Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XXVI, ISSUE 1, 2026, Romania
The journal is indexed in: ERIH PLUS, Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST, DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengage Learning, Cabell's Directories

Science, Movement and Health, Vol. XXVI, ISSUE 1, 2026
January 2026, 26 (1): 73-79
Original article: https://www.doi.org/10.61801/OUA.2026.1.12

IMPACT OF PERIPHERAL HEART ACTION TRAINING ON FUNCTIONAL CAPACITY IN PEDIATRIC OBESITY

GEORGESCU ADRIAN DORIN[1], GEORGESCU ANDREEA ALEXANDRA[2], POPOVICI ILEANA-MONICA[3], FĂGĂRAȘ PIA SIMONA[4], RADU LILIANA ELISABETA[3]

Abstract

Aim. Childhood obesity represents a major public health challenge, traditionally addressed by specialists in the medical, social, and psychological fields. However, this issue also directly involves professionals in physical education and sport, who play a crucial role in promoting active lifestyles and preventing sedentary behaviors. The aim of the present study was to evaluate the effects of a structured physical activity program on body composition and physical fitness parameters in obese middle school students.

Methods. This research sought to contribute to the improvement of quality of life and to the reduction of sedentary behavior among obese students by promoting regular participation in motor activities. The experimental intervention was conducted over a period of approximately six months, from October 2024 to April 2025, in the gymnasium of *Lucian Grigorescu* Middle School in Medgidia. The study sample consisted of students divided into an experimental group and a control group. Both groups were assessed at baseline and at the end of the intervention using somatic and motor evaluations. The somatic parameters analyzed included height, body mass, and body fat percentage. The experimental group participated in a structured physical activity program, while the control group followed the standard physical education curriculum.

Results. Baseline assessments confirmed the comparability of the two groups in terms of somatic and motor characteristics. Following the intervention period, the experimental group demonstrated a statistically significant reduction in body fat percentage at the final assessment compared with baseline values. In contrast, the control group did not show significant changes in this parameter.

Conclusions. The findings suggest that the implementation of a structured physical activity program can produce meaningful improvements in body composition among obese school-aged children. Such programs may represent an effective strategy for combating childhood obesity and promoting healthier lifestyles within the school environment.

Keywords: obesity; children; physical fitness; functional impact; exercise program.

Introduction

The effects generated by modern life, resulting from urbanization and restrictions that limit children's need for physical activity, the lack of rational motivation for engaging in physical activity in clubs and schools, as well as the overall health status of children, represent a series of interrelated problems which, in order to be addressed effectively, require sustained and intensive efforts in the field of scientific research (Hangu, S.Ș., 2016).

The prevention of obesity is a global public health priority, as excess body weight and obesity have a significant impact on health and well-being in both the short and long term. At the international level, the prevalence of childhood obesity continues to increase, although evidence suggests that a slowing of this growth or a plateau has been observed in most European countries, as well as in the United States and Australia (Olds et al., 2011).

In order to prevent and combat overweight and obesity beginning in middle school, every school should implement structured programs through which students, parents, and teachers are informed about the risks associated with this "disease." One of the major causes of excess body weight at such an early age is physical inactivity, often combined with unhealthy dietary habits.

As childhood obesity has become an increasingly evident problem in our country as well, the attention of many specialists in the field has been directed toward this issue. Among the most frequently proposed strategies for combating excess body weight are various intervention approaches, of which physical activity remains the most effective factor.

The primary rationale for selecting the topic of this study is the first-time application of a Peripheral Heart Action (PHA) training program aimed at reducing obesity in students aged 13–14 years. From this perspective, the chosen topic is highly relevant and aligns with the health policies promoted by the European Union and, implicitly, by Romania.

[1] Faculty of Physical Education and Sport, "Ovidius" University of Constanta, Bd Mamaia no 124, Romania; Corresponding author: adrian_georgescu_78@yahoo.com;
[2] Scholar Sports Club Medgidia, Constanta, Romania;
[3] "Alexandru Ioan Cuza" University of Iași;
[4] "George Emil Palade" University of Medicine, Pharmacy, Science, and Technology of Targu Mures.

