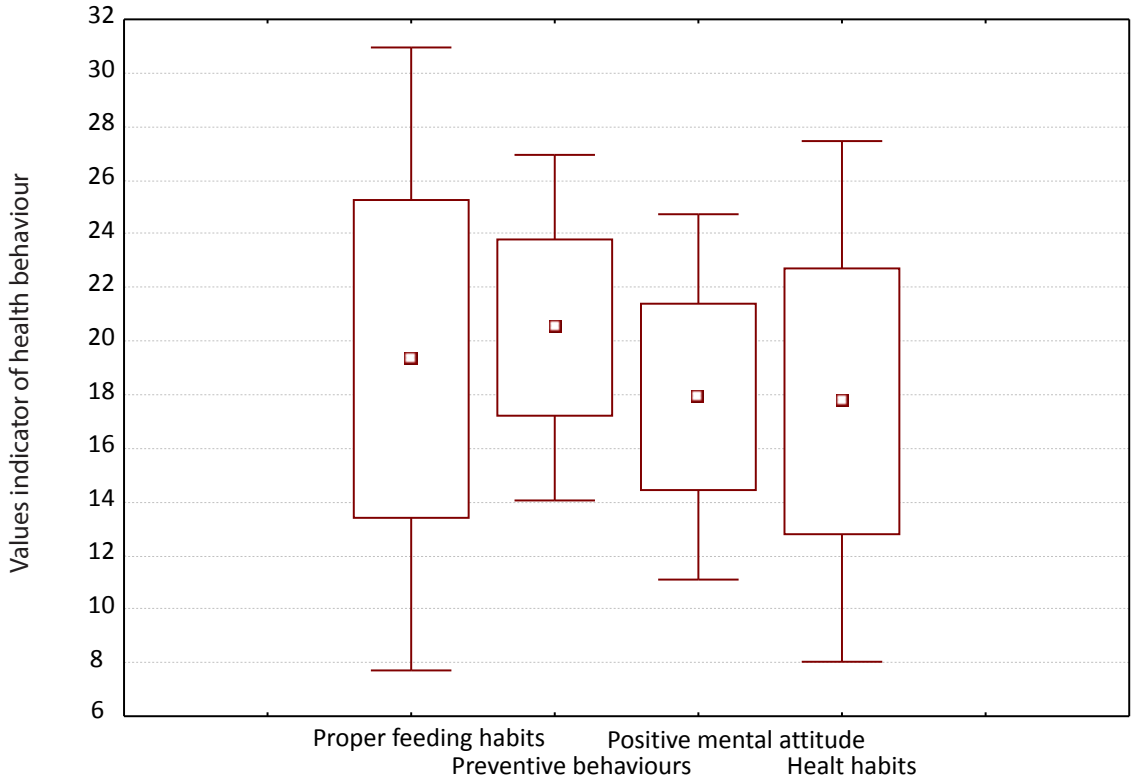

Figure1. The health-related behavior - descriptive analysis (Mean, Mean±SD, Mean±1.96 SD)

Table 4. Healthy behaviours and feeling of personal competence - after K-Means clustering (cluster 1 and cluster 2). The table represents the result of cluster analysis with the use of K-Means Clustering: variance inside clusters.

After K-Means clustering. Variable:	Variance Cluster 1	Cluster 2
Age	25.90	36.26
Proper feeding habits	11.20	13.86
Preventive behaviours	8.16	11.36
Positive mental attitude	4.26	4.16
Health behaviours	18.80	9.90
Feeling of personal competence	1.36	4.56

Table 5. How is a sense of personal competence of senior team in cycle speedway shaped?

N =12	Median	Minimum	max	Lower quartile	Upper quartile	Range	Interquartile range	kewness
Age	26.50	20.00	37.00	22.50	31.50	17.00	9.00	0.30
Feeling of personal competence	20.50	17.00	22.00	18.50	21.00	5.00	2.50	-0.58

Another question was, do top competitors, representing the highest level in cycle speedway, constitute a homogeneous group in terms of health behaviour shown and a sense of personal competence? In the sample group, clusters were identified on the basis of F values and levels of significance ($p<0.05$) (Table 3, Figure 3).

Discussion

Considering the frequency of the occurrence of certain health behaviour indicated by the persons in the research, the general index of the revealed health behaviour types and the values of indexes of certain sub-scales, measuring particular types of health behaviour such as proper eating habits, preventive behaviour, positive mental approach, and health practices, were measured.

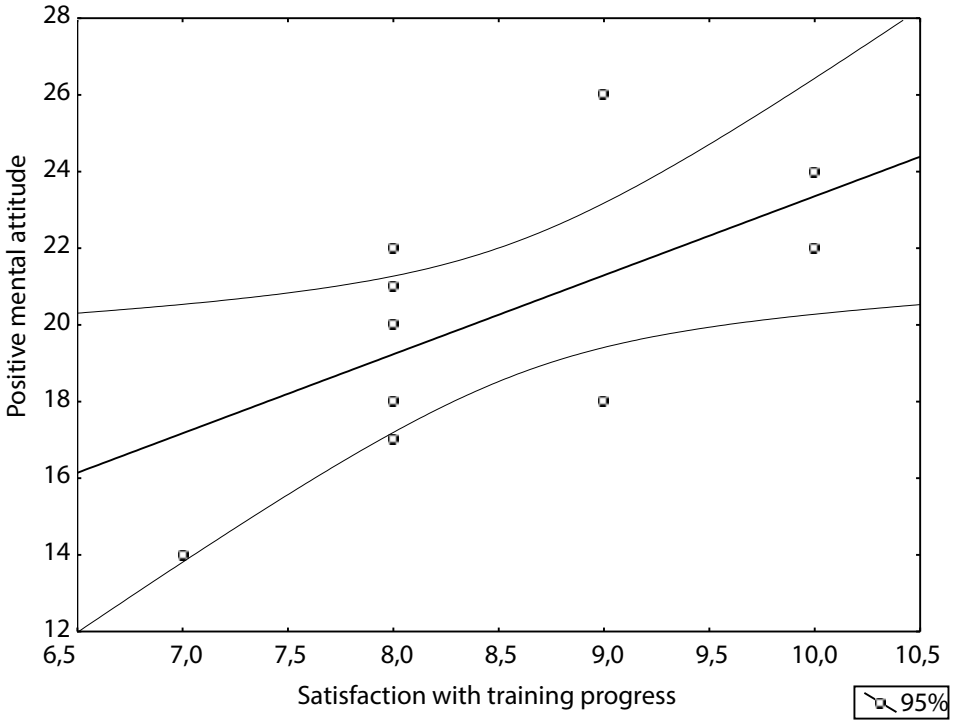

Figure 2. Relationship between positive mental attitude and the satisfaction with training progress **(**r= 0.62; p<0.05)

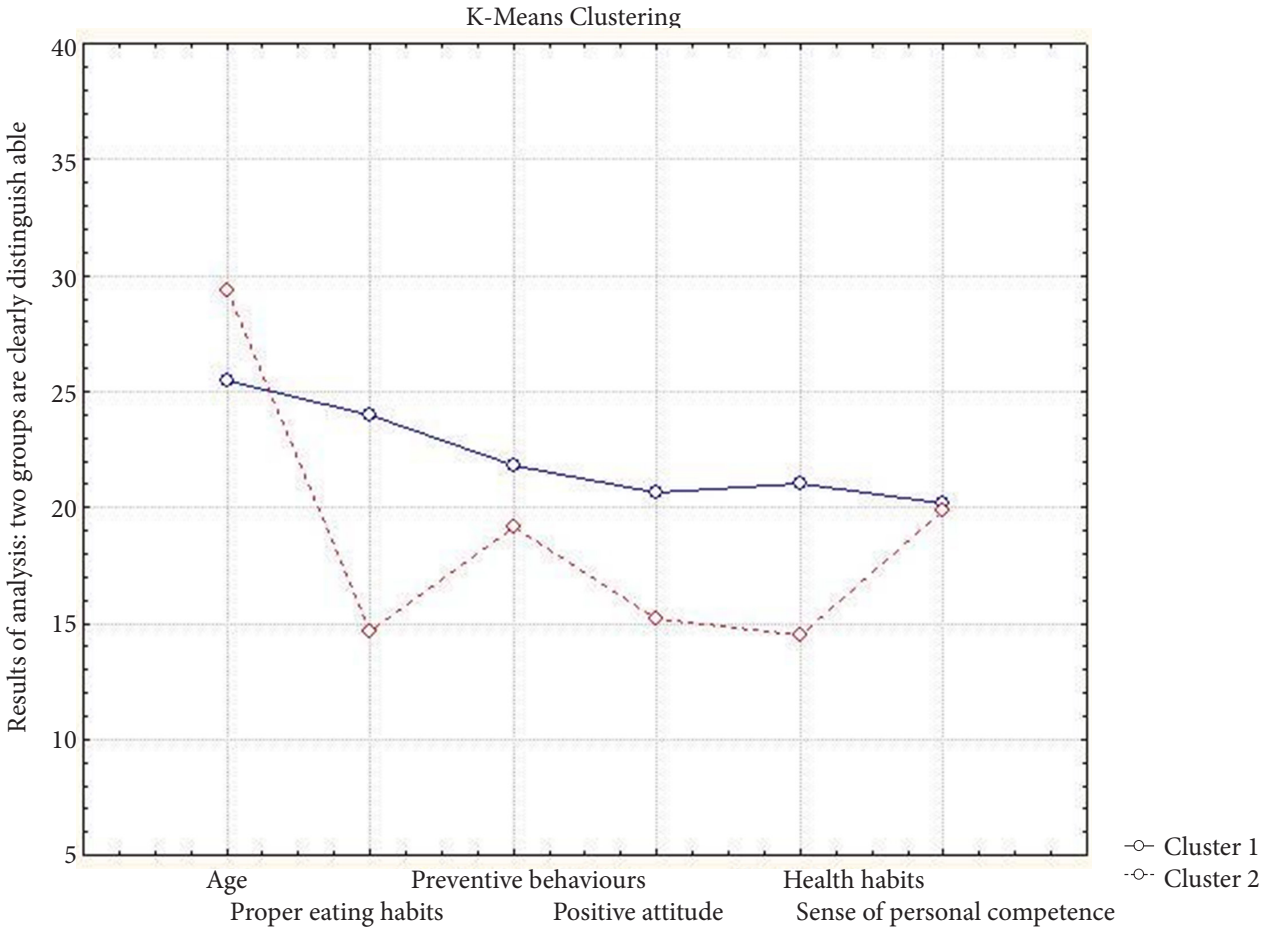

Figure 3. The diagram represents the result of cluster analysis with the use of k-means clustering senior team in cycle speedway sample group. Minimizing variance inside clusters-maximizing between clusters (N=12) (p<0.05)

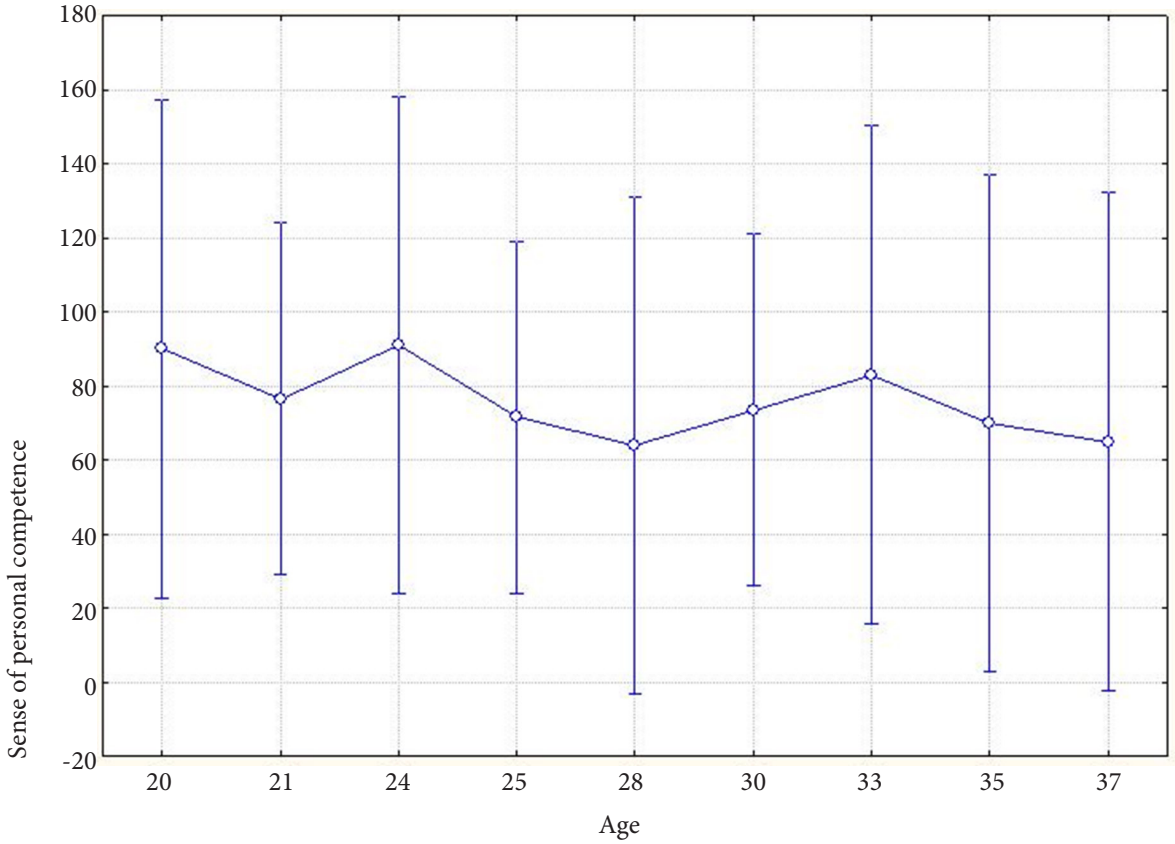

Figure 4. The diagram represents the result of analysis age and feeling of personal competence.

Based on the answers obtained in the Health Behaviour Inventory, it was found that concerning proper eating habits in the group the result was median 18.50, range 19; the value of the preventive behaviour index was 21.50, range 12. The median value of positive mental approach was 18 (range 10), while the value of the health practices index was 17 (range 14). The precise data for these results are presented in Table 2 and Chart 1.

The value of the coefficient between positive mental approach and satisfaction experienced by the competitors caused by progress within a year was $r=0.62$; $p<0.05$; $N=12$ (Chart 2). In the group the value of the index of satisfaction caused by achieved progress in improving condition (during a year) was: median 6.50 (Table 3).

Another question asked was whether the examined competitors constitute a homogeneous group with respect to revealed health behaviour types and the feeling of personal competence (Table 4) and what the feeling of competence in a group of competitors with respect to stamina in undertaken activities is (Table 5, Chart 4).

The present research measured particular health behaviour based on the frequency of revealed behaviour types, including proper eating habits, preventive behaviour, applied health practices and positive mental approach. The values of the parameters are presented in Table 2. The mean value of the general health behaviour index was 75.50 (SD=14.0), which is a lower value in comparison with the results of other groups referred to in the literature [7]. Due to the lack of such data with respect to cycle speedway, we could not make a comparison within competitors of the same sport discipline.

In order to perform the taxonomic analysis of the persons taking part in the research, based on obtained health behaviour indexes, the above-mentioned cluster analysis that includes the methods used to identify homogeneous sub-groups among the members of a heterogenic population was applied. Based on the performed analysis (with the k-means method) it was found that for the health behaviour types in the group of cycle speedway competitors there were two smaller groups (clusters): cluster no. 1 and cluster no. 2 ($p<0.05$) (Table 4, Chart 3).

The obtained results indicate that higher mean values of proper eating habits, such as drawing attention to the proportions of eaten products that also have a specific composition, and the amounts of vegetables, fruit and protein, were identified in cluster no. 1 (Table 4), with a lower average age ($F=20.85$; $p<0.05$). Compared with sub-group no. 2, in sub-group no. 1 there is a higher mean value of the applied health practices index ($F=21.52$; $p<0.05$). Table 4 presents descriptive statistics of particular health behaviour in a group, with the division into two identified sub-groups. No significant difference between the selected sub-groups with respect to the feeling of personal competence was found, as the difference between mean values did not reach statistical significance ($F=1.08$; $p=0.322$).

The obtained results (presented in this paper) to a

certain extent may correspond with the literature of the subject, indicating that health behaviour does not constitute a fully homogeneous notion construct and in the case of one person there might occur various behaviours associated with health care. Some are more desirable, due to the training aims, while some are less desirable.

Based on the calculations, we may assume that there is a correlation between positive mental approach and satisfaction caused by an increase of one's condition as a result of systematic training ($r=0.62$; $p<0.05$; $N=12$) (Chart 2). Based on the statistical descriptive analysis, it was concluded that in the group there are high values of mental positive approach indexes (median 18, range 10) (Table 3).

The obtained result corresponds with the reports of other authors indicating that positive emotions that accompany a positive mental approach and progress in professional sport often coexist [11, 12]. The research devoted to the development of championship level cycling in the UK stresses the role of the coherence of physical and mental preparation [13, 14]. It complies with the widespread belief, supported with the results of research, that psychological factors and a positive mental approach play a significant role in many, if not all, fields of sport activity [15-18]. For instance, the ability to maintain concentration, despite distracting thoughts, and the ability to concentrate on performed tasks of a different degree of complexity, is commonly considered to be a very important factor in obtaining sport results [19].

In the present research, analysing the data concerning the revealed feeling of competence, attention was drawn to the aspect that refers to the self-assessment of stamina in continuing activities.

The research indicates how large the number of tasks initiated and never finished or only partially finished, performed within the presumably properly prepared schedules, is [8]. In the light of research, based on the obtained mean value of the feeling of competence index, with respect to the possibilities of continuing an undertaken activity, we may assume that the index value is relatively high (Table 5). The obtained result corresponds with the reports of research on the relation between the feeling of competence and self-confidence in the case of competitors who constitute the elite of a particular discipline. The sense of self-efficacy expresses a subjective belief about one's impact on the surrounding reality; it has regulatory power [2, 5, 6, 20].

Based on the obtained results, no positive correlation between the feeling of competence and the age of cycle speedway competitors was found (Chart 4).

In the light of literature on health psychology, individuals are active processors of information and not passive reactors. The biopsychosocial model considers many diversified factors [20]. A man actively proceeds information and does not only constitute its passive recipient. This also refers to the feedback concerning the abilities of copying in different challenging situations. The authors draw attention to the fact that usually, in the majority of situations, high self-esteem is very helpful and it can, in some cases, become the source of less desirable behaviour such as lower involvement during training. However, generally, self-esteem and a high but adequate level of the feeling of competence plus the ability to accept feedback help in achieving [2].

Due to its specific nature, cycle speedway is a challenging discipline with respect to physical and mental aspects. It is connected with the risk of not using the bicycle brakes. The participants almost always come across situations in which the feeling of competence and trust with respect to one's possibilities may constitute the form of a buffer in situations of high pressure [21]. Psychological factors and a positive mental approach play an important role in many, if not all, fields of sport activities [15, 16, 18].

The obtained data correspond with the reports of other researchers indicating that a more positive mental approach coexists with higher satisfaction resulting from progress in training [2].

The research referred to in the literature proves the impact of internal monologues on the quality of performance. It is shown by the research meta-analysis covering 32 research analyses that proved the importance of internal monologues containing words such as: "I am able to do it, I am strong enough". Positive messages directed to oneself are considered to be helpful in obtaining a mental state that is in favour of good performance techniques [22].

In the light of the literature within sport psychology, a positive mental approach and trust in one's abilities have a considerable impact, as they increase the possibilities of acting, despite the existence of factors that distract attention, no matter what sub-discipline of cycling sport the competition is [21].

