Journal of Obesity and Overweight
Volume 9 | Issue 1
ISSN: 2455-7633

Research Article Open Access

Effects of High-Intensity Circuit Training on Body Composition and Selected Cardiovascular Parameters in Overweight and Obese Children Aged 9-12

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Citation: Gątarski M, Dudziak T, Czubek Z, Dorniak K, Sawczyn S (2023) Effects of High-Intensity Circuit Training on Body Composition and Selected Cardiovascular Parameters in Overweight and Obese Children Aged 9-12. J Obes Overweig 9(1): 105

Received Date: November 20, 2023 **Accepted Date:** December 20, 2023 **Published Date:** December 25, 2023

Abstract

Introduction: The problem of excess body weight is becoming an epidemic in the general population, especially among children aged to 12 years old. Efforts are being made to find a way to retreat the unfavorable changes related with obesity. This problem is escalating, and the direction of effective protective actions is not sufficiently recognized. The research presented in this study demonstrate the range of changes in overweight and obese children after an 8 weeks of circuit training program, with simultaneous parental education on modifying their children dietary habits.

Materials and Methods: In the research 83 children aged 9-12, including 30 boys and 32 girls participated in the experimental group, in the control group was 21 participants including 16 boys and 5 girls with excessive body weight assessed according to the OLAF scale. The exercise program was applied to keep from 70% to 90% of their maximum heart rate. The effects of the applied high-intensity circuit training were evaluated in terms of changes in body composition and the cardiovascular system.

Results: Significant reductions of body weight (50.76 ± 8.91 kg vs. 50.21 ± 8.88 kg, P<0.01) were observed, assisted with a decrease of visceral fat area (37.43 ± 5.57 cm2 vs. 33.04 ± 5.82 cm2), a decrease BMI (24.16 ± 2.62 kg/m2 vs. 23.38 ± 2.64 kg/m2), a reduction of waist circumference (19.24 ± 5.72 kg vs. 17.82 ± 5.59 kg), resting heart rate (108.18 ± 16.64 mmHg vs. 102.06 ± 21.88 mmHg), heart rate at 3rd minute of rest (103.98 ± 17.04 mmHg vs. 99.94 ± 15.91 mmHg), an increase value of pulse pressure (43.18 ± 13.91 mmHg vs. 47.97 ± 12.16 mmHg), and an increase of skeletal muscle mass (16.65 ± 2.79 kg vs. 17.15 ± 2.94 kg).

Conclusion: Our study shows the beneficial effects of a short-term (8-week) exercise program on body composition indicators, including body fat content and skeletal muscle mass, as well as cardiovascular function parameters such as blood pressure and heart rate.

Keywords: Excessive Body Weight; Heart Rate; Body Composition; Children; Health Training.

Introduction

Obesity and overweight are civilization diseases of the 21st century. In Europe, obesity is becoming increasingly prevalent. The problem of overweight mainly affects residents of highly developed countries, where economic, cultural, and political processes are intensifying. According to the World Health Organization, 58.6% of the European population is overweight, and 23% of them is obese [1]. Over the decades, the percentage of people with excessive body weight the value has tripled. Research conducted in many countries confirms the increasing frequency of obesity during the developmental phase, based on alarming epidemiological data [2, 3, 4]. According to the WHO Report, excessive body weight leads to many diseases, including diabetes, dyslipidemia, and metabolic diseases. It has been shown that the earlier the onset of obesity in childhood, the greater is risk of obesity during adult live [5]. According to the UNICEF Report [6], the prevalence obesity of Polish children aged 11, 13, and 15 years old is one of the highest results in Europe, reaching 17%. Bad dietary habits and low level of physical activity are factors determinating the health of children and can potentially reason of various complications, including cardiovascular diseases, during the adult live. Additionally, psychosocial aspects related to low self-esteem and peer acceptance associated with obesity should be taken into attention [2]. Obesity has imposed personal, social and economic challenges for children and their parents, communities and countries. direct economic impacts of childhood obesity can include medical costs (e.g., prescription medicine, emergency room and hospital treatment costs), while indirect economic impacts may involve labor market costs, such as time absent from work and lower productivity of parents due to caring for sick children. Further, the child. As a result, overweight and obesity can persist throughout adult life with higher lifetime costs, including obesity-related comorbidities and treatment [7]. Numerous publications provide examples of increased incidence of diseases such as hypertension, type 2 diabetes, elevated lipid levels, metabolic syndrome, or heart disease [8, 9, 10, 11]. Predisposition to increased fat tissue accumulation can be determnated both genetic, metabolic, and environmental factors. Information about these factors is crucial to combat obesity. Research comparing the effects of two types of training (aerobic and strength training) on body weight reduction and visceral fat tissue in adult women showed that strength training was more effective in the long term [12]. A investigation conducted in 2006 among over 1000 Polish children aged 11-16 confirmed that insufficient physical activity is the primary reason of increased body weight, followed by unfavorable dietary habits as the second most important rise [13].

