ATLANTIS PRESS

Advances in Health Sciences Research, volume 17

4th International Conference on Innovations in Sports, Tourism and Instructional Science (ICISTIS 2019)

The system of daily self-monitoring of physical activity of youth in various move and energy modes

Nagovitsyn Roman Sergeevich
Department of Physical Culture and Life Safety
Glazov State Pedagogical Institute
Glazov, Russia
gto18@mail.ru
0000-0003-4471-0875

Osipov Aleksander Yurevich[2,3,4]
Department of Physical Culture
[2]Siberian Federal University;
Department of Physical Culture,
[3]Krasnoyarsk State Medical University named after professor V.F. Voyno-Yasenetsky;
Department of physical training,
[4]Siberian Law Institute of the MIA of the Russia
Krasnoyarsk, Russia
Ale44132272@ya.ru
0000-0002-2277-4467

Kudryavtsev Mikhail Dmitrievich
Department of Physical Culture,
[2]Siberian Federal University;
Department of physical training,
[4]Siberian Law Institute of the MIA of the Russia;
Department of physical education,
[5]Reshetnev Siberian State University of Science and Technology
Krasnoyarsk, Russia
kumid@yandex.ru
0000-0002-2432-169

***Abstract*. Objective of the study was develop a system for daily self-monitoring of the physical activity of young people in various move and energy modes and experimentally prove its effectiveness by increasing the level of physical health and body mass index of participants in the experiment. Organization and research methods: the study participants were 42 respondents aged 18 to 25 years old with a diagnosis of "obesity" based on the calculation of body mass index. The respondents of the experimental group in the training process, which lasted 4 months, carried out self-monitoring of individual move activity according to the daily methodological system proposed in the study. Which included the ranking of various types of physical exercises in various move modes for energy consumption in Kcal/min. Results: the implementation of the training process using copyright recommendations for the implementation of continuous daily self-monitoring of move activity of young people is reliably effective in improving their physical health. The obtained statistical results prove a positive effect in the work of the cardiovascular system of the body and improve the overall metabolism of the study participants. Conclusion. The study for the first time systematically presents the most common move modes of youth through their differentiation in energy burning in Kcal. Recommendations on the implementation of move activity of youth at home through the development of a special system of step exercises of various intensities are offered. The study will be useful to a wide range of specialists in the field of physical education and sports, fitness trainers, as well as athletes who are independently engaged in various physical exercises.**

Keywords - daily self-monitoring, physical activity, youth, energy mode, physical health, body weight.

I. INTRODUCTION

Recently, many researchers have proved that the implementation of the optimal move activity of a person in its various forms positively affects the state of health, the level of physical fitness and the functional state of the body [1]. The market of mobile health services offers a variety of systems for monitoring and self-monitoring the state of physical performance of athletes of various ages and qualification categories [2, 3]. Various functional tests for monitoring all body systems are popularized [4, 5], in particular the key one for analyzing the fitness of the body - the cardiovascular system [6, 7]. It is the functional state of the cardiovascular system that is regulated by the central nervous system [8]. It is synergistically associated with the activity of all organs and systems and therefore is a reflection of the functional state of the organism as a whole [9].

One of the main conditions for the full functioning of the human cardiovascular system are systematic physical exercises [10]. It is the sequence of performing physical activity in daily and weekly modes that ensures the transition of urgent adaptive reactions of the body to long-term adaptation to loads [11]. It is based on enhanced adaptive protein synthesis, leading to an increase in the power of functional cellular structures [12]. A positive effect can be achieved only when the effect of one activity is combined with the action of the next, if new activities begin with a background characterized by increased activity of cellular structures and supercompensation of energy resources [13]. In turn, this means that the basis for the development of fitness is the systematic impact of the load and the regularity of its repetition [14]. Long-term adaptation to a specific repetitive load is associated with a constant increase in load. If the load remains the same and does not change, then the effect becomes ineffective. Move activity requires only part of the use of increased body reserves and ceases to be a developing stimulus [15].