The examined group of cycle speedway competitors reveals a high value of the general feeling of competence index (Table 4, *Feeling of personal competence*). The value is slightly higher than the results obtained in other groups described in health psychology [23]. However, we must remember that the results presented here concern persons who, due to the level of skills, constitute an elite of cycle speedway in Poland. Further research should be directed towards a comparison with competitors from other countries but, similarly to the present research, should concern the leaders in cycle speedway, i.e. persons of very high skills in this discipline.

The results of our research indicate the need of further research on the factors that can predispose to stamina in an undertaken activity, aimed at reaching a high level of performance in cycle speedway and, to a wider extent, obtaining a championship level in a chosen sport discipline. The obtained results to some extent correspond with the reports of other researchers who indicate methodological difficulties in conducting research concerning stamina in continuing activities, indicating both the role of psychological factors of a relatively fixed character (personality factors) and the role of situational factors [8, 18].

In the literature of sports psychology, the model in

which, besides comprehensive physical preparation, there are elements of psychological preparation is considered optimal [16, 17, 21]. Neglecting individual differences within psychological features among competitors potentially reduces the effects of preparation [1, 17, 21, 24]. In the literature of the subject within the last two decades there have been many studies that concern the perspective of a biopsychosocial model in the role of mental sphere and emotions, based on the corresponding research reports and everyday observations [15, 21, 24, 25].

The present research results indicate that a group of senior competitors representing Poland at the championship in 2015 in cycle speedway is internally divided with respect to the revealed health behaviour types (Table 4, Chart 3). Recognising the field in which functioning may be additionally optimised constitutes a vital aspect of preparing for a competition [12]. We hope that to some extent this study will support the development of knowledge within cycle speedway. On the way towards the full use of obtained skills, a competitor who practises the discipline performs considerable work, not only at the time directly devoted to training but also in between training sessions. The time is filled with activities in which a key role is played by the choices made by a competitor and concerning the aspects of everyday functioning that potentially co-create his chances during sport rivalry [17].

Conclusions

Based on the conducted research, it was found that the behaviour types associated with health in the group of cycle speedway competitors are heterogeneous and highly individualised. The group of senior competitors representing Poland at the championship in 2015 in cycle speedway is heterogeneous with respect to the revealed health behaviour types. In the light of the biopsychological model of functioning the result seems justified because this model takes into account the importance of individual differences between competitors within different aspects of human functioning on the way to the championship level.

A deeper statistical analysis revealed that these differences take place with respect to the proper eating habits and applied preventive behaviour. The mental approach indicates the interchange ability of satisfaction caused by progress in a year of training and other preparations. No correlation between cycle speedway competitors and their feeling of own competence was observed. The obtained results, including, first of all, the values or health behaviour indexes suggest that there are potential abilities to be used by competitors that, in the future, may mean further great and better results in the undertaken rivalry. The present research was of an explorative character. The obtained data allow us to make hypotheses that require further verification. The results prove the fairness of the assumptions concerning the lack of homogeneity of the group of leading competitors of cycle speedway representing Poland in the 2015 championship.

The available literature does not contain much research concerning the measurement of cycle speedway competitors at the championship level. We hope that this study provides data that can partially fill the gap. Furthermore, desirable health behaviors has a wide range of psychological and physiological beneficial health effect among diverse population in different conditions [26-28]. Additionally, it is necessary to mention that obtaining of maximum effectiveness is associated with effort, and other factors. Passiveness do not facilitate the persistence in realizing different long-terms sports and health goals [29].

The findings of the study, including primarily the values of health behaviour indicators, suggest that there are still potential opportunities to be used by competitors surveyed, which in the future may lead to continued excellent – as at present – and even better performance at competitive events. On the way to the optimal use of acquired skills (during championships, competitions, and preliminaries) a competitor training in cycle speedway performs enormous work, not just at the time directly devoted to training, but also in between training sessions. It is a time filled with activity, in which the choices made by a competitor regarding aspects of functioning which potentially contribute to his chances during the sports competition become crucial.

Perspectives

The results of the study indicate the usefulness of involving measurement of eating habits, mental attitude and preventive behaviours to understand the determinants of effectiveness in cycle speedway. This issue should be considered at the intersection of several disciplines (sports science, nutrition science and sports psychology). Clinical practice with scientific research strengthens and multiplies the effects. The results of our research have shown that not all nutritional options as support for other elements of the preparation process have been used by the riders. In the long term, cycle speedway riders' eating habits can be improved thanks to their cooperation with a nutrition specialist such as a dietitian and an expert on nutrition of sportspeople. Psychological assistance here could take the form of support in achieving regularity during the implementation of habits related to eating. Creating and consolidating habits on many levels would be conducive to the reduction of effort while aiming at making better choices about food. This is because automation is an important factor in achieving training goals.

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Concflict of interests

The authors declare that thare is no conflict of interests.

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Determination of bus drivers' biological age

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Abstract

Purpose: It is determined the influence of harmful production factors on determining the nature and rate of aging of bus drivers.

Material: The experiment was attended by 12 drivers aged 28 to 45 years. Work experience – from 5 to 20 years. Hygienic assessment of the main unfavorable production factors (vibration, dust, noise, climatic conditions, etc.) was carried out at the workplaces of drivers of route buses (Ukraine).

Results: It was also determined and compared the biological age of drivers. It has been established that with an increase in the seniority of drivers, their aging rate increases. In the group of drivers with experience less than 10 years (calendar age 35), the rate of aging was 4.7 years. With the work experience of drivers of 10-15 years (calendar age 35 years), the rate of aging was 7.6 years. The average age of biological drivers over calendar drivers is 7 years.

Conclusions: It is confirmed that work under conditions of harmful factors' influence the production environment worsens the health of drivers and reduces the duration of their lives.

Keywords: biological age, harmful production factors, driver, route bus, hygienic requirements.

Introduction

The efficiency and safety of the transport process for the transport of passengers by road directly depends on the psychophysiological state and health of the driver, the requirements of which are regulated by the current legislation. It is well-known that the adverse effects of harmful factors on drivers during transport work (tense and often changing conditions of the transport process for passenger transportation, the responsibility for the safety of passengers in times of shortage, the imperfection of the design of motor vehicles, the influence of harmful substances), leads to the risk of developing occupational diseases and has an impact on the course of common diseases. Among the main risks of occupational diseases, one can distinguish the following – diseases of the circulatory system, diseases associated with fatigue, fatigue and depression (Fig. 1 [1]).

One of the main modern problems in road transport is the improvement of the quality of passenger transportation. This essentially depends on the rational use of vehicles, the full safety of the participants in the transport process, the culture of service [2]. Of course, the organization of passenger transportation must take into account the driver's functional state and his ability to work, which largely depends on the sanitary and hygienic conditions of work [3]. Also, the safety of passenger traffic is influenced by the psychophysiological state of the driver. It is believed that noise, vibration, elevated air temperature, nervous-emotional stress (Fig. 2) affects it [Fig. 2] [4, 5].

A lot of attention is paid to the study of hygienic conditions of drivers. On their basis, appropriate standards are developed to ensure the proper working capacity of drivers. However, the problem of maintaining occupational health and creating safe working conditions for drivers remains relevant for all countries of the world [6, 7]. This is due to the growth of psychological stresses, increased traffic flow, increased input information for decision-making, increased liability for the safety of the type of traffic, the complexity of the routes.

It should be noted that in Ukraine the regulated requirements for organization of work and rest of drivers have become more frequent. Significantly weakened by the control of the structures of state supervision of the state of drivers' health. This has led to an increase in fatal accidents at the workplace during the transport process and the occurrence of occupational diseases.

At one time, a significant number of publications on this issue were published by domestic and foreign scholars. In particular, Davidich Iu.O. et al [8] were considered the issues of ergonomic provision of the transport process in order to minimize its impact on the workability of drivers. The author has found the possibility to link the change in the physiological state of drivers with the length of the route, its complexity, the power of the car and other parameters. However, little attention has been paid to the impact of sanitary conditions on driver's state of health. This same drawback is manifested in other works [9]. The author considered the problem of optimization of the transport system. Similar data are shown in the work of Lobashov O.O. et al [10]. The author studied the problem of driver's ability to work, his ability to perform physical and mental work, keeping a given pace, the ability not to get tired while driving and overcome fatigue. This direction is also reflected in the scientific

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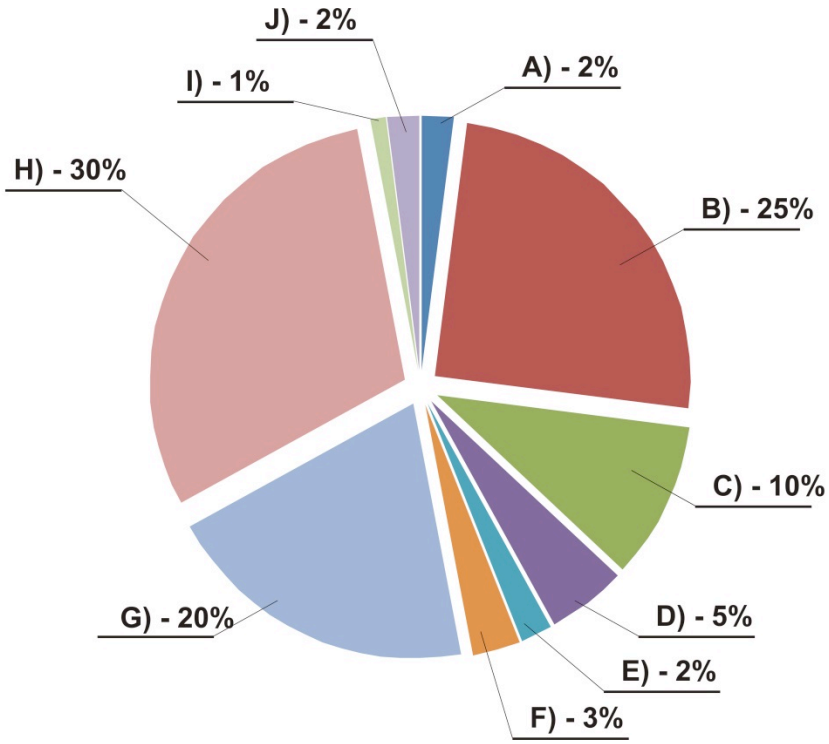


Fig. 1. The structure of the risks of drivers' occupational morbidity, who carry out passenger transport by bus [1]: A) - Diseases of the nervous system; B) - Diseases of the circulatory system; C) - Diseases of the respiratory system; D) - Diseases of the digestive system; E) - Diseases of the genitourinary system; F) - Diseases of the endocrine system; G) - Reduced efficiency caused by stressful situations; H) - Symptoms of fatigue, fatigue and depression; I) - New formation; J) - Other diseases.

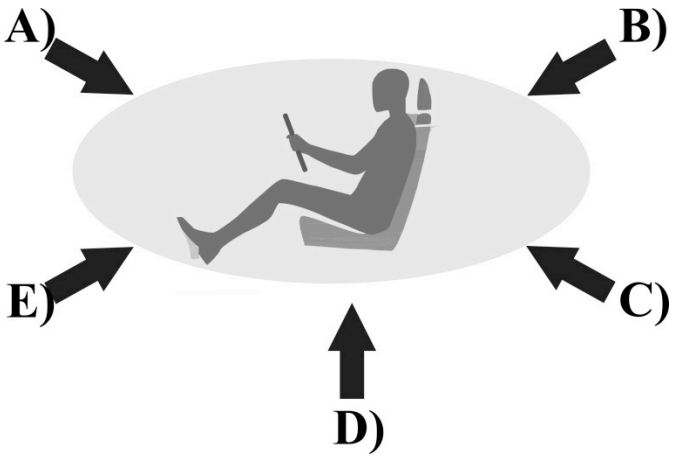


Fig. 2. Harmful production factors of the environment that have an impact on the health of drivers of route buses [4, 5]: A) - Noise; B) - Nervous-emotional stress; C) - Harmful substances; D) - Unfavorable microclimate of the working environment; E) - Vibration.

works of Cybulski M. and Yang J. They substantiate the relationship between the type of personality and its ability to carry the load with the behavior on the road in order to reduce the accident rate [11, 12]. Other results were shown in the work of Liebiedieva T.L. et al [13]. The authors established the relationship between the discrepancy of regulatory requirements of the duration of the management period and chronic fatigue and increased nervous-emotional tension. All this causes changes in the vegetative nervous system of drivers and increases the risk of developing cardiovascular diseases and diseases of the digestive system. However, an existing connection is not established: between working conditions and the risk of developing diseases; between the influence of harmful factors on reducing the driver's life expectancy [14]. Therefore, an urgent task is to assess the impact of harmful production factors and working conditions on the nature and rate of aging of bus drivers. At the heart of this is the definition of drivers' the biological age (BA).

Recently, more and more attention is paid to the criterion of health assessment in the form of biological age. Biological age characterizes the functional state of the

organism and reflects the overall "viability" of the person. To do this, use two types of objective and subjective evaluation indicators. The first group includes the functioning of reserve capabilities of the cardiovascular and respiratory systems with the locomotor apparatus. It takes into account the age-old features of people. The second is the subjective evaluation of health according to the questionnaire. This assessment reflects, to some extent, the characteristics of the central nervous system (CNS) [15-18].

Hypothesis. It is assumed that work under conditions of the production environment harmful factors' influence worsens the health of drivers of route buses and leads to the development of occupational diseases and to shorten their life expectancy.

The purpose of the work is to determine the influence of harmful production factors and working conditions on the determination of the nature and aging of bus drivers on the basis of determining their biological age.

Materials and methods.

Participants. The hygienic estimation of the influence of the main unfavorable production factors (vibration, dust, noise, climatic conditions) was carried out at the workplaces of the drivers of the route buses of the brands Mercedes Benz Sprinter 411, Ruta 23 (Ukraine), Bogdan A20111 (Ukraine). The experiment was attended by 12 drivers aged 28 to 45 with work experience from 5 to 20 years.

Organization of research. Measurement of noise load at the driver's work place was carried out at a speed of 45-60 km/h. From the indicated speeds, they chose the smallest. The measurements were carried out at five values of constant velocities (with a rounding value of up to 5 km/h): the smallest indicator, the largest indicator and the intermediate metric. At each point of the microphone position of the Octave-101 device *(www.zapadpribor.com)*, three measurements of the noise level value were performed. According to the measurements, the arithmetic mean values, rounded to the integer, were taken. Repeat measurement was performed if the difference between the highest and lowest values of noise levels at each point exceeded 2 dB (decibels).

Measurements of the parameters of the temperature environment of the working space of the driver were carried out using the thermometer "TENSOR-41" *(http://www.tenzor.ua)* of the anemometer "TESTO 405-V1" *(http://trade-control.com.ua)* and the aspirational psychrometer "M-34" *(http://arsmt.com.ua)* and the "MX-2" pyrometer *(http://www.izmerimvse.ua).* The research was conducted under the following conditions: air temperature in the shade - +32. . . + 34 ^{0}C, the bus was moving towards the south (deviation from the direction - + 15^0. . . 20^0), the speed is 80 ... 90 km/h. Time to measure temperatures: at the beginning of the change at about 6^{00} in the morning, from 12^{00} to 13^{00} (in the afternoon break) and in the evening at 20^0. The temperatures were repeatedly measured in the following zones: driver's head, chest, stomach-thigh, legs-legs. The research was carried out as follows. We have taken into account that the driver and passenger seats are placed symmetrically. Therefore, the climate conditions for the driver and passenger are the same. Therefore, the thermometers were installed at the passenger seat. Measurements were carried out in each zone three times (repeat after 5 minutes).

Concentration of harmful substances in the driver's working space is carried out with the help of the gas analyzer "GC" *(http://granat-e.ru)*, complete with indicator tubes for monitoring: ammonia, benzene, gasoline, xylene, carbon monoxide, toluene, chlorine, nitrogen oxides, hydrogen sulfide, ethyl ether, hydrocarbons (certified in Ukraine). The total dust concentration in the air was determined using the aspirator AERA *(http://standart-m.com.ua)*, which provided (with an air flow of 20 liters/min.) Sampling in the driver's breathing zone. The analytical filters "AFA-10" were used, which were then weighed on the analytical scales "VLO-200" *(http://gosmetr.ru)*. Sampling time was recorded using the stopwatch "SOPpr-2a-2-010" *(https://www.zlat-zchz.com/)*.

Measurement of the vibration load at the driver's workplace was carried out using the digital contact vibrometer "AR63A (GM63A)" *(https://mpr-kip.com)*. Measurement of the level of vibration load in the workplace of the driver of the respective stamps of route buses was carried out under the following conditions: when moving the bus with constant speed; at carrying out transport work on passenger transportation; on a stationary route bus during drivers' places of rest. The study of the vibration of the gearbox was carried out while driving the route bus on the second gear on an equal area of asphalt highway: the rotational speed of the crankshaft 1200-1300 rpm.

To evaluate the functional state of man was used the following technique: the tone meter "Nissei DS-1902" (*https://http://pribory-si.ru)* and "Omron M10-IT" *(https://http://pribory-si.ru)*, infrared contactless thermometer "Maniquick MQ-160" *(http://www.maniquick.com.ua/)*, medical scales "BM-150" *(http://gosmetr.ru).* Subjective Health Assessment (SHA) - conducted using a questionnaire, which included 27 questions (Table 1).

The first 26 questions include "yes" or 'no' answers. The last one – "good", "satisfactory", "bad", "very bad". The number of negative responses is calculated on the first 26 questions and 1 is added if the last question is "bad" or "very bad". The total number of points gives a quantitative self-esteem of health (index of self-esteem of health) with "ideal" and 27 with "very bad" state of health.

The informativeness of this indicator is evidenced by the presence of a correlation between the level of SHA and many objective indicators of the body's condition (blood pressure, vital capacity of the lungs, hearing impairment, body weight). The SHA index also interconnected psychometric tests that reflect cognitive functions the brain.

Biological age (biological age - BA) was determined by the formula [15-18]:

Table 1. Questionnaire for self-assessment of health [13]

N	Questions
1.	Are you having headaches?
2.	Can you say that you easily wake up from any noise?
3.	Do you have a pain around the heart?
4.	Do you think that your eyesight has worsened?
5.	Do you think that your hearing has worsened?
6.	Are you trying to use only boiled water?
7.	Do you give way to a city transport?
8.	Do you bother with joint pain?
9.	Does your mood change the weather?
10.	Are there any cases that you are losing sleep through excitement?
11.	Does bothering you around the liver?
12.	Do you have dizziness?
13.	Is it harder for you to focus than in past years?
14.	Are you worried about memory impairment?
15.	Do you feel in different parts of the body of tingling?
16.	Are you bored in your ears?
17.	Do you keep one of the following drugs validol, nitroglycerin, heart drops in your home medicine kit ?
18.	Do you have swelling of your legs?
19.	Do you refuse from some dishes?
20.	Do you have shortness of breath when you are on the go?
21.	Does bothering you with lumbar pain?
22.	Do you use any mineral water for medical purposes?
23.	Can you say that you began to cry easily?
24.	Are you on the beach?
25.	Do you think that you now have the same working capacity as before?
26.	Are there such periods when you feel joyfully excited, happy?
27.	How do you rate your health?

$$BA = 26{,}985 + 0{,}215 \times APS - 0{,}149 \times DBADB - 0{,}151 \times SBLL + 0{,}723 \times SHA \quad (1)$$

where APS - arterial pressure systolic; DBADB - duration of breath holding after deep breathing; SBLL - static balancing on the left leg; SHA is a subjective health assessment (shown in Table 1).

