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Original Article

Dynamics of physical activity status in patients with grade I-III obesity in response to a physical rehabilitation program

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Abstract:
Purpose: to determine the dynamics of physical activity in the patients with grade I-III obesity in response to the developed comprehensive program of physical rehabilitation. *Materials:* 124 subjects of middle age (second period) with the alimentary constitutional obesity (56 – I grade, 41 – II grade, 27 – III grade and 63 subjects without obesity signs were surveyed. The International Physical Activity Questionnaire (IPAQ) – Short Form was used to evaluate the physical activity level. The obese patients were tested before and after implementation of one-year individualized comprehensive program of physical rehabilitation that included increase of the physical activity, change of the dietary pattern, acupuncture, massage, improvement of the psychological and emotional state and development of the conscientious active attitude to the weight loss process. *Results:* The patients with grade I-III obesity have demonstrated significantly lower level of physical activity which was directly-proportional to the obesity grade compared to the subjects with the normal body weight. Therefore, the highest grade of hypodynamia has been determined in the patients with grade III obesity. The patients with grade I obesity have achieved the physical activity level of the subjects with the normal body weight ($p>0.05$). The patients with grade III obesity have showed the highest gain of the weekly energy expenditure, mostly due to the intensive physical activity. *Conclusions:* One-year rehabilitation program has demonstrated the statistically significant ($p<0.05$) increase of all types of physical activity (intensive, moderate, walking) in the patients with grade I-III obesity compared to the baseline values.
Key words: obesity, physical activity, physical rehabilitation, program.

Introduction

Obesity is one of the most common global chronic non-infectious conditions. At the turn of the 21st century the mechanization and automation production and life resulted in hypodynamia in most human beings which was the reason of imbalance in the energy expenditure, changes in some biochemical processes and increase in body weight in the population of some economically developed countries. In general, this problem is one of the global issues, as according to the World Health Organization there are over 1.7 billion people in the world who are overweight or obese, and in the most developed European countries, obesity affects 15 to 25 % of the adult population (Williams, 2001; Tukuitonga et al., 2005; Chan et al., 2010; Sturgiss et al., 2016; Kovesdy et al., 2017; Osipov et al., 2017).

Obesity problem becomes more challenging and is getting to be a social threat to human lives (Zharova, & Kravchuk, 2014). This problem is a challenging issue regardless of social and professional affiliation, area of residence, age and sex. The importance of the obesity problem is associated with a risk of disability of young patients and decreased overall life expectancy due to the high incidence of the severe concomitant diseases (type 2 diabetes mellitus, arterial hypertension, dyslipidemia, atherosclerosis and related conditions, reproductive dysfunction, gallstone disease, musculoskeletal system dysfunction, in particular osteochondrosis, etc.) (Kravchuk et al., 2010; Lazareva, 2014; Krusevich et al., 2013; Kashuba et al., 2016). Obesity reduces resistance to colds and infectious diseases and significantly increases the risk of complications of the surgical interventions and injuries (Sedletskiy, 2007; Amundson et al., 2010; González et al., 2017). Physical activity (FA) plays a second important role after nutrition in the formation of human body weight and its low level is a prognostic factor of obesity development (Tukuitonga et al., 2005; Andreeva, 2013-2015).

Physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure. Physical inactivity (lack of physical activity) has been identified as the fourth leading risk factor for global mortality (6 % of deaths globally). Moreover, according to the researchers, physical inactivity is estimated to be the main cause for approximately 21–25 % of breast and colon cancers, 27 % of diabetes and approximately 30 % of ischemic heart disease burden. Globally, around 31 % of adults aged 15 and over were

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insufficiently active in the last decade (men 28 % and women 34 %). Approximately 3.2 million deaths each year are attributable to insufficient physical activity (Gösta, 2004; Tukuitonga et al., 2005).