Therefore, the need for a gradual increase in physical activity is one of the key conditions for organizing physical education in the aspect of a health-improving orientation [16]. Violation of the principle of gradualness in the training process can not only not give the desired healing effect, but

also lead to serious health problems [8]. Individual construction of a program for the implementation of physical activity should provide for the correct selection of exercises, their dosage and power exposure [17]. Only a strictly individual approach to a gradual increase in load will ensure success [15]. However, despite the identified relevance of the implementation of physical exercises. An insufficiently studied issue, in our opinion, is the methodological preparation of young people for self-designing individual physical activity during the day, week or a specific training cycle. In this regard, the study determined the objective of the study - to develop a system for daily self-monitoring of youth physical activity in various move and energy modes and to experimentally prove its effectiveness by increasing the level of physical health and body mass index of participants in the experiment.

II. MATERIALS AND METHODS

Participants. The study was conducted on the basis of the fitness club "Iron", city Glazov, Russia. 42 respondents from 18 to 25 years old, having a diagnosis of "obesity" on the basis of calculating body mass index (BMI), took part. BMI = weight in kilograms / height in meters squared. High level (optimal weight) = 19<BMI<25, average level (overweight) = 25<BMI<30, low level (obesity) = 30<BMI [6]. The groups were divided into two equal focus groups regardless of gender: experimental (EG) and control (CG). All participants in the experiment had the experience of self-study with low and medium intensity of physical activity, at least 2-3 times a week.

Materials. To determine the impact of the study on the respondents' bodies, an express assessment was used to determine the level of physical health (PH) according to the method of V. I. Lyakh. PH = 0.011*HR+0.014*APs+0.008*APd+0.014*A+0.009*W-0.009*G-0.27, where HR - heart rate per minute at rest, APs - arterial systolic pressure, APd - arterial diystolic pressure, A - age in years, W - body weight in kilograms, G - body growth, cm. High level = PH<2,6, average level =2,6< PH<3, low level =3<PH [5].

For daily independent monitoring of the cardiovascular system of the participants in the experiment during the study, a six-step functional test according to V. S. Anishchenko [6]. In this test, the following indicators were taken into account: the heart rate at rest, in the standing position, the difference between the heart rate in the standing and lying position, the heart rate immediately after 20 squats and during the recovery period. All these indicators were evaluated the higher, the less points were scored. The methodology for performing this test was as follows. After a 5-minute rest lying down, it was necessary to count the pulse for 1 minute. Then calmly rise and stand for 1 minute and count the pulse for 1 minute. Next, calculate the difference between the pulse while standing and lying and multiply this figure by 10. The next thing to do was 20 full deep squats for 40 seconds. During the squats, the arms should vigorously rise forward, and when rising, lower down. After the squats, you should sit down and count the pulse for the entire first minute, then for the entire second minute and for the entire third minute after the squats. At the end of the test, all the figures obtained had to be added [6].

Mathematical and statistical processing of the obtained results before the experiment and after its implementation was carried out by Chi-square at $p \leqslant 0.05$. The choice of this criterion for mathematical-statistical processing is due to the fact that its application is possible when the results of the EG and CG according to the state of the studied property, trait are divided into more than two categories, in our case, the levels: high, average and low [18]. Before the experiment, mathematical-statistical uncertainty of the differences between the EG and the CG at $p>0.05$ according to the level of physical health to the method of V. I. Lyakh.

Procedure. All participants in the experiment carried out daily and weekly self-monitoring of food consumption, calculated in Kcal. These data were recorded by each participant in the self-monitoring diary. For participants in the experiment, daily self-monitoring in the morning on a six-step functional test according to V. S. Anishchenko [6]. Special observations have shown that this functional test reflects well the degree of human fitness. The lower the total heart rate, the higher the level of fitness was recorded. For highly trained people, this indicator should be 300-350, for well-trained people - 350-400, for average-trained people - 400-450. And for untrained people who have various deviations in their state of health - 450 or more [6].

The main value for the analysis of data in the study for this sample was not the absolute total indicator, but its changes under the influence of systematic physical exercises for each study participant individually and on average for the group. A decrease in this indicator testified to an improvement in the state of health, the general physical condition and the functional state of the cardiovascular system. In turn, an increase in the indicator is about a deterioration in the general condition of the participants in the experiment. If the respondent of any focus group recorded a result of more than 450 points, on that day he stopped performing physical exercises. Again, the participant in the study could continue to participate in the experiment, if the six-step functional test according to V. S. Anishchenko, his indicator fell below 450 points [6].