Most specialists agree that the global increase in obesity is primarily attributable to increased energy intake and decreased levels of physical activity (Livingstone, 2001; Grier et al., 2007).

As highlighted by Allan and Burridge (2006), recent years have witnessed an alarming rise in both the incidence and prevalence of obesity among children and young people.

Peripheral Heart Action (PHA) training is described as a circuit-style approach that alternates upper- and lower-body resistance exercises with minimal rest, thereby sustaining a heightened cardiovascular demand while providing a meaningful neuromuscular stimulus. This hybrid structure positions PHA conceptually between traditional resistance and aerobic training, making it theoretically relevant for pediatric obesity when the main target is improved exercise tolerance and functional capacity. (Mang et al., 2022)

Compared with conventional hypertrophy-oriented resistance training, PHA can elicit a higher metabolic demand (including cardiorespiratory strain and post-exercise oxygen consumption), even when overall workload is controlled. This time-efficient profile is practically important in interventions for children and adolescents with obesity, where limited time and adherence frequently determine real-world effectiveness. (Mang et al., 2022)

In a controlled comparison between PHA and HIIT, a short-term PHA program produced increases in muscular strength and maximal oxygen uptake (VO_2max), alongside favorable autonomic adaptations (e.g., changes consistent with improved vagal modulation and cardiovagal baroreflex sensitivity). These findings are relevant to functional capacity because they suggest that PHA-type resistance circuits may support cardiorespiratory improvements in addition to neuromuscular gains. (Piras et al., 2015)

Within pediatric obesity research, a strong body of evidence indicates that combined aerobic and resistance exercise improves body composition and multiple metabolic and inflammatory markers, although effect sizes vary depending on intensity, duration, and delivery modality. In this context, a PHA-like structure (resistance performed in a circuit with an inherent cardiovascular component) is plausible as a function- and fitness-oriented intervention rather than an approach focused solely on BMI reduction. (Paes et al., 2015)

Evidence from pediatric interventions using high-intensity circuit formats further supports functional outcomes measured objectively. For example, a 6-week high-intensity circuit training program significantly improved functional capacity assessed via the 6-minute walk distance (6MWD), as well as respiratory muscle strength, in children who were overweight or obese. (Sundararajan & Afle, 2025)

Additionally, a 12-week concurrent training plan incorporating aerobic circuit components and strength exercise improved estimated aerobic capacity (e.g., via the 20 m shuttle run), muscular function, and selected anthropometric indicators in overweight and obese children and adolescents, suggesting that combined circuit/concurrent protocols can be clinically meaningful and reproducible. (Gálvez et al., 2022)

From a rationale standpoint, childhood obesity can be associated with reduced cardiorespiratory and muscular fitness even in the presence of normal body weight ("normal-weight obesity"), reinforcing the importance of functional outcomes (CRF and strength) rather than BMI alone. (Musálek et al., 2020)

Finally, mechanistic evidence indicates that training programs can improve peripheral and central vascular adjustments during exercise in adolescents with obesity, supporting the idea that fitness-oriented interventions may enhance functional capacity through more efficient circulatory responses to exercise. (Julian et al., 2016)

Methods

Fitness represents a form of physical activity that enables the body to use its energy resources to their fullest potential. It can be regarded as an effective pathway toward improving health status, physical appearance, and individual performance capacity.

An individual's ability to perform physical exercise depends largely on factors such as age, sex, personal habits, dietary behavior, and previous training experience. While age and sex cannot be controlled or influenced, specialists emphasize the importance of adapting personal and nutritional habits to a lifestyle that incorporates regular fitness exercise (Statache, 2012).