Formula (1) allows you to evaluate the BA of each of the surveyed drivers. In order to determine the degree of aging relative to the driver's calendar year (HY), an individual BA was matched to the proper BA (PBA). PBA characterizes the average population standard of the rate of aging.

The BA-PBA index shows how many years of probable BA of an individual ia more or less than the average age of their peers. If the degree of aging is less, then BA-PBA<0. If the degree of aging is bigger, then BA-PBA > 0. If the degree of aging is the same, then BA-PBA=0.

Indicators of the functional state of the body (arterial pressure, respiratory depression, static balancing and self-esteem index, weight) were determined at the beginning of the work shift. This procedure is mandatory during a medical review of drivers before the run. Changes in blood pressure were controlled at lunch breaks and after the run. The control of other indicators took place once a month for six months (from March to September 2017).

Statistical analysis. Material processing was carried out using the standard Microsoft Office program – Excel 2010. The data obtained had a normal probability distribution law and Student's parametric criteria were used to analyze them. The number of observations was sufficient to obtain unmatched estimates of the first two points: the arithmetic mean (M) and the mean square deviation (δ). In order to compare the mean values of the quantitative indices in the normal distribution was used Student's criterion. The significance level $p < 0{,}05$ with reliability of 95% was considered reliable.

Results

According to the sanitary-hygienic characteristics of drivers' working conditions, the schedule of work is approved – six-day working week in two changes. In both changes, a regulated technological break for a lunch duration of 30 to 40 minutes is provided. However, observance of the schedule of route buses' drivers is complicated due to fluctuations in passenger traffic, changes in traffic intensity, weather conditions. Also, the participation of drivers in the maintenance and ongoing repair of route buses. This increases the duration of the working day.

As a result of the sanitary and hygienic investigations of working conditions at the workplaces of drivers, the values of the harmful factors acting on them during movement were determined (Table 2).

It was established that the maximum exceedance of the permissible norms in the cabins of route passenger buses has temperature indices. Their significance since the sixth hour of the drivers (at 10.00-11.00 in the morning) was 43-48^{0}C. The given data testify that drivers during the warm period of the year (from June to September) work in conditions of elevated temperatures. This is facilitated by external meteorological conditions, the weakness of air conditioning systems in shuttle bus cabins, flows of additional heat from the engine running and solar radiation and from the cabin. The parameters of the microclimate in the cold and transition period of the year also differ from the permissible indicators (fixed from 8 to 21^{0}C). This indicates the inefficiency of ventilation and heating systems.

According to the Hygienic Classification of Labor, the parameters of the microclimate should be classified as harmful 3.2-3.4. Let's also note the impact of labor intensity. Such work is conditioned by the need for continuous monitoring of the road for more than 5-6 hours per shift and a certain nervous-emotional load (responsibility for the safety of passenger transportation). Microclimate is the most adverse factor in all route buses (Fig. 3). Work in such conditions leads to the tension of the body's thermoregulatory functions, which causes an increase in stress on the cardiovascular system. Calculate the average body temperature according to the formula [19]:

$$t_{tl} = K \times t_p + (1 - K) \times t_{sh} \qquad (2)$$

where t_p is the temperature of the "core" of the body (entotic, in the original modification), ^{0}C; t_{sh} - average weighted skin temperature, ^{0}C; K - mixing factor.

The average weighted skin temperature (t_{sh}), we determine by five points (measurements will be made at five different points of the human body) [9]:

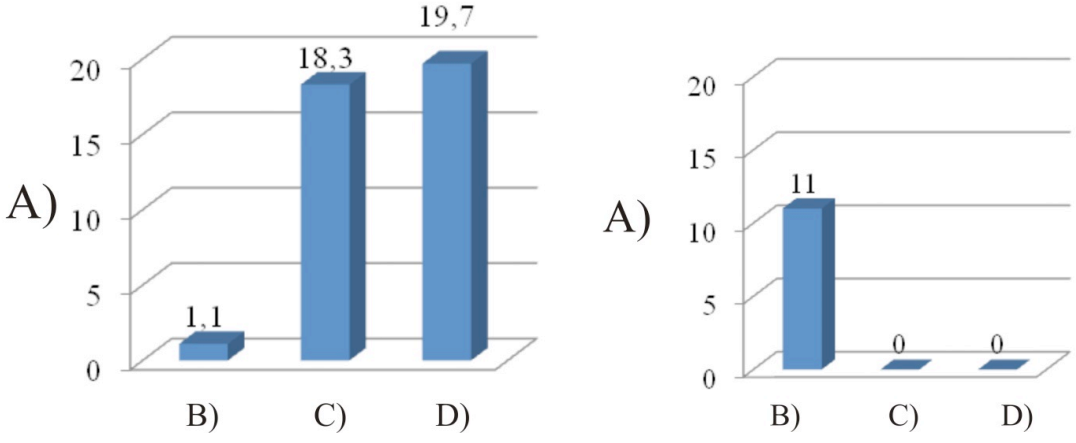
$$t_{sh} = 0,7 \times t_1 + 0,5 \times t_2 + 0,05 \times t_3 + 0,18 \times t_4 + 0,2 \times t_5 \,(3)$$

where t_1 - temperature of the surface of the skin of the forehead, ^{0}C; t_2 - temperature of the surface of the breast, ^{0}C; t_3 - temperature of the surface of the body of the brush, ^{0}C; t_4 - temperature of the surface of the upper thigh, ^{0}C; t_5- temperature of the surface of the body of the foot, ^{0}C.

Another indicator is the assessment of the feeling of sentiment, which was carried out on a seven-point scale: very cold - 1; cool - 2; slightly cool - 3; comfortable - 4; slightly warm - 5; heat - 6; very hot - 7.

Fig. 4 shows the change in the average body temperature and the thermal sensation of workers during the work shift. From the graph, it is clear that the value of the sense of warmth significantly increased inside and at the end of the change by 0,8-0,9 points in comparison with the beginning of the change, which indicated a significant influence of the thermal environment on the thermal state of the workers ($p < 0,05$).

In fig. 5 is shown the dependence of the thermal sensation on temperature. With an increase in the temperature of 1 degree above 24^{0}C, the sensation of heat increases by 0.5 points. At the same time, exceeding the permissible limit of 5 points comes at an air temperature of more than 27^{0}C in the cabin. Thus, the upper limit of the negative influence on the driver is an excess of temperature of 27^{0}C. Possible confirmation of the concluded conclusion is the decrease of fluctuation of diastolic blood pressure (DBP) in winter compared with the summer period of the year (Fig. 6). It is its reduction indicating a significant influence of temperature indices. Increase of the SBP (systolic blood pressure) can take place under the influence of infrared radiation or during physical work. Such data indicate the expressed voltage of functional systems. Lack of change may indicate the ability of a person to tolerate the thermal load. It should be



a). in summer *a). in winter*

Fig. 3. Exceeding the temperature sensor in the air of the cab passenger route buses during the change: *A) - Temperature, ^{0}C; B) - Beginning; C) - Middle; D) - End.*

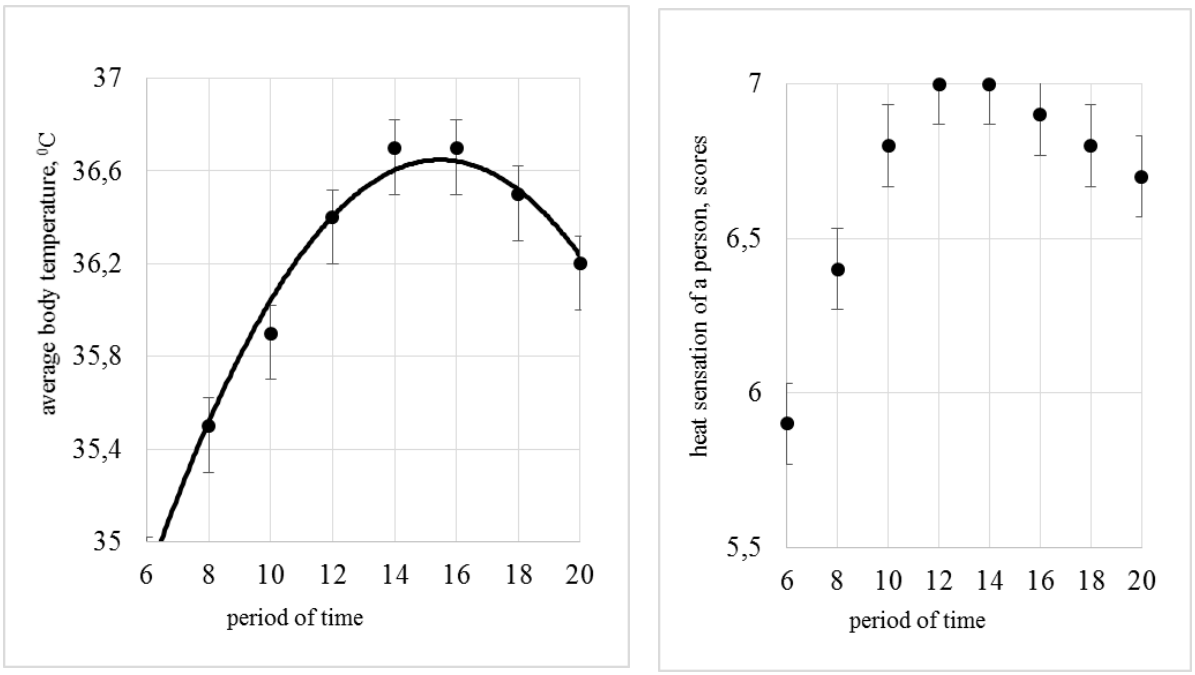


Fig. 4. Change in average body temperature and heat sensation during the day in the driver's cab of route bus in summer.

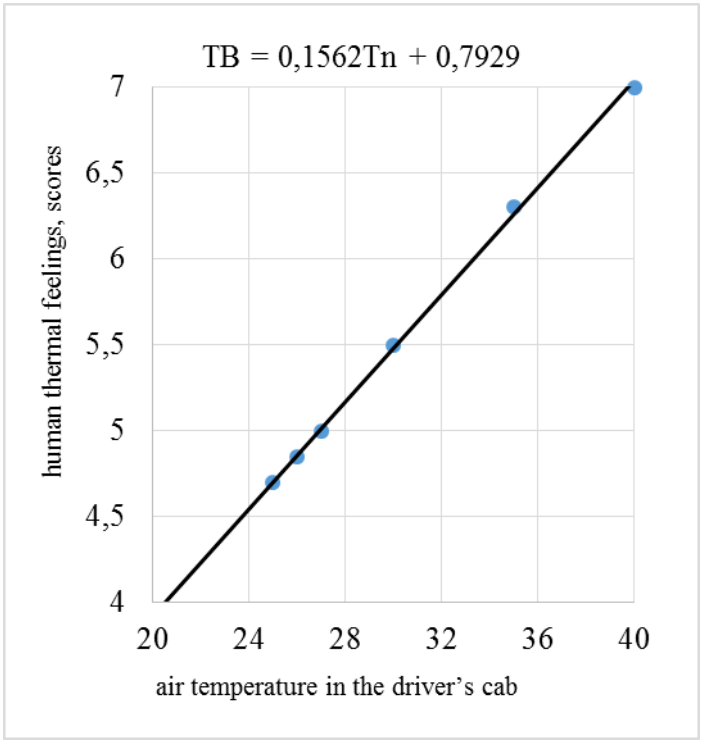


Fig. 5. Dependence of the thermal sensation on the temperature of air in the driver's cabin in the summer: TF - human thermal feelings, scores; AT - air temperature in the driver's cab, ^{0}C.

noted that the increase in the heart rate in a state of rest is fixed at a temperature exceeding 33^{0}C [20, 21].

The fact that drivers work in adverse climatic conditions is established. This requires further assessment of the degree of aging of drivers. The results of factors influencing the performance of transport work in the summer are given in Table. 3. Data indicate an increase in systolic blood pressure, heart rate, and a decrease in static balancing time. Table 4 shows the indexes of basic physiological tests in drivers.

Analysis of the results shows that with the increase in the length of work of drivers increases their rate of biological aging. So in the group of drivers with work experience less than 10 years and the calendar age of 35,4 years the rate of aging was – 4,7 years. With an employment record of 5 to 10 years and a calendar age

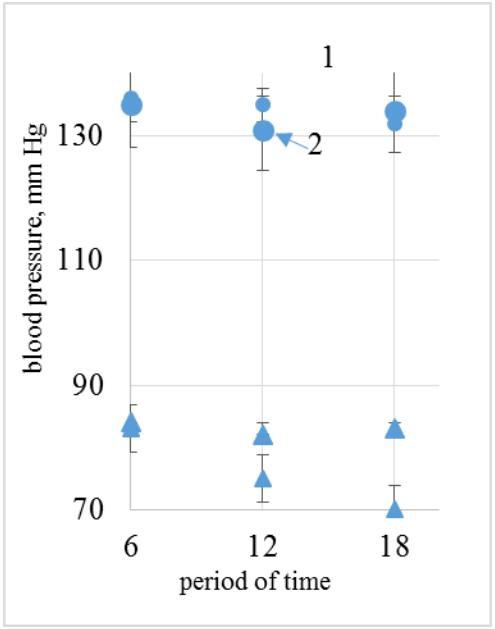


Fig. 6. Fluctuations in systolic (●) and dystolic (▲) blood pressure in summer (1) and winter (2)

Table 3. Estimated average values of the indicators of the functional state of drivers at the beginning and at the end of the change

Indices	Before change	After change	t-Student's criterion	Significance level (p)
SBP, mm Hg	136,08±1,06	139,64±1,44	-1,9954	0,047
DBP, mm Hg	81,59±0,81	71,64±0,74	-0,9544	0,34
Heart rate, beats per minute	72,41±0,46	81,30±0,56	-12,2870	0,0001
SB, s	26±3,46	11±0,46	-3,954	0,412

Note. SBP - systolic blood pressure; DBP - diastolic blood pressure; SB - static balancing on the left foot, seconds.

Table 4. Indicators of basic physiological tests in drivers

Seniority, age	Quantity, drivers	Middle age, age	SBP, mm Hg	BHE, s	SB, s	SEH, points	BA, years
5-10	4	35,4±0,9	121,4±2,6	33,9±3,5	82,1±1,3	6,4±0,6	40,1±1,1
10-15	5	35,5±1,4	133,1±3,2	40,3±2,1	76,2±2,5	7,1±0,7	43,2±0,9
more than 15	3	37,4±0,7	134,8±2,5	35,6±2,3	72,1±1,8	10,7±0,5	46,8±0,9

Note. SBP - systolic blood pressure; BHE - breath hold while exhaling, seconds; SB - static balancing on the left foot, seconds; SEH - self-esteem of health, points.

of 35.5 years, this figure was – 7.6 years. Thus, drivers of coach buses with different work experience (from 5 to 10 years and more than 10 years) have a different aging rate. This allows us to conclude that the influence of professional activity of drivers on the rate of aging. This is to a certain degree reflects the state of their health.

The excess of the biological age over the calendar average is 7 years. According to available data, the difference between BA and the appropriate biological age is equal to 7 years. It characterizes relatively small premature aging.

Discussion.

The result can be explained by the fact that drivers' working conditions are characterized by a high degree of neuro-emotional stress. According to indicators (intellectual and emotional load, sensory voltage, load monotony and mode of operation), it can be attributed to the conditions of harmful work of 2 degrees. During the survey, it was found that about 80% of drivers experience

physical and emotional fatigue after work. This is due to the fact that drivers work for about 10-12 hours and more in one change. This significantly exceeds the permissible standards that regulate this type of transport work. Such working conditions lead to the development of new or to deepen existing chronic diseases. This accelerates the aging process. These include hypertension, chronic ischemic heart disease and stomach ulcer. It can be traced the direct dependence of premature aging of drivers from the conditions of work [22]. The analysis of the test results of the BA allowed to distinguish from the set of physiological parameters the main factor of the formation of BA: arterial pressure (systolic and diastolic). When analyzing the incapacitated letter, it was found that hypertension among drivers ranks first.

This conclusion is confirmed by works by Giuliev N.U. [23] and Ge Y. [24]. The authors studied the change in the psychological state of the driver in traffic flows of varying intensity. The results of their research indicate that the greatest emotional stress of the driver is observed, if necessary, frequent stops, ahead of vehicles. Also, there is a difference in speed in the ride cycle, a driver's execution of a large number of maneuvers.

To the adverse factors of the driver's health on the bus in the cabin is: noise, vibration, elevated air temperature, the presence of pollination and gas pollution of the workplace. In another study [25], it was found that excessive noise levels reach up to 7.7 dBa, vibrational to -20 dB. This contributes to reducing the hearing of drivers [26]. Similar data are also determined when calculating the dynamics of vehicles [27]. Indicators of temperature in the summer exceed by 15-20^{0}C. Their joint action leads to reduced efficiency and reduced adaptive capacity of the person. The result is the premature aging of a person.

Consequently, in order to increase the life expectancy of drivers, it is necessary to reduce the harmful effects of negative factors. It is recommended to view the modes of work and rest. It should be ensured their work is not more than 8 hours with obligatory breaks for rest after each flight made at least 45 minutes.

Conclusions

It is confirmed that work under conditions of production environment harmful factors' influence (especially in conditions of elevated temperatures) worsens the health of drivers and reduces their life expectancy. There is also a decrease in reserve capacity of the body caused by accelerated wear and tear of the cardiovascular system. The discrepancy between the biological age and the calendar age is influenced by a high degree of nervous-emotional stress. This factor is also reflected in the cardiovascular system of the body.

Conflict of interest.

The authors state that there is no conflict of interest.

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Coordinating abilities: recognition of a state of development of 11-13 years old boys

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Abstract

Purpose: To determine the possibility of recognizing the state of development of coordination abilities in boys 11-13 years old based on the methodology of multidimensional statistics.

Material: The study involved boys: 11 (n = 21), 12 (n = 20), 13 (n = 19) years. It was used 14 tests.

Results: In the recognition of the state of development of coordination abilities in boys of 11-13 years old, the most important are the results in the tests: №2 "Standing long jump (cm)" (0.633); №12 "Rhythmic hand tapping" (-0.493); №15 "Tossing a ring over a peg" (-0.347). The enumerated tests characterize speed-power abilities, coordination of movements by hands and spatial precision of throws. In recognition of the state of development of coordination abilities in boys of 12-13 years old, the most important are the results in the tests: №12 "Rhythmic hand tapping" (0.691); №2 "Standing long jump (cm)" (0,387); №1 "30 m running (s)" (-0,356). The enumerated tests characterize the coordination of movements by the hands, speed-strength abilities and speed.

Conclusions: Discriminant analysis allowed to determine: informative indicators for the walkthrough of the development of coordination abilities in boys of 11-13 years old; to answer such question as how significantly distinguished the state of development of coordination abilities in boys of 11-13 years old; which motor tests most significantly affect the differentiation of classes; to which class the object belongs to based on the values of discriminant variables.

Keywords: discriminant analysis, walkthrough, motor tests, boys.

Introduction

In the process of physical education of schoolchildren the tasks of optimizing the physical development of the child are solved [1, 2], improvement of motor abilities, strengthening and health protection [3, 4].

Based on numerous studies, conclusions are drawn:

• the need for a comprehensive development of strength, coordination, endurance and flexibility in children [5, 6];

• the importance of developing coordination of movements in the process of physical education of schoolchildren [3, 7];

• on the relationship of anthropometric, motor and cognitive abilities in children [8, 9];

• the association of the body mass index and subcutaneous adipose tissue with the manifestation of coordination of movements in children 11-14 years [10];

• on the influence of visual perception on the coordination of movements of various parts of the body of children [11, 12];

• on the effect of loads on the plasticity of motor skills in schoolchildren [13, 14].