Regular and adequate levels of physical activity in adults allow reducing the risk of hypertension, coronary heart disease, stroke, diabetes, breast and colon cancer, depression; improve bone and functional health; and are a key determinant of energy expenditure, and thus fundamental to energy balance and weight control (Booth, 2000; Blagiy, & Andreeva, 2013). The current levels of physical inactivity prevalence are partly due to insufficient participation in the physical activity during leisure time and sedentary behavior during the occupational and domestic activities. (Andrieieva et al., 2017; Galan et al., 2017). Likewise, an increase in the use of "passive" modes of transport has also been associated with declining physical activity levels. Increased urbanization has resulted in several environmental factors which may discourage participation in physical activity such as: violence, high-density traffic, low air quality, pollution, lack of parks, sidewalks and sports/recreation facilities (Andreeva, 2014). The physical education specialists are one of the categories of specialists who are consulted by many obese patients, as the high body weight and associated health conditions make people find the ways to manage them and one of such approaches is to increase the physical activity (Lazareva, & Fedorenko, 2012; Andreeva, 2014; Lazareva et al., 2015).

The results of this study are the consequences of the indicators obtained in our previous researches, showing the impaired motor ability observed in the patients with grade I-III obesity in all test exercises from Functional Movement Screen (FMS) (Aravitska, & Lazareva, 2016), and also the availability of the etiological factors of alimentary obesity in this population: lack of physical activity, impaired dietary pattern (increased frequency of food intake, eating at the second half of the day, excessive use of animal fats, salt and sweets, inadequate use of vegetables and fruits, frequent use of fast food) (Aravitska, 2015).

Material and methods

Subjects

124 subjects of middle age (second period) with the alimentary constitutional obesity determined by the calculated body mass index [Quetelet index]) (31 females and 25 males – I grade (basic group 1 (BG1)), 24 females and 17 males – II grade (basic group 2 (BG2)), 15 females and 12 males – III grade (basic group 3 (BG3)), average age: 39.6±1.4 years) and 32 females and 31 males without obesity signs aged 41.3±2.6 years (control group – CG) were surveyed in the study.

Inclusion criteria

Patients without acute somatic diseases or aggravation of chronic visceral disorder at time of examination have been selected for the study. The study has been conducted according to the principles of Good Clinical Practice. The study subjects have been acquainted with the tasks and main provisions of the study and signed informed consent form.

Procedure

Testing was performed twice – at the beginning of the study and after the implementation of the developed program of physical rehabilitation. The International Physical Activity Questionnaire (IPAQ) – Short Form was used to evaluate the physical activity level (Craig et al., 2003). This questionnaire allows calculating the time spent on the different levels of physical activity during a week. To determine the activity level, the duration and frequency of performing some types of loads were summed. The energy expenditure was expressed in the metabolic equivalents (METs). It was taken into consideration that energy expenditure for walking, moderate and high loads were 3.3–4.0–8.0 MET, respectively. Intensity of the weekly loading was calculated by multiplying the time spent on doing that type of activity by its intensity in MET. Three categories of the physical activity were used: insufficient: energy expenditure less than 600 MET × min/week; sufficient: energy expenditure 600–1500 MET × min/week; high: energy expenditure more than 1500 MET × min/week.

Developed program of physical rehabilitation has been implemented within one year and included the following elements:

- Increase of domestic (every day activity) and training physical activity (morning hygienic exercises, fitness-yoga, cardiovascular training, weight training).
- Change of diet pattern (gradual correction to develop the stable stereotype of healthy diet optimizing the caloric content of food and dietary regimen).
- Corporeal and auricular acupuncture (acupuncture exposure to the biologically active points on the body and ears to suppress feeling of hunger and thirst, decrease the grade of somatic and psychological discomfort during the introductory period of restricted diet, improve the function of the visceral organs impaired due to the increased body weight).
- Improvement of the psychological and emotional state (autogenic training, psychological and emotional support to decrease the grade of the exogenous stress that leads to the increase of consumed food).
- Development of the conscientious active attitude to the weight loss process (explanatory conversations on the obesity complications, characteristic features of the weight loss process, explanation of physical rehabilitation effect).

- Massage (lymphatic massage, general, abdominal) to accelerate the elimination of excessive fluid, recover after trainings, improve the function of the visceral organs.

The key principle of program development was the individualized approach considering the obesity grade, physical abilities and the psychological and emotional state of patient.

Results

Analysis of physical activity in the patients with different severity levels of obesity may detect hypodynamia directly-proportional to the obesity grade. Patients with grade I obesity were involved in the vigorous physical activity almost half as often as people with the normal body weight, patients from BG2 – three times as rare as they are, and patients from BG3 spent almost not time on it (Table 1). The weekly energy expenditure for this activity type was appropriate: in BG1 it was 39.71 %, in BG2 – 57.27 %, and in BG3 – 73.72 % less than in the control group (Table 2).