The main objective set for the respondents of both groups before the experiment was to increase the daily and weekly modes of move activity in Kcal, compared with food intake in Kcal by 3-5% per week. In exceptional cases, additionally adjust the diet or reduce daily food intake in Kcal.

Participants in the study of the control group realized the achievement of the goal during the experiment on their own, using mobile content on the Internet, as well as personal mentors. In turn, the subjects of the experimental group during the experiment, which lasted 4 months, monitored individual move activity. It mainly consisted of walking, running, cycling and special exercises of various speed modes based on special copyright recommendations. The author's development included the ranking of various types of physical exercises in various speed modes by energy consumption in Kcal/min.

As a result, a methodological system for daily monitoring was compiled for the experimental group. Which included recommendations for the implementation of move activity of youth in various move and energy modes according to L. Ya. Ivashchenko [6]:

TABLE I. SYSTEM OF DAILY SELF-MONITORING OF PHYSICAL ACTIVITY OF YOUTH IN VARIOUS MOVE AND ENERGY MODES

Kcal/min	Exercise characteristic
0,03333* W	Walking (2.5-3 km/h); bike simulator (0.5-0.6 Wat/kg); elementary gymnastic exercises; step exercise (f * h = 9.5-12)
0,04167* W	Walking (3-3.5 km/h); bicycle (7-8 km/h); bike simulator (0.6-0.7 Wat/kg); gymnastic exercises of medium intensity, step exercise (f * h = 12-14.5)
0,05*W	Walking (3.5-4 km/h); bicycle (8-8.5 km/h); rowing (50-55 m/min); swimming (10 m/min); bike simulator (0.7-0.8 Wat/kg); gymnastic exercises of intensity above average, step exercise (f * h = 14.5-17)
0,05833* W	Walking (4.5-5 km/h); bicycle (8.5-10 km/h); swimming (15 m/min); rowing (55-60 m/min); bike simulator (0.9-1 Wat/kg); sports games of average intensity; gymnastic exercises of speed and speed-strength nature; step exercise (f * h = 17-19.5)
0,06667* W	Walking (5.5-6 km/h); slow running; bicycle (10-15 km/h); rowing (60-70 m/min); swimming (15-20 m/min); bike simulator (1.1-1.2 Wat/kg); skates or rollers (8-10 km/h); sports games of higher average intensity; gymnastic exercises of speed and speed-strength nature; step exercise (f * h = 19.5-22)
0,08333* W	Running (6-6.5 km/h); bicycle (15-16 km/h); rowing (70-80 m/min); skiing (5.5-6 km/h); skates or rollers (13-15 km/h); swimming (25-30 m/min); bike simulator (1.3-1.5 Wat/kg); sports games of higher average intensity
0,10833* W	Running (6.5-7 km/h); bicycle (16.5-17.5 km/h); skiing (6-6.5 km/h); rowing (80-90 m/min), swimming (30-35 m/min), bike simulator (1.6-1.7 Wat/kg); skates or rollers (15-16 km/h); sports games of higher intensity
0,13333* W	Running (7-8 km/h); bicycle (17.5-20 km/h); rowing (90-100 m/min); swimming (35-40 m/min); skiing (6.5-7 km/h); mountain skiing; bike simulator (1.8-2 Wat/kg); high intensity sports games
0,16167* W	Running (9-10 km/h); bicycle (20-21 km/h); skiing (7-8 km/h); kayaking (45-50 m/min); swimming (40-50 m/min); bike simulator (2.1-2.2 Wat/kg); high intensity sports games in competitions
0,195*W	Running (10-11 km/h); bicycle (21-22 km/h); skiing (8-8.5 km/h); rowing (100-110 m/min); swimming (50-52 m/min); bike simulator (2.2-2.3 Wat/kg)
0,23333* W	Running (11-12 km/h); bicycle (21.5-22 km/h); skiing (9-10 km/h); bike simulator (2.3-2.5 Wat/kg); rowing (more than 110 m/min); swimming (52-55 m/min)

*Kcal/min - energy consumption per 1 kilogram of body weight; W - body weight of the test subject, kg; step exercise: f - frequency of rises in 1 minute, h - height of the projectile in meters.

