Introduction

Childhood and adolescence are critical periods of development of a young body and formation of healthy body weight. According to Friedman and associates [1], 53-90% of overweight or obese children had the same problem as adults. Rolland-Cashera et al. [2] as well as Litwin [3] have observed that child obesity not only increases the risk of excessive body weight in adult life but is also closely related to the risk of cardiovascular diseases and diabetes. Kelsey et al. [4] have proved that, in spite of normalization of body weight in adult life, persons who were overweight or obese as children are more prone to illness and death resulting from metabolic diseases. Most clinical recommendations related to treatment of obesity include multidirectional actions: change of eating habits, regular physical activity, and pharmacotherapy [5]. According to Paesa et al. [6], based on specialist literature, it has been observed that aerobic training and resistance training improve body composition, lipid profile, and metabolic profile of exercising persons. However, most of these positive results depend on the type, intensity, and duration of exercise. Walking training is the simplest form of aerobic endurance exercises. According to the definition, walking is a march at a pace up to 6.5 km/h. Such a form of activity leads to an increase in exercise capacity or tolerance of exercise. It has a positive influence on the cardiovascular system, respiratory system, musculoskeletal system, lipid and carbohydrate metabolism, and hormonal balance. Systematic physical training at a healthy level is necessary for maintaining correct body weight, it improves the performance of immune system, improves cardiac electrical stability, increases heart muscle capillarization and diameters of the major coronary vessels [7,8]. In spite of numerous guidelines and research, no standard procedures have been drawn up regarding the form and intensity of physical training recommended for obese children. In the latest literature, Cauderay and
Cachat [9] indicated that physical activity is certainly an integral element of treating child obesity, yet it is still not known, which form of exercise is the most effective. The aim of this paper is to evaluate the influence of walking training on the process of treatment of obese children.

**Material and methods**

The paper considers research results from the recent 10 years. PubMed databases have been analyzed using the following keywords: 'obese adolescents', 'walking training', 'exercise therapy' with 'and' conjunction. It also uses the University’s metasearch engine including a periodical database of the Silesian Medical University in Katowice. Results for persons aged less than 18 were considered (Figure 1). Articles, in which no physical training was applied, and the research that only provided an assessment of exercise tolerance or the parameters of gait were excluded in the first place. In the further selection process, only the walking training (on a treadmill or on a flat ground within a specific period of time) was assumed as an eligibility criterion for the analysis.

**Results**

In total, 110 articles have been found. After reading the publication titles and summaries or full documents, 5 articles complied with the first selection criterion. Three papers presented randomized studies with a clinical control group. Two other publications provided for research using a method of observation with targeted selection in one or two groups. Two articles compliant with further selection requirements have been classified for the analysis [10,11] (Figure 1, Table 1).

Authors of the first article assessed the frequency of obesity among 5,158 schoolchildren (aged, 6-11) and effectiveness of a walking program as a part of organized physical activity. The program was 6 years long and included walking around a playground during breaks between the lessons. Three schools participated in the research. The walking exercise program decreased obesity by 1 to 5% in two of the schools. The percentage of obese children dropped by 5% at the first school and by 1% at the other. In the third school, the walking program had no influence on body mass reduction [10] (Table 2). Another analyzed article presents a population of 40 obese children divided into two groups of 20 on a random basis. The average age of the children in the analyzed groups was 11 ± 1, and their body mass index (BMI) was at least 30 kg/m². The clinical control group included children who did not participate in the training. The treated group participated in a 12-week aerobic training including walking and jogging. The training load was selected in line with Karvonen’s protocol. The children’s blood pressure, body composition, and biochemical factors determining the risk of cardiovascular diseases were examined before and after the training. On average, body mass decreased by 5 kg as compared with the clinical control group, BMI de-

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**Figure 1.** Flow diagram of literature search for walking training in obesity of children and adolescents
creased by 6, lipid profile (LDL, HDL, triglyceride) results improved, and blood insulin level decreased significantly. An improvement in body composition parameters based on bioelectrical impedance measurement and skinfold test pursuant to Holtain method were also recorded. Circumferences of arms, legs, and the torso were measured as well as skinfold thickness at these levels [11].

**Discussion**

Analysis and interpretation of current literature on physical training in treatment of child obesity is difficult. Differences in physical training programs and variety in the parameters used in assessment of training effectiveness make an objective comparison between the individual works problematic [12]. Walking training is certainly the simplest and most available form of aerobic training. This type of physical training allows for easy application of exercise, adapted to the person’s age, and tolerance to physical exercise. However, it cannot be recommended unquestioningly to all obese individuals due to possible degenerative and proliferative lesions in leg joints. Most publications assessing effectiveness of physical training of obese children used walking training as one of many forms of endurance exercises; the other ones included stationary bicycle exercise and rowing machine exercises. Other works combined walking training with resistance training and stretching [12-16]. Analyzed papers by Zuraikat and Zorba support the belief that this simplest form of exercise has many benefits for obese individuals, particularly for children. Walking training has a positive influence on decreasing body mass index in a longer run (6 years) [10]. From a short-term perspective (12 months), this type of exercise reduces body weight, thus improves the body mass index (BMI), normalizes the lipid profile, and decreases blood insulin level. Improvement of body composition is another positive result: a decrease in measurements of arm, leg, and torso circumferences as well as skinfold thickness examined on those levels were observed. Walking training combined with a proper diet is of a significant therapeutic value in controlling body weight; it decreases the risk of cardio-

