THE IMPACT OF DIFFERENT MODELS OF POWER FITNESS TRAINING ON THE RE-ADAPTATION PROCESSES OF OVERWEIGHT ADOLESCENTS

ВПЛИВ РІЗНИХ МОДЕЛЕЙ ЗАНЯТЬ ІЗ СИЛОВОГО ФІТНЕСУ НА ПРОЦЕСИ РЕАДАПТАЦІЇ ПІДЛІТКІВ З НАДМІРНОЮ ВАГОЮ

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Abstracts

The aim is to compare the impact of using different power fitness training models on body composition indicators and muscle strength levels in adolescents with normal and excessive body weight.

Material and Methods. 64 adolescent boys aged 14–15 years (height: 165±4.8 cm) were examined. Among them, 32 untrained individuals with normal weight (NW) had an initial body fat mass (BFM%) of 16.2±1.3% (Group A). Another 32 adolescents were overweight (OW), with a BFM% of 40.7±1.8% (Group B), which is at least 2.2 times higher than the norm. During the study, the groups were divided into subgroups: A^1, A^2, B^1, B^2. Methods: Integrated quantitative assessment of power fitness loads (R_a, m, Wn), bioimpedance analysis (BFM, FFM, ACM), and control testing of muscle strength development (4RM). Monitoring was conducted every 30 days over 16 weeks. Participants in subgroup A^1 followed training model 1 (R_a = 0.71; energy supply via the creatine phosphate mechanism; basic machine exercises). Adolescents in subgroups A^2 and B^1 used training model 2 (R_a = 0.65; anaerobic glycolysis as the energy supply; isolated machine exercises). Training Model 3 (R_a = 0.58; combined anaerobic and aerobic glycolysis; isolated free weight exercises with altered kinematic characteristics) was applied to subgroup B^2.

Results. A long-term use of training model 1 proved to be the most effective stimulus for increasing BFM and active cell mass (ACM), accompanied by a significant increase in muscle strength in NW adolescents. At the same time, the BFM% under these conditions remained virtually unchanged compared to the initial values. Employing model 2 helped increase their BFM and ACM parameters across all study participants. Simultaneously, under this model, the studied muscle strength (4RM) and BFM% indicators among overweight adolescents showed clear positive dynamics. The greatest reduction in BFM% and the highest increase in ACM% among OW adolescents were observed in study participants following the power fitness training model 3.

Conclusions. When developing training models for OW adolescents, it is essential to consider not only their initial body composition parameters but also the level of the body's resistance to physical loads. Using moderate-intensity load (R_a = 0.65) based on anaerobic glycolysis and isolated machine exercises promoted the most pronounced re-adaptation in OW adolescents. Using isolated machine exercises with adjusting body position to reduce stabilizer muscle activity slowed energy resource depletion rates, especially in cases of low adaptive reserves.

Key words: adolescents, overweight, training models, power fitness, body composition indicators, re-adaptation.

Мета – порівняти вплив 16-тижневого використання різних моделей занять із силового фітнесу на показники складу тіла, рівень м'язової сили підлітків з нормальною та надмірною вагою.

Матеріал і методи. Обстежено 64 підлітки (хлопці) віком 14–15 років, зріст 165±4,8 см. Серед них – 32 нетреновані особи з нормальною вагою (NW), вихідні параметри жирової маси (ЖМ,%) –

1.3% (група А). 32 підлітки з надмірною вагою (OW), ЖМ – 40.7±16.2±1.3% (група А). 32 підлітки з надмірною вагою (OW), ЖМ – 40.7±1.8% (група В), що мінімум в 2,2 раза перевищує норму. В процесі дослідження групи були поділені на підгрупи: A^1, A^2, B^1, B^2. Методи: інтегральна кількісна оцінка навантажень у силовому фітнесі (R_a, m, Wn), біоімпедансометрія (ЖМ, БЖМ, АКМ), контрольне тестування розвитку м'язової сили (4RM). Контроль відбувався кожні 30 днів протягом 16 тижнів. Представникам підгрупи A^1 запропонована модель занять № 1 (R_a=0.71; креатинфосфокіназний механізм енергозабезпечення, базові вправи на тренажерах). Підлітки підгруп A^2 та B^1 використовували модель № 2 (R_a=0.65; механізм енергозабезпечення анаеробний гліколіз, ізольовані вправи на тренажерах). Модель № 3 (R_a=0.85; комбіноване енергозабезпечення з анаеробним та аеробним гліколізом, ізольовані вправи з власною вагою зі зміною кінематичних характеристик) використовували учасники підгрупи B^2.

Результати. Встановлено, що тривале використання моделі занять № 1 є найбільш ефективним подразником для підвищення показників БЖМ, АКМ на тлі суттєвого зростання м'язової сили підлітків з NW. При цьому показник ЖМ, % у таких умовах практично не змінюється порівняно з вихідними даними. Виявлено, що використання моделі № 2 позитивно впливає на підвищення показників БЖМ, АКМ усіх учасників дослідження. Одночасно в умовах такої моделі досліджувані показники м'язової сили (4RM) та ЖМ, % серед обстежених підлітків OW демонструють виражену динаміку. Найбільше зниження ЖМ,% та підвищення АКМ, % серед підлітків OW виявлено в умовах використання моделі занять із силового фітнесу № 3.