The purpose of this study is to demonstrate the changes in body composition and cardiovascular parameters under the influence of 8 weeks of increased intensity circuit training program.

Materials and Methods

The study included 101 children from Gdansk as part of the "Your Move" (Twój Ruch) program at the Academy of Physical Education and Sport in Gdansk in association with Medical University of Gdańsk. After an initial analysis, removing children in the puberty period, finally 83 participants aged 9-12 took part in the study. The experimental group was composed of 30 boys and 32 girls with excessive body weight. In the control group was 21 children, with 16 boys and 5 girls, with increased body weight, wchich their not participate in the training program. The value of Excessive body weight in both groups was meassured using the OLAF scale, where overweight responds to the 85th to 94th percentile, while obesity corresponds to the 95th percentile and above. This project was developed under the patronage of the Ministry of Health and consisted of developing standards and creating grids of centiles, characterizing the basic features of the physique of children aged 7-18. The following parameters were taken into consideration: blood pressure, gender, age and height, as well as heart rate, body weight, BMI (body mass index) and WHR (waist/hip ratio). These norms should be updated every 10-15 years, due to the occurrence of the phenomenon of the so-called secular trend, i.e. children and adolescents achieving In subsequent generations, children and adolescents achieve higher values of somatometric parameters and earlier sexual maturation.. This division is used by many researchers [14, 15]. The participants of the

program were examined at the beginning and at the end of the experiment. The examinations were carried out at the Laboratory of Physical Exercise of the Academy of Physical Education and Sport in Gdansk. Body composition was measured by "InBody720" body composition analyser. The Measurements were took place in the morning, The participants were dressed in sportswear and with a empty stomach. Body height was measured with a medical scale. Waist circumference was examined by a measuring tape at the navel after removing the shirt. The following parametres of body composition was: body weight (BW), skeletal muscle mass (SMM), body fat mass (BFM), percent body fat (PBF), visceral fat area (VFA), and body mass index (BMI). Cardiovascular parameters such as systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) were determined according to medical procedures. The exercise test was performed in a cycle ergometer "via sprint 150p". Before the trial was a three minutes of warm-up. During the test, the participants were tasked to keep 50 revolutions per minute (RPM). During the trail load increased gradually by 25W for every 3 minutes. Heart rate was monitored by "Polar" RS 400 the heart rate monitor. The test was ended when participant refuse to countinue trail or when was unable to hold 50 RPM. After completing the test, the participants stayed with the heart rate monitor for 3 minutes. During this time, heart rate monitored the first and third minute of rest. Additionally, random checks of heart rate and blood pressure were conducted during the classes using the "Polar" sport testers on selected participants. This was done to assess the childrens engagement during training and their interest to understand the exercise heart rate ranges.

The training program was planned for 8 weeks, with two 60-minute sessions of physical activity per week. To keep high intensity of exercises, the training porgram was divided into 4 stations. Each station includes several tasks to to keep high exercise intensity (70-90% of maximum heart rate). No resting periods was included, only for task changes and between stations. The choice of training method was guided by the argument of high effectiveness in reducing body fat in exercisers [16, 17, 18]. The study was approved by the Institutional Bioethics Committee.