As can be seen from Table 1, physical exercises were offered to the study participants very diverse. Despite the obvious differences in the forms of classes, all of them had certain general laws. The main content of the classes was active, physical activity aimed at the physical improvement of a person. This physical activity consisted of a number of relatively independent elements: physical exercises themselves, preparation for their implementation and outdoor activities. The dosage of each exercise and the sequence of exercises were supposed to provide optimal health dynamics of the heart rate: the maximum during exercise was no more than 150-160 beats/min and the average pulse in the session should not exceed 130-140 beats/min [19]. The structure of independent physical exercises was largely determined by the individual level of performance of athletes. In these classes, the main criterion for performance, which should be guided by those involved, was continuous monitoring of the body's well-being [15].

During the experiment, the respondents of the experimental group daily calculated the difference between consumed and "burned" Kcal per day according to the methodological system and the diary of self-monitoring of food intake. If a member of this group could not withstand the positive difference in Kcal, he was offered the opportunity to perform a step exercise at home. This physical activity included climbing a special projectile (step, bench, cube, etc.). The subject became facing the projectile. He independently began the exercise according to the Harvard step test system: put one leg on the shell; then another and straighten up; after that, immediately lower the leg with which the exercise began, in front of the projectile, then the second and return to its original position. The exercise had to be repeated continuously, but not more than 30 minutes. It was proposed to calculate the amount of work power when climbing a projectile and burning Kcal on it according to the following formula: X = f * h * W * 0.003, where X - work power, kcal/min, f - frequency of rises in 1 minute, h - height of the projectile in meters, W - body weight of the subject, kg.

III. RESULTS AND DISCUSSIONS

As shown in Fig. 1, the number of participants in the EG and CG in the control section after the experiment, which lasted 4 months, is significantly different at a significance level of $p \leqslant 0.05$ in three level groups: low (obesity), average (overweight), high (optimal weight):

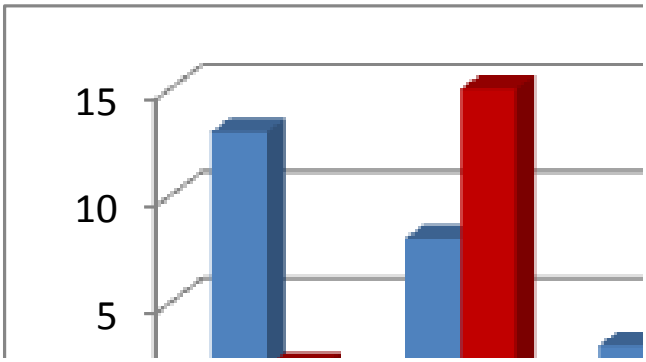

Fig. 1. Results of indicators of body mass index in study participants after the experiment

The analysis of the body mass index of the participants revealed a positive effect of the experiment. Participants in the study of the experimental group with a diagnosis of "obesity" (n=2) compared with the control group (n=13), decreased by 6.5 times. In turn, the respondents of the experimental group with a diagnosis of "overweight" (n = 8) compared with the control group (n = 15), decreased by 2 times. In unison with the significance of differences between the groups in mathematical and statistical processing, the significance of introducing copyright recommendations for weight loss has been visually revealed. The system of daily self-monitoring of youth physical activity in various move and energy modes is effective. This clearly demonstrated an increase in body mass index. In turn, an analysis of the data of the study participants, athletes with optimal normal weight in both focus groups revealed a reliably small amount. To determine the significance of differences, a longer experiment period of at least 6-8 months is required.

