

Effectiveness of After-School Physical Activity Intervention on Body Mass Index and Waist Circumference/Height Ratio among Overweight Adolescents in Selected Schools at Puducherry, India: A Randomized Controlled Trial

Sumathy Ponnambalam, Soundararajan Palanisamy¹, Rajeswari Singaravelu², Hemamalini Arambakkam Janardhanan³

Department of Child Health Nursing, Kasturba Gandhi Nursing College, Sri Balaji Vidyapeeth Deemed to be University, ¹Department of Paediatrics, Mahatma Gandhi Medical College and Research Institute, Sri Balaji Vidyapeeth Deemed to be University, Puducherry, ²Department of OBG Nursing, Faculty of Nursing, Sri Ramachandra Institute of Higher Education and Research Deemed to be University, ³Department of Clinical Nutrition, Sri Ramachandra Institute of Higher Education and Research Deemed to be University, Chennai, Tamil Nadu, India

Abstract

Background: Globally, the prevalence of overweight and obesity has dramatically increased in the recent years. In India, more than 10% of schoolchildren are overweight or obese. Schools play a major role in the modification of behavior. The aim of this study was to assess the effectiveness of after-school physical activity intervention on body mass index (BMI) and waist circumference/height ratio as primary outcomes. **Materials and Methods:** A randomized controlled trial was adopted where the schools were randomized. Each group, i.e., study and control groups, had 140 overweight adolescents. BMI and waist circumference/height ratio were measured. After-school physical activity intervention was carried out for a period of 9 months by the study group. The posttests were carried out at an interval of 3 months up till 9 months. **Results:** There was a statistically significant difference in BMI between the study and control groups during the 6th and 9th months ($t = 1.256, P < 0.001$ and $t = 0.920, P < 0.001$), respectively. The repeated measures analysis of variance did not show a significant reduction in BMI and waist circumference/height ratio over a period of time. **Conclusion:** School-based physical activity interventions are effective in prevention of childhood overweight/obesity and are a very cost-effective measure that can be easily implemented in schools.

Keywords: Adolescents, after school, body mass index, obesity, overweight, physical activity, waist circumference/height ratio

INTRODUCTION

Overweight and obesity have become much more prevalent globally in recent years.^[1] Overweight and obesity defined by the World Health Organization (WHO) are abnormal or excessive fat accumulation that may impair health.^[2] Childhood obesity is a major public health challenge in both developed and developing countries.^[3] Surveys in Indian cities have shown that more than 10% of schoolchildren are overweight or obese.^[4] A report from the WHO Commission on Ending Childhood Obesity 2016 identifies obesogenic environments as the major cause which includes decreased levels of physical activity, high levels of sedentary behavior, and intake of high-calorie foods.^[5]

Any body movement requiring energy expenditure that is produced by skeletal muscles is defined as physical activity

as per the WHO.^[6] Physical inactivity is on the rise, among children and adolescents, and is thought to be one of the leading causes of overweight and obesity. Only 30% of adolescents engage in adequate physical activity that promotes a good physical, psychological, and emotional development.^[7] As

Address for correspondence: Dr. Hemamalini Arambakkam Janardhanan, Department of Clinical Nutrition, Sri Ramachandra Institute of Higher Education and Research Deemed to be University, Chennai, Tamil Nadu, India. E-mail: srmcphd03@gmail.com

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per the international data published in the Lancet Physical Activity Series, nearly 80% of 13–15-year-old children did not meet the current physical activity recommendations of 60 min of moderate-to-vigorous physical activity per day, and this highlights the need for increased physical activity.^[8]

Adolescence has been designated as the most critical period for the development of obesity.^[9] Overweight children and adolescents are highly prone to become obese and are likely to develop noncommunicable diseases during adulthood.^[10]

Physical activity accounts for 25%–35% of energy expenditure in children and hence it is considered to be a key component in reduction of overweight/obesity. Hence, interventions targeted during adolescent period would lay a strong foundation for lifelong health-related behavior.^[9] Many intervention studies, mainly in high-income countries, have often been school based with combined health education. Hence, schools play a prime role in the behavior modification as compliance with the interventions can be improved. Large school-based health and nutrition education programs in India have reported increased knowledge and/or health-related behaviors.^[11,12] A small ($N=99$) multicomponent school-based intervention done among adolescents in Delhi for a period of 6 months depicted a significant decrease in their waist circumference.^[13] Very few studies in India have focused on after-school physical activity interventions to reduce obesity. The aim of this study was to determine how effective the after-school physical activity intervention would yield the desirable changes in body mass index (BMI) and waist circumference/height ratio from the baseline data and a follow-up data done at an interval of 3 months up till 9 months.

