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Original Article

Efficiency of dance therapy for weight loss and improvement of the psychological and physiological state in overweight or obese young women

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Abstract
The relevance of the study is explained by the fact that despite the numerous available health-training programs for body weight loss, there is still need for development of new forms of physical training and ways of motivation.
The objective of the present study is to evaluate the efficiency of dance therapy for body weight loss and improvement of physiological and functional state in young women with overweight.
Materials and Methods. The study enrolled 82 students from Sechenov University with overweight and first-degree obesity. Forty two girls took exercises within individual health-training programs for 9 months. The programs were based on aerobic activity, including dance therapy. Forty students were engaged in physical training within the curriculum of the university. Before, during and after the training course the authors evaluated the components of body composition; functional state and psycho-emotional status.
Results. The final tests showed significant excessive body weight loss in students in the main group due to fat mass reduction by 20%; increase of physical performance by 24.5%; self-confidence level growth by 24%.
Conclusion: The results of the study confirmed that dance therapy is an effective type of physical training with high motivational component for excessive body weight loss in young women. This fact is proved by significant positive dynamics of the majority of morphofunctional and psychological parameters in students in the main.
The materials of the article are of practical value for specialists in physical rehabilitation, general practice doctors, PT tutors and advisors on healthy way of life and public health.
Key words: dance therapy, overweight, young

Introduction

According to the WHO experts' opinion, presently, the epidemics of obesity reached the plateau. However, the problem remains relevant. In 2016 the number of people older than 18 years old with overweight in the world exceeded 1.9 billion, obesity was diagnosed in more than 650 million people (The WHO, 2000). The report of the WHO committee on obesity says that "excessive body weight and obesity are so widespread that influence the population health more than traditional problems of healthcare, in particular, starvation and infectious diseases" (The WHO, 2000). The USA remains the leading country with high rate of obesity among population, 34% of the population are overweight and 27% are obese (Wang et al, 2008; James et al, 2008). The incidence rate of this disease among people of different age, sex, social status, and ethnicity is increasing every year in the whole world, especially, this tendency is becoming evident in European countries, Japan, Northern America, and Australia (The WHO, 2000; James et al, 2008; The WHO). According to the research data of Russian scientists, presently, in Russia not less than 30% of the working-age population are overweight and 25% of them are obese (Shalnova et al, 2017). The incidence rate of obesity among children and teenagers sharply increased in the 2nd part of the XX century, creating new distinct problem of public health in many countries.

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According to the WHO data, in 2016 41 million children, aged younger than 5 years old, were overweight, more than 340 million children and teenagers, aged from 5 to 19 years old, were overweight or obese (The WHO, 2000). In Russia, according to the research data, 11.8% of teenagers aged from 12 to 17 years old are overweight and 2.3% of them are obese (Dedov et al, 2006).

Considerable increase of obesity incidence rate during the past 30 years is the result of cultural and environmental influence. The incrementing disbalance between the consumed and spent calories is explained by the researchers by high-caloric nutrition, proper eating behavior ignorance and increase of serving size at meals (Schoeller et al, 2008; Kushner et al, 2014). Progressing hypokinesia in all the spheres of modern people life is considered by many scientists to be a major pathogenic factor of obesity and overweight development (Fock, et al, 2013; Tsigosa et al, 2008; Kielgast et al, 2017; McQueen, 2009; Jakicic et al, 2003).

Some researchers, observing a clear tendency towards population physical activity decrease, associate it with the prevalence of low activity job, rest, and entertainment types, with change of means of transportation and increase of urbanization (Kielgast et al, 2017).

Since the majority of researchers agree that reduction of physical activity is the major factor in the development of obesity in people of different ages, it is physical activity that plays the key role in treatment and prevention of obesity and concomitant diseases (Kushner et al, 2016; Fock et al, 2013; McQueen et al., 2009; Jakicic et al, 2003). The most effective and beneficial activities are considered to be aerobic exercises of intermediate intensity like walking, running, cycling, rhythmic fitness equipment, swimming, and aerobics (McQueen et al., 2009, Jakicic et al, 2003).

The efficiency of all pathogenic methods of obesity treatment considerably increases at active involvement and commitment of the patients. The specialists note that people with excessive body weight are characterized by a certain psychological type, peculiar behavior, and low self-confidence (Bobrov, 2014; Luppino et al, 2010). For this reason, among the necessary conditions of successful excessive body weight loss program completion are objective actualization, behavioral modifications, psychological correction, motivation, and creation of comfortable psychological environment (Mikhailova, 2014; Kiepe, 2012).

Some researchers specify positive influence of dance therapy on somatic state and mentality of patients with excessive body weight and obesity due to formation of positive emotional background, created in training groups, and popular music, used during the training sessions (Kiepe, 2012; Strassel et al, 2011). Therapeutic effect of dance programs is associated with increase of self-confidence, decrease of stress and muscle tension, anxiety and aggression reduction and rapport development (Strassel et al, 2011, Achkasov et al, 2015).

The analysis of scientific literature on this issue showed that, at present, despite the numerous available health-training programs for body weight loss, there is lack of focus at their development on peculiarities of psychological status of people with overweight and obesity. For this reason, at present, development of new forms of physical activities and motivation factors for the involvement of the specified population group into health and training process remains relevant.