Obesity is a heterogeneous condition with a multifactorial pathogenesis (Brewis et. al., 2011). The main determinants of obesity overlap with the health determinants model proposed by Dahlgren and Whitehead (1991), as cited by Charleswell (2013). These determinants can be grouped into individual factors (genetic predisposition, age, sex, behavioral factors, and lifestyle), social factors (family environment, social relationships, living and working conditions, peer influence), and broader socioeconomic, cultural, and environmental factors.

The research hypothesis was formulated as follows: it was assumed that the introduction of a weekly fitness exercise program—specifically a Peripheral Heart Action (PHA) training protocol—for obese children would lead to positive outcomes in terms of body weight reduction.

The experiment was conducted between October 2024 and April 2025, over a period of approximately six months, in the gymnasium of *Lucian Grigorescu* Middle School in Medgidia.

A total of 31 students (9 girls and 22 boys), aged between 12 and 14 years, enrolled at *Lucian Grigorescu* Middle School in Medgidia, participated in the study. Based on the results of the initial somatic and motor assessments, the participants were divided into an experimental group (N = 14) and a control group (N = 17).

The intervention consisted of two (2) specific training sessions per week, which were conducted during regular physical education classes. The experimental group followed a structured PHA training program throughout the entire duration of the experiment. In contrast, the control group participated only in standard physical education lessons, following the same curricular framework as the experimental group, but without the inclusion of the proposed PHA training program.

Since students from two intact classes were assessed, the results allowed one class to be designated as the experimental group and the other as the control group. This approach was also chosen for practical reasons, as it facilitated group management without the need to modify class schedules or require students to attend additional sessions outside regular physical education lessons.

Initial and final assessments were carried out in the gymnasium of *Lucian Grigorescu* Middle School in Medgidia, with baseline testing conducted in October and final testing in April. During both assessments, upper limb strength, abdominal muscle strength, and body composition were measured. Based on the initial testing results, the experimental and control groups were formally established. Participation in the study was voluntary, and all students provided their consent to take part in the experiment.

Assessment Procedures

The tests applied to validate the research outcomes included a series of somatic measurements (Appendix 1). The following parameters were recorded:

- Body height (cm), measured using a stadiometer;
- Body mass (kg), measured using a standard medical scale;
- Body fat percentage / body composition, assessed through skinfold measurements using the Jackson–Pollock four-site method, with skinfolds collected at the abdominal, thigh, triceps, and suprailiac sites. Body fat percentage was measured using a *Fitness Fat Caliper* skinfold caliper.

Training Model

The training model implemented in the present study consisted of a Peripheral Heart Action (PHA) fitness program (Appendix 3), structured as circuit-based workouts combining cardiovascular and resistance exercises.

Week 1

Session 1: Cardio Mini-Circuit
(3 sets; 1 min 30 s rest between sets)

- Jumping jacks – 30 seconds
- Incline push-ups using a gymnastics bench – 10 repetitions
- Trunk flexions from the supine position – 10 repetitions
- Squats – 10 repetitions

Session 2: Cardio Mini-Circuit
(3 sets; 1 min 30 s rest between sets)

- Jumping jacks – 30 seconds
- Bench triceps dips – 10 repetitions
- Supine trunk flexions (crunches) – 10 repetitions
- Jump squats – 10 repetitions

Week 2

Session 1: Cardio Mini-Circuit
(3 sets; 1 min 30 s rest between sets)

- Rope skipping – 30 seconds
- Shoulder girdle exercise: overhead lift with a 1 kg medicine ball from chest level, arms extended – 10 repetitions
- Supine position with knees flexed and feet on the floor; alternating ankle touches with the ipsilateral hand (right to right, left to left) – 20 repetitions
- Squats with a 1 kg medicine ball – 10 repetitions

Session 2: Cardio Mini-Circuit
(3 sets; 1 min 30 s rest between sets)

- Rope skipping – 30 seconds
- Bent-over kettlebell row (back exercise) – 10 repetitions
- Supine position with legs extended and elevated at 40°; trunk flexion until hands reach the toes – 10 repetitions
- Squats with two pulses during the lowering phase – 10 repetitions

Results

To establish the experimental and control groups, students from the two classes included in the study were assessed using both somatic and motor evaluations. The somatic parameters analyzed included height, body mass, and body fat percentage (Table 1).