In other works, attention was focused on clarification of the concept of coordination abilities [2, 5], as well as on the definition of their structure [15, 16].

It is established that in the motor readiness of children and adolescents, coordination abilities occupy a leading place [17, 18]. Multidimensional methods of mathematical statistics are used to study the structure of motor readiness of schoolchildren: factor and discriminant analysis [3, 19]. The use of factor analysis allowed to establish the structure of development of coordination abilities in 11-13 years old boys and girls [20, 21]. However, in available literature there is not enough data on the peculiarities of the dynamics of development of coordination abilities in high school students.

Thus, the study of the peculiarities of the dynamics of development of coordination abilities on the basis of recognition of their state of development in middle school boys is relevant.

The purpose of the study is to determine the possibility of recognizing the state of development of coordination abilities in 11-13 years old boys based on the methodology of multidimensional statistics.

Materials and methods

Study participants. The study involved boys: 11 (n = 21), 12 (n = 20), 13 (n = 19) years old.

The study protocol was approved by the Ethical Committee of H. S. Skovoroda Kharkiv National Pedagogical University. In addition, the children and their parents or legal guardians were fully informed about all the features of the study, and a signed informed-consent document was obtained from all the parents.

Study organization. The study used the following methods: analysis and collation of scientific and

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methodological literature, general scientific methods of theoretical level, such as analogy, analysis, synthesis, abstraction, induction, as well as general scientific methods of empirical level: observation, testing, experiment.

Testing procedure. The testing program included well-known tests [3, 5, 22]. To evaluate motor preparedness, the study recorded the results of motor tests, body height and weight [21]:

- Test 1 "30 m running (s)";
- Test 2 "Standing long jump (cm)";
- Test 3 "Six standing accuracy ball handlings to a partner from a 7 m distance using one of the techniques learned".
- Test 4 "Pull-ups (number of times)";
- Test 5 "Sit-ups in 30 seconds";
- Test 6 "Evaluation of the sense of movement speed in sprinting";
- Test 7 "Evaluation of the ability to differentiate movement speed (reproduction accuracy of running speed at 80% intensity of maximum)";
- Test 8 "Evaluation of the ability to differentiate movement speed (reproduction accuracy of running speed at 90% intensity of maximum)";
- Test 9 "Static equilibrium evaluation by E. Ya. Bondarevsky's method";
- Test 10 "Evaluation of dynamic equilibrium by the BESS method";
- Test 11 "Evaluation of the ability for vestibular (statokinetic) stability. Running with turns";
- Test 12 "Rhythmic hand tapping";
- Test 13 "Rhythmic movements of upper and lower limbs";
- Test 14 "Shuttle run (4×9 m)";
- Test 15 "Tossing a ring over a peg".

Pedagogical testing was conducted to determine the possibility of recognizing the state of development of coordination abilities in boys aged 11-13 years based on the methodology of multidimensional statistics.

Statistical analysis.

In discriminant analysis we formed prognostic model of belonging to group. This model builds discriminant function (or if the quantity of groups is more than two – a set of discriminant functions) in the form of linear combination of variables-predictors that ensures the best groups' division. These functions are built by a set of observations, for which their belonging to groups is known. Further, these functions can be used for new observations with known values of variables- predictors and unknown belonging to group.

For every variable we calculated the following: mean values, standard deviations, single - factorial dispersion analysis for every variable (Box's M test, in-group correlation matrix, in-group covariance matrix, co-variance matrixes for separate groups, general covariance matrix). For every canonic discriminant function we calculated: eigenvalue, dispersion percentage, canonic correlation, Wilks' Lambda, Chi-square. For every step we calculated: priory probabilities, Fisher function's coefficients, non-standardized coefficients of function, Wilks' Lambda for every canonic function.

Results

The tables show the results of discriminant analysis, which allows to recognize the state of development of coordination of movements in boys of 11-13 years.

The first canonical function explains the variation of the results by 77.2%, the second - by 22.8%. This indicates their informativity (Table 1). The coefficients of canonical correlation indicate the prognosticity of the first and second functions.

Table 2 shows the analysis of canonical functions. The first line contains the value $\lambda = 0.099$ ($p = 0.001$) for the entire set of canonical functions. The second line contains data after the exclusion of the first function ($\lambda = 0{,}472$; $p = 0{,}002$). The first and second functions have a high discriminative ability and meaning in the interpretation of the general population.

Table 3 shows the normalized coefficients of the canonical discriminant function, which allow us to determine the ratio of the contribution of variables to the result of a function. The greatest contribution to the first canonical function is the variables number 2, 16, 12, 15: the larger the values of these variables, the greater the value of the function. With the greatest contribution to the second canonical function, the variables are number 12, 2, 1: the larger the values of these variables, the greater the value of the function.

In identifying the state of development of coordination

Table 1. Summary of Canonical Discriminant Functions. Eigenvalues. Boys of 11-13 years

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	3,789[a]	77,2	77,2	,889
2	1,120[a]	22,8	100,0	,727

Table 2. Canonical discriminatory functions. Wilks' Lambda. Boys of 11-13 years

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	,099	113,563	34	,000
2	,472	36,817	16	,002

abilities in boys of 11-13 years old, the most important are the results in tests: №2 "Standing long jump (cm)" (0.633), №12 "Rhythmic hand tapping" (-0.493), №15 "Tossing a ring over a peg" (-0.347). The named tests characterize speed-power abilities, coordination of movements by hands and spatial precision of throws.

In the recognition of the state of development of coordination abilities in boys of 12-13 years old the most important are the results in tests: № 12 "Rhythmic hand tapping" (0.691), №2 "Standing long jump (cm)" (0.377), test №1 "30 m running (s)" (-0.356). The enumerated tests characterize the coordination of movements by the hands, speed-strength abilities and speed.

Table 4 shows the structural coefficients of the first and second canonical discriminant functions, which are coefficients of the correlation of variables with a function. Thus, the first canonical discriminant function is most closely connected with the results of tests №2, 17, 16, 9, 14: hence, the significant difference between boys 11, 12 and 13 years is observed in the level of development of high-speed force, coordination of movements and anthropometric data. The structural coefficients of the second canonical discriminant function indicate that the function is most closely related to the variables №12, 13, 15, 3: hence, the significant difference between the boys of 12 and 13 years is observed in coordinating the movements of the hands and the accuracy of the throws.

Table 5 shows the results of classification of groups, 93.3% of the output grouped observations are categorized correctly. Thus, a canonical discriminatory function can be used to recognize the state of coordination of movements in boys aged 11-13 years.

Discussion

The presented results indicate that discriminant analysis allows to recognize the state of development of coordination abilities in boys aged 11-13 years on the results of testing. Our research complements data on the use of discriminant function in the classification of students by motor activity [23, 24]. According to our results, there is a high discriminant and prognostic ability of the received functions in assessing the motor readiness of children and adolescents. Similar results were obtained in Geoffrey D.B. et al [25], Ivashchenko et al. [26].

For the practical application of the results of discriminant analysis, the coefficients of the canonical discriminant function are used (Table 6). The probability of belonging to a certain case to the predicted group is calculated based on the substitution of the discriminant function of the values of the set of variables. These variables correspond to this case. Comparison of the obtained results with the size of centroids makes it possible to determine the group to which the result belongs (Table 7).

Previously, it was found that in the structure of coordination abilities of boys aged 11-13 years the most informative is vestibular stability. For pedagogical control of motor readiness of boys aged 11-13 years can be recommended: test №2 "Standing long jump (cm)"; test №9 "Static equilibrium evaluation by E. Ya. Bondarevsky's method"; test №10 "Evaluation of dynamic equilibrium by the BESS method" [27].

The results of the discriminant function allowed to determine that for recognizing the level of development of coordination abilities in boys aged 11, 12 and 13 years

Table 3. Standardized Canonical Discriminant Function Coefficients. Boys aged 11-13 years old

№	Test	Function	
		1	2
1	30 m running (s)	,001	**-,356**
2	Standing long jump (cm)	,633	,387
3	Six standing accuracy ball handlings to a partner from a 7 m distance using one of the techniques learned	-,370	-,349
4	Pull-ups (number of times)	,240	-,064
5	Sit-ups in 30 seconds	,287	-,090
6	Evaluation of the sense of movement speed in sprinting	,162	,303
7	Evaluation of the ability to differentiate movement speed (reproduction accuracy of running speed at 80% intensity of maximum)	-,074	-,307
8	Evaluation of the ability to differentiate movement speed (reproduction accuracy of running speed at 90% intensity of maximum)	,211	-,001
9	Static equilibrium evaluation by E. Ya. Bondarevsky's method	,113	-,314
10	Evaluation of dynamic equilibrium by the BESS method	-,290	-,165
11	Evaluation of the ability for vestibular (statokinetic) stability. Running with turns	,148	,132
12	Rhythmic hand tapping	-,493	,691
13	Rhythmic movements of upper and lower limbs	,024	,330
14	Shuttle run (4x9 m)	-,301	,312
15	Tossing a ring over a peg	**-,347**	-,269
16	Height (cm)	**,547**	,210
17	Body weight (kg)	,226	,348

Table 4. Structure Matrix. Boys aged 11-13 years old

№	Test	Function 1	2
2	Standing long jump (cm)	**,419***	,127
17	Body weight (kg)	**,395***	,167
16	Height (cm)	**,378***	,196
9	Static equilibrium evaluation by E. Ya. Bondarevsky's method	**,358***	-,156
14	Shuttle run (4x9 m)	**-,282***	,200
4	Pull-ups (number of times)	,245*	-,004
10	Evaluation of dynamic equilibrium by the BESS method	-,184*	,119
8	Evaluation of the ability to differentiate movement speed (reproduction accuracy of running speed at 90% intensity of maximum)	,164*	-,071
12	Rhythmic hand tapping	-,266	**,523***
13	Rhythmic movements of upper and lower limbs	-,039	**,313***
15	Tossing a ring over a peg	,047	**-,271***
3	Six standing accuracy ball handlings to a partner from a 7 m distance using one of the techniques learned	-,077	**-,233***
5	Sit-ups in 30 seconds	,104	-,203*
7	Evaluation of the ability to differentiate movement speed (reproduction accuracy of running speed at 80% intensity of maximum)	,077	-,158*
1	30 m running (s)	-,083	-,129*
6	Evaluation of the sense of movement speed in sprinting	-,047	,067*
11	Evaluation of the ability for vestibular (statokinetic) stability. Running with turns	,055	,059*

Table 5. Classification Results[a]. Boys aged 11-13 years old

Scale	Age (years)	Group	Predicted Group Membership 1,00	2,00	3,00	Total
Original	Count	5,00	21	0	0	21
		6,00	2	17	1	20
		7,00	0	1	18	19
	%	5,00	100,0	,0	,0	100,0
		6,00	10,0	85,0	5,0	100,0
		7,00	,0	5,3	94,7	100,0

93,3% of original grouped cases correctly classified.

Table 6. Canonical Discriminant Function Coefficients. Boys aged 11-13 years old

№	Test	Function 1	2
1	30 m running (s)	,002	-,976
2	Standing long jump (cm)	,057	,035
3	Six standing accuracy ball handlings to a partner from a 7 m distance using one of the techniques learned	-,335	-,317
4	Pull-ups (number of times)	,211	-,056
5	Sit-ups in 30 seconds	,057	-,018
6	Evaluation of the sense of movement speed in sprinting	1,237	2,316
7	Evaluation of the ability to differentiate movement speed (reproduction accuracy of running speed at 80% intensity of maximum)	-,619	-2,555
8	Evaluation of the ability to differentiate movement speed (reproduction accuracy of running speed at 90% intensity of maximum)	2,290	-,006
9	Static equilibrium evaluation by E. Ya. Bondarevsky's method	,011	-,030
10	Evaluation of dynamic equilibrium by the BESS method	-,045	-,026
11	Evaluation of the ability for vestibular (statokinetic) stability. Running with turns	,143	,128
12	Rhythmic hand tapping	-,351	,493
13	Rhythmic movements of upper and lower limbs	,023	,307
14	Shuttle run (4x9 m)	-,333	,346
15	Tossing a ring over a peg	-,139	-,108
16	Height (cm)	,070	,027
17	Body weight (kg)	,026	,040
	(Constant)	-13,658	-8,482

Table 7. Functions at Group Centroids. Boys aged 11-13 years old

Group	Function	
	1	2
5	-2,061	-,848
6	-,274	1,451
7	2,567	-,590

can be used: test №9 "Static equilibrium evaluation by E. Ya. Bondarevsky's method"; test № 14 "Shuttle run (4x9 m)". These tests characterize vestibular stability and overall coordination of movements. For recognition of the state of development of coordination abilities in boys 12 and 13 years can be used tests: № 12 "Rhythmic hand tapping"; №13 "Rhythmic movements of the upper and lower limbs"; №15 "Tossing a ring over a peg". These tests characterize the coordination of movements of different parts of the body and the accuracy of throws. These data supplement the results of Agricola et al. [11] and Palomo-Nieto et al. [12] on the importance of coordinating movements of various parts of the body in assessing the coordination abilities of children and adolescents. The given data confirm conclusions of Ivashchenko O. [3]: for the estimation of the current state of motor readiness, a factor analysis is used; to assess the dynamics of the state in the age range, a discriminant analysis is used, which makes it possible to determine informative indices for the cross-sectional control of motor readiness.

The above data supplements the results of the study of the peculiarities of motor readiness of middle school students [15, 28].

Conclusions

Discriminant analysis allowed to determine: informative indicators for the end control of the development of coordination abilities in boys aged 11-13 years; to answer the question as to how significantly the state of development of coordination abilities in boys of 11, 12 and 13 years old; which motor tests most significantly affect the differentiation of classes; to which class the object belongs to based on the values of discriminant variables.

For the recognition of the level of development of coordination abilities in boys 11, 12 and 13 years can be used: test №9 "Static equilibrium evaluation by E. Ya. Bondarevsky's method"; test № 14 "Shuttle run (4x9 m)". These tests characterize vestibular stability and overall coordination of movements.

For recognition of the state of development of coordination abilities in boys of 12 and 13 years old can be used tests: № 12 "Rhythmic hand tapping"; №13 "Rhythmic movements of the upper and lower limbs"; №15 "Tossing a ring over a peg". These tests characterize the coordination of movements of different parts of the body and the accuracy of throws.

The prospect of further exploration is the study of methodological approaches to programming of the development of coordination abilities in schoolchildren of secondary school age.

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Conflict of Interest

The authors state that there is no conflict of interest.

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Physical health of schoolchildren aged 14-15 years old under the influence of differentiated education

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Abstract

Purpose: to determine the dynamics of indicators of schoolchildren physical health under the influence of a multilevel system of differentiated education.

Material: The study involved schoolchildren (n = 148, age 14-15 years). Two control groups and two experimental groups were formed. Quantitative assessment of physical health was carried out according to 5 indices.

Results: a low level of physical health of schoolchildren is established. The influence of the means of a multilevel system of differentiated education on the individual level of physical health of schoolchildren is determined. The most susceptible systems of the organism are determined to influence the differentiated training. An improvement in the adaptive capacity of the cardiovascular system during the recovery period after standard physical activity was revealed.

Conclusions: The marked decrease in the heart rate at rest and blood pressure is evidence of a better state of adaptation mechanisms. A significant increase in the vital capacity of the lungs and the delay in breathing testifies to the improvement of the functional capabilities of the respiratory system and the body's resistance to hypoxic phenomena. Improvement in the development of strength, speed, speed endurance of the muscles of the back and abdominal press indicates an increase in the specific intensity of the performed work.

Keywords: multi-level system of differentiated education, functional systems, constitution, physical development, schoolchildren.

Introduction

At present, there is a tendency in Ukraine to decrease the level of health and physical fitness of students. In a number of works is paid attention to deviations in the state of health, decrease in working capacity, initial disturbances in the activity of a number of functional systems of the organism of the younger generation. So, studies of Mameshina M. [1] have been established inadequate adaptive reserves of the cardiovascular and respiratory systems of schoolchildren of 13 years old. The necessity of correction of the indicated deviations by means of a purposeful influence is shown. In another study, a decrease was found in the majority of indicators of kinesthetic, orientational and reactive qualities in the learning process [2]. Podrigalo L. et al. [3] studied the relationship between mental performance and the physical state of students. The authors determined that the intensification of educational activity requires the mastery of a higher level of information and significantly increases the burden on the body. As a result, the young people are receiving prenosological disorders of the body. Other studies show the possibilities of physical education in strengthening the level of health of students [4]. The authors propose the correction of the component composition of the biological age of female students. Some authors note that a negative trend of decreasing the level of health of students is typical for all countries [5, 6]. The main goal of such research is to find ways to improve the health of students, develop certain sports, create favorable conditions for the formation of a positive attitude of young people to a healthy lifestyle. In other studies [7, 8] there is a significant deterioration in the physical and psychological health of students. The authors point out the need to study the features of development the previous pedagogical systems of the health-improving orientation. This will allow to determine the ways of introducing health conservation measures in modern educational institutions.

According to a number of authors, the deterioration in the state of health and the reduction in the level of physical preparedness is due to the lack of motor activity of children aged 6-11 years old in the period of schooling in primary school [9, 10], the decrease in physical activity of schoolchildren between 11 and 15 years old [11, 12], insufficient motivation and a decrease in students' interest in physical education [13-15]. Studies have found that deficiency in motor activity adversely affects the adaptive capabilities of the body, the functioning of various systems, mental and physical performance: children aged 7-15 years [15, 16]; adolescents aged 11-16 years [17]; students [18, 19]; women aged 20-25 years [20]. As a result, the state of health deteriorates substantially.

Specialists in the field of physical education note that the standard organization and the typical content of the educational process do not compensate for the lack of motor activity of schoolchildren [21]. Therefore, the search for new, non-traditional approaches to the organization of physical education in educational institutions is relevant.

A number of authors indicate that one of the conditions for increasing the effectiveness of physical education is a differentiated approach. Issues of theory and technology of differential education of schoolchildren of different ages have been considered in many studies [22, 23]. Differentiated methods of physical education have been

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developed and presented for different age groups: blind and visually impaired schoolchildren [24]; preschoolers [25]; children of primary school age [26-28]; adolescents [29].

The review of scientific and methodical literature showed the existence of a number of works devoted to differentiated teaching. They discussed the issues of differentiation of physical education, taking into account the level of physical preparedness [24]; features of the physical development of schoolchildren aged 6-11 years [26]; adolescents of 13 years old [29]; differentiated application of information and computer technologies in the physical education of preschool children (5-6 years) and schoolchildren (11-16 years) [21, 30]; the level of physical health of schoolchildren aged 13-14 years [31].

At the same time, the issue of the differentiation of the educational process, taking into account the functional state of students aged 14-15 years, has not been studied. In our opinion, such an organization of the educational process for physical education will positively affect the state of physical health of schoolchildren aged 14-15 years.

An aim of the study is to determine the dynamics of indicators of physical health of schoolchildren aged 14-15 years as a result of applying a multilevel system of differentiated education.

Material and methods.

Participants: The study involved 148 schoolchildren aged 14-15 (n = 78 - boys, n = 70 - girls), assigned to the main medical group. All participants received informed consent to participate in the study.