Objective: evaluation of dance therapy efficiency for excessive body weight loss, increase of physical working capacity and improvement of psychological state in girls (young women) with overweight and first-degree obesity.

Materials and methods.

The present study was approved by the Expert Advisory Board of I.M. Sechenov First Moscow State Medical University of the Ministry of Health of the Russian Federation. Based on the study inclusion criteria (female sex, age from 17 to 21 years old, BMI 25 – 34.9 kg/m^2), the researchers examined 82 students from Sechenov University with overweight and first-degree obesity (average age 18.5±1.4 years old).

To identify the excessive body weight and obesity degree, the authors used the WHO classification based on BMI, which represents the relation of body mass in kilos to body height in square meters. According to this classification, normal body weight is equal to BMI in the range from 18.5 to 24.9 kg/m^2, excessive weight – from 25.0 to 29.9 kg/m^2, first-degree obesity – from 30.0 to 34.9 kg/m^2. Out of 82 students enrolled into the study, 27 (32.9%) girls had first-degree obesity and the rest 55 students (67.1%) were overweight.

After primary complex examination, the girls were distributed into the main and control groups. The main (I) group included 42 motivated girls, who showed interest to the study. Within 9 months they were training by individual health-training programs, based on aerobic activities, in particular, dancing. Forty students from the control (II) group were engaged in physical training within the curriculum of the university. Additionally, 36 girls with normal body weight were examined, they were included into the group III. In groups I and II the percentage of the students with excessive body weight and first-degree obesity was similar (Table 1).

Table 1. Distribution of the students into groups I and II by BMI.

The examined students	Group I n=42		Group II n=40	
	Number	%	Number	%
Overweight (BMI 25.0-29.9 kg/m^2)	28	66.7	27	67.5
First-degree obesity (BMI 30.0-34.9 kg/m^2)	14	33.3	13	32.5

Individual health and training programs were developed based on the results of complex examination, which included questionnaire survey, evaluation of body composition components with bioimpedance analyzer ABC-01-0362 "Medass" (Russia), evaluation of physical working capacity by the results of the Physical Working Capacity test - 170 (PWC-170) (Fletcher et al, 2013) in Carpman's V.L. modification (Karpman et al, 1988) with estimation of maximal oxygen consumption, evaluation of psycho-emotional status by Luscher test (Max, 1985) in Sobchik (Sobchiket et al, 2001) modification and checklist form "Health, Activity, Mood" (HAM) (Doskin et al, 1973).

The tests PWC_{170}, Luscher and HAM, including analysis and calculation of the studied parameters, were conducted with the help of hardware and software complex (HSC) "Istoki Zdoroviya", Center of Preventive Care, Ryazan, Russia (Patent, 2004).

During primary examination, the authors filled in specially developed a participant questionnaire that included questions on routine physical activity, physical training, and sports experience, previous attempts to reduce excessive weight, and the obtained results.

Bioimpedance analysis included the evaluation of fat mass, lean body mass, musculoskeletal mass in kilos and percentage from the total body weight, total and extracellular fluid volume in the body.

Submaximal test PWC_{170} identified individual power working capacity for heart rate of up to 170 bpm. The choice of this heart rate is explained by the fact that within the range from 110 bpm to 170 bpm, it is linearly dependent from the physical working capacity, which allows estimating PWC_{170} by the two relatively low physical loads. Besides, particularly at this heart rate optimal intensification of oxygen transportation system performance, which functional possibilities are studied in this test, is observed. This test includes two increasing physical loads on the veloergometer, duration of each load was 3 minutes with 2-minute interval between them.

The power of the first load (N1) was defined by the dependence of body weight and level of physical training in a way so that by the 3rd minute the heart rate (f1) reached 110-115 bpm. The power of the second load (N2) was defined depending on the reached heart rate at the end of the first load in a way so that by the end of the third minute of the second load, the heart rate (f2) was within the range from 135 bpm to 150 bpm.

Registration of the heart rate by cardio sensors, analysis of pulsogram and calculations of N1, N2, PWC_{170} powers and maximal oxygen consumption (MOC) was done automatically by a special module of HSC "Istoki Zdoroviya" (Patent, 2004).

The following formula was applied for estimation of PWC_{170} :

$PWC_{170} = N_1 \pm \frac{(N_2-N_1)}{f_2-f_1} \times 170-f_1$, where

f_1 – heart rate at the end of the 1st load;

f_2 – heart rate at the end of the 2nd load;

N_1 – power of the 1st load (kgm/min);

N_2 power of the 2nd load (kgm/min).

Due to high correlation of PWC_{170} and MOC, the authors used the method of indirect evaluation of MOC by the Carpman's formula (Karpman, 1988).

$MOC = 1.7 \times PWC\text{-}_{170} \pm 1240$.

For estimation of quantitative parameters of emotional stability, anxiety, and stress resistance the authors used Luscher color choice test with 8 colors (Max, 1985) in Sobchik L.N. (Sobchik et al, 2001) modification. According to the test developer, the choice of color preferences reflects the subject's intention to certain activity, mood, functional state and mostly persistent traits of character. The testing includes consecutive choice by the subject of mostly pleasant colors from the offered row, reflected on the PC monitor (in original test, 8 color sheets were placed in front of the subject on the table). The test is repeated 2-3 minutes after, the order of color sheets is changed. Further, the authors analyze the sequence of the chosen colors in each test and compare them.