Statistical Analysis

Statistical analysis was performed using the SPSS Statistics for Windows software, version 27 (IBM Corp., Armonk, N.Y., USA). The level of statistical significance was set at alpha equal to 0.05. (Statsoft, Poland). Mean values and standard deviations were calculated, and tests of significance between mean values were performed. Between group differences were examined using the Chi-square test, and mean differences were analyzed using the Student's t-test with the application of the Welch correction, which allows for precise estimation in such situations. The differences measured in the test were also expressed in standardized form - the Cohen's d effect size. A value of $p \leq 0.05$ was considered statistically significant.

Results

The percentage of body fat mass in the experimental group was reduced. The applied circuit training method had a positive effect on the loss of body fat. The study results (Table 1, Figure 1) showed both significant changes in body fat percentage and body fat mass. In the second parameter, the reduction was the biggest and reached to 7.4%. In the control group before and after 8 weeks, the values of studied parametres determining body fat content were at a similar level from 85.79 ± 29.18 cm2 to 87.53 ± 29.12 cm2. That changes was statistically insignificant.

It is known that one of the most important types of adipose tissue is visceral adipose tissue,. Excess leads to many diseases. Outcomes in the experimental group showed a reduction in the visceral fat area (VFA) from 75.17 ± 24.09 cm2 to 70.12 ± 21.53 cm2. This reduction was 6.7% and was statistically significant at $p < 0.001$. In the control group, the VFA value does not decrease, on the contrary, after 8 weeks it slightly increased from 85.79±29,12 % to 85,79 ± 29,18%.

Waist circumference in the experimental group decreased by 3.7% from 80.10 ± 8.86 cm to 77.10 ± 8.69 cm. These changes are statistically significant. Also in the control group, after 8 weeks of observation, the waist circumference was slightly reduced to 1.3%.

This change of 88.67 ± 11.56 cm vs. 87.48 ± 9.97 cm was statistically insignificant.

It prevents an increase in plasma leptin concentration which leads to a decrease in appetite and the appearance of a feeling of satiety. This results is tendency to excessive fat storage and a reduced metabolic rate.

Table 1: Characteristics of the results of body composition tests in the experimental and control groups before and after 8 weeks of circuit training.

	Study 1		Study 2						
	M	*SD*	*M*	*SD*	Meanvalues	*%*	*t*	*p*	*Cohen's d*
Experimental group									
Body mass [kg]	50,76	8,91	50,21	8,88	-0,55	1,1%	2,69	**0,009**	0,34
Body mass index [kg/m2]	24,16	2,62	23,38	2,64	-0,78	3,2%	8,41	**<0,001**	1,07
Olaf scale / Obesity index [percentile]	94,84	3,41	93,19	3,89	-1,65	1,7%	7,34	**<0,001**	0,93
Skeletal muscle mass [kg]	16,65	2,79	17,15	2,94	0,5	-3,0%	-6,37	**<0,001**	0,81
Body fat mass [kg]	19,24	5,72	17,82	5,59	-1,42	7,4%	8,54	**<0,001**	1,08
Percentage of body fat [%]	37,43	5,57	35,04	5,82	-2,39	6,4%	10,99	**<0,001**	1,40
Visceral fat area [cm2]	75,17	24,09	70,12	21,53	-5,05	6,7%	6,73	**<0,001**	0,85
Waist circumference [cm]	80,10	8,86	77,17	8,69	-2,93	3,7%	4,89	**<0,001**	0,62
Control group									
Body mass [kg]	59,99	13,16	60,73	13,05	0,74	-1,2%	-2,73	**0,012**	0,60
Body mass index [kg/m2]	25,47	3,28	25,56	3,23	0,09	-0,4%	-1,06	0,301	0,23
Olaf scale / Obesity index [percentile]	95,29	4,14	95,19	4,13	-0,1	0,1%	0,36	0,724	0,08
Skeletal muscle mass [kg]	20,13	4,10	20,26	4,03	0,13	-0,6%	-2,38	**0,027**	0,52

Body fat mass [kg]	22,62	7,32	23,01	7,42	0,39	-1,7%	-1,91	0,071	0,42
Percentage of body fat [%]	37,07	5,61	37,35	5,54	0,28	-0,8%	-1,47	0,156	0,32
Visceral fat area [cm2]	85,79	29,18	87,53	29,12	1,74	-2,0%	-2,07	0,051	0,45
Waist circumference [cm]	88,67	11,56	87,48	9,97	-1,19	1,3%	1,06	0,299	0,23

Annotation. Statistical significance level p = 0.05. Strength of Cohen's d effect weak below 0.50, moderate 0.50 - 0.80, strong above 0.80.