Presentation of data at the initial assessment:

Table 1. Somatic parameters of the tested students (N = 31; Mean ± SD)

Subject	Parameters		
	Waist (cm)	weight (kg)	Body fat percentage (%)
Experimental group (N = 14)	164.79 ± 8.37	63.07 ± 11.95	23.86 ± 6.52
Control group (N = 17)	160.94 ± 10.38	65.17 ± 9.72	23.92 ± 5.28
t	1.141	0.530	1.194
p	p > 0.05	p > 0.05	p > 0.05

Statistical analysis of the data showed that the recorded values were relatively similar across all participants for all tested parameters, with no statistically significant differences between group means, as presented in Table 2.

Presentation of data at the final assessment:

Table 2. Somatic parameters of the tested students (N = 31; Mean ± SD)

Subject	Parameters		
	Waist (cm)	Greutatea (kg)	Body fat percentage (%)
Lot experimental (N = 14)	164.79 ± 8.37	59.00 ± 9.79	21.35 ± 6.95
Lot control (N = 17)	160.94 ± 10.38	64.52 ± 9.36	22.78 ± 5.20
t	1.141	2.595	2.248
p	p > 0.05	p < 0.05	p < 0.05

Statistical analysis of the data indicated that, at the final assessment, no statistically significant differences were observed for the height parameter, whereas statistically significant differences were identified for body mass and body fat percentage in the experimental group.

A partial conclusion drawn from the analysis of the final assessment data is that, for four out of the five tested parameters, the experimental group achieved significantly better results compared with the control group. These differences can be attributed primarily to the Peripheral Heart Action (PHA) fitness program implemented in the training protocol of the experimental group.

Discussions

Other authors have reported similar findings, concluding that after a period of controlled and regular physical activity, obese children experienced reductions in body weight, reflected by decreases in body fat percentage. (Livingstone, 2001; Addo & Himes, 2010; Mocanu et al., 2011; Puhl, Luedicke & Heuer, 2011)

The primary finding of the present study was the statistically significant reduction in body fat percentage observed in the experimental group following the implementation of a Peripheral Heart Action (PHA) training program, whereas no significant changes were recorded in the control group. This result highlights the effectiveness of a structured, circuit-based fitness intervention integrated into regular physical education classes for obese adolescents aged 12–14 years.

Body fat percentage was selected as the main outcome variable because it represents a more accurate and clinically relevant indicator of adiposity than body mass index (BMI), particularly in pediatric populations. During adolescence, growth-related changes in height and lean mass may obscure meaningful improvements in body composition when BMI alone is considered. Consequently, changes in body fat percentage provide a more sensitive marker of training-induced adaptations in obese youth (García-Hermoso et al., 2018).

The findings of the present study are consistent with previous research demonstrating that combined exercise interventions, integrating aerobic and resistance components, are more effective in improving body composition in

Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XXVI, ISSUE 1, 2026, Romania
The journal is indexed in: ERIH PLUS, Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST, DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengage Learning, Cabell's Directories

children and adolescents with overweight or obesity than aerobic training alone. A systematic review and meta-analysis reported greater reductions in adiposity-related outcomes following concurrent training programs, supporting the rationale for circuit-based models such as PHA in pediatric obesity interventions (García-Hermoso et al., 2018).

From a physiological perspective, PHA training is characterized by the alternation of upper- and lower-body exercises with minimal rest intervals, which maintains a sustained cardiovascular load while simultaneously engaging large muscle groups. This training structure increases total energy expenditure during exercise and enhances post-exercise oxygen consumption, mechanisms that are known to contribute to reductions in adipose tissue even in the absence of marked body weight loss. Studies investigating the metabolic and cardiovascular profile of PHA training have reported elevated cardiorespiratory responses and favorable autonomic adaptations, which may explain the significant decrease in body fat percentage observed in the experimental group (Mang et al., 2022; Piras et al., 2015).