Luscher testing, analysis of the results and parameters estimation was conducted by a special module of HSC "Istoki Zdoroviya" (Patent, 2004).

At calculation of vegetative coefficient (VC), that characterizes the stress relieving capability, positions of main colors in the second choice are taken according to the formula:

$VC = (18 – X3 – X4) / (18 – X1 – X2)$,

where:

X1 – the place of blue color;

X2 – the place of green color;

X3 – the place of red color;

X4 – the place of yellow color.

According to the calculation formula, VC can be within the range from 0.2 to 5 points.

VC < 1, tendency towards minimization of efforts, unwillingness to get involved in physical activities, the degree of this mindset intensity includes certain % from the maximal level in accordance with the following correspondence:

VC = 0.2 → 100% VC = 0.6 → 52%

VC = 0.3 → 91% VC = 0.7 → 39%
VC = 0.4 → 78% VC = 0.8 → 26%
VC = 0.5 → 65% VC = 0.9 → 13%

VC within the range from 1 to 1.5 corresponds to optimal level of activity and energy consumption with high potential of successful performance in stress situation, which is explained by normal balance of sympathetic and parasympathetic divisions of vegetative nervous system.

VC > 1.5 corresponds to overexcitement, hyperactivity with excessive energy consumption as a result of sympathetic division of vegetative nervous system domination. The intensity of this state includes certain % from the maximal level in accordance with the following correspondence:

ВК = 1.6 → 2.9% ВК = 2.8 → 37.7% ВК = 4.0 → 72.5%
ВК = 1.7 → 5.8% ВК = 2.9 → 40.6% ВК = 4.1 → 75.4%
ВК = 1.8 → 8.7% ВК = 3.0 → 43.5% ВК = 4.2 → 78.3%
ВК = 1.9 → 11.6% ВК = 3.1 → 46.4% ВК = 4.3 → 81.2%
ВК = 2.0 → 14.5% ВК = 3.2 → 49.3% ВК = 4.4 → 84.1%
ВК = 2.1 → 17.4% ВК = 3.3 → 52.2% ВК = 4.5 → 87%
ВК = 2.2 → 20.3% ВК = 3.4 → 55.16% ВК = 4.6 → 89.9%
ВК = 2.3 → 23.2% ВК = 3.5 → 50.0% ВК = 4.7 → 92.8%
ВК = 2.4 → 26.1% ВК = 3.6 → 60.9% ВК = 4.8 → 95.7%
ВК = 2.5 → 29.0% ВК = 3.7 → 63.8% ВК = 4.9 → 98.6%
ВК = 2.6 → 31.9% ВК = 3.8 → 66.7% ВК = 5.0 → 100%
ВК = 2.7 → 34.8% ВК = 3.9 → 69.6%

For evaluation of emotional stability degree, sum of deviations (SD) from the norm of neuropsychic well-being is estimated. The test's developer considers that the reference indicator of neuropsychic well-being corresponds to the following color combination choice:

On the 1st place 3 – red;
On the 2nd place 4 – yellow;
On the 3rd place 2 – green;
On the 4th place 5 – violet;
On the 5th place 1 – blue;
On the 6th place 6 – brown;
On the 7th place 0 – green;
On the 8th place 7 – black.

At such color combination, that reflects neuropsychic well-being, the sum of deviations (SD) = 0.

The deviation from the neuropsychic well-being norm is calculated as the sum of deviations on all the 8 color combinations that were chosen by the subject (Table 2).

Table 2.Points of deviation from the favorable combination of color choice

Place of color by choice	1	2	3	4	5	6	7	8
Color	Points of deviation							
3 - red	0	1	2	3	4	5	6	7
4 - yellow	1	0	1	2	3	4	5	6
2 - green	2	1	0	1	2	3	4	5
5 - violet	3	2	1	0	1	2	3	4
1 - blue	4	3	2	1	0	1	2	3
6 - brown	5	4	3	2	1	0	1	2
0 - green	6	5	4	3	2	1	0	1
7 - black	7	6	5	4	3	2	1	0

The obtained values of SD after the summing can range from 0 to 31 points.

To model the resulting evaluation of emotional stability, the following correspondence is used.

CO = 31 → 3.2% CO = 20 → 38.4% CO = 9 → 73.6%
CO = 30 → 6.4% CO = 19 → 41.6% CO = 8 → 76.8%
CO = 29 → 9.6% CO = 18 → 44.8% CO = 7 → 80%
CO = 28 → 12.8% CO = 17 → 48% CO = 6 → 83.2%
CO = 27 → 16% CO = 16 → 51.2% CO = 5 → 86.4%
CO = 26 → 19.2% CO = 15 → 54.4% CO = 4 → 89.6%
CO = 25 → 22.4% CO = 14 → 57.6% CO = 3 → 91.8%
CO = 24 → 25.6% CO = 13 → 60.8% CO = 2 → 95%
CO = 23 → 28.8% CO = 12 → 64% CO = 1 → 98.2%
CO = 22 → 32% CO = 11 → 67.2%
CO = 21 → 35.2% CO = 10 → 70.4%

For differentiated self-evaluation of psychological state, the authors used HAM test, developed by the psychologists at Sechenov University in 1973 (Doskin et al, 1973). It is named after the first letters of the words Health, Activity and Mood. The test is offered in the form of questionnaire, based on principles of polar profiles

(from 0 to 3) of 30 pairs of opposite concepts, reflecting the rate and frequency of different actions (activity), health, strength, fatigue (well-being), as well as characteristics of their emotional status (mood).