MATERIALS AND METHODS

Study design

A randomized controlled trial was used for the study. Randomization of schools was carried out as a measure to overcome extraneous variable. Four schools consented to participate in the study. The investigator prepared a list in which the names of the schools were numbered (1–4) and kept confidentially. Four chits numbered 1–4 were folded and put in a box numbered 1 and mixed thoroughly. Two-folded chits, namely study group and control group, were kept in another box numbered 2. The headmistress of one of the schools picked out the chits with the consent of the other headmistress. She picked 2 chits from box 1 and 1 chit from box 2. The picked up 2 chits were included in the group as per the chit picked from box no. 2. The remaining numbered chit was allotted to the other group.

The study was carried out among 280 overweight adolescents aged 11–14 years from four urban private schools of Puducherry, and the socioeconomic status of parents were mostly from upper-middle class.

Sample size

Using power analysis with the power of 80% and α as 5%,

the estimated sample size was 126 in each group (total = 252). Considering the chance of attrition, an increase of 14% was done and the obtained value was increased to 140 in each group (total = 280). However, no attrition was seen in both the groups as the adolescents were regular to school and the school authorities were also quite supportive.

Selection of children in schools

The eligible participants in both the groups were recruited by simple random sampling technique using lottery method. (In the study group out of 163 overweight children and in the control group out of 151 overweight children, 140 overweight children in each group were selected by lottery method.)

Inclusion and exclusion criteria

The inclusion criteria included overweight adolescents whose BMI was between $>+1$ SD and $+ <3$ SD as per the WHO BMI-for-age (5–19 years) charts for boys and girls in the age group of 11–14 years. Children who were sick, physically challenged, and children and parents who refused to participate in the study were excluded from the study.

Approval was obtained from the Institutional Human Ethics Committee of Sri Ramachandra Institute of Higher Education and Research, Chennai. Informed consent was obtained from the parents and assent from the adolescents. The pretest which included assessment of BMI and waist circumference/height ratio was carried out for the overweight adolescents in both the groups. Following pretest, the participants in the study group were given a health teaching which consisted of two sessions: one on the importance of physical activity and the other on ill effects of obesity. The after-school structured physical activity intervention was given for 5 days in a week, for 1 h for 9 months. The number of sessions planned for the academic year was 150. It included aerobic workouts and muscle-strengthening and bone-strengthening activities. During the 1st week, the investigator conducted the exercises in the presence of the physical trainer, and was also present for the 2nd week to observe the students' activities, and later, the study participants were under the supervision of the physical trainer. The researcher met the study participants twice in a month. The control group received no intervention, and they carried out their routines. The posttests were carried out at the end of the 1st, 3rd, 6th, and 9th months.

The data related to anthropometric measurements from the study group and control group were collected by the principal investigator along with the help of research assistants who had completed their Bachelor in Nursing. The team members remained same throughout the study period.

Tools used: Part I

Sociodemographic variables of overweight children which included age, gender, type of family, parents' education, occupation of parents, and mode of transport to school.

Instrument and techniques

Weight, height, and waist circumference/height ratio were

measured using standardized techniques. Children were asked to wear light clothing to measure their height and weight, and standard protocol was followed. Body weight was measured with a calibrated electronic weighing scale using Omron’s Digital Body Weight Scale series-HN-286 manufactured in Japan. Height was measured using a standard wall-mounted stature meter-MCP 2 m/200CM Roll Ruler Wall Mounted Growth Stature Meter manufactured by Medicare Products Inc. from India. The same instruments were used for all study participants each time to check the anthropometric measurements. The BMI for the adolescents was calculated by dividing weight in kilograms by the square of his/her height in meters. BMI z-scores of more than one standard deviation (> +1 SD) are considered overweight. According to the WHO’s BMI growth charts for children aged 5 to 19 years.^[14] The waist circumference/height ratio was calculated by dividing the waist circumference/height, and a value >0.5 was considered the cutoff.

Data were analyzed using the Statistical Package for the Social Sciences version 20 (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: USA IBM Corp). Descriptive statistics that included frequency, percentage, mean, and standard deviation were used to describe the demographic variables, BMI, and waist circumference/height ratio. The effectiveness of physical activity intervention on BMI and waist circumference/height ratio was evaluated by inferential statistics. Independent *t*-test was carried out to compare the data between the groups, and repeated measures analysis of variance (ANOVA) test was done to study the effectiveness of the intervention on the anthropometric measurements over a period of time between the groups.

RESULTS

Sociodemographic variables

Majority of the subjects were 13 years, with 56 (40%) in the study group and 41 (29.2%) in the control group. With regard to gender, in the study group, females were 82 (58.7%), while in the control group, it was males 73 (52.1%). The mode of transport to school was by two-wheelers which was 58 (41.4%) in the study group and 60 (42.9%) in the control group.