Organization of the study:

The research was carried out on the basis of the general school No. 150 (Kharkov, Ukraine). Two experimental and two control groups were formed from the study participants. The students of the experimental groups were divided into homogeneous subgroups, taking into account their level of physical health. The content of the program material of physical education lessons in these groups consisted of two levels: basic and variable. The basic level was based on the types of motor activity typical for general educational institutions. Lessons of basketball, football, volleyball, gymnastics, athletics were held. The content of the variational level was developed by us and was based on a differentiated approach, taking into account the individual characteristics of the students. So, for each subgroup a system of physical exercises was developed and implemented. This system is aimed at increasing the functional state of those systems of the body, which, according to the results of primary research, had an insufficient level of development. The first complex included exercises and modified mobile games aimed at improving the regulation of the cardiovascular system. The second complex included exercises to increase the functionality of the respiratory system. The third complex included exercises for the development of strength, speed and speed endurance of the muscles of the back and abdominal press. The developed system of physical exercises of differentiated education was also included in the system of independent studies and was offered as homework assignments.

The level of physical health was determined [32]. Quantitative assessment of physical health was carried out according to 5 indices. To calculate the indices were determined: length and weight of the body; vital capacity of the lungs (VCL); blood pressure (BP); time of breath retention on usual inhalation (Stange's test); heart rate (HR) at rest and after a dosed physical exercise (30 sit-ups in 45 seconds); the number of torso lifts in the saddle from the supine position for 60 seconds (NTL). Determined:

1) mass-growth Ketle index 2, characterizing the degree of harmony of physical development and constitution. Calculated by the formula: body weight (kg) / body length² (m²);

2) Robinson index, characterizing the state of regulation of the cardiovascular system. Calculated by the formula: HR (bpm) x BP systolic (mm Hg) / 100

where, BP systolic – blood pressure systolic;

3) Skibinski index, characterizing the functional capabilities of the respiratory system and the body's resistance to hypoxic phenomena. Calculated by the formula: VCL (ml) x Stange test (c) / HR (bpm);

4) Shapovalova index, characterizing the development of strength, speed and speed endurance of the muscles of the back and abdominal press. Calculated by the formula: (body weight (g) / body length) x (NTL/60);

5) Ruffier index, characterizing the reaction of the cardiovascular system to the standard physical load. Calculated by the formula: $4 \times (P_1 + P_2 + P_3) - 200/10$.

Where P_1 – HR for 15 s at rest, P_2- HR for the first 15 seconds of the recovery period after the load, P_3- HR for the last 15 seconds from the first minute of recovery.

The obtained results were compared with the scale and evaluated by a certain number of points. The amount of points was determined by the level of physical health.

Statistical analysis:

The research materials were processed using Excel. Calculated:

- arithmetic mean $\overline{X}$ - to characterize the population by separate parameters;
- standard error of the mean (m) - to determine the deviation of the arithmetic mean from the corresponding parameters of the population;
- the reliability of the differences (p) - was calculated in order to determine the degree of change in the mean values of the studied characteristics after the experiment using the Student's parametric criterion (t) with a significance level of at least 0.05.

Results.

The analysis of the primary indicators of physical health indicates the identity of the control and experimental groups ($p>0.05$). A comparison of the results obtained with the scoring scale [32] showed "below average" level of physical health of students aged 14-15 years. The exception is the boys of 14 years old of control groups who have an "average" level (Table 1).

After introduction of the multilevel system of differentiated education (Table 2-3), the results of schoolchildren of experimental groups showed positive changes in all parameters (p <0.05-0.001). The only exception is P_1 (girls of 14 years) and P_2 (boys of 14 years and girls of 15 years): the changes are not reliable (p>0.05).

The data of the schoolchildren of the control groups did not change significantly (p>0.05). The exception is the mass-growth indicators of schoolchildren of 14 and boys of 15 years: changes are significant (p<0.05-0.001).

Comparing repeated results with the scoring scale [32], there was no significant change in the indices of the Ketle index. In schoolchildren of 14 years (experimental groups) and 14-15 years (control groups), these indicators correspond to harmonious constitution (3 points). In schoolchildren of 15 years of experimental groups correspond to inharmonious constitution (with a body weight deficit - 2 points). The Robinson index established an increase in the score on 1 point for schoolchildren in experimental groups. As a result, the level of regulation of the cardiovascular system increased from "low" to

Table 1. Assessment of physical health of schoolchildren aged 14-15 years before the experiment

Age	Boys	Points	Girls	Points
Level of physical health				
	Experimental group			
14 years old	«Below average»	13	«Below average»	12
15 years old	«Below average»	11	«Below average»	11
	Control group			
14 years old	«Average»	14	«Below average»	12
15 years old	«Below average»	12	«Below average»	12

Table 2. Physical health indicators of boys of experimental groups before and after the experiment

Indicators		Before experiment $\overline{x} \pm m$	After experiment	t	p
14 years old (n=29)					
Body length (cm)		1619,66±9,42	1639,91±9,42	10,40	<0,001
Body mass (kg)		50,97±0,97	52,90±0,96	8,12	<0,001
Heart rate (bpm[1])		88,00±3,10	76,14±1,06	5,08	<0,001
Vital capacity (ml)		2124,14±71,37	2544,83±57,94	16,20	<0,001
Systolic blood pressure (mm Hg)		120,38±2,16	102,34±1,24	11,98	<0,001
Diastolic blood pressure (mm Hg)		77,07±1,71	68,76±0,68	6,59	<0,001
Time of breath-holding (s)		32,41±1,85	41,21±1,70	11,08	<0,001
Heart rate in 15 seconds (number of times)	P_1	20,86±1,13	18,28±0,30	3,21	<0,01
	P_2	31,93±1,16	32,76±0,53	1,59	>0,05
	P_3	25,03±1,27	20,86±0,32	6,34	<0,001
Lifting the trunk into the seat in 1 minute (the number of times)		37,41±1,86	39,28±1,70	8,05	<0,001
15 years old (n=19)					
Body length (cm)		1727,37±21,81	1748,95±21,18	15,62	<0,001
Body mass (kg)		57,26±2,92	59,58±2,75	8,38	<0,001
Heart rate (bpm[1])		86,37±1,64	76,79±0,68	8,61	<0,001
Vital capacity (ml)		2826,32±124,68	3278,95±137,57	13,11	<0,001
Systolic blood pressure (mm Hg)		124,26±2,38	109,37±1,68	9,43	<0,001
Diastolic blood pressure (mm Hg)		82,05±1,78	71,05±0,82	7,77	<0,001
Time of breath-holding (s)		33,63±2,91	44,32±2,28	11,48	<0,001
Heart rate in 15 seconds (number of times)	P_1	22,84±1,10	19,47±0,76	7,32	<0,001
	P_2	33,42±1,37	32,00±0,68	2,95	<0,05
	P_3	25,58±1,01	21,74±0,77	5,57	<0,001
Lifting the trunk into the seat in 1 minute (the number of times)		28,16±1,22	32,58±1,22	15,84	<0,001

Note. P_1 is the heart rate in 15 seconds at rest, P_2 is the heart rate in the first 15 seconds of the recovery period after the load, P_3 is the heart rate in the last 15 seconds of the first minute of recovery.

"average".

The schoolchildren of the control groups did not show significant changes in the evaluation scale. In the Skibinsky index, an increase in the results of schoolchildren of experimental groups was established the following: in boys (14 years) and girls (15 years) - 1 point; boys (15 years) and girls (14 years) - 2 points. As a result, the level of development of the respiratory system has increased as follows: from "low" to "below average" - in boys (14 years); from "below average" to "average" - in girls (15 years); from "low" to "average" - for girls (14 years) and boys (15 years).

The schoolchildren of the control groups have not established any significant changes. In Shapovalova index, the results were increased on 1 point in girls (14 years) and boys (15 years) (experimental groups). As a result, the level of development of strength, speed, speed endurance of the muscles of the back and abdominal press increased from "low" to "below average". The figures for boys (14 years) and girls (15 years) also increased. However, these changes were not reflected in the overall assessment. A similar comparison of the data of students in the control groups revealed a lack of significant changes after the experiment. The only exception is the results of boys (15 years): unreliable improvements. The boys' points increased on 1 point and became "below average" level.

A comparison of Ruffier index revealed an increase in the results of girls (14 years) and boys (15 years) in experimental groups on 1 point. As a result, the level of adaptive capacity of the cardiovascular system in girls (14 years) has become "above average". The boys (15 years) – "average". Improvement in the indicators of boys (14 years) and girls (15 years) on the scoring scale is not affected. According to the evaluation criteria, significant changes were not detected in schoolchildren of control groups. The exception is the results of girls (14 years), who rose by 1 point. The results began to correspond to the "average" level. And boys (15 years), the results dropped from "average" to "below average" level.

The general level of physical health of the schoolchildren of the experimental groups was determined after the experiment (Table 4). Its increase from "below average" to "average" has been established.

Table 3. Indicators of the physical health of girls of experimental groups before and after the experiment

Indicators		Before experiment $\bar{x} \pm m$	After experiment	t	p
14 years old (n=23)					
Body length (cm)		1595,65±18,10	1614,78±16,95	9,66	<0,001
Body mass (kg)		48,57±1,04	50,52±1,05	9,18	<0,001
Heart rate (bpm[1])		90,91±3,50	76,48±1,15	5,62	<0,001
Vital capacity (ml)		2113,04±75,60	2504,35±61,15	9,28	<0,001
Systolic blood pressure (mm Hg)		122,22±2,03	104,26±1,37	12,83	<0,001
Diastolic blood pressure (mm Hg)		77,70±1,45	68,83±0,73	8,44	<0,001
Time of breath-holding (s)		32,61±2,50	42,83±1,84	10,06	<0,001
Heart rate in 15 seconds (number of times)	P_1	18,09±0,79	17,26±0,32	2,00	>0,05
	P_2	30,78±1,27	32,43±0,54	2,36	<0,05
	P_3	21,61±1,07	19,61±0,32	3,09	<0,01
Lifting the trunk into the seat in 1 minute (the number of times)		34,57±0,66	38,70±1,15	3,28	<0,01
15 years old (n=23)					
Body length (cm)		1642,17±13,17	1661,30±12,99	14,03	<0,001
Body mass (kg)		48,91±1,64	50,61±1,08	10,87	<0,001
Heart rate (bpm[1])		86,30±4,22	76,43±1,27	3,63	<0,01
Vital capacity (ml)		2321,74±73,56	2760,87±66,10	14,07	<0,001
Systolic blood pressure (mm Hg)		121,13±2,52	106,30±1,63	10,99	<0,001
Diastolic blood pressure (mm Hg)		80,57±1,81	70,13±0,99	8,77	<0,001
Time of breath-holding (s)		32,52±2,47	44,04±1,99	13,63	<0,001
Heart rate in 15 seconds (number of times)	P_1	18,30±1,10	17,26±0,54	2,10	<0,05
	P_2	29,83±1,46	30,00±0,60	0,25	>0,05
	P_3	23,22±0,84	19,48±0,57	7,54	<0,001
Lifting the trunk into the seat in 1 minute (the number of times)		25,91±0,81	29,57±0,78	25,08	<0,001

Note. P_1 is the heart rate in 15 seconds at rest, P_2 is the heart rate in the first 15 seconds of the recovery period after the load, P_3 is the heart rate in the last 15 seconds of the first minute of recovery.

Table 4. Assessment of physical health of schoolchildren aged 14-15 years after the experiment

Age	Boys	Points	Girls	Points
	Experimental groups			
14 years old	«Average»	17	«Average»	17
15 years old	«Average»	15	«Average»	15
	Control groups			
14 years old	«Average»	14	«Below average»	13
15 years old	«Below average»	12	«Below average»	12

In schoolchildren of control groups, the level of physical health has not changed.

Thus, the author's system of differentiated education and the methodology for its implementation proved to be reliably effective in the majority of the studied indicators.

Discussion.

Analysis of the study data revealed the natural character of changes in the mass-growth indicators of schoolchildren aged 14-15 years: during the pedagogical experiment, the indicators significantly increased in the experimental and control groups ($p < 0.05$-0.001). The obtained dynamics of results agrees with the data of a number of researchers. In other studies, certain physical exercises (elements of cheerleading [33, 34], tourism [35]) did not have a significant impact on the body structure of adolescents. We have not found any work devoted to the study of the effect of differentiated education on the constitution of schoolchildren aged 14-15 years.

Analysis of the data of the functional state of the cardiovascular system revealed their significant improvement in schoolchildren of experimental groups ($p<0.01, 0.001$). So, after introduction of the differentiated training it is established the tendency to decrease in blood pressure and frequency of warm reductions at teenagers of 14-15 years old. In our opinion, the introduction of specially designed exercises widens the range of functionalities of the circulatory system. Such exercises also improve the nervous regulation of the cardiovascular system. The results obtained are in agreement with the data of a number of authors. Other studies have established an improvement in the functional capabilities of the cardiovascular system under the influence of cheerleading in schoolchildren aged 13-15 years [33] and girls aged 16-18 years [36, 37], tourism classes [35], and differential education [31]. The schoolchildren of the control groups also improved. However, these changes are not significant and are not reliable ($p>0.05$). Our research proves that the differentiation of the educational process, taking into account the individual characteristics of those involved, positively influenced the functional state of the cardiovascular system of students aged 14-15 years.

Analysis of the results of the functional state of the respiratory system made it possible to establish that in schoolchildren of experimental groups they significantly improved after the experiment ($p<0.001$). In schoolchildren of control groups, no significant and significant changes were detected ($p>0.05$). In our opinion, positive changes are the result of modification of the lessons of physical culture. At the heart of this lesson is the differentiation of education, taking into account the individual characteristics of schoolchildren. In our opinion, this is explained by an increase in the vital capacity of the lungs, improvement in pulmonary ventilation, and increased oxygen saturation of the blood. Accordingly, the functional capabilities of the respiratory system are increased. The data obtained are consistent with a number of studies. The authors found a positive effect on the functions of the respiratory system of cheerleading exercises in schoolchildren [35, 36].

Thus, in our study, the positive effect of differentiated education on the level of physical health of schoolchildren in experimental groups was established: an increase in indicators from "below average" to "average". During the research, the data of other authors [17, 38, 39] were supplemented, which indicate a low level of physical health of schoolchildren. Our data confirm the results of Dumich O. et al. [23] about the positive influence of the differentiated approach in the process of physical education of schoolchildren of lower grades; Podoliaka A.Ie. [25] – senior preschoolers; Ierakova L. [24] – blind and visually impaired; Mameshina M.A. et al. –13-14 years old schoolchildren [31].

For the first time, the influence of the means of a multilevel system of differentiated education on the individual level of physical health of schoolchildren aged 14-15 years was determined. Also the most susceptible systems of the organism are established to influence differentiated learning.

Conclusions:

The application of the experimental model of organization of multilevel lessons of physical culture on the basis of differentiation of teaching positively influenced the level of physical health of schoolchildren of 14-15 years old. After the application of differentiated training, the adaptation capabilities of the cardiovascular system were improved during the recovery period after the standard physical load. The marked decrease in the heart rate at rest and blood pressure is evidence of a better state of adaptation mechanisms. A significant increase in the vital capacity of the lungs and the delay in breathing testifies to the improvement of the functional capabilities of the respiratory system and the body's resistance to hypoxic phenomena. Improvement in the development of strength, speed, speed endurance of the muscles of

the back and abdominal press indicates an increase in the specific intensity of the work performed.

Thus, our studies allow us to recommend to teachers of physical culture of general educational institutions to supplement the content of the educational process of the differentiated training system developed by us. This allows to increase the level of physical health of schoolchildren.

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Conflict of interest.

The authors report that there is no conflict of interest.

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The effect of an exercise program on communication and behavior of a child with Autism Spectrum Disorder

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Abstract

Purpose: The purpose of this study was to examine the effect of exercise in the communication skills and behavior of a child with Autistic Spectrum Disorder (ASD).

Material: The survey involved a 7 years old boy attending a mainstream school who was diagnosed at 2.5 years of age with pervasive developmental disorder and at 3.5 years of age with ADS. The annual re-assessment, at the age of 6 defined him as a child with high functional autism. The study consisted of three phases. In the interview process through a questionnaire, data concerning the overall picture of the boy was collected. The same questionnaire was answered by all participants (parents, general class teacher, parallel support teacher and physical education teacher) two days prior and two days after the implementation of the intervention program, so as to record observations. The questionnaire investigated four areas, that is, intention or function of communication, semantic categories and use of words, context (framework) communication and ways (means) of communication. The intervention program lasted 12 weeks, at a frequency of 3 sessions per week, of 40-45 minutes each session including balance activities, self-awareness exercises, group games (3-4 people), visual - motor coordination activities, lateral movement and time and space orientation games.

Results: After the implementation of the intervention program, the child showed significant improvement in all domains and in almost all subcategories.

Conclusions: An individually structured exercise program results in a significant improvement in behavior, skills and communication for a child with ASD.

Keywords: Questionnaire, autism, neurodevelopmental condition, training, treatment.

Introduction

Autism spectrum disorders (ASD) are complex, lifelong, neurodevelopmental conditions largely unknown, characterized by deficits in social reciprocity and communication, as well as by unusual, limited and recurrent behaviors that affect the child's social skills, communication and behavior [1].

ASDs appear in childhood and early childhood, causing delays in many key areas of development, such as learning speech, playing and interaction with others. Signs and symptoms of autism vary widely, as well as its effects. Some autistic children face only mild problems, while others have more barriers to overcome. Nevertheless, every child in autistic spectrum disorders experiences problems at least to some extent, in the areas of verbal and non-verbal communication, interpersonal relations and flexible thinking and behavior [2].

Exercise for children with autism, is a unique challenge and an integral part of fostering development, promote physical health and combat the manifestations of the disorder, since many children with ASD exhibit motor imbalances that affect body posture and performance of gross motor abilities such as walking, running, jumping, climbing, pushing and pulling. Motor deficits and imbalances occurring in childhood continue to persist in the later stages of life [3] since few intervention programs that focus on the long-term effect of exercise on children, adolescents and adults with autism do exist.

The social and behavioral effects of autism are caused by inefficient sensory processing, which is manifested by problems in attention, behavior, learning, speech development, movement and coordination. Szot [4], examining the effect of exercise on improving static and dynamic balance of children with autism reported an improvement of 47.9% of this motor skill of great developmental importance, following the implementation of a 3 months' intervention program. As Szot [4] concluded, as the intensity and repetition of exercise during childhood increases over time, positive changes in child's movement and behavior are also noted.

Self-stimulating stereotyped behaviors are a defining feature of autism, maintained by inadequate sensory feedback exhibited by children with ASD. Ospina et al. [5] study found that the participation of children with autism in a low intensity program as this is determined by heart rate during exercise, decreases stereotyped and nonfunctional behaviors by 17.5%. Fedak [6] study also showed that a program of intense physical activity was effective in reducing stereotypic behaviors in 23 children with ADS aged 5-13 years. Lang et al. [7] study observed a decrease in stereotyping, aggression, and problematic behavior in 64 individuals with ADS as a result of their participation in exercise, indicating also that fatigue was not the likely cause of diminishing maladaptive behaviors. Hence, it appears that exercise is responsible for reducing self-stimulating behaviors and especially intense aerobic

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activity can be used to control non-functional behaviors associated with autism improving in this way the overall functionality level of these individuals in everyday life [5]. Nevertheless, a recent study [8] concerning exercise for children with ADS, reported that participation in aerobic activities did not stereotyped behaviors.

Exercise that stimulates movement and deepens social communication can also be used as a treatment for improving social skills. In this regard, the use of creative dance as a treatment for children with autism is based on the possibility of social feedback produced. Mason [9] compared social skills of children with ASD with and without speech ability during a creative dance program, showing that both groups and especially children with no speech ability have benefited from this program, showing that creative dance eliminates social pressure of children with ASDs due to their interaction with peers.