In contrast, the lack of significant changes in body fat percentage in the control group suggests that standard physical education alone may be insufficient to induce meaningful improvements in body composition among obese adolescents. This observation aligns with previous findings indicating that traditional physical education programs, when not supplemented with structured and sufficiently intensive exercise protocols, often fail to elicit significant reductions in adiposity in pediatric populations (Statache, 2012; Hangu, 2016).

An important practical implication of the present study is the feasibility of implementing PHA training within the school environment. The intervention was delivered during regular physical education classes, without the need for additional training time or specialized equipment. Similar school-based circuit or high-intensity exercise interventions have been shown to be effective and feasible in improving fitness and body composition in adolescents, supporting the ecological validity of the present findings (Martin-Smith et al., 2020).

Overall, the results of this study support the use of body fat percentage as a primary outcome measure in pediatric obesity research and provide evidence that Peripheral Heart Action training represents an effective, practical, and school-compatible strategy for improving body composition in obese adolescents. These findings contribute to the growing body of evidence supporting structured, time-efficient exercise interventions as part of comprehensive school-based obesity prevention and management programs.

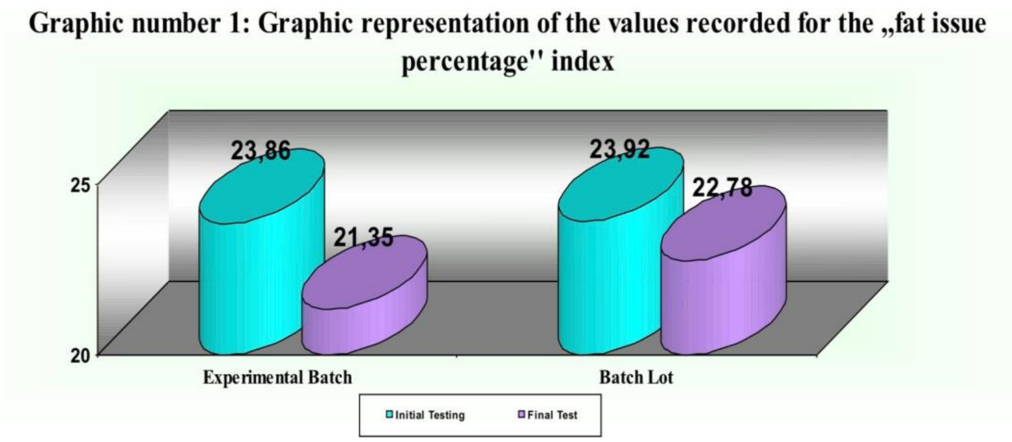
Conclusions

In the following section, the results obtained by the two groups at the final assessment are compared.

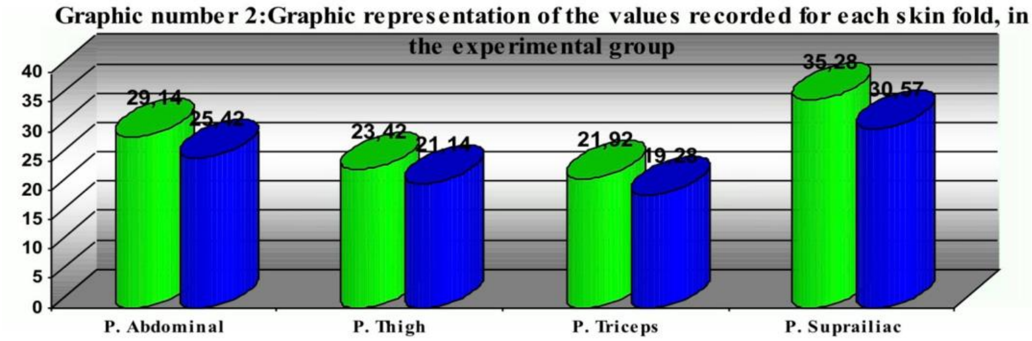
1. Body fat percentage

The experimental group recorded a mean body fat percentage of 21.35 ± 6.52%, whereas the control group showed a mean value of 22.78 ± 5.28%. Statistical analysis demonstrated that, for this parameter, the experimental group achieved significantly better results than the control group (t = 2.248, $p < 0.05$).

