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# Effectiveness of a school-based nutrition education program on waist circumference and dietary behavior among overweight adolescents in Puducherry, India

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## Abstract:

**BACKGROUND:** The influence of western lifestyle such as high-caloric dense food and sedentary lifestyle has a great influence on Indian children, and the current prevalence of childhood overweight in India ranges between 4% and 22%. The primary aim of the study was to determine the change in growth parameters (waist circumference) as well as dietary behaviors at baseline and at the end of first, third, sixth, and ninth months among overweight adolescent girls and boys following a school-based nutritional education program.

**MATERIALS AND METHODS:** The study was conducted in 2019 in four urban schools at Puducherry which were randomly assigned to study and control groups by lottery method, and 140 overweight children aged 11–14 years were in the study group and 140 children were in the control group. Simple random sampling method was used to select the samples. A nutrition education program highlighting the importance of balanced nutrition and the ill effects of obesity was imparted to students in the study group through a PowerPoint presentation. As a means of reinforcement, posters and pamphlets were distributed. The waist circumference and the mean calorie, protein, and fat intake were assessed at baseline and at the first, third, sixth, and ninth months and compared between groups using independent *t* test.

**RESULTS:** There was a statistically significant reduction in waist circumference in the study group when compared to the control group at  $P < 0.05$ . A significant decrease in the calorie intake at  $P < 0.001$  and fat intake at  $P < 0.01$  was observed in the study group. The protein intake in the study group increased at the end of 9 months, which was significant at  $P < 0.001$ .

**CONCLUSION:** School-based nutritional education program has been found to be a successful intervention in controlling unnecessary weight gain among overweight adolescents.

## Keywords:

Adolescents, dietary behavior, nutrition education, overweight, waist circumference

## Introduction

Healthy nutrition is the foundation of an individual's health and well-being, while on the other hand, unhealthy nutrition behaviors are major contributors to chronic diseases and health problems.<sup>[1]</sup> The

influence of western lifestyle, such as intake of high-caloric dense food and sedentary lifestyle, has a great influence on Indian children.<sup>[2]</sup> Childhood obesity has eventually become a major public health problem in many developing countries including India.<sup>[3]</sup> Our country is going through an

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economic and nutrition transition, where the latter transition is associated with a change in dietary habits shifting to processed and unhealthy foods and drinks, decreasing physical activity, and increasing sedentary lifestyle.<sup>[4]</sup> The prevalence of childhood obesity in India among school children is between 5.74% and 8.82%. In urban South India, 21.4% of boys and 18.5% of girls aged 13–18 years are either overweight or obese.<sup>[5]</sup> The current prevalence of childhood overweight in India ranges from 4% to 22%.<sup>[6]</sup>

Health, nutrition, and education are three fundamental pillars for growth and development, and they are interconnected.<sup>[7]</sup> Nutrition education in schools and schoolteachers are important in providing health education and improving a healthy lifestyle.<sup>[8]</sup> Nutrition education has also been effective in creating positive attitudes toward fruits and vegetables among children. Since poor dietary habits tend to be carried over from childhood to adulthood, childhood and adolescence are the periods when good nutritional diet quality is important to establish healthy dietary behaviors.<sup>[9]</sup>

Most studies of adolescent obesity had been done in western countries, but a few of them, with less focus on prevention at school, had been done in schools in Puducherry, India. Obesity is an entirely preventable disease, and its prevention mainly needs to be started early with effective intervention and prevention programs in order to reduce the negative health consequences in later life. This study is focused on children aged 11–14 years, considering that early adolescence may be the best time for implementing nutrition-related and lifestyle-related education before determining their relatively stable habits.<sup>[10]</sup>

The primary aim of the study was to assess the change in growth parameters (waist circumference [WC]) and change in eating behavior of overweight adolescent participants, which includes both girls and boys, after they complete the nutritional education program.