Therapeutic riding is also an activity that provides benefits ranging from the therapeutic effects of the repeated gait movement to the gradual social interaction of the rider. In general, this form of exercise is particularly beneficial to children with autism allowing each child to interact with the horse and others without the worries caused by social and communicative deficits [9]. A similar later study [10] showed that a combined exercise program with therapeutic riding caused a significant reduction in stereotyped behavior in children with severe autism. Sowa & Meulenbroek [11] study, assessing social and motor disorders in 133 children with ADS also reported significant benefits in terms of movement and social skills following their participation in physical activities.

Swimming also offers significant benefits to children with ASD. Yilmaz et al. [12], reported significant gains in balance, speed and agility skills, as well as in muscle strength, flexibility and endurance following a ten weeks' swimming program with increased intensity. Water orientation improvement was also highly related with a significant reduction in self-stimulating stereotypic behaviors, whereas children participating in the swimming program exhibited a more self-confident and self-awareness behavior following a water adaptation period. As Yilmaz et al. [12] stated, water exercise does not only benefit cardiovascular capacity of children with autism, but it is also believed to help in linguistic development as well as in self-perception and adaptive behavior improvement particularly during the early intervention period.

Reviewing the literature, it seems that swimming, creative dance, jogging and horse riding are effective forms of treatment for children with ASD. Nevertheless, in view of the fact that modern research literature has focused mainly on the relationship of psychomotor therapy to autism, the purpose of this study was to identify the degree of correlation between psychomotor treatment through exercise with behavioral modification. The main issue was to answer whether indirect contact or lack of social contact of children with ADS with their peers, relatives and friends without ADS can be improved through exercise in the form of psychomotor education. In this regard, a detailed analytic inventory of behavior of the participant prior and after intervention was attempted.

Material and Methods

Participant

This study aimed to provide educational intervention to a 7-year-old boy who was diagnosed at 2.5 years of age with pervasive developmental disorder and at 3.5 years of age with ADS. The annual re-assessment, at the age of 6 defined him as a child with high functional autism. During the study, he attended a public primary school in the first grade and was supported by a parallel private personel (special education teacher). The boy had normal physical development according to his age, he was calm as a character with his own opinion and he was social with people he knew and wished their friendship, even with unfamiliar people who looked friendly. Otherwise, he kept his distance, feeling uncomfortable with social interaction. He had the tendency to play alone although he wanted at the same time to get in touch with other peers. His reaction depended on their reactions displaying eye contact except when reacting reluctantly.

Procedure

In this study, the following training tools were used to evaluate the participant.

1) The Childhood Autism Rating Scale (CARS) is a diagnostic tool designed to evaluate children at risk of developing ADS and determine the degree of autism among respondents. Appropriate for the assessment of children aged two years and older, CARS examine and rates a number of factors that can help distinguish children with ADS from those with other developmental disorders. In the form of a questionnaire, this scale is based on the direct observation of behavior by a practitioner, as well as reports from parents, teachers or children supervised by the child [13].
2) The Psycho-Educational Profile (PEP-R) [14], an instrument that assesses skills, behaviors and the developmental level of children with autism and other related disorders, useful to design their individualized educational programming [15].
3) A questionnaire used in the previous study [10], in which all respondents, that is, the parents of the child, the physical education (PE) teacher, the primary school (PS) teacher and the parallel support (personnel) teacher were asked to respond prior and after intervention. The interview questionnaire is a valid assessment tool that gathers data concerning the overall children's profile of strengths and weaknesses through questions that assesses emotional and behavioral issues and explores four areas of communication related to its means, function, framework, and semantic categories and use of words. All respondents replied to the same questionnaire two days before and two days after the intervention program.

Intervention program

The total duration of the intervention program was 12

weeks, at a frequency of 3 sessions per week of 40-45 minutes each time. Each session started with a 7-minute warm-up, followed by the main part of the intervention program including balance activities, self-awareness exercises, group games (3-4 people), visual - motor coordination activities, lateral movement and time and space orientation games. A 1-2 minutes break interfered in every 10 minutes of exercise. Each session was completed with a 5-minute cool down period of walking around the basketball court line.

Statistical analysis

A qualitative research approach [1] was used for the analysis and processing of data, as it is effective in collecting information related to social behaviors, personal opinions and emphasizing data collection through questions and interventions that have not pre-decided.

Results

Results for behavior and each of the four areas of communication (function, semantic categories and use of words, framework and means) as recorded by the four respondents (parents, physical education (PE) teacher, primary school (PS) teacher and the parallel support personnel) prior and after intervention are presented in following figures.

Regarding 'intention or function' of communication changes were observed after intervention in "General" and "Asks" according to the PS teacher and parallel support personnel, in 'Draws attention" and "Requires information" according to parents and 'provides information according to the PE teacher. No changes were observed in all other factors (Figure 1).

Regarding "semantic categories and use of words", post intervention changes were observed in "General" according to parents, PS teacher and parallel support personnel, in "Objects" according to parallel support personnel, in "Individuals", "Actions" and "Internal condition" according to parents' opinion and "Quality" according to parents and the PE teacher. No other changes were observed in the two remained factors (Figure 2).

In relation to the Communication Framework following the implementation of the exercise program, changes in behavior were observed in questions 1 and 8 according to parents, in question 2 according to parents, PS teacher and PE teacher, in questions 3, 4 and 5 according to all 4 respondents in questions 6, 9, 10, 11 and 12 according to 3 out of 4 respondents except the PS teacher and in questions 7 and 13 as answered by the parallel support personnel (Figure 3).

As for communication means, behavior changes were observed following intervention in questions 1 (Kinetic/ objects) and 8 (Clarity) as reported by all 4 respondents in questions 2 (Gestures) and 5 (Written words) according to parents, PS teachers and PE teacher, in question 3 by parents and parallel support personnel, in question 6 (Speech) by parents and PS. No changes were noted in questions 4 and 7 (Figure 4).

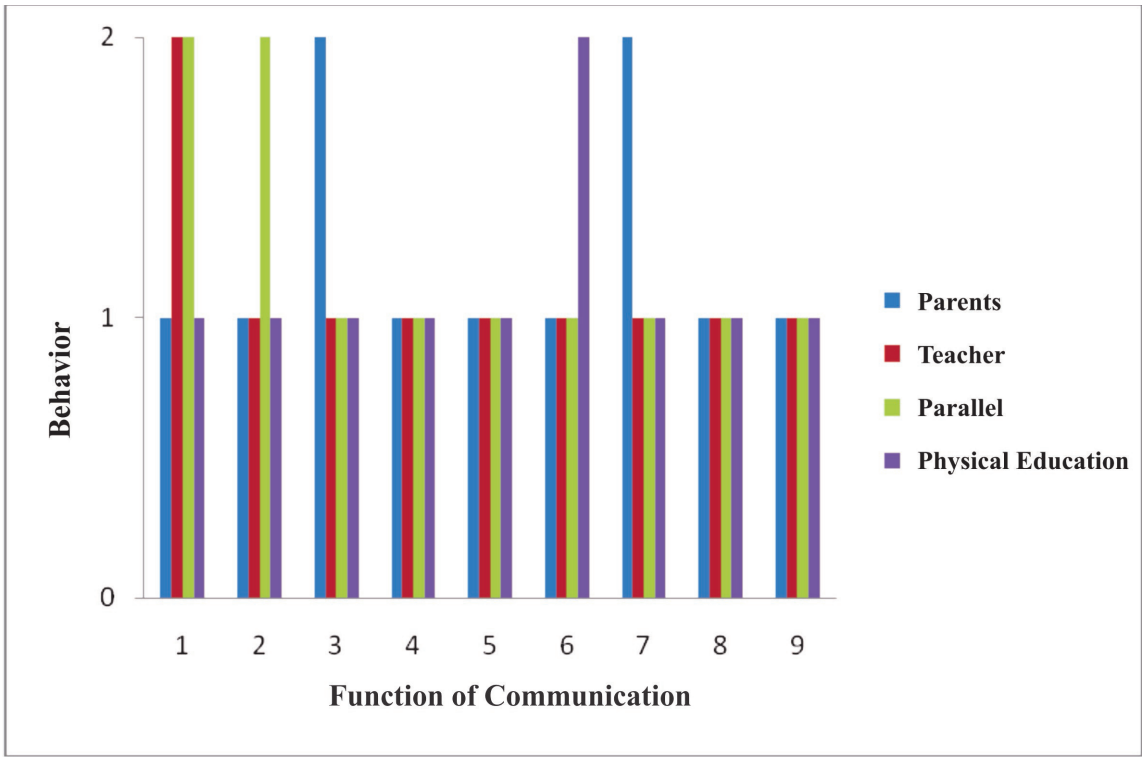

Figure 1. Intention or Function of Communication
Behavior: 1: No Change, 2: Change
Intention or Function of Communication: 1: General 2: Asks, 3: Draws attention, 4: Comments, 5: Refuses, 6: Provides information, 7: Requires information 8: Expresses emotions 9: Social routine

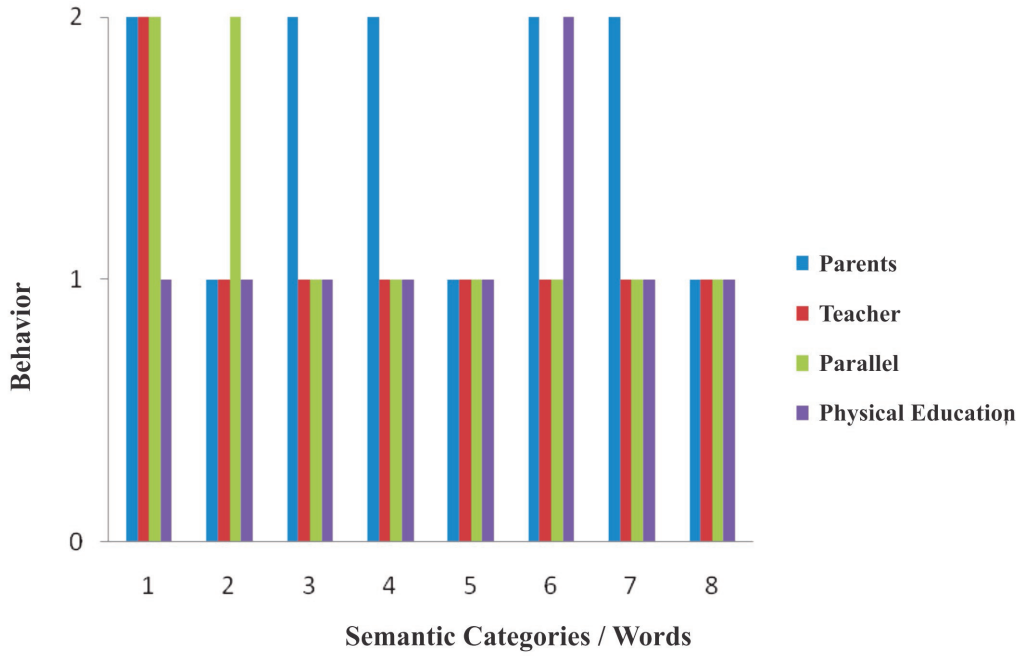

Figure 2. Semantic Categories and Use of words
Behavior: 1: No Change, 2: Change
Semantic Categories / Use of Words: 1: General, 2: Objects, 3: Individuals, 4: Actions, 5: Spaces, 6: Quality, 7: Internal condition, 8. Other.

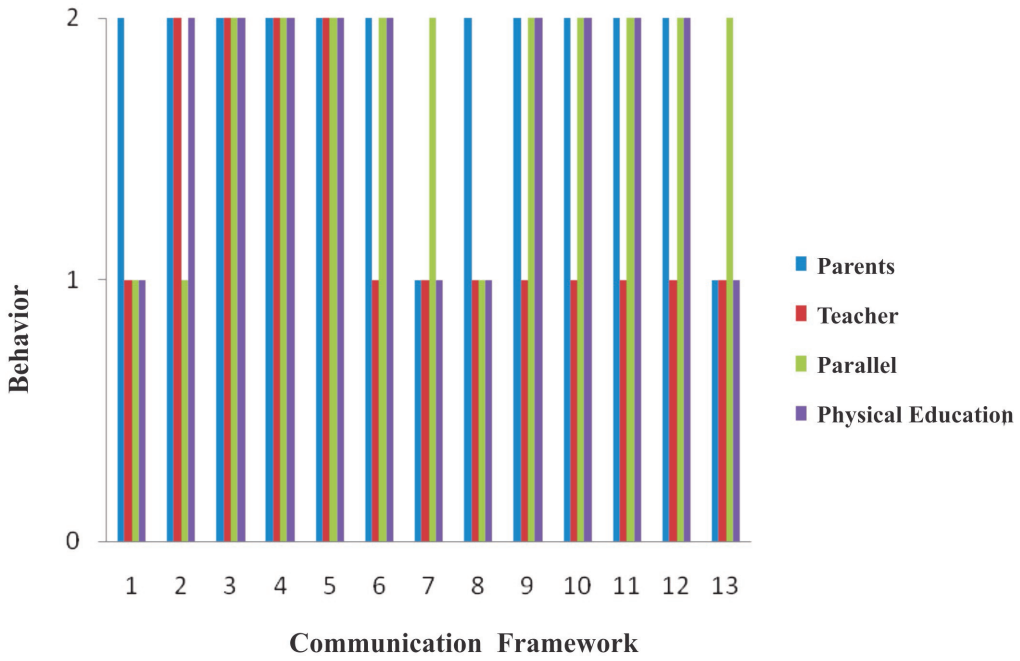

Figure 3. Communication Framework
Behavior: 1: No Change, 2: Change
Communication Framework: 1. General: With whom the child is most trying to communicate with? Under which circumstances does he/she usually communicate more? 2. Does the child communicate better with you (the parents)? 3. Does the child communicate better with his/her brother(s) or sister(s)? 4. How about child's communication with his/her peers or other youngsters? 5. Does the child communicate with family friends and relatives? 6. Does the child communicate easily with unknown persons? 7. Does the child usually communicate during lunch time? 8. Does he communicate about housework that he can do? 9. Does he communicate for actions such as dressing, washing, brushing teeth etc? 10. Does he initiate communicate with you when you let him play on his own? 11. When you go out together there are some activities you do or some places you go to which it is highly likely for him to communicate? 12. Are there other situations where you have noticed that he is highly communicative? 13. Are there other situations in which you noticed that he is highly non-communicating or where communication is particularly inappropriate?

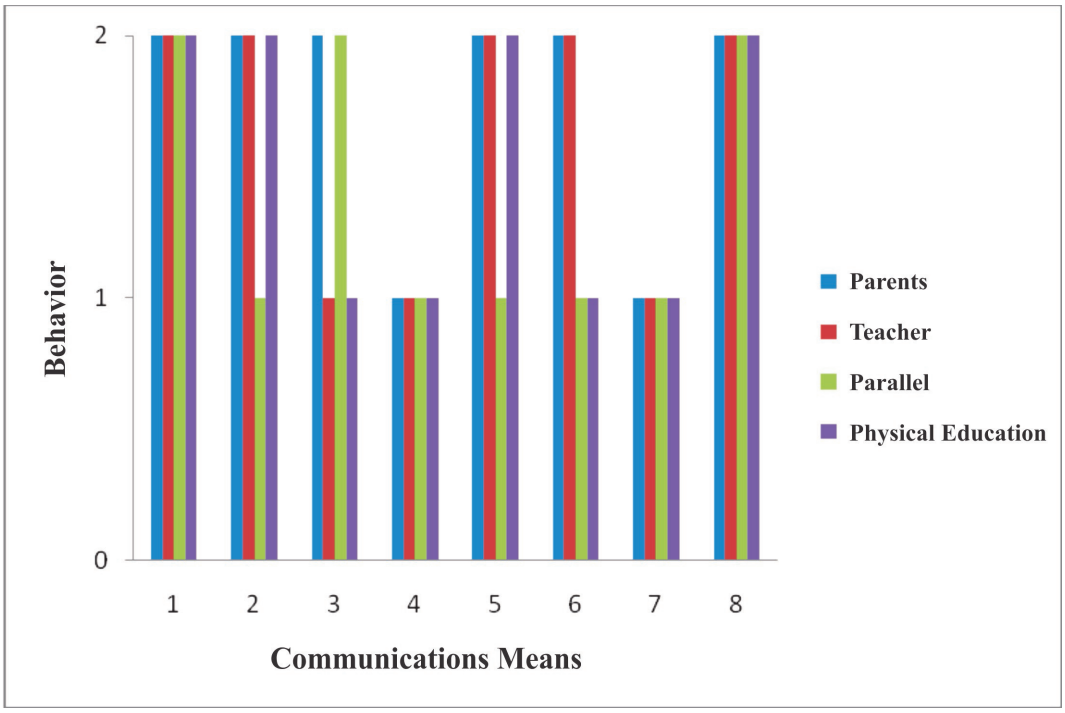

Figure 4. Communication Means
Behavior: 1: No Change, 2: Change
Communication Means: 1: Motor/objects, 2: Gestures, 3: Pictures, 4: Symbols, 5: Written words, 6: Speech, 7: Other, 8: Clarity.

Discussion

The purpose of this study was to investigate whether a psychomotor training program in the form of exercise is capable of bringing about positive changes in communication and behavior skills of a child with ADS.

In intention - function of communication the child following intervention showed a significant change according to all four respondents in most factors. In providing information, the positive change was equally significant and evident for the PS teacher and the parallel support personnel, except parents who saw little progress and the PE teacher who did not notice any progress at all. In commenting, the PS teacher reported little improvement, while the other three respondents perceived improvement as great. Finally, the boy continued not to ask for help from the PS teacher, in contrast with the other three respondents.

As for semantic categories and use of words, the PS teacher noticed no improvement in 'objects' and 'actions', while the parents reported little progress concerning internal condition (emotions). In all other categories a significant improvement was noticed by all respondents.

No change has been noted in communication framework during food and homework with the child continuing not to communicate. Furthermore, the classroom teacher did not notice any improvement in communication with non-familiar individuals contrast with all other respondents. In all other communication features, significant progress has been made.

In terms of the means that the child uses to communicate, the most significant and evident improvement was recorded by all respondents in all motoe, gesture, written words speech and clarity features, with the boy no longer using images and symbols anymore.

In summary, the findings of this study point out that the child completely stopped using images and symbols to communicate and began to use speech. The fact that he made himself understood by others in almost all of his speech efforts helped him to stop using PECS. Also, it is important to note that no deterioration was noticed in any trait measured, since only a few remained the same.

With regard to the research questions initially set, the answer to the first issue on whether there was a positive change noted in child's behavior following the psychomotor program is yes as the boy significantly improved his behavior in all trait areas measured. As for the second assumption on whether improvement could be evident in all three areas of child's activity, the outcome is positive in most behavior features but not all, especially according to the PS teacher point of view. Therefore, the main hypothesis of the child expected to show a marked improvement in all areas of behavior and relative skills after the intervention program is verified for most features, with the footnote that in some behavior and communication traits on differ settings, progress was not apparent.

The finding is in agreement with the study of Garcia-Villamisar and Dattilo [8], who concluded that exercise for children with ADS helps them to cope with the manifestations of the disorder. Similar findings were also verified by the study of Filiou [1] stating that the most effective interventions for children with autism are those involving movement as in this study. Other researchers also reported that through exercise, positive behavior and

motor changes are noted in children with ADS leading to a reduction of non-functional manners [6, 8, 17, 18]. Szot [19] stated that exercises of high intensity are needed to achieve the desired behavior outcome, and unfortunately, the most well-known and widespread methods of treatment through movement for children with ADS do not focus on this area. His exercise program was based on repeating the exercises that incorporate duration, strength and frequency all together. Since repetition of exercises at a fixed duration often encountered the reluctance and often the refusal to perform, he also used a therapist or guardian who provided immediate help at any stage of the exercise program so as to reinforce positive outcomes. Following 4 years of scientific observation, a positive correlation was evident between repetition and alternation of exercises with positive changes in child's behavior. Similar results of positive correlation between exercise and behavior change although the relation of the exercise intensity and better outcomes was not measured.