Table 3 HAM Questionnaire

	Parameter	3	2	1	0	1	2	3	Parameter
1	Good well-being								Feeling unwell
2	I feel myself strong								I feel myself weak
3	Passive								Active
4	Hypodynamic								Dynamic
5	Joyful								Sad
6	Good mood								Bad mood
7	Hard-working								Crashed
8	Full of energy								Worn out
9	Slow								Quick
10	Inactive								Energetic
11	Happy								Unhappy
12	Cheerful								Sad
13	Tensed								Relaxed
14	Healthy								Sick
15	Indifferent								Enthusiastic
16	Apathetic								Anxious
17	Excited								Depressed
18	Cheerful								Down hearted
19	Well rested								Tired
20	Refreshed								Exhausted
21	Drowsy								Agitated
22	Rest oriented								Work oriented
23	Calm								Concerned
24	Optimistic								Pessimistic
25	Enduring								Fatigable
26	Vigorous								Weak
27	Slow-witted								Quick-minded
28	Absent-minded								Attentive
29	Full of hopes								Disappointed
30	Satisfied								Dissatisfied

Most negative evaluation of the pair parameter is 1 point, most positive evaluation of the pair parameter is 7 points.

Health is evaluated by the questions: 1, 2, 7, 8, 13, 14, 19, 20, 25, 26.
Activity is evaluated by the questions: 3, 4, 9, 10, 15, 16, 21, 22, 27, 28.
Mood is evaluated by the questions: 5, 6, 11, 12, 17, 18, 23, 24, 29, 30.

The obtained sum of the points in each category is divided by 10. The average score for each category of the HAM questionnaire is within 5 – 5.5, which corresponds with favorable psycho-emotional state, good mood, and well-being.

Calculations, analysis, and conclusions on the HAM test were conducted automatically by a special module of HSC "Istoki Zdoroviya" (Patent, 2004). Optimal range of average score (5 – 5.5) for each category

was taken for 100%, and actual scores for "health", "activity" and "mood" were presented as certain percentage from this favorable range. The authors evaluated integral score for "general self-evaluation" by the results of isolated points for "health", "activity" and "mood".

The control of being within target heart rate zone during the trainings was realized by heart rate monitors (POLAR, Finland).

Complex examination of the students from the main and control groups was done 4 times: in the beginning, in 3, 6 and 9 months from the training program start.

Results.

At the first stage of the study morphofunctional peculiarities of students' organisms with overweight and first-degree obesity (Table 4) were identified. They were later used for development of individual health and training programs.

Table 4. Comparative analysis of morphofunctional parameters of students with overweight and first-degree obesity in comparison with the students with normal weight.

Analyzed morphofunctional parameters	Students with overweight (n=55)	Students with first-degree obesity (n=27)	Students with normal body weight (n=36)	P_1	P_2	P_3
BMI	26.83±2.27	33.38±2.73	21.56±1.81	<0.05	<0.05	<0.05
Fat mass (%)	36.52±4.48	39.62±7.03	19.32±3.21	<0.05	<0.05	<0.05
Skeletal-muscle mass (%)	48.12±1.75	47.83±1.91	49.61±1.61	>0.05	>0.05	>0.05
Total fluid (kg)	37.83±3.15	38.17±3.46	31.38±2.83	>0.05	<0.05	<0.05
Extracellular fluid (kg)	15.96±1.35	16.24±1.22	13.51±1.26	>0.05	<0.05	<0.05
PWC/kg (kgm/min/kg)	9.41±2.82	9.15±2.21	13.42±2.30	>0.05	<0.05	<0.05
MOC/kg (ml/min/kg)	31.24±5.42	30.83±5.15	39.25±5.73	>0.05	<0.05	<0.05

P_1- significance of difference between the parameters of the students with overweight and the students with first-degree obesity.

P_2 - significance of difference between the parameters of the students with overweight and the students with normal body weight.

P_3 - significance of difference between the parameters of the students with first-degree obesity and the students with normal body weight.

The results of the primary psychologic testing, including Luscher test and HAM questionnaire, of the students with overweight and first-degree obesity in comparison with the respective parameters of the students with normal body weight are shown in Table 5.

Table 5. Comparative analysis of psychological state of students with overweight and first-degree obesity in comparison with the students with normal weight.

Analyzed psychological parameters	Students with overweight and first-degree obesity (n=82)	Students with normal body weight (n=36)	P
VC – norm (Luscher test)	25.6% (21 students)	83.3% (30 students)	>0.005
Emotional stability (Luscher test)	58.8±4.9%	79.3±5.4%	>0.005
Health (HAM questionnaire)	62.5±3.8%	78.4±5.6%	>0.005
Activity (HAM questionnaire)	56. 3±5.3%	82.5±4.5%	>0.005
Mood (HAM questionnaire)	64.8±4.1%	85.3±9.2%	>0.005
Self-confidence (HAM questionnaire)	60.6±4.2%	81.3±6.2%.	>0.005