As shown in Fig. 2, the number of participants in the studied focus groups in the control section after the experiment is statistically different at a confidence level of $p \leqslant 0.05$ in three tier groups according to the rapid assessment of the level of physical health:

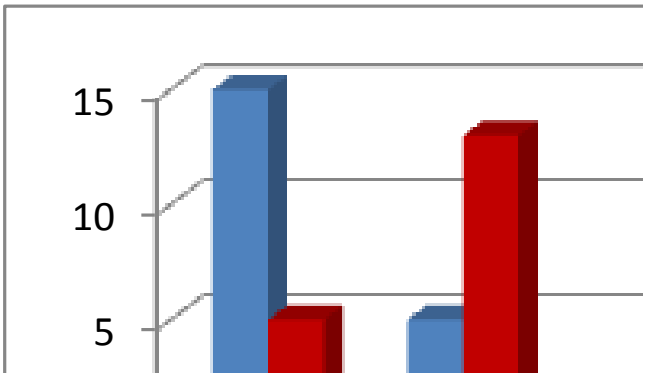

Fig. 2. Results of the indicators of the participants in the study of the level of physical health to the method of V. I. Lyakh after the experiment

From the data obtained by the participants after the end of the study, positive results were recorded through the prism of health monitoring. According to the method of V. I. Lyakh (n=5) as compared to the CG (n=15), the respondents from the EG with low physical health were decreased by 3 times. The same comparative result between focus groups was obtained by the average level of physical health. A more detailed analysis revealed that the main changes were recorded in a decrease in heart rate at rest and body weight of the subjects. Which in turn proves a positive effect in the work of the cardiovascular system of the body and improve the overall metabolism of the study participants.

The author's recommendations on the implementation of continuous daily self-monitoring of move activity of youth are reliably effective both in terms of body weight and physical health. Nevertheless, it should be noted that the majority of EG respondents had borderline values between average and low level of physical health. In this regard, in order to identify patterns in the improvement of the youth organism, further studies in this direction are necessary. Experimental work should be carried out over a longer period and with a larger sample of respondents.

Since the effectiveness of the experimental work was determined not only by analysis of the absolute total indicator. And also in addition to its change within 4 months under the influence of systematic physical exercises with the implementation of continuous monitoring. A further analysis of the data was carried out each week on average for the group and each participant in the study individually. This study was carried out using daily monitoring of the cardiovascular system of the participants in the experiment on a six-step functional test according to V. S. Anishchenko. Due to the fact that a graphical demonstration of this work by each participant (n=42) of both focus groups is not possible within the framework of the article, we present only average results for each group.

In Fig. 3 presents the average indicators for focus groups for a six-step functional test according to V. S. Anishchenko, provided 2 times a week by all subjects during the first two months of the experiment (March-April):

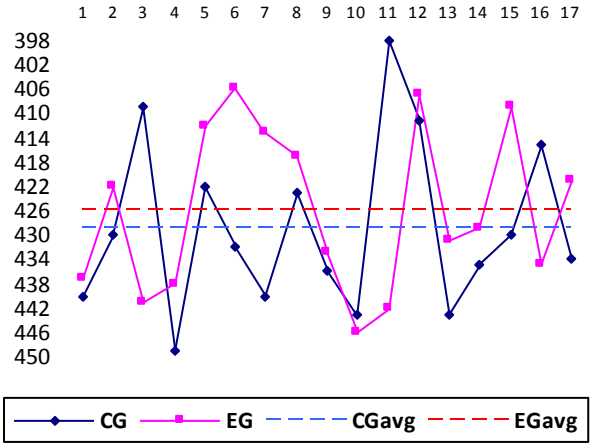

Fig. 3. Results of focus group averages for a six-step functional test according to V. S. Anishchenko in 1-2 months of the experiment

In Fig. 4 shows the average values for focus groups for a six-step functional test according to V. S. Anishchenko, provided 2 times a week by all subjects during the last two months of the experiment (May-June):

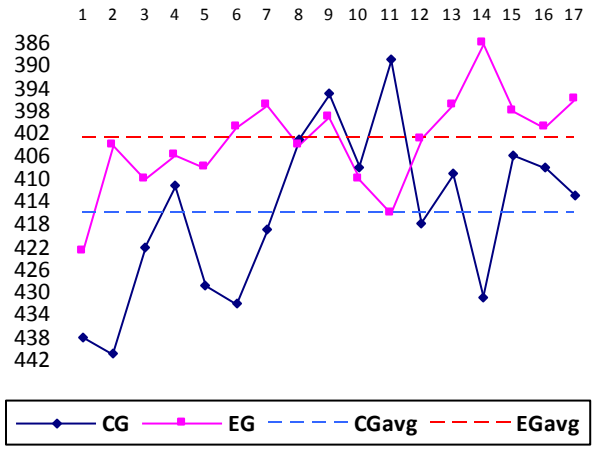

Fig. 4. Results of focus group averages for a six-step functional test according to V. S. Anishchenko in 3-4 months of the experiment