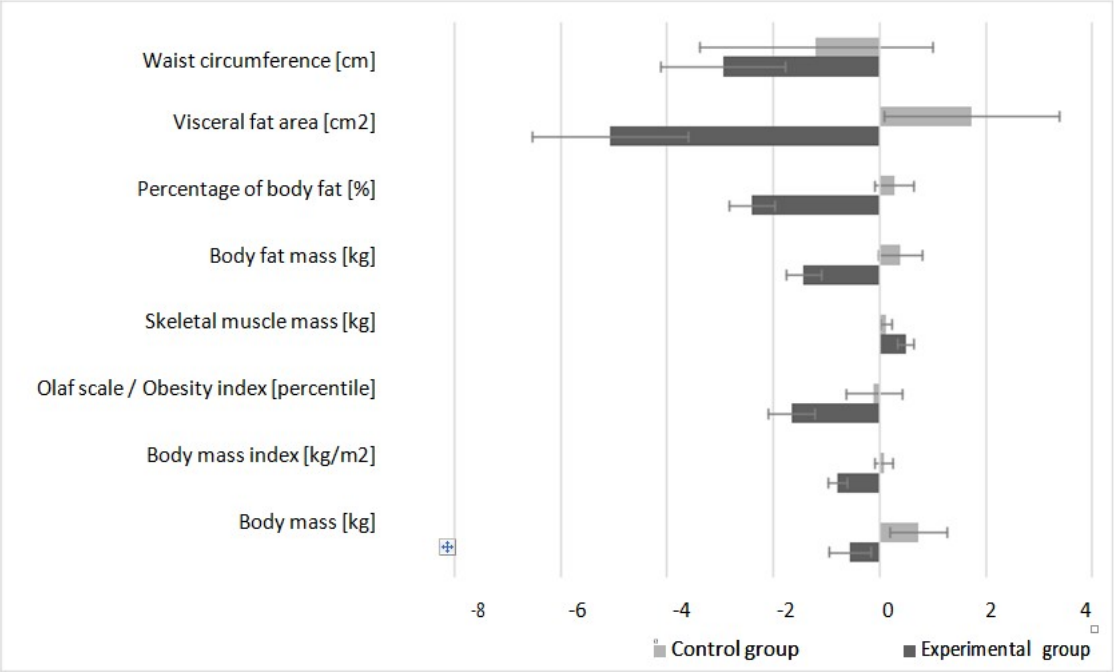

Figure 1: Mean values with 95% confidence intervals for changes in body composition in the experimental and control groups.

The heart rate in the experimental group after 8 weeks of training underwent favorable changes at the beginning of the test, during maximum effort (HR max) and in the 3rd minute of rest (Table 2, Figure 2). The mean HR value at the beginning of the endurance test decreased after 8 weeks of circuit training in the second measurement. Similar results were obtained in the 3rd minute of rest after the trail. However value of HR max underwent slightly smaller changes. Data analysis showed that HR at the beginning of the trial decreased by 5.7% after 8 weeks and by 3.9% at the 3rd minute of recovery after the trial. In both cases, the differences in the means before and after 8 weeks of circuit training showed statistical significance (Cohen's d < 0.5). In the control group, no beneficial changes were observed in the heart rate. In the 3rd minute of rest after the test, HR increased by 2.5%. This change was not statistically significant (p = 0.064).Changes in other HR parameters during the endurance test were barely visible.

The results show the adaptation of the cardiovascular system to keep increased intensity of training unit. So it's more efficient to burn more calories and prevent excessive body weight cardiovascular diseases in adulthood.

Table 2: Characteristics of the results of heart rate tests during the exercise test in the experimental and control groups before and after 8 weeks of circuit training.