## Materials and Methods

### Study design and setting

The study design adopted for the study was randomized controlled trial. The study was conducted in four urban schools of Puducherry. The schools were randomly assigned by lottery method to the study and control groups.

### Study participants and sampling

The study participants included a total of 280 overweight adolescents in both the groups. The eligible participants in both groups were randomized by simple random

sampling technique using lottery method. One hundred and forty overweight children were selected from each group (out of 163 overweight children in the study group and 151 overweight children in the control group). The inclusion criterion was children who were in the category of overweight with a body mass index (BMI) between  $>+1$  SD and  $<+3$  SD as per the World Health Organization (WHO) BMI-for-age (5–19 years) charts for boys and girls.<sup>[11]</sup>

### Data collection tool and technique

#### Tools used

The data collection tools included sociodemographic variables, 3-day food intake record, and measurement of WC.

#### Part I

Information on the sociodemographic variables included the child's gender, age, educational level, parent's education, occupation of the parents, dietary habits, and family income, which was obtained through a structured questionnaire.

#### Part II

A 3-day food intake record that consisted of two weekdays and one weekend was collected at baseline and at the end of 1, 3, 6, and 9 months. The participants were asked to recall the foods and beverages they consumed over the course of three days and nights. The tool included three components: time, type of food consumed, and quantity. The calorie, protein, and fat intake was calculated using the Nutriify India Now App developed by the Indian Council of Medical Research – National Institute of Nutrition (2018).<sup>[12]</sup>

#### Part III

The WC of children was checked at baseline and at the end of 1, 3, 6, and 9 months using a nonstretchable measuring tape at the level of the umbilicus to the nearest 0.1 cm, with the subject standing erect and after normal expiration. The cut-off value for the risk of central obesity was WC greater than 71 cm.<sup>[13]</sup>

### Data collection procedure

The pretest included assessment of WC and eating behavior, which was carried out for the overweight adolescents in both the groups. Following pretest, the participants in the study group were seated in their class auditorium and the researcher explained the objectives of the nutrition education program. It consisted of two sessions of 45 min each, which was imparted for two consecutive days. It was an interactive ICT-Information and communication technology based teaching through PowerPoint presentation. The first session was on the importance of balanced nutrition for adolescents, highlighting the need to take more proteins, vitamins,

and minerals and cutting down on high-calorie foods. The second session focused on the ill effects of obesity and its detrimental effects on health. At the end of the first week, posters on balanced diet and healthy eating behaviors were displayed in the school noticeboards. In addition, pamphlets on healthy nutrition and sample menus were distributed to the students. These visual aids were intended to reinforce and promote healthy eating behaviors. Further, the researcher met the participants twice a month daily for 9 months and reinforced the importance of taking healthy diet. The control group study participants were allowed to continue with their usual practice. However, after the completion of the study, the study participants were taught on the importance of balanced nutrition and ill effects of obesity. The posttests were carried out at the end of the first, third, sixth, and nine months for both the groups.

### Statistical analysis

Data was analyzed using the Statistical Package for Social Sciences version 20. Descriptive statistics that included frequency, percentage, mean, and standard deviation was used to describe the study variables such as the demographic variables and WC. In addition, between-group differences (study group vs. control group) in the mean changes of scores were determined by independent *t* tests. *P* value < 0.05 was considered statistically significant.

### Ethical considerations

Ethical clearance was obtained from the Institutional Human Ethics Committee of Sri Ramachandra Institute of Higher Education and Research, Chennai (IEC-NI/15/OCT/49/62). Confidentiality of the participants' identity and response was ensured. Informed consent was obtained from the parents and assent from the adolescents.

## Results

### Sociodemographic variables

Out of 140 overweight children, 30% were in the age group of 11 years and 35% were in the age group of 13 years. More than 50% were females, and majority (34.3%) were in their ninth standard. Also, 37.9% were from upper middle class. Almost 80.7% were nonvegetarians.