Furthermore, when the results were analyzed separately for each of the four measured skinfold sites, the experimental group showed statistically significant improvements at the final assessment compared with the initial assessment.



Graph 1. Graphic representation of the values recorded for the ”fat issue percentage” index



Graph 2. Graphic representation of the values recorded for each skin fold, in the experimental group

In the control group, no statistically significant differences were recorded between the two testing sessions, either in terms of total body fat percentage or for each individual skinfold measurement.

In contrast, the experimental group exhibited statistically significant improvements in this parameter at the final assessment compared with baseline, whereas no such changes were observed in the control group. We consider that these differences can be attributed to the PHA training program implemented throughout the experimental period.

Although these authors did not specifically employ this type of fitness training, previous studies have also reported that fitness programs exert positive effects on abdominal muscle strength (Statache, 2012; Piras et al., 2015; Dorgan et al., 2016; Hangu, S.Ș., 2016).

Based on the statistical analysis of the final assessment data, it can be concluded that the experimental group achieved significantly better results than the control group across all tested parameters.

These differences are most likely attributable to the training program applied to the experimental group.

References

Addo, Y., & Himes, J. H. (2010). Reference curves for triceps and subscapular skinfold thicknesses in U.S. children and adolescents. *The American Journal of Clinical Nutrition, 91*(3), 635–642. https://doi.org/10.3945/ajcn.2009.28385.

Allan, K., & Burridge, K. (2006). *Forbidden words: Taboo and the censoring of language*. Cambridge University Press.

Brewis, A. A., Wutich, A., Falletta-Cowden, A., & Rodriguez-Soto, I. (2011). Body norms and fat stigma in global perspective. *Current Anthropology, 52*(2), 269–276. https://doi.org/10.1086/659309.

Charleswell, C. (2013). *Dollars & sense: Why equal gender pay matters*. Women's Issues Analysis.

Dorgan, V., Liușnea, C. Ș., & Gheorghiu, A. (2016). Rolul mijloacelor din fitness în realizarea obiectivelor de dezvoltare fizică la adolescenți. *Sport. Olimpism. Sănătate: Materialele Congresului Științific Internațional* (pp. 441–447). USEFS.

Gálvez, E., Cifuentes-Silva, E., González, F., Bueno, D., Foster, P., & Inostroza, M. (2022). Effect of a 12-week concurrent planification exercise program in overweight and obese children and adolescents. *Andes Pediatrica, 93*(5), 658–667. https://doi.org/10.32641/andespediatr.v93i5.4194.

García-Hermoso, A., Ramírez-Campillo, R., Peterson, M. D., & Martínez-Vizcaíno, V. (2018). Concurrent aerobic plus resistance exercise versus aerobic exercise alone to improve health outcomes in paediatric obesity: A systematic review and meta-analysis. *British Journal of Sports Medicine, 52*(3), 161–166. https://doi.org/10.1136/bjsports-2016-096605 .

Grier, S. A., Mensinger, J., Huang, S. H., Kumanyika, S. K., & Stettler, N. (2007). Fast-food marketing and children's fast-food consumption: Exploring parents' influences in an ethnically diverse sample. *Journal of Public Policy & Marketing, 26*(2), 221–235. https://doi.org/10.1509/jppm.26.2.221.

Hangu, S. Ș. (2016a). *Educația fizică și activitățile motrice în prevenirea obezității infantile*. Editura Universitară.