	Study 1		Study 2						
	M	*SD*	*M*	*SD*	Meanvalues	%	*t*	*p*	*Cohen's d*
Experimental group									
Heart rate [1/min] – rest	108,18	16,64	102,06	21,88	-6,12	5,7%	2,06	**0,043**	0,26
Heart rate [1/min] – maximum	180,00	11,93	178,44	14,50	-1,56	0,9%	0,89	0,379	0,11
Heart rate [1/min] – 3rd minute rest.	103,98	17,04	99,94	15,91	-4,04	3,9%	2,38	**0,020**	0,30
Control group									
Heart rate [1/min] – rest	100,76	11,25	101,19	10,13	0,43	-0,4%	-0,26	0,800	0,06
Heart rate [1/min] – maximum	176,62	13,83	177,10	13,65	0,48	-0,3%	-0,45	0,660	0,10
Heart rate [1/min] – 3rd minute rest.	112,33	12,24	115,14	12,87	2,81	-2,5%	-1,96	0,064	0,43

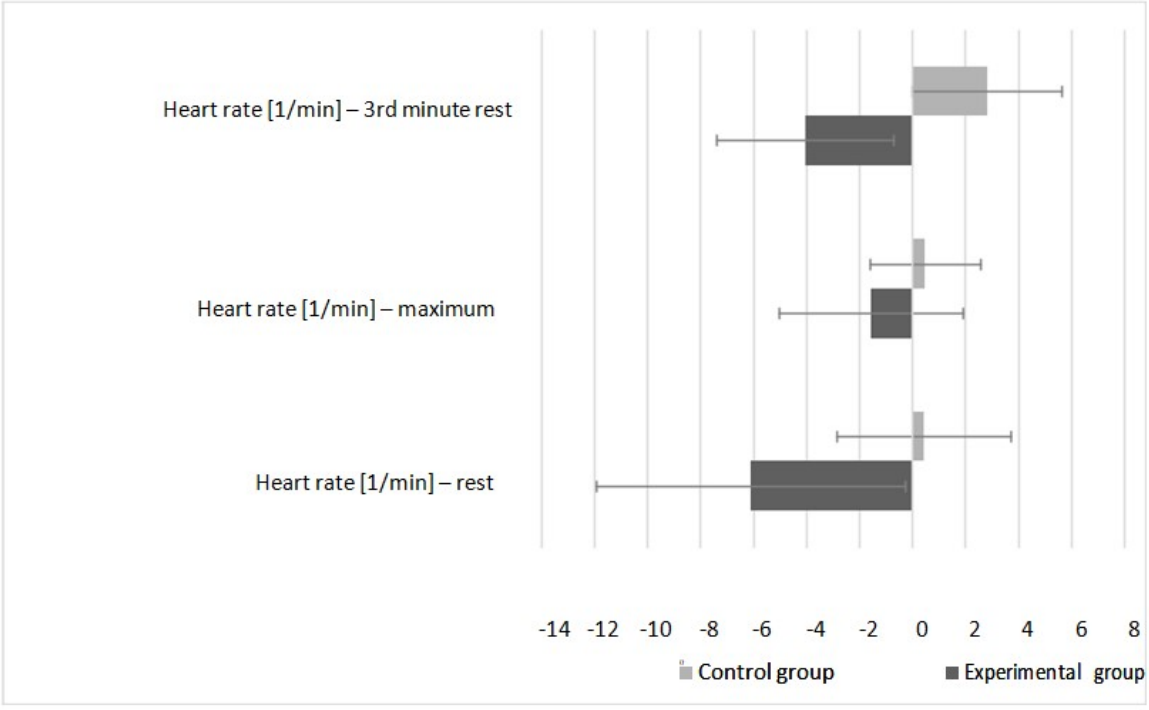

Figure 2: Mean values with 95% confidence intervals for the change in heart rate measurement results in the experimental and control groups.

The values of systolic and diastolic blood pressure in the experimental group before and after 8 weeks of training did not change statistically significantly (Table 3). The change in systolic blood pressure in the experimental group was 0.2%, and in the control group the value of systolic blood pressure after 8 weeks of observation was higher by 2.5%. Diastolic blood pressure in the experimental group decreased by 4.0%. In the control group, the diastolic blood pressure was slightly higher by 3.4%.