Висновки. У процесі розробки моделей занять для підлітків з OW необхідно враховувати не лише вихідні параметри складу тіла, але й рівень резистентності організму до навантажень. Використання режиму навантажень середньої інтенсивності (R_a=0.65) на тлі анаеробного гліколізу в поєднанні з комплексом ізольованих вправ на тренажерах сприяє найбільш вираженим процесам реадаптації підлітків OW. Використання ізолюючих вправ на тренажерах за умов зміни положення для зменшення активності м'язів стабілізаторів уповільнює швидкість виснаження енергоресурсів, особливо за умов низького рівня адаптаційних резервів.

Ключові слова: підлітки, надмірна вага, моделі занять, силовий фітнес, показники складу тіла, реадаптація.

Introduction. One of the most complex and simultaneously most debated issues in the context of modern hypokinesia is the search for effective mechanisms to combat overweight and obesity [3; 7; 8]. This issue becomes particularly acute during adolescence, which in most cases results from progressive physical inactivity [1; 10]. The increased adaptation failure represents a negative manifestation of the body's compensatory reactions to stress stimuli due to the lack of sufficient muscular activity required for the balanced functioning of its systems [5; 15; 18]. These changes in the bodies of overweight adolescents may lead to adverse consequences associated with the development of irreversible pathological conditions [9; 16; 21]. The absence of timely interventions aimed at promoting the re-adaptation of functional capacities and the neuromuscular system will only further complicate the resolution of this problem [12; 17].

Despite the growing number of various fitness programs, health projects, and the development of innovative workout routines for overweight adolescents, the problem has remained unresolved for many years [2; 8; 15]. The challenge in the practical implementation of this issue stems from the necessity of an integrated approach to the design of physical training models and the development of a comprehensive system for diagnosing re-adaptation processes [11; 14]. One of the main problems is the lack of a clear algorithm for developing training models using an appropriate combination of load modes and a set of exercises [4; 13]. The issue of determining clear physiological and biochemical markers for assessing the compliance of the adaptive reserves of the body of overweight individuals with given load parameters remains unresolved [6; 19]. The problem is that in adolescents of this category, in most cases, the level of body resistance to loads of different intensity and volume in anaerobic or aerobic energy supply modes will be different [11; 14]. Accordingly, it is essential to employ a comprehensive range of diagnostic methods to assess individuals' adaptive reserves; however, this requirement is rarely fulfilled in practical settings. The issue of identifying optimal mechanisms for adjusting load regimes during the re-adaptation of overweight adolescents remains unresolved due to the lack of fundamental research in this area.

The study **aims** to compare the impact of 16 weeks of using different power fitness training models on body composition indicators and muscle strength levels in adolescents with normal and excessive body weight.

Material and methods. The total number of participants was 64 adolescent boys aged 14–15, with an average height of 165 ± 4.8 cm. Among them, 32 were untrained individuals with normal weight. Based on preliminary medical examination results, these adolescents were physically healthy and had no contraindications for power fitness training. Simultaneously, another group of adolescents (32 individuals) exhibited pronounced external signs of overweight. According to preliminary bioimpedance analysis results, body fat mass indicators in this group exceeded age norms by 2 to 2.5 times.

The study was conducted in 2024 at the Research Center for Modern Kinesiology “KINEZUS” and its branches (located in Rivne, Chernivtsi, and Uzhhorod, Ukraine). The Lesya Ukrainka Volyn National University ethics committee approved the study design. After explaining the risks and benefits of the study, the participants’ parents signed an informed consent form prepared per the ethical standards of the Declaration of Helsinki.

Parameters of Physical Load. Using the *Integral method of quantitative estimation of load capacity in power fitness* [4], the load coefficient (R_a) was calculated for each of the experimental models of power fitness training, taking into account the participants’ functional capacities. The parameters of this coefficient reflected the intensity level of the strength training regime in each proposed model and the optimal workload. Simultaneously, the working mass of the equipment (m) and the workload volume per set (Wn) were calculated for each of the employed load regimes. Adjustments to the parameters R_a, m, and Wn were made every four weeks throughout the study, depending on the participants’ muscular strength development.

Level of Muscular Strength Development. The dynamics of muscular strength development (4 RM) among the examined adolescents were assessed throughout all stages of the study. The rationale for using 4 RM indicators instead of 1 RM was based on the participants’ low resistance to strength loads and their insufficient technical preparedness. Considering the participants’ age and the potentially limited adaptive reserves, strength assessments using the 4 RM indicator were conducted with exercise machines. Considering the characteristics of the study participants, especially those with overweight, safety was prioritized by selecting the safest exercise techniques. A key feature was minimizing the involvement of stabilizing muscle groups, which allowed for a reduction in the load weight during control exercises while still ensuring adequate fatigue of the primary muscle groups (agonists).

Chest muscle strength (4 RM) was assessed using the horizontal bench press on the Hammer Strength machine. Back muscle strength was evaluated using the lat pulldown chest exercise. Lower body strength development was assessed via 4 RM monitoring during the seated leg extension exercise. Control measurements were conducted at the beginning of the study and every four weeks throughout the intervention period, during which participants engaged in the prescribed strength fitness training models.