A statistical significant reduction in BMI was observed between the study and control groups, during posttest 3 ($t = 1.256 P < 0.001$) and posttest 4 (0.920, $P < 0.001$). No

significant difference in BMI was seen between the study and control groups over a period of time, during repeated measures ANOVA [Table 1].

A significant reduction was seen in the mean scores of waist circumference/height ratio in the study group when compared to the control group at $P < 0.001$ [Figure 1]. No significant reduction was observed in waist circumference/height ratio between the study and control groups over a period of time.

DISCUSSION

The study was undertaken to determine the changes in anthropometric measurements by engaging the overweight adolescents in after-school physical activity. As the prevalence of childhood obesity is on the rise, interventions are targeted toward its reduction. In the present study, the physical activity intervention was done by the overweight adolescents daily for 60 min which lasted for 9 months. No statistical reduction in BMI was seen between the study and control groups during pretest and posttests 1 and 2. However, during the 6th and 9th months, there was a reduction in the BMI between the study and control groups. The study findings are consistent with a similar study which involved a multicomponent childhood obesity prevention program carried out for 1-year period where one of the primary outcomes was change in the BMI. Compared with the control group, the study group had a decrease in BMI (odds ratio = 1.44, 95% confidence interval = 1.10, 1.87) by 0.5 kg/m² or above.^[15]

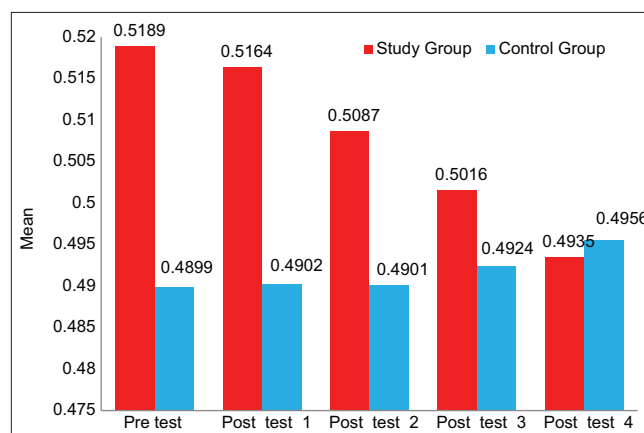


Figure 1: Comparison of waist circumference/height ratio between groups

Table 1: Comparison of body mass index between the study and control groups (n=280)

Observation	Study group (n=140)		Control group (n=140)		t	F, P value
	Mean	SD	Mean	SD		
Pretest	23.565	1.3180	24.136	4.3796	1.504	
Posttest 1	23.538	1.3471	23.541	1.1013	0.024	
Posttest 2	23.331	1.2815	23.578	1.1179	1.720	1.87,0.4
Posttest 3	23.111	1.2907	23.684	1.1536	1.256*	
Posttest 4	22.822	1.2756	23.795	1.1580	0.920*	

* $P < 0.001$. SD: Standard deviation, F = Repeated measure ANOVA

No statistical reduction in BMI was there at the end of the 9th month between the study and control groups during repeated measures ANOVA. The study findings are similar to a study where interventions included recreational noncompetitive physical activity program done after school hours for a 1-year period.^[9] The result revealed that there was no difference in BMI between the study and control groups. It was further supported by another study where at the end of 2 years of physical activity intervention, there was no difference between the study and control groups for BMI ($P = 0.89$) and BMI z-score ($P = 0.85$).^[16] A recent meta-analysis showed that even though school-based interventions were effective, long-running programs were more successful than their shorter counterparts.^[17]

The current study findings reveal that there was a significant reduction in waist circumference/height ratio between the study and control groups at the end of the 1st, 3rd, and 6th months. It is relevant to previous studies, which also reported that there was a significant inverse correlation between physical activity and the ratio of waist to height ($P < 0.001$).^[18]

The repeated measures ANOVA showed that there was a marginal decrease in the mean values of waist circumference/height ratio between groups. This corroborates with a similar study where there was lack of significant differences in waist circumference and waist–height ratio between groups at 6 months and was consistent with the previously reported difficulty of sustaining a healthy lifestyle in spite of repeated reinforcement.^[19] Another reason is that to find an apparent change in anthropometric measurements, an intensive intervention is required for a longer period of time.^[20]

CONCLUSION

Physical activity interventions done in schools are found to be more promising in reduction of childhood overweight/obesity. It seems to be a very practical approach, which can be easily adopted in schools. A multicomponent intervention for a longer period of time can be considered for future studies.

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Conflicts of interest

There are no conflicts of interest.

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