The value of pulse pressure in the experimental group after 8 weeks of training slightly increased by 6.9%. However, this change was statistically insignificant. In the control group, the pulse pressure increased slightly by 0.8%. This change was also statistically insignificant.

Heart rate in the experimental group was slightly reduced by 3.8%. This change, despite the favorable tendency, turned out to be statistically insignificant. In the control group, the heart rate was slightly higher after 8 weeks of observation by 2.4%, also not statistically significant.

Beneficial changes can prevent in the future disorders of metabolic processes which insulin resistance can have an impact on the activation and development of type 2 diabetes. This can induce an increase in blood pressure pressure, ultimately leading to hypertension

Table 3: Characteristics of the results of blood pressure and heart rate tests in experimental and control groups before and after 8 weeks of circuit training.

	Study 1		Study 2						
	M	*SD*	*M*	*SD*	Meanvalues	%	*t*	*p*	*Cohen's d*
Experimental group									
Systolic blood pressure [mmHg]	116,34	11,68	116,61	12,66	0,27	-0,2%	-0,16	0,870	0,02
Diastolic blood pressure [mmHg]	71,35	11,23	68,52	12,13	-2,83	4,0%	1,31	0,196	0,17
Pulse pressure [mmHg]	44,98	13,00	48,10	11,68	3,12	-6,9%	-1,52	0,133	0,19
Heart rate [1/min]	87,87	15,61	84,56	12,93	-3,31	3,8%	1,44	0,156	0,18
Control group									
Systolic blood pressure [mmHg]	109,05	10,79	111,76	12,88	2,71	-2,5%	-1,57	0,132	0,34
Diastolic blood pressure [mmHg]	71,14	10,95	73,57	12,94	2,43	-3,4%	-1,47	0,157	0,32

Pulse pressure [mmHg]	37,90	8,69	38,19	10,25	0,29	-0,8%	-0,24	0,816	0,05
Heart rate [1/min]	82,71	11,31	84,67	10,20	1,96	-2,4%	-1,44	0,165	0,31

Annotation. Statistical significance level p = 0.05. Strength of Cohen's d effect weak below 0.50, moderate 0.50 - 0.80, strong above 0.80.

Discussion

The growing problem of excess body mass in children is becoming widely recognized. Currently in the United States 33% of the population has BMI above normal range [19]. It is known that the basic cause is the wrong proportion between the reduced consumption of calories and their intake. This causes the accumulation of adipose tissue and a number of consequences, including cardiovascular system (CV) and metabolic disorders (MS) [20]. Changes in health due to excess body weight are already observed in adolescence [8]. A sedentary lifestyle is considered the main risk factor for the development of obesity, diabetes, CV diseases and osteoporosis [21, 22].

The relationship between the time spent in front of the TV and the body mass index (BMI) has been proven [23]. The most common changes in CV include increased blood pressure, the correlation of which with abnormal BMI values has also been confirmed [24].

Research is being undertaken to find an effective way on weight loss and reduction of risk factors for cardiovascular disease, not only for children and adolescents. In addition to the recommended physical exercises, it is advisable to educate children and parents leading to a change in eating habits, presenting the benefits of weight reduction as well as presenting the risks of reluctance to introduce changes.

The time of increased activity, defined in the literature, is different, and the form of physical exercise is not the same. After implementing a longer time of physical activity compared to the current study (8 months vs. 8 weeks of exercise), a group of 46 children and adolescents aged 6-16 years showed a reduction in blood pressure, cholesterol and body fat [25]. The program of including two additional exercises a week, 45 minutes each, carried out throughout the school year, in combination with education, not only reduced the volume of body fat, measured by the thickness of the skin fold, but also improved the physical condition in the 20-meter run and improved the well-being of the participants, based on the opinion contained in the completed quality of life questionnaire. Children from the cited publication also received instructions on exercise at home and recommendations for dietary modifications. [26].