Body composition. A non-invasive bioimpedance method was used to assess body composition parameters and their dynamics throughout the study. Computerized analysis of the study data enabled assessing a comprehensive set of informative body composition parameters. During the study, we monitored only a subset of these parameters: FFM (kg), ACM (kg), ACM (%), and BFM (%). The bioimpedance measurements were recorded at the start and every four weeks over 16 weeks. The diagnostic computerized hardware-software complex KM-AP-01 of the “Diamant – AST” configuration (VYUSK. 941118.001 PE) was used for determining the body composition parameters.

Research Organization. The study was conducted in several stages:

At the first stage, based on the initial analysis of bioimpedance results, primarily the baseline

BFM (%) values, the participants were divided into two groups (A and B). Group A consisted of 32 untrained NW adolescents, whose average BFM before the study was 16.2 ± 1.3 %, corresponding to normative values. Meanwhile, 32 OW adolescents with an average BFM of 40.7 ± 1.8%, which is at least 2.2 times above the norm, were assigned to Group B.

Considering the lack of fundamental studies on the effectiveness of various strength fitness training models on the re-adaptation processes in OW adolescents, several combinations of load regimes and exercises were proposed to the participants. To conduct a comparative analysis of the effects of the proposed training models (Figure 1) on strength capabilities and body composition parameters in NW and OW adolescents, the participants were divided into subgroups.

Participants in subgroup A^1 were assigned to training model 1. The key feature of this model is the implementation of a high-intensity load protocol (R_a = 0.71) alongside the creatine phosphokinase pathway for ATP regeneration. The training emphasizes machine exercises that allow simultaneous activation of the maximum number of muscle groups, including agonists, synergists, and stabilizers.

Simultaneously, adolescents in subgroups A^2 (NW) and B^1 (OW) were assigned to the power fitness training model 2. This model is characterized by a combination of a moderate-intensity load regime (R_a = 0.65) with anaerobic glycolysis as the primary energy supply mechanism for muscle activity. Priority is given to isolated machine exercises, which selectively target muscle groups of agonists and synergists. The ability to change body position or its segments during isolated exercises reduces the activation of stabilizer muscles, slowing the rate of energy resource depletion, especially under conditions of low adaptive reserves. Subgroup B^2 (OW) adolescents were assigned to the power fitness training model 3. The primary characteristic of this model is the use of a low-intensity load regime (R_a = 0.58) with a high volume, combined with a mixed energy supply involving both anaerobic and aerobic glycolysis. This model prioritizes isolated free weight exercises with altered kinematic characteristics, which promotes early fatigue of stabilizer and synergist muscle groups.

Each subgroup performed the assigned training models three times per week, with each training lasting 35–40 minutes.

At the second stage, control testing determined initial strength capacity development (4 RM) of specific muscle groups. Considering the lack of experience, age-related characteristics, and hypokinesia in 50% of the participants, machine exercises were used during testing to minimize the risk of injury. The parameters of projectile working mass and load volume per set were calculated using the baseline 4 RM data and analyzing the characteristics of the load regimes applied in the specified training models. The obtained load parameters corresponded to the initial resistance of the examined adolescents' bodies, which is expected to positively influence the re-adaptation in overweight individuals.

At the third stage, the features of changes in body composition indicators and the level of muscle strength development in adolescents of the examined subgroups were determined using the specified models of power fitness training for 16 weeks. Control was carried out at the beginning of the study and every four weeks. At the same time, considering the changes in 4 RM indicators in control exercises, the parameters of the projectile working mass and the load volume were changed at each stage. A comparative analysis of the obtained data was carried out. The obtained results were processed.

Statistical analysis. Using the IBM SPSS Statistics 26 software package (StatSoft Inc., USA), statistical analysis of the research results was conducted. The G-Power 3.1.96 program was used to determine the minimum sample size for the study (statistical power calculation). Non-parametric statistical analysis methods were applied. The median (Me) and interquartile range (IQR) were calculated. The Kruskal-Wallis test was used to compare baseline parameters among all examined subgroups. The Wilcoxon t-test was used to compare two dependent samples.

Study Results. Table 1 presents the results of bioimpedance measurement in adolescents NW (A^1, A^2) and OW (B^1, B^2) during 16 weeks of the study.