Table 1. Outcomes of obese patients according to the International Physical Activity Questionnaire (IPAQ, Short Form) in response to the rehabilitation program (M±m)

Questionnaire questions	CG (n=63)	BG1 Before course (n=56)	PR	After course (n=49)	PR	BG2 Before course (n=41)	PR	After course (n=36)	PR	BG3 Before course (n=27)	PR	After PR course (n=23)
1. Doing vigorous physical activities during the last 7 days (days per week)	2.09± 0.16	1.25± 0.15*		2.01±2.03○		0.61± 0.12*		1.62±0.32○		0.25± 0.08*		1.54±0.37○
2. Time spent on doing vigorous physical activities on one of those days (minutes per day)	70.56± 16.21	42.54± 9.42*		72.23±10.78○		30.15± 8.42*		57.36±10.37○		18.54±5.74*		53.25±12.49○
3. Doing moderate physical activities during the last 7 days(days per week)	2.51± 0.25	2.05± 0.18		3.08±0.31○		1.75± 0.15*		2.21±0.12○		1.07±0.13*		2.04±0.29○
4. Time spent on doing moderate physical activities on one of those days (minutes per day)	70.26± 12.65	71.23± 10.41		78.14±6.84		41.25± 6.75*		72.48±9.55○		24.68±3.84*		60.33±11.41
5. Number of days when you walk for at least 10 minutes during the last 7 days (days per week)	5.28± 0.29	4.92± 0.40		6.12±0.14*○		4.57± 0.41*		5.07±0.28○		3.59±0.13*		4.92±0.58○
6. Time spent on walking on one of those days (minutes per day)	112.67± 18.15	62.69± 9.10		100.15±10.36○		39.11± 6.12*		69.71±8.11○		26.12±3.68*		58.14±7.28○
7. Time spent sitting on a weekday during the last 7 days (minutes per day)	305.14± 25.24	381.53±32.07*		310.90±22.65○		443.50±36.51*		356.14±19.85○		517.36±51.45*		408.15±25.55*○

Note: * – statistically significant difference compared to the corresponding value in control group ($p<0.05$); ○ - statistically significant difference compared to the corresponding value before rehabilitation.

Analysis of the time spent on the moderate physical activity has demonstrated no significant difference in duration of this activity in CG and BG1. At the same time subjects from BG2 spent half as much time on this activity and subjects from BG3 – 3 times less (Table 1). Difference in the weekly energy expenditure on this type of the physical activity in the subjects from control group and basic groups 1 and 2 was 41.29% and 64.87%, respectively in favor of subjects with the normal body weight (Table 2).

Table 2. Weekly energy expenditure in the obese patients according to IPAQ (Short Form) in response to the rehabilitation program (M±m)

Energy expenditure on physical activity , MET	CG (n=63)	BG1		BG2		BG3	
		Before physical rehabilitation (n=56)	After physical rehabilitation (n=49)	Before physical rehabilitation (n=41)	After physical rehabilitation (n=36)	Before physical rehabilitation (n=27)	After physical rehabilitation (n=23)
Vigorous	564,48±24,15	340,32±32,59*	577,84±36,12○	241,28±15,47*	458,88±20,87*○	148,32±24,12	426,00±40,51*○
Moderate	281,04±28,63	284,92±19,64	312,56±30,53	165,08±28,94*	289,92±44,20○	98,72±10,22*	241,32±26,08*○
Walking	338,01±38,45	188,07±36,21*	300,45±29,78○	129,33±12,58*	209,13±30,58*○	84,36±8,71*	174,42±33,65*○
Total weekly	1183,53±78,7	813,31±56,4*	1190,85±90,38○	535,53±27,3*	957,93±42,33*○	331,40±19,6*	841,74±50,12*○

Note: * – statistically significant difference compared to the corresponding value in control group ($p<0.05$); ○ - statistically significant difference compared to the corresponding value before rehabilitation.

Determination of the walking duration has shown that patients with the obesity, especially of high grade, spent less time on walking compared with the subjects with the normal body weight (Table 1). The energy

expenditure on this type of physical activity was respectively less: in BG1 it was 44.36 %, in BG2 – 61.74 %, and in BG3 – 75.04 % less than in CG (Table 2).