Parameter	Group I (n=42)	Group II (n=40)	Normal body weight (n=36)	P_1	P_2	p_3
Body weight (kg)	82.57±11.38	81.45±12.13	59.42±5.74	>0.05	<0.05	<0.05
BMI (kg/m^2)	29.47±3.17	28.81±2.63	21.56±1.81	>0.05	<0.05	<0.05
Students with overweight	28 students 66.7%	27 students 67.5%	-	>0.05		
Students with first-degree obesity	14 33.7%	13 32.5%	-	>0.05		
Fat mass (%)	39.25±4.85	38.26±5.29	22.32±2.04	>0.05	<0.05	<0.05
Skeletal-muscle mass (%)	47.55±2.12	46.64±1.75	49.61±1.61	>0.05	>0.05	>0.05
Total fluid (kg)	38.17±3.62	37.55±3.16	31.38±2.83	>0.05	<0.05	<0.05

Extracellular fluid (kg)	16.61±1.58	15.78±1.47	13.5±1.26	>0.05	<0.05	<0.05
PWC 170 (kgm/min)	796.21 ±158.62	786.72 ±208.09	746.19 ±142.57	>0.05	>0.05	>0.05
PWC 170 /kg (kgm/min/kg)	9.38±2.50	9.04±2.29	13.42±2.30	>0.05	<0.05	<0.05
MOC (ml/min)	2,598.95 ±298.03	2,577.23 ±354.20	2,520.25 ±258.08	>0.05	>0.05	>0.05
MOC/kg (ml/min/kg)	31.15±6.55	30.52 ±4.30	39.25±5.73	>0.05	<0.05	<0.05

P – significance of differences between the parameters of the students with overweight and normal body weight.

After the complex examination, the students with overweight and first-degree obesity were told about the present study and offered to participate in it. During formation of the main (I) and control (II) groups, the authors tried to get similar morphofunctional parameters in both groups (Table 6) for further correct results analysis.

Table 6. Comparison of morphofunctional parameters of the students from the I and II group prior to the program beginning

p_1 – significance of difference between the parameters of the students from group I and II.

p_2 – significance of difference between the parameters of the students from group I and healthy students without excessive body weight.

p_3 – significance of difference between the parameters of the students in group II and healthy students without excessive body weight.

The analysis of the structure of initial data after the complex examination of students with overweight and first-degree obesity showed that the sampling was not consistent by functional state and level of training, for this reason, the students from the group I (n=42) were divided into subgroups “A” and “B” by the received level of physical working capacity.

Functional parameters of relatively trained (subgroup “A”) and relatively untrained (subgroup “B”) students from the group I in comparison with the students with normal body weight (group III) are presented in Table 7.

Table 7. Functional parameters of the students from subgroup “A” – “trained” and subgroup “B” – “untrained”

Parameter	Students with normal weight, group III (n=36)	Subgroup «A», group I (n=18)	Subgroup «B», group I (n=24)	p_1	p_2	p_3
PWC-170/kg (kgm/min/kg)	13.42±2.30	13.21±1.52	6.53±1.46	>0.05	<0.05	<0.05
MOC ml/min/kg	39.25±5. 73	38.25±2.82	26.42±2.26	>0.05	<0.05	<0.05

P_1 – significance of difference between the parameters of students with normal weight and students from subgroup “A” – “trained”

P_2 – significance of difference between the parameters of students with normal weight and students from subgroup “A” – “trained” and from subgroup “B” – “untrained”

P_3 – significance of difference between parameters of students from subgroup “A” – “trained” and subgroup “B” – “untrained”.

The developed individual health-training programs for excessive body weight loss were based on aerobic activities, in particular, dancing. For 18 “trained” girls from subgroup “A”, whose physical working capacity was at the level of healthy students, the health, and training program was based on their aerobic capacity. It included trainings in dancing classes 2 times a week 1.5 hours long each with moderate and heavy intensity (dance therapy and hip-hop aerobics). For 24 “untrained” students from subgroup “B”, dancing activities were chosen for low intensity loads – tribal dances 2 times a week 1.5 hours long each. As an additional individual training (3rd time a week) the students were offered the following aerobic activities: brisk walking, swimming, fitness cycling and other cardiovascular equipment trainings (running track, ellipsoid, and step simulator). Depending on the season, the students were recommended to go cycling and cross-country skiing. Running was not recommended for students with overweight and obesity with BMI higher than 27 kg/m^2, because of heavy shock loads on their joints and spine.

At the development of individual health and training programs, the authors focused on precise dosing of physical loads. The range of heart rates for individual training zones (HR_{train}) during individual aerobic activities were calculated by the formula of Karvonen (Karvonen et al,1957):

HR_{train} = intensity load coefficient × (HR_{max}–HR_{rest}) + HR_{rest}.

This method of intensity load calculation allowed the researchers to include the planned objective of the training (Table 8) and individual potential of heat rate (differences between maximal HR and HR_{rate}).

Table 8 Coefficients of physical load intensity for upper and lower limit of heart rate training zone (Karvonen et al,1957)

Training zone	Coefficients of HR lower limit	Coefficients of HR upper limit
Zone of recreation of disease prevention	0.5	0.6
Zone of body weight reduction	0.6	0.7
Zone of aerobic activity	0.7	0.8
Zone of anaerobic activity	0.8	0.9
Zone of maximal load	0.9	1.0

For the "trained" students from subgroup "A", the target limits of HR were estimated by the formula of Karvonen, using coefficients for aerobic load training zone and for reduction of body weight equal to 0.6 to 0.8. For "untrained" students from subgroup "B" the target limits of HR was estimated by the formula of Karvonen, using coefficients for recreation and disease prevention training zone and body weight reduction zone from 0.5 to 0.7. The control of target heart rate during the trainings was conducted by heart rate monitors.