To identify the average deviation for each focus group in Fig. 3-4 additionally reflects the average values for each focus group as a whole (EGavg and CGavg), during the entire analyzed period: March-April and May-June. As a result of this comparative analysis, it was revealed that EG respondents on average in the group in the second half of the study reliably showed the best indicators in terms of fitness level. In the first half of the study (1-2 months), the results of the daily deviation from the average for this period of the experimental work were reliably the same: daily deviation in the EG $\sigma = 12.5$, in the CG $\sigma = 13.8$. However, the recorded data in the second half of the study (3-4 months) were significantly different: the deviation in the EG $\sigma = 8.3$, in the CG $\sigma = 14.8$. In this regard, it should be noted that in the second half of the study, the level of fitness of the participants in the EG study according to the results of the analysis of the cardiovascular system of the body of athletes became more stable compared to the level in the CG and the level in the previous analyzed period, since the deviation was recorded in comparison statistically different.

Discussions. The obtained mathematical and statistical results of this study are associated with the results of research on the introduction of self-control in the training process [2, 20]. In particular, on the analysis of the effectiveness of various types of move and energy activity through the introduction of continuous self-monitoring and self-diagnosis technologies [8, 13]. A theoretical analysis of studies on the correlation in increasing indicators of the physical health of the population, in particular the cardiovascular system [7], from an increase in their physical activity during a certain fixed cycle explains the reliability and relevance of the results obtained in our study from a theoretical point of view [9, 21]. As is proved in many experiments, the increase in the health indicators of the body among respondents is additionally associated with positive emotions received from move activity [11, 22]. A cheerful mood during and after physical exercises is based on the enhanced formation of endorphins and enkefamines in the body, which are the main conditions for a positive effect [1, 4]. Through the accessibility of various types of physical exercises and their transparency in energy value, our study directs non-professional athletes to independent physical education and sports.

Various studies have experimentally confirmed that aerobic endurance exercises, to a greater extent than other types of activity [23], have a key positive effect on changes that occur in the body as a result of training [15, 24]. In turn, they are crucial in improving health, increasing the energy potential of the body, expanding the possibilities of oxygen transport and economizing metabolism [12, 14]. In unison with these results, our study supplements various experimental data to substantiate the effectiveness of continuous self-monitoring [3, 25]. In particular, it is the continuity of introspection of daily physical activity that helps to increase the functional abilities and stability of the athlete's body, the reliable stability of metabolic processes [2, 13]. The systematic monitoring of the implementation of move activity, proposed in our study, allows the athlete's body to be optimally and consistently adapted to prolonged muscular activity of an aerobic nature.

Many studies prove that not only cyclic exercises contribute to favorable changes in the body [4]. Systematic gymnastics and strength exercises, common in health fitness, also cause positive changes in the body [7]. They are an effective means of physical development and improvement of human move abilities [15]. Nevertheless, as our experimental results show, gymnastic and strength exercises cultivated among the participants in the CG, according to the specifics of the impact, cannot fully replace aerobic exercise. Participants in the EG study, performing physical activity of an aerobic nature, achieved a higher result in functional development and weight loss.

The daily or weekly move modes of amateur athletes in studies is formulated as "active rest", implemented under continuous monitoring in terms of the intensity of the load. As further studies prove, it is this type of rest that stimulates the restoration of working capacity for various types of muscular and mental activity [8]. However, its effectiveness depends on the nature of fatigue, the degree of fitness for this type of activity, and many other reasons. When choosing the type of physical exercises for outdoor activities from labor and mental activity, one should focus not only on interest in a particular sport, but also individual characteristics of the body [2]. The novelty of our study lies in the fact that athletes are offered various options for physical activity. And the energy characteristics of each type of physical activity are offered in detail, including the author's combinations in terms of the intensity of physical exercises. Amateur athletes can choose from a variety of physical exercises depending on individual preferences during the daily or weekly period for differentiation in move and energy modes.