In the present study, it was examined whether physical exercises in a relatively short time, compared to the cited programs - 8 weeks, a total of 120 minutes a week, can have a positive effect on changes in body composition and whether they will affect the parameters of the circulatory system. Changes in overweight and obese children were beneficial and proceeded in a similar way. Their ranges were also close. There was a significant decrease in the visceral fat area index (VFA) of 5.05 cm2. On the other hand, the skeletal muscle mass (SMM) increased by 0.50 kg. Both of these indicators had a positive impact on the value of waist circumference, which decreased by 3.7%. The area of visceral fat is an indicator of the severity of the metabolic syndrome in adults [27]. The reduction of visceral fat area obtained after 8 weeks in overweight and obese children is an action towards preventing later metabolic changes in adulthood. Martinez-Viscaino, et al. conducted extensive research on the positive impact of physical exercise on body fat, cholesterol and waist circumference in 712 children aged 8-10 [28].

Seo Y-G et al. proved that after 16 weeks ofexercise, overweight children achieved a reduction in BMI, a decrease in percentbody fat and a reduction in diastolic blood pressure. Similar to the results obtained in the present study, proposing the implementation

of increased activity programs in daily life [29]. Chaput et al. showed a significant beneficial effect on overweight reduction as a result of moderate to intense exercise. Without regardless of sleep duration or sedentary lifestyle in 507 children of similar age [30]

Examination of cardiovascular parameters in children is not an easy problem due to the fact that literature data on the measurement methodology are ambiguous. The definition of hypertension in childrens is still matter to debate. This is due to the fact that children do not know what blood pressure values may pose a threat to their health. American scientists recommend measuring blood pressure from the age of 3 [31]. According to the Olaf program, a value < 95th percentile corresponds to elevated, an adult blood pressure is above 140/90 mmHg. Between the 90th and 95th percentile, borderline high blood pressure is defined, which allows for non-pharmacological treatment, which includes physical activity. Growth charts have been developed for children aged 7 to 18. Thanks to this, it is possible to present the upper limit of the normal value for a given age of a child in Poland. These results were obtained after examining over 17,000 Polish childrens [32].

Age	95 percentile BOYS		95 percentile GIRLS	
	SBP (mmHg)	DBP(mmHg)	SBP (mmHg)	DBP (mmHg)
9 years	119	73	120	73
10 years	121	73	122	74
11 years	122	74	124	75
12 years	124	74	127	75

Table 4: Blood pressure upper limits values (95 percentile) in age groups 9 to 12 years.

The prevalence of hypertension increases in parallel with increased BMI values: from the 5th percentile - 2% of children to =95th percentile 11% - children [17].

In comparision to Table 4 of upper SBP/DPP limits for participants aged 9-12 years the most common blood pressure values for children according to The Olaf scale were for 9-year-olds 104/60 mmHg, for 10-year-olds: 105.5/61 mmHg for 11-year-olds - 106/61.5 mmHg and for 12-year-olds: 108/62.5 mmHg, respectively. The arithmetic mean for children aged 9-12 is 105.74/61.25 mmHg [15].

If we compare the results of measurements in children at the beginning of exercise, the average blood pressure in overweight children (SBP/DBP) was 116.34/71/35 mmHg, which is normal but higher than the most common for this age. At the end of the exercise program, the mean blood pressure (SBP/DBP) was 116.61/68.52 mmHg. After exercise, there was a slight increase in systolic pressure and a slight decrease in diastolic pressure. An increase in systolic blood pressure is a natural reaction to physical exertion. The reduction in diastolic blood pressure may be related to the effect of regular physical exercise on the change in the balance of the autonomic nervous system from the sympathetic to the parasympathetic. The sympathetic system is responsible for the increase and the parasympathetic system for the decrease of blood pressure and heart rate.

Researchers Freedman et al. in a meta-analysis from this year confirmed a significant correlation between risk factors for CV diseases, such as diastolic blood pressure or abnormal lipid level parameters, and BMI in adolescents aged 8-19 years assessed over 5 years [33]. In the presented study, recommendations to change incorrect eating habits after the end of the experiment were used, but additional exercise was not recommended, because the children had classes at school at that time (compulsory physical education classes) and individually attended other extracurricular physical activities.