The mean WC at baseline in the study and control groups was 78.700 with a SD of 4.14 and 74.536 with a SD of 4.517 respectively. During posttest 4, the mean WC in the study group was 75.914 with an SD of 4.049 and in the control group was 74.599 with an SD of 4.306 [Table 1]. There was a progressive decrease in the mean values of WC in the study group, whereas in the control group, the mean values did not show any variation, which implies that

the nutrition education intervention had a significant impact in reducing the WC.

The mean value of WC was lower in the control group when compared to the study group in pretest, which was statistically significant at  $P < 0.001$ . The mean values of WC in posttest 1, 2, and 3 in the study group were 78.44, 77.65, and 76.81, respectively, and in the control group were 74.60, 74.78, and 74.5, respectively, which were significant at  $P < 0.001$ . However, at the end of 9 months, during posttest 4, the mean value in the study group reduced to 75.914, but in the control group it was 74.599, which continued to remain the same as in pretest [Table 2]. This indicated that the study group participants had attempted to follow healthy eating habits when compared to the control group participants, as the WC of the control group students continued to remain the same.

During pretest, the intake of fat was more in the study group when compared to the control group, which was statistically significant at  $P < 0.001$ . At the end of 6 months, during posttest 3, there was a statistically significant reduction in caloric intake and increase in protein intake between the study and control groups at  $P < 0.01$  and  $P < 0.05$ , respectively. In posttest 4, at the end of 9 months, the calorie intake and fat intake significantly reduced in the study group at  $P < 0.001$  and their protein intake increased when compared to the control group at  $P < 0.01$  [Table 3]. This is due to the effect of nutrition education given by the investigator.

## Discussion

The study highlights the importance of nutrition education program provided by health-care providers. The study outcomes included reduction in WC and improved dietary behaviors. WC is a technique to quantify visceral adipose tissue, which is linked to metabolic problems in children and adolescents and is even considered a risk factor for obesity and also found to be effective in predicting adiposity.<sup>[14]</sup> The study findings revealed that at the end of 9 months, there was a significant decrease in WC in the study group when compared to the control group at  $P < 0.05$ . The findings are consistent with a previous study where there was a reduction in WC at the end of 3 months in a Lifestyle Intervention for Teenagers group program, a family-based behavioral lifestyle intervention for overweight and obese adolescents.<sup>[15]</sup>

It is in line with another study where the nutrition education program had a significant impact on the WC in obese adolescents. There was a significant reduction in WC in the study group at  $P < 0.001$  and conversely an increase in WC in the control group.<sup>[16]</sup> The reduction in

**Table 1: Waist circumference of study participants in both groups**

Variable	n=280									
	Study group					Control group				
Waist circumference	Pretest	Posttest 1	Posttest 2	Posttest 3	Posttest 4	Pretest	Posttest 1	Posttest 2	Posttest 3	Posttest 4
Mean	78.70	78.44	77.6	76.8	75.9	74.5	74.5	74.6	74.7	74.5
Standard deviation	4.14	4.166	4.02	4.01	4.04	4.51	4.52	4.50	4.56	4.30

**Table 2: Comparison of waist circumference between the study and control groups**

Duration	Study group		Control group		Mean difference	t P
	Mean	SD	Mean	SD		
Pretest	78.00	4.14	74.536	4.517	-4.1643	-8.034 <0.001
Posttest 1	78.443	4.166	74.550	4.523	-3.8929	-7.490 <0.001
Posttest 2	77.650	4.026	74.607	4.502	-3.0429	-5.960 0.000 <0.001
Posttest 3	76.814	4.010	74.782	4.565	-2.0321	-3.957 <0.001
Posttest 4	75.914	4.049	74.599	4.306	-9.8571	-1.973 <0.05

WC in the study group can be attributed to adoption of healthy eating behaviors.