IV. CONCLUSIONS

The author's study supplements previous scientific developments with the proposed system of holistic monitoring, including daily calculation of Kcal for various types of physical activity, including differentiation according to the intensity of physical exercises. The implementation of continuous self-monitoring, in the end, as shown by statistically significant research results, has a positive effect on the athlete's body and stimulates respondents to increase their move activity.

The presented study for the first time systematically presents the most common move modes of youth through differentiation in energy burning in Kcal. This approach to a high degree determined the positive effectiveness of the study in solving one of the key problems of youth: an increase in the number of adolescents who are overweight and obese. The results of the study offer a number of significant recommendations for optimizing the move activity of young people at home. An original approach to the implementation of physical activity through the development of a special system of step exercises, differentiated by various energy modes, is proposed and justified.

The study will be useful to a wide range of specialists in the field of physical education and sports, fitness trainers, as well as athletes who are independently engaged in various physical exercises. The author's recommendations for the implementation of continuous self-monitoring will provide feedback to the user of the program, increase motivation to set the individual goals of athletes - amateurs and strategies for its further achievement. Further research will be aimed at studying the influence of the system of continuous monitoring of physical activity on different age and gender categories. Non-traditional move modes will be studied at various levels of energy intensity. An experimental study will cover a larger sample of subjects with different individual capabilities and needs for the implementation of move activity.

REFERENCES

[1] W. E. Kraus, K. F. Janz, K. E. Powell, W. W. Campbell, J. M. Jakicic, R. P. Troiano, K. Sprow, A. Torres, and K. L. Piercy, "Daily Step Counts for Measuring Physical Activity Exposure and Its Relation to Health," Medicine and Science in Sports and Exercise, vol. 51, iss. 6, pp. 1206-1212, June 2019.

[2] P. S. Freedson, and K. Miller, "Objective monitoring of physical activity using motion sensors and heart rate," Res Q Exerc Sport, vol. 71 (2 Suppl), pp. 21–9, June 2000.

[3] M. Kirwan, M. J. Duncan, C. Vandelanotte, and W. K. Mummery, "Using smartphone technology to monitor physical activity in the 10,000 Steps program: a matched case-control trial," J Med Internet Res, vol. 14, e55, 2012, doi:10.2196/jmir.1950

[4] D. Andre, and D. L. Wolf, "Recent advances in free-living physical activity monitoring: a review," J Diabetes Sci Technol, vol. 1, pp. 760–7, 2007, doi:10.1177/193229680700100522

[5] V. I. Lyakh, “Tests in the physical education of schoolchildren,” Moscow, Ast, 1998.

[6] V. S. Anishchenko, “Physical education: methodical and practical classes for students,” Moscow, RUDN University.

[7] M. L. Irwin, B. E. Ainsworth, and J. M. Conway, “Estimation of energy expenditure from physical activity measures: determinants of accuracy,” Obes Res, vol. 9 (9), 517–25, Sep. 2001.

[8] A. V. Kurpad, R. Raj, K. N. Maruthy, and M. Vaz, “A simple method of measuring total daily energy expenditure and physical activity level from the heart rate in adult men,” Eur J Clin Nutr, vol. 60 (1), pp. 32–40, Jan 2006.

[9] H. Montoye, H. Kemper, W. Saris, and R. Washburn, “Measuring physical activity and energy expenditure. Champaign (IL)”, Human Kinetics, 1996.

[10] T. I. Mokrova, A.Y. Osipov, M. D. Kudryavtsev, R. S. Nagovitsyn, and K. K. Markov, “Practice of Kangoo Jumps Fitness to improve female students' cardiorespiratory fitness,” Physical education of students, vol. 23, iss. 4, pp. 191-197, 2019, doi:10.15561/20755279.2019.0405

[11] D. E. Warburton, C. W. Nicol, and S. S. Bredin, “Health benefits of physical activity: the evidence,” CMAJ, vol. 174, pp. 801–9, 2006, doi:10.1503/cmaj.051351