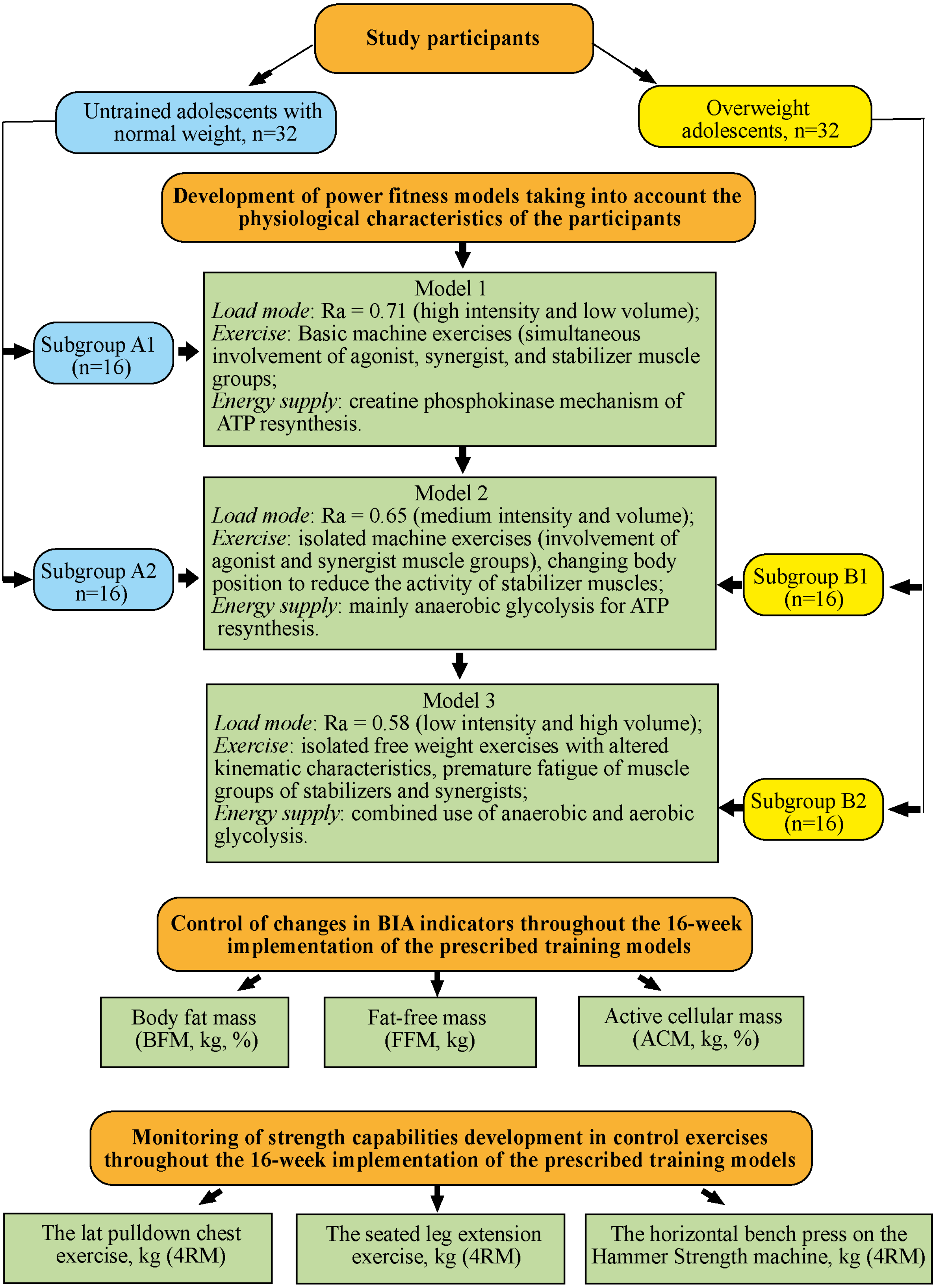

Fig. 1. Organization and content of the research

The results of the analysis of baseline body composition parameters among the examined subgroups of adolescents demonstrate the following. The BFM (%) in OW adolescents (groups B^1, B^2) was 2.2 times higher than the results recorded in the NW group.

The baseline FFM parameters showed no differences among the study participants. Significantly higher values of ACM (kg) were recorded (+7.8%) in B^1 and B^2 subgroups, compared to the results observed in the A^1 and A^2 subgroups. However, the ACM (%) was 13.4% lower in OW adolescents compared to the NW.

The results obtained after 16 weeks of using the proposed power fitness training models by each subgroup of study participants showed sufficiently diverse changes in bioimpedance parameters. The most pronounced reduction in

Table 1

Results of bioimpedance measurements in the groups of NW (A^1, A^2) and OW (B^1, B^2) adolescents during the 16-week study (Me, IQR), n=64