Reviews reveal that interpersonal health education and health promotion theories/models have an overall positive impact on various health outcomes.<sup>[17]</sup> This is consistent with the current findings where the calorie and fat intake significantly reduced in the study group and their protein intake increased when compared to the control group at the end of 9 months. This indicates that nutrition education had an influence on the eating habits. Interactive nutrition education and counseling programs when done routinely in all schools can, to a greater extent, help in the reduction of weight and prevent the furthering of obesity. Tailoring and testing family-based nutrition interventions with appropriate theories suggested to follow a family healthy lifestyle.<sup>[18]</sup> Nutrition education helps obese adolescents to change their excessive daily energy intake to become more balanced over a period of time.<sup>[19]</sup> There is convincing evidence from this analysis that school-based prevention interventions can lead to an improvement in dietary behaviors by increasing the consumption of healthy foods and decreasing the consumption of unhealthy foods. The findings are supported by a similar cross-sectional study which was carried out to determine the impact of nutrition education program on obese adolescents. At the end of 4 months, the participants in the intervention group switched on to healthy eating behaviors by reducing high-calorie dense foods.<sup>[20]</sup> This is further consistent with another study where after 12 weeks of nutrition education, the obese adolescents followed

healthy dietary habits and were eating healthy foods frequently. On the contrary, majority of the students in the “non-intervention group” were not following healthy dietary habits and the difference between the groups was significant ( $P < 0.001$ ).<sup>[21]</sup> Nutrition education has been shown to have a significant effect in fostering healthy dietary behaviors.<sup>[22]</sup>

Evidence-based nutrition education programs are rarely implemented in schools in Puducherry. Hence, this education program has resulted in desirable changes.

**Limitations and recommendation**

The limitation of the study included use of self-reported data (e.g., 24 h food recall).

Nutrition lessons can be woven into the core curriculum classroom subjects that help students choose and maintain healthy lifestyles. In addition to teaching evidence-based nutrition, teachers should ensure that students bring healthy snacks and meals to schools. This approach when practiced in every school would definitely help in preventing child obesity at large. In addition to only schools being involved, an integrated approach that involves family members, community, and government can formulate strategies to prevent obesity in childhood.

**Conclusion**

Obesity is a growing epidemic that needs to be averted. The structured and supervised nutrition education provided was found to be effective in significantly reducing the excessive consumption of high-calorie and high-fat foods among the study participants. This model of school-based nutrition education program has been found to be a successful intervention in controlling unnecessary weight gain among overweight adolescents and reducing the corresponding increase in their WC, which is an indicator of future onset of metabolic syndrome.

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**Table 3: Comparison of calories, proteins, and fat**

Duration	n=280				Mean difference	t P
	Control group		Study group			
	Mean	SD	Mean	SD		
Pretest: calories	2571.13	231.67	2562.77	239.68	8.35	0.297 0.767
Proteins	49.90	7.20	48.40	6.51	1.50	1.836 0.067
Fat	48.20	3.81	50.27	6.35	-2.07	-3.309 <0.001
Posttest 1 Calories	2572.84	232.52	2555.65	238.72	17.18	0.610 0.542
Proteins	49.92	7.23	48.31	6.44	1.60	1.962 <0.05
Fat	48.33	3.905	49.97	6.227	-1.644	-2.646 <0.01
Posttest 2 Calories	2581.34	231.08	2538.93	233.73	42.41	1.527 0.128
Proteins	50.27	7.27	48.36	6.29	1.90	2.345 <0.05
Fat	49.00	3.74	49.69	5.94	-0.694	-1.171 0.243
Posttest 3 Calories	2584.63	231.40	2515.64	232.42	68.99	2.489 <0.01
Proteins	50.35	7.23	48.48	6.10	1.87	2.342 <0.05
Fat	49.32	3.75	49.02	5.56	0.297	0.524 0.601
Posttest 4 Calories	2588.54	229.28	2486.35	232.91	102.19	3.700 <0.001
Proteins	50.46	7.13	48.76	5.96	1.70136	2.164 <0.001
Fat	49.76	3.86	48.44	5.80	1.320	2.241 <0.01

SD=standard deviation

**Conflicts of interest**

There are no conflicts of interest.

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