[12] S. Michie, C. Abraham, C. Whittington, J. McAteer, and S. Gupta, “Effective techniques in healthy eating and physical activity interventions: a meta-regression,” Health Psychol, vol. 28, pp. 690–701. 2009, doi:10.1037/a0016136

[13] M. L. Butryn, S. Phelan, J. O. Hill, and R. R. Wing, “Consistent self-monitoring of weight: a key component of successful weight loss maintenance,” Obesity (Silver Spring), vol. 15, pp. 3091–6, 2007, doi:10.1038/oby.2007.368

[14] C. J. Greaves, K. E. Sheppard, C. Abraham, W. Hardeman, M. Roden, P. H. Evans, and P. Schwarz, “Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions,” BMC Public Health, vol. 11, pp. 119-126, 2011, doi:10.1186/1471-2458

[15] J. F. Sallis, and B. E. Saelens, “Assessment of physical activity by self-report: status, limitations, and future directions,” Res Q Exerc Sport, vol. 71 (2 Suppl), pp. S1–14, Jun 2000

[16] R. S. Nagovitsyn, A. Y. Osipov, I. M. Manurov, R. A. Zhuikov, and N. B. Vershinina, “Adaptation of foreign female students to physical activity based on the dexterity development,” Physical education of students, vol. 23, iss. 2, pp. 70-74, 2019, DOI: 10.15561/20755279.2019.0203

[17] M.D. Kudryavtsev, V. Lyakh, S.S. Iermakov, A.Y. Osipov, Y. Alexandrov, L. Konoshenko, et al., “Implementation of the inclusive learning model in the process of physical education of the students with physical disabilities”, Journal of Physical Education and Sport, vol. 19 (3 Suppl), pp. 971-979, 2019, doi:10.7752/jpes.2019.s3140

[18] R. S. Nagovitsyn, D. K. Bartosh, A. Y. Ratsimor, and N. V. Neverova, “Modernization of Regional Continuing Pedagogical Education in the "School-College-Institute,” European journal of contemporary education. vol. 8, iss. 1, pp. 144-156, 2019, doi: 10.13187/ejced.2019.1.144

[19] B. Conroy, K. O. Yang, K. Elci, M. Gabriel, J. Styn, A. Wang, S. Kriska, S. Sereika, and L. Burke, “Physical activity self-monitoring and weight loss: 6-month results of the SMART trial,” Med Sci Sports Exerc, vol. 43, pp. 1568–74, 2011, doi:10.1249/MSS.0b013e31820b9395

[20] K. Y. Chen, S. A. Acra, K. Majchrzak, C. L. Donahue, L. Baker, L. Clemens, M. Sun, and M. S. Buchowski, “Predicting energy expenditure of physical activity using hip- and wrist-worn accelerometers,” Diabetes Technol Ther, vol. 5 (6), 1023–33, 2003.

[21] F. Y. Hsieh, “Sample size tables for logistic regression,” Stat Med, vol. 8, pp. 795–802, 1989, doi:10.1002/sim.4780080704

[22] R. S. Nagovitsyn, A. A. Miroshnichenko, D. R. Merzlyakova, and G. Z. Faizullina, “Interrelation of mental "burn out" level and psychological health in athletes with different qualification,” Physical education of students, vol. 22, iss. 6, pp. 327-331, 2018, doi:10.15561/20755279.2018.0608

[23] T.I. Mokrova, A.Y. Osipov, R.S. Nagovitsyn, “Modern types of fitnes practices in academic physical education (kango-jump fitnes)”, Teoriya i Praktika Fizicheskoy Kultury, vol. 7, pp. 104, 2019.

[24] C. C. Yang, and Y. L. Hsu, “A review of accelerometry-based wearable motion detectors for physical activity monitoring,” Sensors (Basel), vol. 10, pp. 7772–88, 2010, doi:10.3390/s100807772

[25] R. Glasgow, C. Nelson, K. Kearney, R. Reid, D. Ritzwoller, V. Strecher, M. Couper, B. Green, and K. Wildenhaus, “Works citing "Reach, Engagement, and Retention in an Internet-Based Weight Loss Program in a Multi-Site Randomized Controlled Trial,” J Med Internet Res, vol. 9 (2), e11, May 2007, doi: 10.2196/jmir.9.2.e11