Subgroups of adolescents	Observation term, weeks					χ^2, p df=4
	initial data	After 4 weeks	After 8 weeks	After 12 weeks	After 16 weeks	
Body fat mass (BFM, %)						
A^1	16.90 (2.18)	16.97(2.14) 0.1%^{1}	17.12(2.19) 0.2%^{1}	16.75(2.10) -0.4%^{1}	16.50 (2.00) -0.2%^{1};-0.4%^{2}	χ^2=60.10* W=0.93*
A^2	16.70 (2.22)	16.70(2.28) 0.0%^{1}	16.35 (2.17) -0.3%^{1*}	16.02 (2.19) -0.3%^{1*}	15.87 (2.09) -0.1%^{1};-0.8%^{2*}	χ^2=62.35* W=0.97*
B^1	37.40 (3.48)	35.80(3.68) -1.6%^{1*}	33.95(4.40) -1.8%^{1*}	32.15(4.20) -1.8%^{1*}	31.10 (4.18) -1.1%^{1*};-6.3%^{2*}	χ^2=64.00* W=1.00*
B^2	37.30 (3.83)	34.60(4.02) -2.7%^{1*}	32.10 (4.10) -2.5%^{1*}	30.00(3.92) -2.1%^{1*}	28.65 (3.93) -1.3%^{1*};-8.6%^{2*}	χ^2=64.00* W=1.00*
Fat-free mass (FFM, kg)						
A^1	39.67 (6.14)	40.49(6.35) 2.1%^{1*}	41.72 (6.07) 3.0%^{1*}	42.90 (6.20) 2.8%^{1*}	43,37 (6.09) 1.1%^{1}; 9.3%^{2*}	χ^2=64.00* W=1.00*
A^2	40.80 (6.42)	40.99(6.23) 0.4%^{1*}	42.35 (6.57) 3.3%^{1*}	42.97 (6.60) 1.5%^{1*}	43.13 (6.55) 0.4%^{1*}; 5.7%^{2*}	χ^2=61.60* W=0.96*
B^1	43.33 (2.17)	43.44(2.36) 0.2%^{1}	43.97 (2.30) 1.2%^{1}	43.89 (2.64) -0.2%^{1}	44.29 (2.70) 0.9%^{1*}; 2.2%^{2*}	χ^2=23.20* W=36.00*
B^2	43.53 (2.08)	44.00(2.03) 1.1%^{1*}	43.92 (2.09) -0.2%^{1*}	43.67 (2.82) -0.6%^{1*}	43.38 (2.81) -0.7%^{1*};-0.3%^{2*}	χ^2=48.00* W=0.75*
Active cellular mass (ACM, %)						
A^1	54.43 (1.40)	54.38(1.40) -0.1%^{1}	54.28 (1.43) -0.1%^{1}	54.52 (1.38) 0.2%^{1}	54.69 (1.31) 0.2%^{1}; 0.3%^{2}	χ^2=56.80* W=0.88*
A^2	54.56 (1.43)	54.50(2.08) -0.1%^{1}	54.79 (1.23) 0.3%^{1*}	55.00 (1.38) 0.2%^{1*}	55.09 (1.38) 0.1%^{1}; 0.5%^{2*}	χ^2=61.60* W=0.96*
B^1	41.00 (2.27)	42.05(2,96) 1.1%^{1*}	43.26 (2.89) 1.2%^{1*}	44.44 (2.75) 1.2%^{1*}	45.13 (2.74) 0.7%^{1*}; 4.1%^{2*}	χ^2=64.00* W=1.00*
B^2	41.06 (2.50)	42.84(2.64) 1.8%^{1*}	44.48 (2.69) 1.60%^{1*}	45.85 (2,55) 1.4%^{1*}	46.73 (2.57) 0.9%^{1*}; 5.6%^{2*}	χ^2=64.00* W=0.06
Active cellular mass (ACM, kg)						
A^1	25.97 (3.93)	26.52(4.15) 2.1%^{1*}	27.32 (3.98) 3.0%^{1*}	28.08 (4.06) 2.8%^{1*}	28.40 (3.99) 1.1%^{1}; 9.3%^{2*}	χ^2=64.00* W=1.00*
A^2	26.71 (4.21)	26.84(4.07) 0.5%^{1*}	27.73 (4.31) 3.3%^{1*}	28.14 (4.32) 1.5%^{1*}	28.24 (4.28) 0.3%^{1}; 5.7%^{2*}	χ^2=61.60* W=0.96*
B^1	28.37 (1.36)	28.45(1.34) 0.3%^{1}	28.80 (1.52) 1.2%^{1*}	28.75 (1.73) -0.2%^{1}	29.00 (1.76) 0.8%^{1*}; 2.2%^{2*}	χ^2=23.20* W=0.36*
B^2	28.51 (1.36)	28.81(1.32) 1.0%^{1*}	28.76 (1.57) -0.2%^{1*}	28.60 (1.83) -0.5%^{1*}	28.40 (1.84) -0.6%^{1*};-0.4%^{2*}	χ^2=48.00* W=0.75*

Notes: 1 – difference (%) compared to previous results; 2 – difference (%) compared to initial values; df – degrees of freedom; χ^2 – Friedman test; W – Kendall coefficient; * – p< .05.

BFM (-8.6%) was observed in OW adolescents of subgroup B^2, who followed training model 3 during the study. However, using model 2 had quite different effects on the dynamics of the BFM among adolescents of subgroups A^2 (-0.8%) and B^1 (-6.3%).

The greatest increase in FFM (+9.3%) was observed in adolescents of subgroup A^1, who used training model 1 for 16 weeks. The studied body composition parameter did not change over this period in participants of subgroup B^2. Despite the prolonged use of training model 2, the FFM demonstrated different dynamics among adolescents of subgroup A^2 (+5.7%) and subgroup B^1 (+2.2%).

The parameters of ACM (kg) and ACM% showed quite different patterns of change among representatives of all subgroups throughout the study. Monitoring the ACM (%) parameter over 16 weeks indicated no changes among subgroups A^1 and A^2. At the same time, this parameter increased in subgroups B^1 (+4.1%) and B^2 (+5.6%). The ACM (kg) significantly increased among adolescents of subgroups A^1 (+9.3%) and A^2 (+5.7%). However, this parameter decreased (-0.4%) among participants of subgroup B^2.

Figure 2 presents the results of assessing back muscle strength development (4RM) during the execution of the lat pulldown chest exercise in the NW (A^1, A^2) and OW (B^1, B^2) subgroups over the 16-week study period.