Example. In a 20-year-old student M* from the training subgroup "A" the heart rate at rest was 66 bpm and maximal HR was equal to 200 bpm. For excessive body weight loss she was recommended to train in the aerobic zone with 60-80% intensity from the maximum (coefficient of body weight reduction from 0.6 to 0.8).

The estimation of heart rate limits for the training zones were done by the following formula:

Lower limit HR of the training zone = 0.6 × (200 – 66) + 66 = 146 bpm

Upper limit of the training zone = 0.8× (200 – 66) + 66 = 173 bpm

Thus, student M* was recommended to get physical load within the heart rate range from 146 to 173 bpm.

During the health-training program control tests were conducted in 3, 6 and 9 months after the primary examination of the students from both groups. The results of the final testing of the students from group I are presented in Table 9, from group II – in Table 10.

Table 9 The results of the final testing of the students from the main group (group I) 9 months after in comparison with initial data and parameters of the students with normal body weight (group III)

Parameter	Group I initial data (n=42)	Group I 9 months after (n=42)	Group III (n=36)	P_1	P_2
Body weight (kg)	82.57±11.38	74.26±7.55	59.42±5.74	<0.05	<0.05
BMI	29.47±3.17	26.50±3. 11	21.56±1.81	<0.05	<0.05
% fat mass	39.25±4.85	31.42±3.79	28.32±4.04	<0.05	<0.05
Share of skeletal muscle mass (%)	47.55±2.12	51.17±1.68	49.61±1.61	>0.05	>0.05
Total fluid (kg)	38.17±3.62	32.15±2.47	31.38±2.83	<0.05	>0.05
Extracellular fluid (kg)	16.61±1.58	13.89±1.37	13.5±1.26	<0.05	>0.05
PWC-170 (kgm/min)	796.21 ±158.62	1,011.95 ±180.25	746.19 ±142.57	>0.05	>0.05
PWC/kg (kgm/min/kg)	9.38±2.50	13.52± 2.39	13.42±2.30	<0.05	>0.05
MOC (ml/min)	2,598.95 ±298.03	2,916.90 ±302.27	2,520.25 ±258.08	>0.05	>0.05
MOC/kg (ml/min/kg)	31.15 ±6.55	38.79 ±5.57	39.25±5. 73	<0.05	>0.05
VC - norm (Luscher test)	26.2% (11 students)	80.9% (34 students)	83.3% (30 students)	<0.05	>0.05
Emotional stability (Luscher test)	59.6±4.9%	79.5±4.7%	79.3±5.4%	<0.05	>0.05
Health (HAM questionnaire)	63.3±4.1%	81.2±5.7%	78.4±5.6%	<0.05	>0.05
Activity (HAM questionnaire)	56. 7±4.9	79.3±5.4%	82.5±4.5%	<0.05	>0.05
Mood (HAM questionnaire)	65.7±3.8%	87.1±8.5%	85.3±9.2%	<0.05	>0.05
Self-confidence (HAM questionnaire)	61.3±3.5%	85.3±7.8%	81.3±6.2%.	<0.05	>0.05

P_1 – significance of difference between the initial data of the students from group I and data, obtained 9 months after the beginning of the training program.

P_2 – significance of difference between the initial data of the students from group I 9 months after the beginning of the training program and students with normal body weight.

Table 10 Results of the final testing of the students from the control group (II) 9 months after in comparison with the initial data and parameters of the students with normal body weight (group III)

Parameter	Group II Initial data (n=40)	Group II in 9 month (n=40)	Group III (n=36)	P_1	P_2
Body weight (kg)	81.45±12.13	80.37±8.23	59.42±5.74	>0.05	<0.05
BMI	28.81±2.63	28.54±2.78	21.56±1.81	>0.05	<0.05
% fat mass	38.26±5.29	36.69±4.26	28.32±4.04	>0.05	<0.05
Share of skeletal muscle mass	47.64±1.75	48.85±1.72	49.61±1.61	>0.05	>0.05

(%)					
Total fluid (kg)	36.55±3.16	36.18±2.45	31.38±2.83	>0.05	<0.05
Extracellular fluid (kg)	15.78±1.47	15.38±1.54	13.5±1.26	>0.05	<0.05
PWC-170 (kgm/min)	786.72 ± 208.09	806.63 ± 195.14	746.19 ± 142.57	>0.05	>0.05
PWC/kg (kgm/min/kg)	9.04±2.29	10.33±2.49	13.42±2.30	>0.05	<0.05
MOC (ml/min)	2,517.23 ± 354.20	2,570.58 ± 354.39	2,520.25± 258.08	>0.05	>0.05
MOC/kg (ml/min/kg)	30.52 ±4.30	32.56±4.62	39.25±5.73	>0.05	>0.05
VC - norm (Luscher test)	25% (10 students)	30% (12 students)	83.3% (30 students)	>0.05	<0.05
Emotional stability (Luscher test)	56.3±4.9%	59.5±3.7%	79.3±5.4%	>0.05	<0.05
Health (HAM questionnaire)	62.5±3.8%	65.2±3.4%;	78.4±5.6%	>0.05	<0.05
Activity (HAM questionnaire)	55. 8±5.1	56.7±4.6	82.5±4.5%	>0.05	<0.05
Mood (HAM questionnaire)	63.9±3.2%	67.1±2.3%	85.3±9.2%	>0.05	<0.05
Self-confidence (HAM questionnaire)	59.8±3.9%	61.5±4.7%.	81.3±6.2%.	>0.05	<0.05