Even in earlier research efforts [20], the usefulness of physical activity was demonstrated as a possible method of reducing self-stimulation behaviors. In seven children who had very high levels of self-stimulation, post-intervention findings showed that exercise reduced self-stimulation and increased play and academic performance behavior. Positive behavior changes were evident in three different research environments regarding their academic performance (kindergarten skills), during ball games; and in the quiet room where no other activity took place. Measurements in a classroom environment during school also exhibited similar results.

In another earlier study [21], five boys with ADS who participated in three different programs, that is, exercise, TV watching and simple academic work, showed lower levels of self-stimulation after exercise, and no differences or decreases in self-stimulation levels after watching TV or doing simple academic work. Nevertheless, their performance in formulating correct answers to questions related to their socialization and communication was not affected by any of the three different programs preceded and did not differ in relation to the level at which they were prior the start of research inquiry. The latter finding is in contradiction with the findings of the present study as the participant showed an increase in his social and communicative skills through exercise. This difference is due to the fact that autism in each child is different and therefore a wise choice of following an individualized approach prior intervention is needed.

Kern et al. [22] examined the effect of light exercise on stereotypical behavioral patterns of three children aged 7-11 who participated in two exercise outdoor programs (jogging and relaxed ball games) of 15 minutes duration each. Following light exercise, no significant results of little or no effect on their stereotypic behavior were produced concerning the behavior of children, while continuous and intense exercise caused a significant reduction in stereotypic behaviors. The first finding is inconsistent with the findings of the present study since the child showed a significant reduction in stereotyped behaviors after exercise of low intensity. However, PEP-R and CARS diagnostic tools either were not available at that time or they were modified and upgraded later on to compare the contradictory results between the two studies.

Schurrer et al. [23] studied the behavior of five individuals with ADS who participated in an aerobic exercise program and recorded a performance increase in social activities and a reduction of aggressive and disruptive behavior of these individuals. Stahmer & Schreibman [24] applied an exercise program through play activities to 3 children with ADS exhibiting persistent problematic self-stimulation behavior (hand hitting, toy spinning, etc.) and oobserved that self-stimulation behaviors were reduced as the intensity of playing increased.

Lang et al. [7], reviewing 18 previous researches and also implementing a study involving 64 individuals with ADS aged 3-41 years concluded that participants with ADS improve their behavior by incorporating regular and specific forms of physical activity, a finding that is in agreement with the findings of our study.

Axarli [10] reported that a combined exercise program of physical education activities and therapeutic riding improved the communication of 5 autistic children with their parents and teachers, a finding identical to the findings of this study. As Axarli [10] concluded, it is now generally accepted that autism in each child is manifested in a different way, thus, future intervention programs should be individualized.

Conclusions

The findings of the present study show that adapted physical education seemed effective in reducing stereotypical behavior of the child and developing his motor, social and communicative skills. Exercise has greatly improved communication skills of the child with autism, something that has reinforced collaboration with parents, teachers and team of experts. Improvement was evident in all three environments at home, school and outdoors. No deterioration was observed in any communication traits apart from some features remaining the same whereas most communication skills were improved. Furthermore, the psychomotor program seemed to be pleasant and acceptable to the child with ADS, enabling him to participate in socially acceptable motor activities.

An important role played the preparation of the child with ADS by all respondents and the way that this was done by each respondent so as to positively influence the psychology of the child, reduce his anxiety, increase self-confidence and consequently maximize the overall potential to improve performance and behavior. The effort of the parallel support personnel to integrate the child within different environments and the role of the PE teacher to select proper exercises that foster self-confidence and communication skills are also considered crucial.

The value of findings emerging after 12 weeks of thorough investigation has its limitations related to case study designs that cannot be generalized. Future researches

should also use semi-structured interviews to further look into deeper thoughts and beliefs of all participants that cannot be examined only through questionnaire use. A combination of qualitative and quantitative approach using larger sample of children with ADS could help to further ascertain the effect of exercise on behavior and communication skills as well as other ADS traits that were not examined in this study.

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Concflict of interests

The authors declare that thare is no conflict of interests.

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Physical development of hockey players aged 13-16 years

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Abstract

Purpose: Identify the age features of hockey players aged 13-16 years old physical development.

Material: Elite hockey players (n = 83, age - 13-16 years) were surveyed. Standard anthropometric methods for measuring length and body weight were used. The body mass index (BMI) was calculated.

Results: The average value of the body length of hockey players did not differ from peers, who do not engage in sports. The cental distribution of the absolute values of the indicator relative to nomograms has been shifted to the right. Most hockey players had average body lengths. The excess of the average body weight of hockey players was recorded in comparison with the average population values. The cental distribution of absolute values was characterized by a significant shift to the right (range 3% -90% percentile). Most hockey players had a body weight "above average" (55-66%). The group of athletes with body weight and BMI "below average" was 6% (age from 13 to 15 years).

Conclusions: The physical development of elite hockey players is characterized by an average body length with a tendency to shift to values "above average". The proportion of hockey players with mean body lengths below the mid-population is very small. Elite hockey players are characterized by large body weight and BMI compared to peers who do not engage in sports. As the age increases from the morphological criteria, the body weight and BMI have the greatest value for the hockey player's success in sports selection.

Keywords: athletes, ice hockey, pubertal period of development, body length, body weight, body mass index.

Introduction

The anthropometric profile of athletes is determined by the two most important interrelated factors: sport selection and the impact of specific physical (muscle) loads. The physical development of most adolescents is harmonious with the mean length and body weight relative to the population. With the increase in sports experience, the proportion of athletes with body length and body weight "above average" and "high" is greater [1-3]. In this case, the appearance of secondary sexual characteristics in athletes occurs later in time. The main reason is the delay in the onset of the pubertal period of development [4, 5]. It is known that anthropometric parameters (length and body weight) have a high degree of genetic determinacy [6, 7]. Therefore, the nature and intensity of physical exertion can have a positive and negative impact on the pace of physical development [9-11]. Anthropometric parameters are often used as indicators of the success of athletes [12, 13].

Adult highly skilled hockey players are characterized by a relatively large body weight (91.4-94.5 kg) and body length above the average (185.3-186.5 cm) [14-16]. There is a correlation between the success of international teams and the body mass indicator and body mass index (BMI) [17]. A similar relationship is revealed in relation to the rating of hockey leagues within individual countries [18]. The power character of the game is typical even for children and youth hockey with a puck. This causes close attention to the anthropometric profile of young hockey players. In various countries, power collisions have been permitted since the age of 10-12 years. This leads to a significant increase in the risk of injury to hockey players of childhood and adolescence [19-21]. Hockey agents and scouts of hockey teams pay much attention to the analysis of the indicators of game statistics and physical development parameters of prospective players [22]. In the future, successful athletes participate in competitions in hockey leagues of North America.

The pubertal period is a critical period of development. This is reflected in the appearance of relative instability in the parameters of activity of all functional systems of the body. There is an active neurohormonal change, which leads to significant alterations in the physical development of children. Absence or insufficient consideration of the age characteristics of a young athlete organism can lead to a slowing-down in physical development. During this period, the risk of injury significantly increases. This is especially noticeable in hockey with a puck [13, 17].

For non-sporting children, there are age-sex regional nomograms that are used in pediatrics [23, 24]. In the scientific literature, data on the anthropometric profiles of hockey players of the pubertal period of development are few and isolated. However, knowledge of the features and regularities of the parameters of total body size and physique in the age aspect are necessary for sports athletes.

Hypothesis – there are specific features in the parameters of hockey players' physical development of the puberty period of development, depending on age.

Material and methods.

Participants. Male hockey players (n = 83, age 13-

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16 years) were examined. Game role – forward and full-back. In the distribution of groups were taken into account the features of physical development: the beginning of the pubertal period is characterized by great variability in the parameters of physical development [19]. The distribution for groups was conducted in steps of one year: 13 years old hockey players (mean age 13.31 ± 0.48 years, n = 16); 14 years old hockey players (age 14.22 ± 0.42 years, n = 26); 15 years old hockey players (age 15.22 ± 0.43 years, n = 18); 16 years old hockey players (age 16.24 ± 0.44 years, n = 23). As comparison groups, the data of children and adolescents of the South Ural region of Russia for 2002-2014 were used. [25, 26]. The study followed ethical measures to conduct scientific research in accordance with the Helsinki Declaration.

Organization of the study. The physical development of hockey players was studied on the basis of the specialized children's and youth school of the Olympic reserve (SCYSOR) "Tractor" (Chelyabinsk, Russia). This school is one of the best hockey schools in Russia. A prospective cross-sectional study was conducted. The terms of the study corresponded to the beginning of the preparatory period. Anthropometric studies were conducted according to the standard method using standard instruments [9, 27]. Measurements of body length and body weight were carried out. BMI is also determined. The research conditions were standardized: morning time; on an empty stomach. To assess the characteristics of physical development of hockey players were used centile tables [23]. According to the medical-physical examination, hockey players are healthy children. Therefore, the study adopted the following distribution of anthropometric indicators relative to nomograms: interval 25-75% percentile – "medium", 25% percentile and less – "below average"; 75% percentile and above – "above average".

Statistical analysis. For the statistical processing of the results of the study it was used a package of statistical programs "Statistica.10.0": descriptive statistics methods, parametric methods for determining the reliability of the differences between unrelated samples by the Student's criterion.

Results.

The average value of hockey players' length and body weight was the following: at the age of 13 years - 159.9 ± 8.3 cm, 175.3 ± 6.6 cm; at the age of 15 years - 51.9 ± 8.0 kg, 64.4 ± 8.0 kg (Table 1). These data did not differ statistically reliably from the values of anthropometric indicators of children not engaged in sports [15] ($p>0.05$). According to the length of the body, hockey players aged 14 and 16 did not differ from peers who did not engage in sports [15] ($p>0.05$). The weight of the body of hockey players was more ($p <0,05$). BMI of hockey players had more indicators of children not involved in sports [15, 20] ($p <0.05$ in all cases).

The cental distribution of the absolute values of the hockey players' body length (13-16 years) relative to nomograms was shifted to the right (Table 2). The least pronounced shift was recorded in the centile interval of "very high" body length (97% percentile, from 14 years to 16 years). The centrally distributed absolute body weight of hockey players (13-16 years) relative to nomograms was characterized by uneven shifts to the right, depending on ranges and age (Table 2). The most significant shift to the right was recorded in the range of 3% -90% percentile in all age groups. The body weight of hockey players (at 13 and 15 years old) with very high values of the indicator (97% percentile) did not differ from peers who do not engage in sports. In all the centile intervals, the indicators of hockey players' BMI (14 and 16 years) relative to nomograms [23] was revealed a shift to the right. In hockey players of 13 years old, the shift of the centrally distributed BMI to the right is determined only for the range of 3% -75% percentile. The hockey players of 15 years old: the shift to the right is fixed only in the range of 3% -50% percentile; in the intervals of 90% and 97% percentile, the absolute values of BMI are even smaller than in nomograms.

Among the age group of 13 years, 50% of hockey players had a mean value of body length for the population relative to nomograms: 38% - "above average" and 12% - "below average" (Figure 1). In the age group from 14 to 16 years, the value of body length "average" and "above average" are saved. The relative number of hockey players with a body length "below average" during this period was stable (6%).

A group of hockey players with a body weight "above average" was 55-66% of the total sample (Figure 2). A group of hockey players with a body weight of "below average" was 6%. This group was allocated only up to 15 years of age.

Table 1. Anthropometric indicators of hockey players from 13 years to 16 years

Group	n	Body length (cm) M±m; σ	Body mass (kg) M±m; σ	BMI (kg/m²) M±m; σ
13 years old	16	159,9±2,1; 8,3	51,9±2,0; 8,0	20,2±0,5; 2,1
14 years old	26	168,9±1,1; 6,8	59,9±1,5; 8,9	22,1±0,4; 2,7
15 years old	18	175,3±1,6; 6,6	64,4±1,9; 8,0	20,9±0,4; 1,7
16 years old	23	178,3±1,1; 6,3	74,3±1,63; 9,4	23,3±0,4; 2,0

Table 2. Cental tables of distribution of length and body weight of hockey players from 13 years to 16 years

Group	Cental interval						
	3%	10%	25%	50%	75%	90%	97%
Body length (cm)							
13 years old	145,0	152,0	153,5	159,0	166,5	172,0	175,0
14 years old	155,0	161,0	165,0	170,0	173,5	177,0	178,0
15 years old	159,0	165,0	173,0	177,0	180,0	183,0	183,0
16 years old	166,0	170,0	173,0	180,0	182,0	187,0	188,0
Body mass (kg)							
13 years old	34,00	43,00	47,50	52,50	56,00	65,00	66,00
14 years old	40,00	48,00	53,50	63,00	65,50	70,00	73,00
15 years old	47,00	48,00	61,00	67,50	70,00	72,00	73,00
16 years old	55,00	61,00	68,00	75,00	79,00	87,00	100,00
BMI (kg/m^2)							
13 years old	16,2	17,5	18,7	20,5	21,6	23,2	23,4
14 years old	18,7	19,3	19,9	22,1	23,2	25,2	29,2
15 years old	17,3	18,8	19,7	21,1	22,2	23,1	23,1
16 years old	19,3	20,6	22,0	23,5	24,7	25,4	28,6

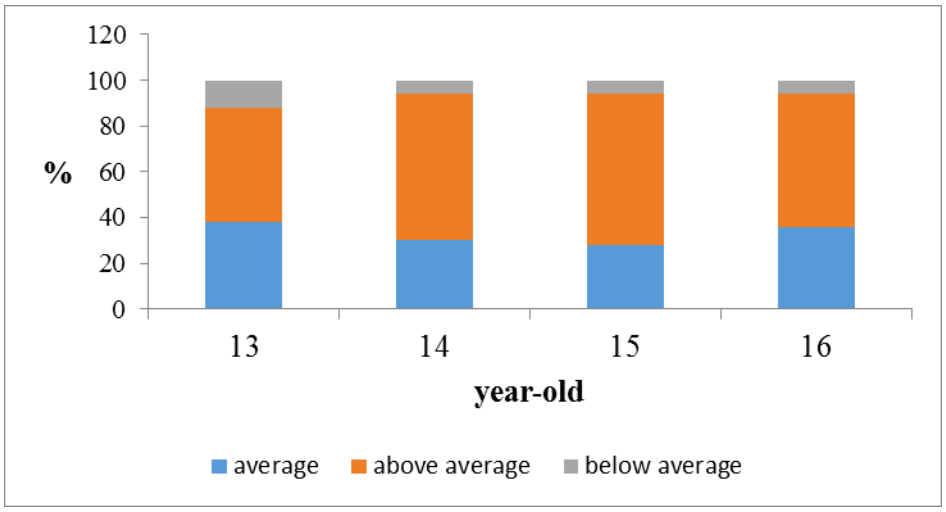

Fig. 1. In-group distribution of hockey players from 13 to 16 years old according to the body length relative to nomograms

In 13 years 37% of hockey players were characterized by BMI "above average". At 14 years the part of hockey players of this group increased to 53% (Figure 3).

The proportion of players with average BMI values in this age group was approximately the same (50-47%). At the age of 15 most athletes had average absolute values of BMI: 22% - "above average" and 11% - "below average". Among hockey players aged 16 years old 61% had absolute values more than age-sex norms. "Average" level is established in 39% of hockey players. The relative number of hockey players with the BMI level "below the average" was established in groups of 13 years (13%) and 15 years (12%) old.

Discussion.

The process of sports training for children and adolescents in SCYSOR is limited by the program on ice hockey [28]. According to the literature, children are already selected in the initial training groups, among whom the majority have average length and body weight [1]. The proportion of children with "below-average" parameters is only 17% and 8% respectively. At the same time, 84% of hockey players in the initial training groups are developed harmoniously: BMI does not go beyond the average population values [1]. At the age of 13, hockey players are comparable in length and body weight with peers who do not engage in sports. There is no statistically significant difference in anthropometric parameters. However, hockey players exceed their peers in terms of

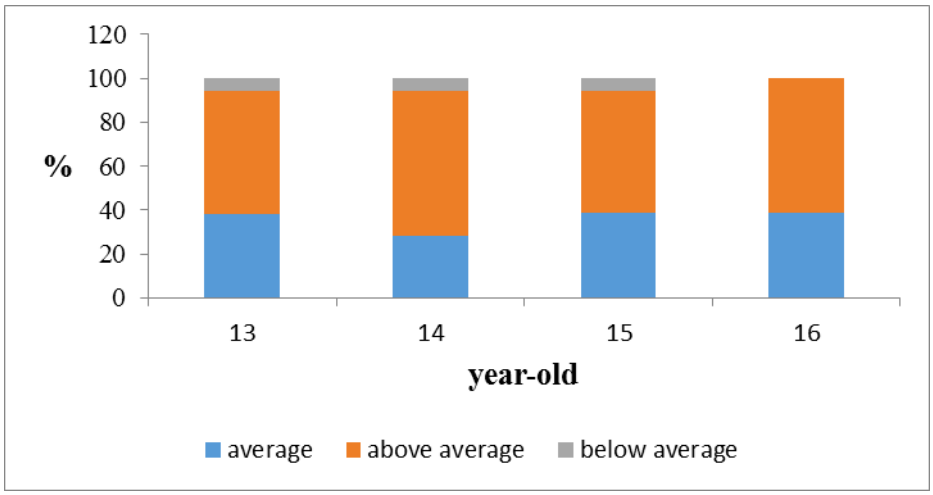

Fig. 2. Intra-group distribution of hockey players from 13 to 16 years old according to the body weight relative to nomograms

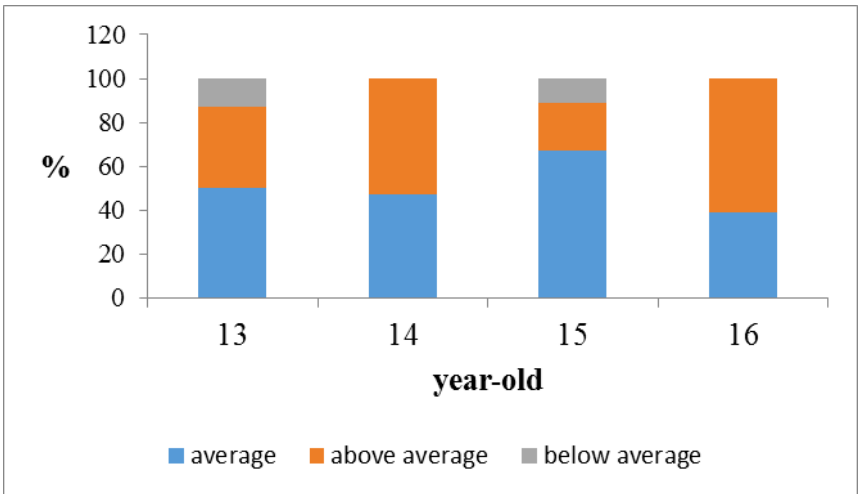

Fig. 3. Intra-group distribution of hockey players from 13 to 16 years old according to the BMI relative to nomograms

body density. This fact is confirmed by a shift in the values of the centile distribution to the right along the length and mass of the body. We were unable to compare data on hockey players from other regions of Russia: the lack of up-to-date informative data. Hockey players had large total body sizes and BMI compared to peers engaged in football in teams of professional clubs [29].