At the beginning of the study, the back muscle strength (4RM) in subgroups A^1 and A^2 was 51.2% higher compared to the results demonstrated by participants of subgroups B^1 and B^2. The study results showed an increase in the 4RM indicator in this control test among participants of all subgroups. The most significant increase in back muscle strength (by 74.6%) was observed among adolescents of subgroup A^1 under the conditions of training model 1. The application of training model 2 supported an improvement in the measured indicator in subgroups A^2 (+41.5%) and B^1 (+40.4%). The least pronounced increase in the 4RM indicator (+34.9%) during the lat pulldown chest exercise was observed in participants of subgroup B^2.

Figure 3 presents the results of the assessment of leg muscle strength development (4RM)

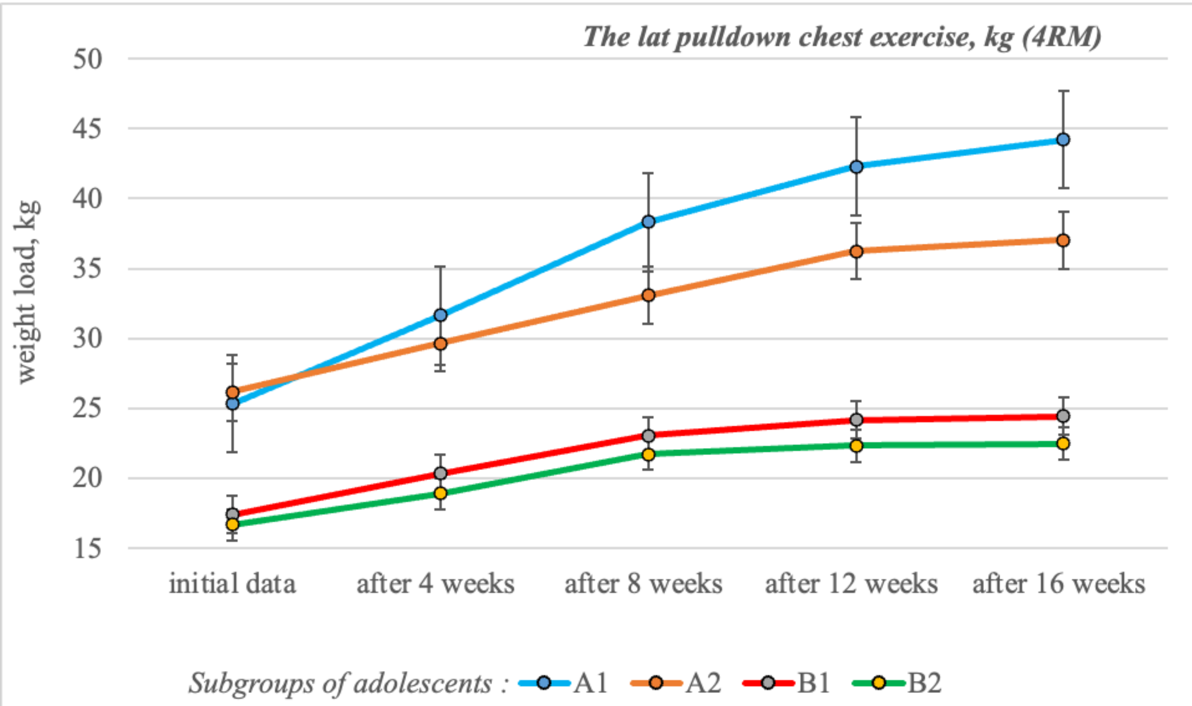

Fig. 2. Results of assessing the development of back muscle strength (4RM) during the lat pulldown chest exercise in NW (A^1, A^2) and OW (B^1, B^2) adolescents during 16 weeks of research, n=64

during the execution of the seated leg extension exercise in NW (A[1], A[2]) and OW (B[1], B[2]) adolescents over the 16-week study.

The results indicate that the initial parameters of leg muscle strength development in NW adolescents exceeded those recorded in both OW subgroups by 50.5%. The most significant increase in the studied parameter (by 68.8%) was observed in adolescents of subgroup A[1], who used training model 1 for 16 weeks. The use of model 2 had a positive effect on the dynamics of leg muscle strength development in subgroups A[2] (+48.9%) and B[1] (+38.0%). The smallest increase (+35.7%), though still statistically significant, in the 4RM parameters during the seated leg extension exercise was recorded in adolescents of subgroup B[2].

Figure 4 demonstrates the results of assessing the development of chest muscle strength (4RM) during the horizontal bench press on the Hammer Strength machine in NW (A[1], A[2]) and OW (B[1], B[2]) adolescents during the 16 weeks of research.

An analysis of the results obtained at the beginning of the study indicates that the difference in chest muscle strength development between the NW and OW adolescent subgroups was 40.1%. Applying the prescribed power fitness training models over the 16 weeks brought positive results. However, throughout the study, the greatest increase in chest muscle strength was observed in participants of subgroup A[1] (+77.0%), while the smallest increase was recorded in adolescents of subgroup B[2] (+33.5%). The use of training model 2 contributed to the positive trend in the studied parameter among A[2] (+57.5%) and B[1] (+45.0%) adolescents.