P1 – significance of difference between initial data and parameters of the students from group II and data, obtained 9 months after the beginning of the training

P_2 – significance of difference between the data, obtained 9 months after the beginning of the training program, in students with normal body weight

The changes in percentage of students with overweight and first-degree obesity, defined 9 months after in the main and control groups, are presented in the Figure 1.

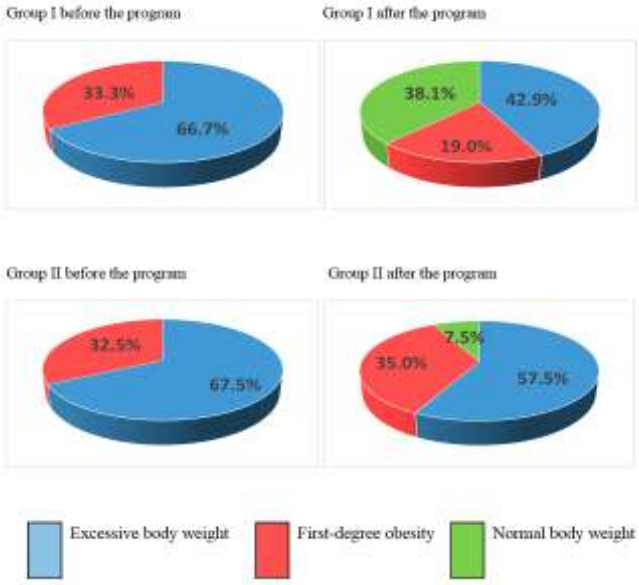

Figure 1. The change in percentage of the students with overweight and first-degree obesity in groups I and II before and after the health-training program.

Discussion

The analysis of the data from the participant questionnaire forms showed that diets prevailed among individually chosen methods of body weight loss, 69 out of 82 girls practiced it (84.1%), and only 9 of the respondents considered them effective (13%). Only 20 respondents (24.4%) preferred physical activities for body weight loss. Thirty five of the respondents (42.7%) explained their unwillingness to train by the lack of interest to traditional physical training programs. Subjective feeling of heaviness and discomfort during the trainings were marked by 52 girls (63.4%). Fifty three students (64.3%) explained their low physical activity by the curricular occupation and deficit of free time. Thus, at this stage of the questionnaire the authors identified low motivation to physical activity among the girls with overweight, which was primarily explained by the lack of physical training of the majority of the respondents and lack of interest to the offered training programs.

Morphofunctional peculiarities of the body in students with overweight and first-degree obesity were identified during the primary complex examination. Body composition tests revealed excess of fat mass by

17.2% in overweight girls and by 20.3% in students with first-degree obesity in comparison with the percentage of fat mass in students with normal body weight. In girls with overweight and first-degree obesity the content of total and extracellular fluid was not significantly different, exceeding respective parameters in students with normal body weight on average by 20%. The share of skeletal muscles was not significantly different in all the examined students. The analysis of functional state of the students with overweight and first-degree obesity showed significant reduction of relative values of physical working capacity PWC/kg and maximal oxygen consumption MOC/kg on average by 25%.

The analysis of psychological testing results showed significant decrease of some parameters in the group with students with overweight and first-degree obesity in comparison with the respective parameters in girls with normal body weight (Table 5). Results of Luscher tests identified that in 30 out of 36 students with normal body weight (83.3%) VC was within the normal range ($1 \leq VC \leq 1.5$). Only 21 out of 82 girls (25.6%) with overweight and first-degree obesity had this parameter within the normal range. 46 girls with overweight and first-degree obesity (56.1%) had $VC < 1$, which indicated that they were not ready for physical activity and were oriented on minimization of efforts for difficulties overcoming. The level of emotional stability, identified by Luscher test, in students with overweight and first-degree obesity, was significantly lower than in students with normal body weight and was equal on average to 58.8±4.9% in comparison with 79.3±5.4% in girls with normal body weight ($p<0.05$).

The analysis of HAM questionnaire results showed that average self-confidence level of the students with excessive body weight and first-degree obesity was significantly lower (60.6±4.2%) than in students with normal body weight (81.3±6.2%), ($p<0.05$). The level of "health" was 62.5±3.8% in students with overweight and first-degree obesity and 78.4±5.6% in students with normal weight ($p<0.05$). Similar significant difference was in evaluation of "activity" and "mood", in girls with overweight and first-degree obesity it was lower by 20%. These peculiarities of psychological status, together with revealed low motivation to physical activities, were taken into account during health-training programs development. For young girls the most attractive type of physical activity was dancing due to positive emotional background, interest to modern dances and group method of training accompanied by popular music.