Players 14 years of age were the same length of the body with peers who do not engage in sports. At the same time, there is a distinct tendency of the shift of the centile distribution relative to the age nomograms to the right. This is especially true for hockey players with very high growth. The body weight of 14 summer hockey players was more in comparison with the teenagers, not engaged in sports. This is indicated by a shift in the values of the centile distribution to the right and an increase in BMI. BMI of 14 years old hockey players has become more approximate to the values of adult highly skilled hockey players [16-18]. Compared to peer-to-peer players [29, 30], hockey players of this age have large BMI values, length and body weight.

At the age of 15 at the length of the body, hockey players are similar to peers who do not engage in sports. But hockey players are distinguished by large body weight and BMI. The centrally distributed parameters of the physical development of players of this age are characterized by a shift to the right along the length of the body and an even larger shift in body weight. In this case, tall hockey players and (or) having a large body weight (97% percentile or less) do not differ from their peers who do not engage in sports. According to the BMI the cental distribution of 15 years old hockey players differs only in the expansion of the range of average values. BMI in the zone of high and very high values becomes less compared with peers who do not engage in sports. At the age of 15, hockey players from Canada and the United States begin to be selected as professional teams [31]. Already at this age they begin to differ from the players of leading team of Russia in terms of physical development. Hockey players of Canada are more than Russian hockey players in total body size and BMI [31, 32]. This fact is due to the existence of a smaller number of hockey infrastructure facilities in Russia. Therefore, there is a significant lag behind other leading hockey countries in the relative number of children and teenagers engaged in ice hockey. This reduces the competition in

children's and youth sports. Indirect influence of the level of hockey development and the level of competition on the parameters of the physical development of players is confirmed by the fact of a shorter body length for hockey players of the Republic of Belarus [33]. At the age of 15, the total body size of hockey players with a puck is similar in their average values to football players [29, 30]. This is determined by the criteria for sports selection at the stage of sports improvement when moving to professional football.

At the age of 16, hockey players differ in their body weight and BMI from peers who do not engage in sports. For comparison, we used the data of the leading hockey teams of the zone "Ural-Western Siberia" [1]. Hockey players of the South Ural region are distinguished by a smaller span of centile intervals ("25% -75%" percentile). They have an extension to the right of the interval "less than 25% percentile" along the length of the body. The physical development of elite hockey players in the South Ural region is characterized by a higher BMI score. 16 years old hockey players are characterized by large total body sizes compared to football players. This confirms the specificity of the body weight and BMI for ice hockey. This is due to the forceful style of fighting on hockey grounds and a higher probability of injuries in a collision. Therefore, when selecting young people, coaches pay more attention to the parameters of body weight and BMI of hockey players. At the youthful age (17-21 years) hockey players also have a large mass in comparison with football players [29] and representatives of cyclic sports [34].

The BMI value is the selection criterion. This confirms the existence of a high degree of interrelation between the BMI and the maximum speed of movement, the level of speed-strength qualities [29, 35]. Significant BMI values may increase the risk of injuries among hockey players [18].

Hockey as a sport belongs to acyclic situational sports. The success of a competitive struggle depends on a very large number of factors. This leads to an expansion of the range and variability of parameters in the model characteristics of the hockey player. From the age of 13 the hockey team becomes more variable in length and body weight. Appears a small group of hockey players with a body length "below average". In the future, the intra-group distribution of players along the length of the body becomes more stable: a group of athletes with the "below average" level decreases to a minimum and remains up to 16 years. A group of players with a body weight of "below average" is very small. This group stands out in the teams of hockey players only to 15 years of age. The largest representation in the hockey team has a group with a body weight of "above average" (with a maximum of 14 and 16 years). Relative heterogeneity in body weight is due to the discrepancy in the rates of biological maturation in the pubertal period of development of hockey players [5, 36]. Hockey players with a shorter body length and body weight undergo sport selection due to the high level of development of other qualities of importance for hockey [37]. In 11-12 and 13 years in the hockey team appears a group of hockey players with BMI "below average". This group is most numerous at the age of 13. This is due to intra-group differences in the timing of the onset of puberty. At the age of 14 and 15, the intra-group distribution of hockey players according to BMI varies considerably in the ratio between the individual groups. This is due to differences in the rates of biological development of players of different roles. At the age of 16, the increase in the absolute body weight of hockey players contributes to the disappearance of a group of players with BMI below the average population values. A significant decrease in intra-group variability is due to higher requirements to the parameters of physical development. This is very important to take into account in sports selection in youth hockey.

Conclusions.

The physical development of elite hockey players of 13-16 years old is characterized by an average body length with a tendency to shift to "above average" values. The proportion of hockey players with mean body lengths below the mid-population is very small.

Elite hockey players at 14 and 16 years old have different body weight and BMI compared to peers who do not go in for sports. The proportion of hockey players with body weight values below the average population is very small. This is observed only at the age of 13 to 15 years old.

The physical development of hockey players from 13 to 16 years old is characterized by large total body size and BMI relative to representatives of other game sports.

As the age increases from the morphological criteria, the body weight and BMI have the greatest value for the success of the hockey player in the passage of the stages of sports selection.

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Conflict of interest

The authors state that there is no conflict of interest.

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Modern strategies for regulating the motor activity of preschool and school age children in the educational space

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Abstract

Purpose: the systematization of modern strategies for regulating the motor activity of preschool and school-age children. The criteria for assessing motor activity taking into account the individual characteristics of children and sociocultural conditions are considered. The adaptive strategy of regulation of the motor activity of a growing person in modern educational space is substantiated.

Material: 10 theses and more than 80 papers published in specialized journals of Russia, Ukraine, Kazakhstan, Belarus were analyzed. In the article is used quantitative approach, which has research and descriptive character. This approach includes methods for examining documents. The identification of studies over the past 50 years has been carried out. The analysis of normative program-methodological materials, educational standards, exemplary educational programs and the results of their own research was carried out. These studies substantiated various approaches to regulating and forming positive dynamics of motor activity in preschool and school-age children.

Results: Three strategies for regulating motor activity were identified: biological, value-social and biosocial (adaptive). Their compliance with the level of scientific and methodological knowledge and domestic experience is established. The limiting factors have been established and ways of transforming the system of physical education at different levels of education have been concretized. The modern adaptive strategy of regulation of the motor activity of preschool children and younger schoolchildren is substantiated. The expediency of its introduction into the educational process is shown. This creates a favorable environment for the physical development of children.

Conclusions: The adaptive system for regulating motor activity should take into account: the interests and opportunities of children at all levels of the educational system; regional sports traditions; sociocultural and climatic conditions. It is extremely important to recreate the playing space of childhood. This contributes to the formation of an active position in relation to the physical culture of the individual.

Keywords: Motor activity, physical education, regulatory strategies, preschool institutions, school, optimization, adaptation strategy.

Introduction

In recent years, the environment for modern children has changed. In place of the exciting mobile games, came no less exciting – computer games. In the preferences and interests of preschool children and younger schoolchildren, there have been significant changes in the structure of their free time [1, 2].

In the development of modern children, the following phenomena are observed: hyperactivity; hypodynamia; increase the influence of psycho-emotional stress on the body. Such phenomena slowly and imperceptibly affect the children's organism. They cause disturbances in the balance between the body and the natural and social environment. Also lead to serious diseases of the cardiovascular system and metabolic disorders. Their negative impact on the musculoskeletal system (MSS) is noted. According to the World Health Organization (WHO), 80% of the world's population is affected by various MSS disorders. [3-5].

Reduction of motor activity and muscular effort depends on many factors. This is determined by the inactive way of life of modern children in highly developed countries [6, 7]. The prevalence of hypodynamia in young children is associated with: the destruction of the playing space of childhood; enthusiasm for digital or virtual environments; change of interests; the emergence of a variety of forms of leisure, excluding motor activity; strengthening the orientation of the educational process in educational institutions [8-10].

Thus, an increasing number of children are in conditions of hypodynamia. The biological need for movement of children in the modern educational space of Russia is satisfied only by 60%. Similar trends are observed in other countries [11-13].

The state of hypodynamia is characterized by a decrease in the functions of all organs and systems, a disorder of their interrelations in the body. Biological

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reliability and stability of the human body is reduced with significant functional loads and exposure to adverse environmental factors. These limits the working capacity of the organism [14-16]. With regard to children, we can only talk about relative hypodynamia. It is known that a certain minimum of motor activity is realized by the child in independent motor activity. Inadequate motor activity adversely affects many functions of the growing organism. It can serve as a pathogenetic factor in the onset and progression of a number of diseases [17-19]. Studies show that insufficient motor activity of children adversely affects the development and functional state of the cardiovascular system [20, 21]. Many preschoolers and schoolchildren are distinguished by good physical development. They also have an inadequate performance of some functions, a decrease in physical performance. All this is due to pronounced hypodynamia [22, 23]. Thus, children of preschool and school age need optimal motor activity. It must satisfy: the biological need of a growing organism in movements; promote physical development, high efficiency, the formation of a variety of physical qualities and skills [24, 25].

The problem of hypodynamia acquires a social character. Its successful solution can be achieved only through comprehensive efforts of the state, educational and public organizations, teachers, parents and children themselves. We believe that at the present stage of development of preschool and primary education, one more problem – the problem of hyperactivity – requires attention.

According to statistics, hyperactivity is diagnosed in almost 18% of children. This is much more common in boys than in girls [9, 26]. In hyperactive students of lower grades, the nervous system can not cope with the increased demands of mental and physical exertion. Therefore, in the school there is a significant deterioration in their condition: the inability to concentrate attention; inability to sit in one place for a while; imbalance; low self-esteem; short temper; headache; nervous tic; the emergence of a variety of phobias. At the same time, hyperactive senior pupils have a perfectly developed intellect. But they differ in poor performance [18, 20]. The reasons lie in inattention. High school students are distinguished by impulsiveness, inability to assess the consequences of acts, aggressiveness. Such schoolchildren find it very difficult to find common language with peers and are prone to various conflicts [18].

At present, scientific and practical importance has an assessment of the existing motor activity of modern preschool children and schoolchildren. It is important to define: scientific approaches and improving the principles of rationing activity; minimum motor activity and ways to achieve it, which is necessary to ensure the harmonious physical development of the child.

There is a contradiction between the need for society to preserve and strengthen children's health and the lack of motor activity and regulation of hyperactivity in preschool children and schoolchildren. All this confirms the relevance of the problem of regulating the motor activity of children at the social, pedagogical, scientific-theoretical and scientific-methodical level. Optimal motor activity should contribute to the harmonious development of the child in the broadest sense of the word. Such activity should optimally influence physical and mental development, strengthen health, ensure high performance in subsequent periods of human life. Children need to create conditions in which they can fully satisfy the biological need for movement and improve their general physical training. To this end, a sufficient volume of organized and independent forms of motor activity should be included in the children's mode of life.

The aim of the study is to determine the leading strategies for regulating the motor activity of preschool and school children in the modern educational space.

Material and methods.

Participants and parameters. 10 theses and more than 80 papers published in specialized journals of Russia, Ukraine, Kazakhstan, Belarus and other countries were analyzed.

Study Design: in the paper is used quantitative approach, which has research and descriptive character. This approach includes methods for examining documents.

Data collection: identification of studies for the last 50 years has been carried out [6, 10, 27]. The analysis of normative program-methodological materials, educational standards, exemplary educational programs and the results of their own research was carried out [28, 29]. These studies substantiated various approaches to regulating and forming positive dynamics of motor activity in preschool and school-age children [22, 23, 30]. In most of the works, the main means of regulating motor activity were exercise and mobile games [9, 31]. Working with the material of the studies made it possible to distinguish three strategies for regulating motor activity. Deep analysis of modern strategies for regulating the motor activity of preschool and school age children allows to: identify their compliance with the level of scientific and methodological knowledge and domestic experience; establish limiting factors; concretize the ways of transforming the system of physical education at different levels of education. This approach can be considered a significant evidence of the justification of the modern adaptive strategy for regulating the motor activity of preschool children and junior schoolchildren. The expediency of introducing such a strategy into the educational process is justified by the creation of a favorable environment for the physical development of a growing person.

Data analysis: articles and dissertations were analyzed and classified according to their content and type.

Results.

The rapid progress of the spectrum of human sciences in the past century put the issue of a new paradigm of thinking on the agenda. Such a paradigm would allow us to rethink our ideas about the mechanisms governing the motor activity of a person. Such mechanisms represent an integral system in all the diversity of interaction between

the individual and social sides.

It is known that movement is the basis of all the physiological functions of the human body. This is manifested in interaction with the external environment [15, 23]. Therefore, movement is an obligatory component of all types of homeostasis. Movement should be characterized by the consistency of its characteristics. Therefore, the full development of the children's organism is possible only on condition of maximum satisfaction of their biological need for movement [18, 27]. If this condition is not met, then defects in physical development inevitable appear. There is also an obvious or hidden pathology of individual functional systems. Already at this stage of age development, hypokinesia becomes a significant risk factor in the development of various diseases. Therefore, before 7-8 years of age, the level of motor activity should be consistently and intensively increased [4, 5]. At the stage of early growth (3-7 years) there is a process of development of coordination mechanisms of vital activity and all functional systems. To improve them, the motor potential is needed, which accumulates in previous years [5, 6].

Let us turn to an analysis of the biological strategy for regulating the motor activity of a growing person. It laid the idea of N.A. Bernstein [32] and I.A. Arshavsky [33]. The authors defined a new understanding of the vital activity of the organism. It is seen as an active and purposeful system: the process of life is an active interaction with this environment.

The energy rule of skeletal muscles is formulated. According to this rule: the state and development of the organism in each age period is determined by the functioning of the muscular system; every movement is a factor in the induction of excess anabolism. As a result, growth and development of the organism becomes possible. This rule operates throughout the ontogenesis, beginning with the embryonic period.

Other studies confirm the need for a value-social strategy for regulating motor activity [3, 18]. Understanding the socio-biological inheritance of the healing effects of physical culture influences the reorientation of public consciousness in the field of physical culture. This contributes to improving the health of children [18, 19]. Important role in the upbringing of the younger generation is given to the family. The role of the family is determined by the independence of its impact on the development of children. This allows you to take into account the characteristics of the child, which parents know much better than other caregivers [16].

The social environment has a significant influence on the formation of various activities. The physical activity of teachers, parents and friends can influence the increase and decrease in the level of physical activity of children. The targeted impact of the social environment is aimed at: intensifying the efforts of the child's personality; the solution of problems arising before it; creation of conditions for improving motor activity; initiation of their regular physical activity.

The basis of the formation of physical activity of children is the need-motivational processes. They allow children to achieve the goals of physical improvement and to strengthen mental and physical health. Such processes contribute to the achievement of social well-being and improving the emotional state of children. [22, 30]. The same thing happens with studies: the acquisition of physical culture and sports knowledge should be seen as a means to make your physical activity more effective. Physical exercises begin to serve as a means of acquiring knowledge, skills, health, and development of a personality [28, 34].

Analysis of modern preschool education programs has shown that in most of them actual tasks are set for the development of the child's motor activity. They reflect modern trends in the physical education of preschool children: stimulating physical activity at the expense of the social determinant. Such socially-determined physical culture motives and needs provide a stable motivation for motor activity [15, 18]. The developed mechanisms and means for implementing these tasks for children of younger preschool age are effective only in cooperation with an adult.

One of the most important conditions for the mental and physical health of children in this age period is rational socialization. It is also important to improve the skills of adaptation to the changing conditions of the social environment. The child develops when he himself is active and interacts with the world. The nature of this activity is determined by the subjectively free relation of personality.

Athletic and sporting motives and needs, knowledge and skills are a specific content of motor activity. This is acquired through social determination and allows the child to become the creator of his bodily nature. This provision we will take into account when developing criteria and indicators of motor activity.

At the heart of the pedagogical component of the value-social strategy for regulating motor activity lies a number of studies by Russian scientists [3, 23]. In the work of L.K. Sidorov showed that in the methodology of building a system of physical education, the foundation of the state of motor need will be the fundamental principle: the need for physical training will be assessed at the subconscious level [31]. Only such a level of the formation of the motor need will allow to solve successfully all the problems facing physical education.

We can state that the systemic, activity-based and humanistic approaches become the answer to the vital questions of optimizing the motor activity of the child.

In domestic studies, various methods of measuring motor activity are reflected: for time costs (per day, per week); by the number of locomotion performed per day (pacing); on energy costs (in calories or Joules per unit of time).

It is important to obtain reliable and objective information that allows us to judge the proper norms of the motor activity of various social groups of the

population. This is especially important for modern youth. It is important to understand the influence of factors that determine the storyline of their behavior in everyday life. The methods of questioning (polling, ranking, observation) will help objectively evaluate the optimality of the motor regimes of young people.

In the field of physical education in programs and technologies should be taken into account the socio-pedagogical factor. The most significant criterion is the degree of fulfillment of the social order. Management decisions seem reasonable only from the standpoint of their social effectiveness and expediency.

All these makes it necessary critically analyze the approaches, principles and technologies for regulating the motor activity of children of preschool and school age that are actually working in practice. Such approach will allow to reveal their conformity to the level of scientific and methodological knowledge. Also, it will allow to establish limiting factors and to specify ways of transformation.

Discussion.

Our analysis of the regulation of the motor activity of preschool children and junior schoolchildren proves the existence of a problem situation. This issue is given much attention. Scientists offer different approaches to regulating the motor activity of children. Optimization of the motor activity of children requires an appropriate analysis of modern curricula, technologies, health systems. Some authors have substantiated approaches to the organization of physical culture and sports in general educational institutions. The authors take into account the peculiarities of working with children of preschool age [30].

In other studies, great importance is attached to the formation of the physical culture of the personality of children through joint activities with parents [22]. The authors disclose the tasks of intellectual development of children in physical education. They determine the content and direction of activity of children of preschool and school age by means of physical culture. Also, the approaches for solving the above problems are substantiated [22, 23]. Other authors integrate intellectual and social activities into the formation of the need for motor activity [24, 31].

These campaigns uncover various aspects of the realization of the motor potential of children. They point out the shortcomings of the educational process in physical culture and social environment. This allows you to form the needs of children, motives, knowledge and skills.

The problem of regulating the motor activity of a growing person is significant for specialists in the field of physical culture and medicine in Poland, Sweden, Ukraine, Australia and in other countries of the world [13, 35-38]. The analysis of scientific research on the problems of regulating the motor activity of children allows to study all aspects of the implementation of this activity. For this we propose an adaptive approach. This approach takes into account the internal components of regulation. Also takes into account the external aspects of stimulating motor activity in the social, psychological, and biological environments.

Conclusions.

Analysis of the results of the studies allows us to identify three areas in the definition and regulation of motor activity. At the heart of each of them is one advantageous factor. This fact determines the level and conditions of motor activity. We have identified three strategies for regulating motor activity: biological, value-social and biosocial (adaptive).

An analysis of the studies on this problem points to the lack of a holistic strategy for the formation of an active motor regimen of children. The biological needs, desires and interests of children are not taken into account. Do not take into account the social environment in which children develop. The lack of a pedagogical system and the technology of its implementation make it very difficult to achieve the goal of raising healthy children.

All of the above indicates the need to create an appropriate system for regulating the motor activity of children. The basis of such a system is the adaptation approach. This approach combines modern ideas to regulate motor activity. This will allow to form an active position of children and regulate the motor activity at the biological level. This approach allows at the pedagogical level to: fill the lack of activity; direct excessive activity towards specific goals. This will ensure the adaptation of children to the educational process and social conditions. The adaptive system of regulation of motor activity should take into account: wishes and opportunities of children; regional sports traditions at all levels of the educational system. It is extremely important to recreate the social environment and the playground of childhood, which contribute to the formation of an active healthy position in relation to the physical culture of the individual.

Conflict of interest.

The authors state that there is no conflict of interest.

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