Heart rate variability (HRV) is dependent on the activity of the parasympathetic autonomic system. Based on a meta-analysis of HRV changes, Eyre et al. found that obesity interferes with the proper development of the child's autonomic system [34]. In obese children, Lucini et al. observed impaired regulation of the autonomic nervous system, elevated SBP and impaired SBP variability, indicating abnormal regulation of the sympathetic nervous system even among those practicing sports - football [35].

In the group we studied, the initially elevated blood pressure, compared to the norm, underwent favorable changes. Changes in the form of DBP reduction did not reach statistical significance. In the Danish program, a decrease in blood pressure and an increase in insulin sensitivity were obtained after planned exercise for 20 weeks in a small group of 36 children aged 7-9 years, which could explain one of the mechanisms affecting the reduction of diastolic blood pressure [36]. As in the currently presented work by Hunt et al. found a significant reduction in diastolic blood pressure after training in a large group of 3,594 overweight children aged 9 years, in addition, they confirmed the dependence on the degree of overweight [37]. In a study of 525 children aged 4-18, a significantly higher HR frequency was found in the obese group compared to the group with normal weight [38]. After the training in the group of obese children, HR decreased from 94.07 beats/min. at 83.63 beats/min.

Heart rate (HR) at rest was also reduced. This value decreased under the influence of training by -6.12% and reached the level of statistical significance. The HR value also decreased during the 3-minute rest after the test. At the level of -4.04% and also reached the level of statistical significance. Favorable changes were also noted in HR max, but this value did not reach the threshold of the statistical level. Changes in the parameters of the circulatory system approached the results of children who are not burdened with the problem of excess body fat and the resulting increased risk of complications in the circulatory system in adult life. The trend of changes was favorable, i.e. it approached the level of normal values for the age group (defined by the Olaf program [15]. Confirmation of the impact of physical exercise on the regulation of the autonomic nervous system and possible biochemical changes, for example, insulin levels and their correlation with cardiovascular parameters of obese people children would require further research in the future.

Conclusion

Research has proven that the authors increased intensity circuit training program demonstrated the beneficial changes in body composition and cardiovascular system, and therefore can be recommended for children with excessive body weight

Ethics Approval and Consent to Participate

The research was approved by the Bioethics Committee of the District Medical Chamber in Szczecin. Consent number (OIL-Sz/K-B/MF/452/10/03/2012). The Commission give permission (No. 19/KB/IV/2012), expressing a positive opinion on the our research project entitled: „Health training implemented by the circuit training method program, body composition and physical fitness of overweight and obese children aged 9-11" Which is part of project: „Effect of polymorphism of selected genes on the character and extent of post-exercise body adaptation in obese children". Parents or guardians gave written informed consent and their child's participation int he study for week during 8 week program. The participants were under control of medical staff as well. All experiments were performed in accordance with relevant guidelines and regulations in Poland: Regulation of Ministry of Education 20 July 2018 r. Act.2018 poz. 1668.

Consent for Publication

Not Applicable

Availability of Data and Materials

All raw data are deposited on electronic database at the University of Physical Education and Sport in Faculty of Physical Culture in the Department of Sailing. Gdansk, Poland. Data is available upon reasonable request. Contact Dr Tomasz Dudziak (tomasz.-dudziak@awf.gda.pl) for access.

Competing Interests

The authors declare no competing of interests.

Funding

The study was carried out with own funding from the University of Physical Education and Sport as part of the project: "Health training implemented by the circuit training method program, body composition and physical fitness of overweight and obese children aged 9-11".

Author Contribution

M. Gątarski. (25%): Study Design, Data Collection, Data Interpretation, Manuscript Preparation, Literature Search.

T. Dudziak (35%): Study Design, Data Collection, Statistical Analysis, Data Interpretation, Manuscript Preparation, Literature Search.

Z. Czubek. (10%): Data Collection, Manuscript Preparation, Literature Search.

K. Dorniak. (20%): Data Interpretation, Manuscript Preparation, Literature Search.

S. Sawczyn. (10%): Study Design, Data Interpretation, Manuscript Preparation,

Literature Search, Funds Collection.

Acknowledgement

I give permission to publish our research results and take full responsibility for the authors for granting permission. All authors read and approved the final version.

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