The results pertinent to the time that obese people spent sitting were particularly evident. If the patients with the normal body weight spend sitting about 5 hours per day, the subjects from BG1 spend 6.35 hours, from BG2 – 7.38 hours, and from BG3 – 8.62 hours (Table 1).

In general the level of the weekly energy expenditure in the subjects with the normal body weight may be evaluated as the sufficient physical activity. The energy expenditure in the patients with grade I obesity was lower than in CG (by 31.28%, $p<0.05$), however, it was at the level of sufficient physical activity. Patients with grade II and III obesity had insufficient level of activity – lower than in CG by 54.75 % and 72.00 %, respectively ($p<0.05$) (Table 2). Identified hypodynamia may be considered to be one of the leading etiological factors of obesity.

One-year developed comprehensive program of physical rehabilitation has demonstrated the following outcomes.

Time spent on doing the vigorous physical activities showed the statistically significant increase in all groups with obesity, especially in BG2 and BG3 ($p<0.05$) (Table 1). The corresponding weekly energy expenditure increased in BG1 by 69.79 %, in BG2 – by 90.25 %, in BG3 – by 187.21 % compared with the baseline values ($p<0.05$) (Table 2).

Also the time spent on doing the moderate physical activities in the subjects with obesity (especially with grade II-III) increased ($p<0.05$) (Table 1), demonstrating the total increase in the weekly energy expenditure – by 75.71 % and 144.45 %, respectively, compared with the baseline values ($p<0.05$) (Table 2).

Comparison of time spent on walking has shown the same tendencies – it was statistically significantly increased on all groups with obesity ($p<0.05$) (Table 1), demonstrating the increase in the physical load in this type of physical activity – in BG1 by 59.75 %, in BG2 – by 61.70 %, in BG3 – by 106.75 % ($p<0.05$) (Table 2).

In accordance with the above mentioned changes, the total weekly energy expenditure increased: in BG1 – by 46.42 % ($p>0.05$ versus CG); in BG2 and BG3 – by 78.88 % and 153.99 % ($p<0.05$ versus the baseline values, achievement of level of sufficient physical activity) (see Table 2).

Discussion

A theoretical analysis of the specific literary data on the studied problem has shown that the current state of health status correction in the obese patients has become extremely important globally and requires looking for the new comprehensive ways of solving it with the involvement of different specialists.

Our studies confirm the available data on the challenging problem of health status correction in the obese patients (Amundson et al., 2010). Our outcomes supplement and widen the information on the need in comprehensive approach to the body weight correction, especially to the increase in the physical activity level, as one of the key factors of obesity in order to decrease the body weight, prolong and improve the quality of life as a result of reduction of cardiovascular complications (Andreeva, 2014; Lazareva, 2014; Sargent, et al., 2016; Zharova, 2016; González, et al., 2017). We have expanded the idea about the importance of problem of achieved result maintenance for a long time by changing the patient life style.

Our study has practically tested the comprehensive program of physical rehabilitation for the obese patients by one of the most important factors of obesity – physical activity. We think that the significantly increased physical activity in obese patients in response to the developed rehabilitation program is the result of the effective individualized work with the patients, selection of type and regiment of the physical activity, timely physiological support and encouraging maintenance of the achieved result, focusing on the lifestyle change, rather than the short-term decrease in body weight.

Conclusions

The problem of correction of the health status of obese patients is an important issue in the world society and it requires the new ways of solving in the framework of implementation of the state programs and individual work with patients. In particular, the physical activity of obese people is subject to the obligatory modification.

The conducted study has shown that the patients with grade I-III obesity are associated with the significantly lower level of physical activity, directly-proportional to the obesity grade, compared with the subjects with the normal body weight. The highest hypodynamia was detected in the patients with grade III obesity. It was the reason to develop the individualized comprehensive program of physical rehabilitation which involved the life style modification and included the increase of the everyday and training motor activity, optimized diet, acupuncture, massage, improvement of the psychological and emotional state and development of the conscientious active attitude to the weight loss process.

One-year rehabilitation program has demonstrated the statistically significant increase in all types of physical activity (intensive, moderate, walking) in the obese patients compared to the baseline values. Patients with grade I obesity have achieved the physical activity level of subjects with the normal body weight ($p>0.05$). The patients with grade III obesity have showed the highest gain of the weekly energy expenditure, mostly due

to the intensive physical activity.

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