**Table 1.** Characteristics of the studies

<table>
<thead>
<tr>
<th>Author (reference number), year</th>
<th>Study design</th>
<th>Patients description</th>
<th>Drop out (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zuraikat [10], 2015</td>
<td>OBS</td>
<td>Children 6-11 years old School 1, n = 724 39% overweight; School 2, n = 603 37% overweight; School 3, n = 462 32.6% overweight</td>
<td>NR</td>
</tr>
<tr>
<td>Zorba [11], 2011</td>
<td>RTC</td>
<td>40 boys 11 ± 1 years Exercises group, n = 20 BMI: 34.87 ± 4.1 kg/m² Control group, n = 20 BMI: 35.46 ± 3.2 kg/m²</td>
<td>NR</td>
</tr>
</tbody>
</table>

*BMI – body mass index, NR – not reported, OBS – observational study, RCT – randomized control trial*

**Table 2.** Analysis of walking training for treating obesity in children and adolescents: a review of recent programs

<table>
<thead>
<tr>
<th>Author (reference number), year</th>
<th>Duration (months)</th>
<th>Description of intervention</th>
<th>Weekly time</th>
<th>Reported intensity</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zuraikat [10], 2015</td>
<td>72</td>
<td>Walk the perimeter of the playground</td>
<td>5-10 miles each semester</td>
<td>NR</td>
<td>BMI (kg/m²)</td>
</tr>
<tr>
<td>Zorba [11], 2011</td>
<td>3</td>
<td>Walking-jogging</td>
<td>Three days a week (20-45 min)</td>
<td>Targeted heart rate of 60-65% of age-based maximum</td>
<td>Weight (kg) BMI (kg/m²) Circumference (cm) Skinfold Thickness Fat mass Fat-free mass Insulin (mU/ml) LDL (mg/dl) HDL (mg/dl) Triglyceride (mg/dl) Total cholesterol (mg/dl) LDL (mg/dl) VLDL (mg/dl)</td>
</tr>
</tbody>
</table>

*BMI – body mass index; HR – maximal heart rate; PA – physical activity; NR – not reported*
vascular diseases by reducing LDL cholesterol level and increases HDL cholesterol level [11]. Evaluation of exercise tolerance covers simple walking tests used in analyses of energy expenditure, gait cadence, and speed of walking [17]. A 6-minute walking test is a good alternative method; the distance covered by the patient in 6 minutes, walking lengthwise a marked section of a corridor or another flat surface might be assessed. This test measures an increase in heart rate, a post-exercise change in saturation, and allows calculating maximum oxygen uptake ($V_{\text{O}_{2\text{max}}}$) indirectly, according to the formula by Cahalin et al. [18]. However, this oxygen uptake evaluation method is not as good as the test with the use of a cycle ergometer, as the results are reproducible [18-22]. In case of obese children, these tests should be conducted under control of an experienced physiotherapists. Walking can result in increased stress in obese children’s leg joints and might lead to overstraining other joints [23].

Walking, strolling, and running are the most natural forms of a human’s physical activity. It is easy, does not require employing financial resources or special infrastructure, which makes it not only the easiest, but also the most accessible form of exercise for everyone. Walking does not require specialist skills such as other forms of exercise do; therefore, it is particularly useful in case of children and adolescents, also overweight and obese ones [24]. Fast walking might be done at any hour, irrespective of the weather and season, and might be divided into sections adapted to the particular child’s capability: they might vary in terms of distance and duration. Unlike other sports, walking does not put emphasis on winning and does not allow for assessment and classification of a participant’s skills. In fact, quite the opposite, it might be a way of overcoming barriers, establishing interpersonal relations, and a form of leisure as part of a peer group [25,26].

Assessment of walking as a form of exercise is also relatively simple. Pedometers used for calculating steps are becoming increasingly important. Traditional pendulum pedometers, telephone pedometers, and increasingly popular pedometer smartphone applications are an additional incentive for children to undertake physical activity in the form of walking. Moreover, in addition to counting steps, pedometer applications provide a lot of useful information on body parameters during exercise and effectiveness of training. They are useful in terms of assessment of a child’s exercise. Promoting walking among children and adolescents aged 5 to 18 as a simple form of exercise is very important, as the research authors indicate [25,27]. Obese children are at risk of abnormal stress on tibiofemoral joints, in the medialis section, which might contribute to pain in the knee. A doctor’s and physical therapist’s assessment of a child’s walk is important in qualification for walking training [23].

A review and analysis of available articles meeting the criterion of walking as the only physical exercise has its limitations. A small number of publications, based on which individual factors cannot be compared between various tests, are one of them. Various observation times (6 years versus 3 months in the two publications) are another limitation. Nonetheless, the results indicate that walking training has a significant influence on auxiliary process of treating obesity. This can be inspiring to extend the research on the application of walking training as a form of independent physical training for obese children.

Conclusions

The comparative analysis and interpretation of the current literature concerning walking training as the only form of physical exercise in treating child obesity is difficult. There are few publications on this subject. However, a review of results presented in these works indicates that walking training has a positive influence on the process of conservative treatment of obese children.

Disclosure

The authors report no conflict of interest.

References

23. Lerner ZF, Browning RC. Compressive and shear hip joint contact forces are affected by pediatric obesity during walking. J Biomech 2016; 49: 1547-1553.