Discussion. This study presents research that demonstrates an attempt to address one of the complex issues of hypokinesia associated with the re-adaptation processes in OW adolescents [1; 7; 16]. The challenge in practically addressing this issue stems from the limited functional capacity of their bodies and, as a result, an inadequate ability to withstand physical exertion [2; 10]. These circumstances complicate finding effective modes of physical activity with optimal sets of exercises, which in their parameters would be appropriate to the initial level of the body's adaptive reserves [6; 18].

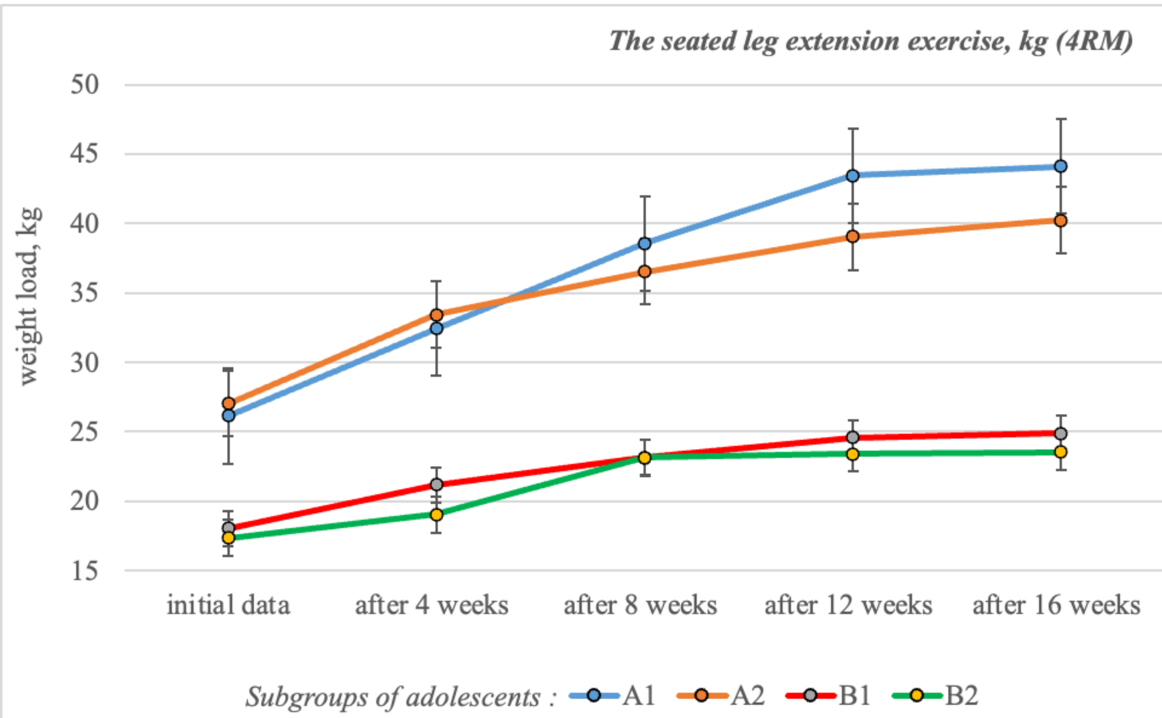

Fig. 3. Results of assessing the development of leg muscle strength (4RM) during the seated leg extension exercise in NW (A[1], A[2]) and OW (B[1], B[2]) adolescents during 16 weeks of research, n=64

The study examined changes in body composition indicators (BFM, FFM, ACM) and the level of muscle strength development in OW adolescents under different power fitness training models. A comparative analysis was conducted to assess the effectiveness of various load modes, exercise sets, and energy supply mechanisms in the OW adolescents' re-adaptation and in enhancing the body reserves of NW adolescents. During the development of power fitness training models, the primary focus was finding the optimal balance between load parameters, the number of muscle groups involved in exercise performance, and potential energy expenditures [5; 13]. Addressing this issue will help solve one of the most common problems in the re-adaptation of OW adolescents, which is associated with the premature exhaustion of the body's adaptive reserves [9; 16; 21].

The study results indicate that OW adolescents showed a rather diverse dynamic in body composition indicators and strength development after prolonged use of the prescribed power fitness training models. A similar difference was observed between the results of NW and OW adolescents who followed identical training models. These data will contribute to addressing the problem of finding optimal training models to increase the efficiency of re-adaptation processes in overweight adolescents.

The lack of scientific substantiation of contemporary approaches to load adjustment systems, considering the individual resistance levels of OW adolescents' bodies to stress-induced physical stimuli, significantly impedes the re-adaptation process [11; 17]. Selecting the optimal combination of load regimes and the balance between basic and isolated exercises against the background of low adaptive capacity and excessive weight is particularly acute [5; 21]. The need to revise the generally accepted principles for constructing re-adaptation training models for overweight adolescents constantly provokes discussions among scientists [15; 19].