Morphofunctional parameters in students from group I and II (presented in Table 6), in comparison with students with normal body weight, proved the correct formation of main and control groups. Before the training program nearly all analyzed parameters were not significantly different ($P_1>0.05$). The number of students with overweight and first-degree obesity in each group was also similar. At the same time, some parameters in students from group I and II were not significantly different from respective parameters in students with normal body weight. In particular, the following parameters were practically identical: share of skeletal-muscle mass, absolute physical working capacity and maximal oxygen consumption (p_2, $p_3>0.05$).

During individual training programs development for the students from group I, the authors focused on their sports background and level of physical fitness. Because of non-uniformity by functional state and degree of physical fitness, the students from group I (n=42) were divided into subgroups "A" and "B" by the level of physical working capacity. The main criteria for inclusion into the "strong" subgroup were the following: PWC-170/kg – higher than 12 (kgm/min/kg) and MOC/kg – higher than 36 ml/min/kg. The data, presented in Table 7, indicated significant aerobic capacities in students with overweight in subgroup "A", who were not different by physical working capacity from the students with normal body weight ($P_2>0.05$). This fact was taken into account at individual dosing of physical loads by means of estimation of target heart rate zone by the method of Karvonen (Karvonen et al,1957).

For 9 months the students from group I had dancing sessions 2 times a week and additionally individual aerobic training within the estimated target heart rate zone. The students from group II were involved into standard university curricular physical training. The control tests were conducted in 3 and 6 months. The results of the final testing, presented in Table 9, showed positive dynamics in all morphofunctional parameters of the students in the main group. On average, body weight reduction was 11%, BMI was close to normal body weight and was equal to 26.50±3.11, fat mass decreased by 20% in comparison with initial data, total and extracellular fluid volume decreased by 16%, relative level of PWC-170/kg increased from 9.38±2.50 to 13.52±2.39 (kgm/min/kg), and MOC/kg increased by 24.5% and was not significantly different from the levels in healthy students with normal body weight.

The dynamics of psychological status parameters deserved a separate analysis. Before the program, vegetative coefficient in Luscher test, that characterized the capability to overcome stress situations, was within optimal range only in 11 out of 42 students with overweight and first-degree obesity in group I (26.2%) and in 30 out of 36 students (83.3%) with normal body weight. In 9 month the levels of 34 out of 42 students ($1 \leq BK \leq 1.5$) from group I were within normal range (80.9%).

Average level of emotional stability in students from group I increased by 20% from 59.6±4.9% to 79.5±4.3% ($p<0.05$). The analysis of HAM questionnaire showed that average self-confidence of the students from group I increased by 24% from 61.3±3.5% to 85.3±7.8% ($p<0.05$), that slightly exceeded average level of self-confidence in girls with normal body weight (81.3±6.2%). The level of self-confidence in students in the main group on average increased by 18 % from 63.3±4.1% to 81.2±5.7% ($p<0.05$); the level of "mood"

increased by 21.4% from 65.7±3.8% to 87.1±8.5% ($p<0.05$), that slightly exceeded the level of mood in students with normal body weight, which was on average 85.3±9.2% ($p>0.05$). Thus, the testing of psychological parameters dynamics in students from group I, 9 months after, showed positive dynamics of emotional stability, capability to overcome stress, health and self-confidence, which proved the normalization of psychological status and maintenance of high motivation to training.

The analysis of the data, presented in Table 10, indicated the absence of significant positive dynamics in group II (control) by the majority of morphofunctional and psychological parameters. There was no significant body weight loss, BMI, % of fat mass and increase of MOC/kg ($p>0.05$). There were no significant changes in emotional stability, health, mood, self-confidence and capability to overcome stress either ($p>0.05$).

The effectiveness of the developed health-training programs was proved by the defined qualitative changes (Figure 1). 16 students (38.1%) from group I moved from the category "overweight" to "normal body weight" with BMI – 18.5-24.9 kg/m^2. 8 out of 14 students with first-degree obesity moved to "overweight" category. In group II there were no significant qualitative changes. Despite the fact that 3 students (7.5%) lost weight and moved to the category "normal body weight", body weight of 11 students increased, and one of them moved from the category "overweight" to "first-degree obesity".

Conclusion

Dance therapy efficiency for excessive body weight loss, physical working capacity increase and psychological status improvement in girls with overweight and first-degree obesity was proved by significant positive dynamics of the majority of morphofunctional parameters after the training course in students from the main group. In particular, fat mass on average decreased by 20% and physical working capacity (MOC/kg) increased on average by 24.5%. Psychological status improved due to the increase of stress-resistance and emotional stability on average by 20%, improvement of health by 18%, mood by 21.4% and level of self-confidence by 24%.

Dance therapy efficiency is explained by emotional comfort and psychologic attractiveness of this type of physical activity for young women, which keeps them highly motivated to start and follow the training course. Individual dosing of physical loads by means of estimation of target heart rate zone, and the possibility to control it during the trainings with heart rate monitors acts as an additional motivation factor.

Thus, during the development of health and training programs for people with overweight and obesity, the peculiarities of psychological status of this category of people should be in focus, along with complex morphofunctional status evaluation results. The type of physical loads and the form of training sessions should be defined not only by physical fitness, but also by motivational factors, that provide emotional comfort during the trainings. Dance therapy can be recommended as a method of physical rehabilitation for patients with first-degree obesity. Dancing therapy can be used as an alternative form of PT within the curriculum for pupils and students with overweight and first-degree obesity.

Conflicts of interest. The authors declare no conflicts of interest.

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