Hangu, S. Ș. (2016b). *Eficiența jocurilor de mișcare în ameliorarea compoziției corporale și în îmbunătățirea motricității generale la copiii antepubertari* (Rezumat teză de doctorat). UNEFS, București.

Julian, V., Thivel, D., Pereira, B., Costes, F., Richard, R., & Duclos, M. (2016). Improving peripheral and central vascular adjustments during exercise through a training program in adolescents with obesity. *Obesity Facts, 9*(5), 321–331. https://doi.org/10.1159/000447456 .

Livingstone, M. B. (2001). Childhood obesity in Europe: A growing concern. *Public Health Nutrition, 4*(1A), 109–116. https://doi.org/10.1079/PHN2001144 .

Mang, Z. A., Moriarty, T. A., Realzola, R. A., Millender, D. J., Wells, A. D., Houck, J. M., Bellissimo, G. F., Fennel, Z. J., Beam, J. R., Mermier, C. M., & Amorim, F. T. (2022). A metabolic profile of peripheral heart action training. *Research Quarterly for Exercise and Sport, 93*(2), 412–422. https://doi.org/10.1080/02701367.2021.1876941.

Martin-Smith, R., Cox, A., Buchan, D. S., Baker, J. S., Grace, F., & Sculthorpe, N. (2020). High-intensity interval training (HIIT) improves cardiorespiratory fitness in healthy, overweight, and obese adolescents: A systematic review and meta-analysis. *International Journal of Environmental Research and Public Health, 17*(8), 2955. https://doi.org/10.3390/ijerph17082955.

Mocanu, V., Găleșanu, C., Măndășescu, S., Haliga, R., Costan, A. R., & Bădescu, M. (2011). Depistarea și prevenția obezității la copii – considerații practice. *Revista Română de Pediatrie, 60*(3), 223–232.

Musálek, M., Clark, C. C. T., Kokštejn, J., Vokounová, Š., Hnízdil, J., & Mess, F. (2020). Impaired cardiorespiratory fitness and muscle strength in children with normal-weight obesity. *International Journal of Environmental Research and Public Health, 17*(24), 9198. https://doi.org/10.3390/ijerph17249198.

Olds, T., Maher, C., Zumin, S., Péneau, S., Lioret, S., Castetbon, K., & Bellisle, F. (2011). Evidence that the prevalence of childhood overweight is plateauing: Data from nine countries. *International Journal of Pediatric Obesity, 6*(5–6), 342–360. https://doi.org/10.3109/17477166.2011.605895.

Paes, S. T. T., Marins, J. C. B., & Andreazzi, A. E. (2015). Metabolic effects of exercise on childhood obesity: A current view. *Revista Paulista de Pediatria, 33*(1), 122–129. https://doi.org/10.1016/j.rpped.2014.11.002.

Piras, A., Persiani, M., Damiani, N., Perazzolo, M., & Raffi, M. (2015). Peripheral heart action (PHA) training as a valid substitute to high-intensity interval training to improve resting cardiovascular changes and autonomic adaptation. *European Journal of Applied Physiology, 115*(4), 763–773. https://doi.org/10.1007/s00421-014-3057-9.

Puhl, R. M., Luedicke, J., & Heuer, C. (2011). Weight-based victimization toward overweight and obese adolescents: Observations and reactions of peers. *Journal of School Health, 81*(11), 696–703. https://doi.org/10.1111/j.1746-1561.2011.00646.x.

Statache, F. (2012a). *Fitness și sănătate*. Editura Discobolul.

Statache, F. (2012b). Reguli de bază în obținerea condiției fizice prin fitness. În *Impactul practicării activităților corporale asupra calității vieții* (pp. 168–170). Universitatea Politehnica din București.

Sundararajan, S., & Afle, G. M. (2025). Effect of high-intensity circuit training on functional capacity and respiratory muscle strength in children who are overweight and obese: An experimental study. *International Journal of Contemporary Pediatrics*. https://doi.org/10.18203/2349-3291.ijcp20251469.