At the beginning of the study, the baseline parameters of body fat mass in OW adolescents were 2–2.5 times higher than NW participants of the same age. The ACM (%) values were significantly lower (by 13.5%) in the OW group compared to NW. OW adolescents exhibited

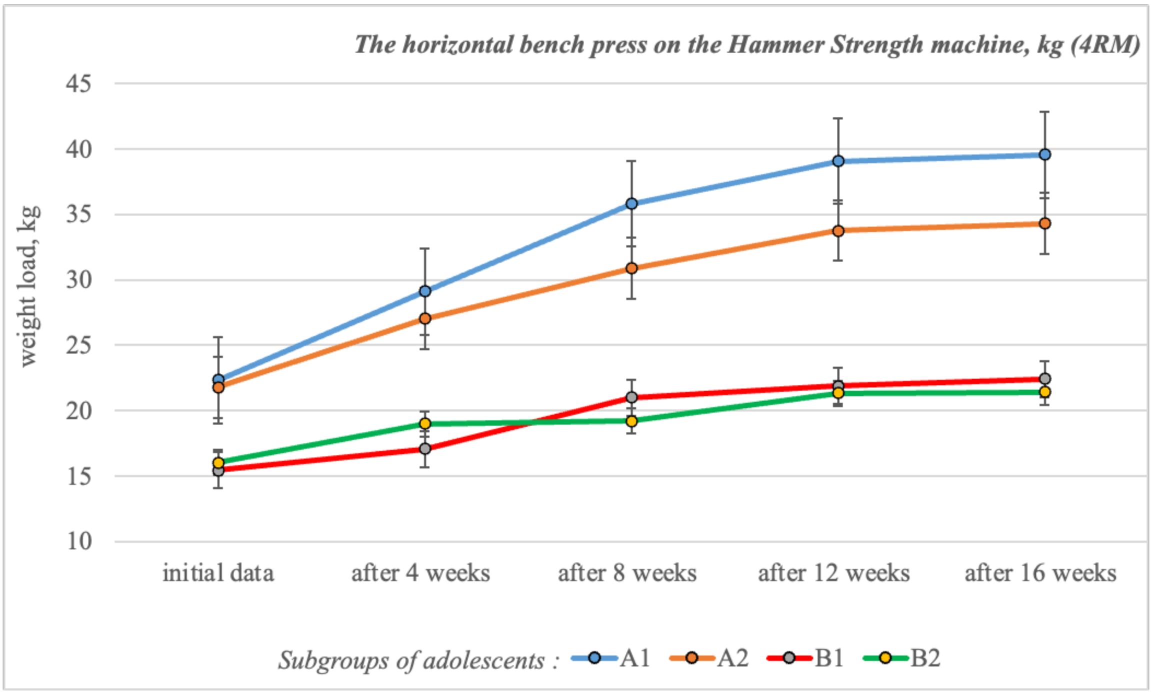

Fig. 4. Results of assessing the development of chest muscle strength (4RM) during the horizontal bench press on the Hammer Strength machine exercise in NW (A^1, A^2) and OW (B^1, B^2) adolescents during 16 weeks of research, n=64

initial muscle strength development parameters that were 47.2% lower than those of NW peers. These findings reflect clear deviations in body composition indicators of OW adolescents from normative values and demonstrate pronounced manifestations of adaptation failure [6; 11; 16]. The low level of muscle strength development against the background of such hypokinesia suggests potential manifestations of muscle atrophy and a significant reduction in the number of active motor units as a consequence of hypodynamia [5; 13].

The identified body composition characteristics and changes in muscle strength development following 16 weeks of implementing the proposed power fitness training models indicate diverse re-adaptation among participants. Employing a load regime of $R_a = 0.71$, combined with basic strength machine exercises and creatine phosphokinase energy supply mechanism, served as the optimal stimulus for enhancing BFM and ACM against substantial gains in muscle strength among NW adolescents. These findings reflect long-term adaptation under power fitness conditions, which are associated with the hypertrophy of fast-twitch muscle fibers and an increase in intramuscular coordination [11].

Applying the load regime of $R_a = 0.65$ with isolated machine exercises and anaerobic glycolysis energy supply mechanism provided the basis for increasing BFM and ACM across all study participants. Simultaneously, muscle strength indicators among OW adolescents demonstrated the most pronounced dynamic response during training model 2. These data indicate significant re-adaptation processes, associated with enhanced resistance due to the increased recruitment of motor muscle units during loading [5; 13].

The greatest reduction in BFM% and increase in ACM% among OW adolescents was observed under the load regime of $R_a = 0.58$. These changes are attributed to the low-intensity and high-volume loads under the combined use of anaerobic and aerobic glycolysis for energy supply [4; 15]. An important aspect was the premature fatigue of muscle groups of stabilizers and synergists before using isolated free weight exercises with altered kinematic characteristics [5; 13; 21].

Conclusions. The results indicate the necessity of developing new mechanisms to optimize training models using the fundamental principles of power fitness in the re-adaptation of OW adolescents. When designing training models for this population, it is essential to consider the initial parameters of body composition and the organism's resistance to physical loads. The study showed that utilizing a moderate-intensity load regime ($R_a = 0.65$) against the anaerobic glycolysis energy supply and isolated machine exercises promoted the most pronounced re-adaptation processes in OW adolescents. Applying isolated machine exercises, accompanied by changes in body position to reduce the activity of stabilizing muscles, helped slow down the depletion of energy resources, particularly under conditions of low adaptive capacity.

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