

# Impact of a Multidisciplinary Lifestyle Intervention on Weight Reduction in Overweight and Obese Adolescents- A Longitudinal Study

ARIVOLI KALIYAN<sup>1</sup>, VENKATESH SINGA KUMARAN<sup>2</sup>, SUDHAKAR PRASANNA<sup>3</sup>,  
NARAYANAN ETHIRAJAN<sup>4</sup>, REJI MANJUNATH<sup>5</sup>, SATHYA JEGANATHAN<sup>6</sup>



## ABSTRACT

**Introduction:** Childhood obesity is a multifactorial pathology that increases the risk of diabetes, hypertension and coronary artery disease in adolescent period. Initiation of lifestyle modification at younger age plays a major role in preventing morbidity and mortality at a younger age.

**Aim:** To examine the effect of a multidisciplinary lifestyle intervention program executed with the support of parents and teachers to treat overweight/obese in school going adolescents.

**Materials and Methods:** A longitudinal study was carried out for a period of 12 months on a population of 193 children of age group between 10-17 years. Initially adolescents were classified into overweight/obese based on Body Mass Index (BMI). Individual adolescents were counseled regarding diet, lifestyle changes, physical activity and school based activity; while they were suggested to maintain a diary. Once in two months, they were assessed by reviewing their diaries. Once in four months parents along with students was assessed regarding diet, life style changes,

physical activity and school based activity. BMI of the adolescents was measured before and after intervention. Paired t-test was used to analyse the significance of the outcome based on BMI of the children measured before and after the intervention.

**Results:** Mean age of the population was 13.7±4.3 years. Males were predominant 109 (56.5%) compared to females 84 (43.5%). In females, BMI reduced from 26.104 to 25.235 (p=0.0001) while in males BMI reduced from 25.677 to 24.904 (p=0.0002). BMI in the whole population marginally reduced from 25.863±3.644 to 25.048±3.50 after intervention. The overall reduction of BMI in males (0.77) and females (0.87) was statistically significant (p=0.0004) with greater difference in females.

**Conclusion:** Multidisciplinary intervention approach with family members and school teachers is effective to manage weight reduction by maintaining a healthy nutritional status with beneficial physical activity in obese and overweight school going adolescents.

**Keywords:** Body mass index, Nutritional status, School going

## INTRODUCTION

Childhood obesity is a multifactorial pathology that increases the risk of diabetes, hypertension and Coronary Artery Disease (CAD) in an adolescent's period and may cause morbidity and mortality even at younger age [1,2]. The International Association Study of Obesity (IASO) and the International Obesity Task Force (IOTF) estimated that almost 200 million school children across the world are either overweight or obese [3]. Childhood obesity is one of the biggest problems in India because India has 14.4 million children with obesity and second highest after China [4]. The main hypothesis behind obesity is connected with energy imbalance between number of calories consumed and calories spent by the children [5]. In today's fast modern life, dietary pattern consists of energy dense foods and less physical activity due to the increasingly sedentary nature of recreation, changing modes of transportation using vehicles [2].

World Health Organisation (WHO) recommends three strategic areas for action such as health education, treatment for childhood obesity and advocacy regarding healthier environments [6]. Internationally recommended treatment for childhood obesity includes behavioural family lifestyle intervention program with dietary and physical activity along with family targeted focus in children [7]. Acting early on prevention of childhood obesity will have major benefits for healthcare services and wider economy of country [5]. A few reports addressed the prevalence of obesity among school going adolescents rather than focusing on the intervention approach [8,9]. Studies in developing countries shows combination of diet, exercise, physiological factors

which play an important role in prevention and control of childhood obesity [10]. This study aimed to examine the effect of implementation of life style modifications on BMI among overweight adolescent school going children of 10-17 years of age in Chengalpattu (Tamil Nadu, India) by changing the dietary pattern and physical activity of children.

## MATERIALS AND METHODS

This longitudinal study was conducted in Chengalpattu district, Tamil Nadu, India, from January 2018 to February 2019 after approval by the Institutional Ethical Committee, Government Chengalpattu Medical College, Chengalpattu, Tamil Nadu, dated 27/03/2018.

**Inclusion criteria:** Adolescents with overweight and obesity aged 10-17 years, studying in municipal area of Chengalpattu, Tamil Nadu, India were included in this study.

**Exclusion criteria:** Children who were unable to adhere to the lifestyle interventions were excluded. Other exclusion criteria were medical co-morbidities and previous enrolment in any behavioural treatment program with the focus on reducing obesity.

A written permission from the Honorable District Collector of Kanchipuram was obtained. Authors informed the schools located in Chengalpattu Municipal area prior to initiation of the study and got consent from the Head of the school/Institution. Written consent was obtained from parents and children data collection was done using semi-structured interview schedule.

**Sample size calculation:** 
$$N = \frac{z^2 p(1-p)}{d^2}$$

$z=1.96$ ,  $p=20\%$  (as the percentage of overweight/obesity in adolescent population),  $d$ -margin of error-5%.

Estimated sample size was 245, assuming attrition rate of 20%, hence 196 was calculated as sample size required for the study. Simple stratified sampling was used in the study.

### Study Procedure

Indian Academy of Paediatrics (IAP) BMI growth charts for 5-18 years is based on International Obesity Task Force (IOTF) [11]. The 23 and 27 adult equivalent cut-offs lines (for risk of overweight and obesity, respectively) are more appropriate for use in Asian children as Asians are known to have more adiposity and increased cardio-metabolic risk at a lower BMI [12]. Hence, to define overweight and obesity in children from 5-18 years of age, adult equivalent of 23 and 27 cut-off lines as presented in BMI charts are used.

**Overweight:** A child is defined as overweight if more than adult equivalent of 23 cut-off line as per IAP BMI Growth Charts 5-18 years.

**Obese:** A child is defined as obese if more than adult equivalent of 27 cut-off line as per IAP BMI Growth Charts 5-18 years.

Baseline period for screening and selecting target population was started from January to February 2018 and intervention period was one year (from March 2018 to February 2019). Total of 207 overweight/obese adolescents were included, eight were excluded due to denial of parental consent, total 199 participated in the study and were followed-up once in two months for lifestyle modifications and at one year for anthropometry. Six participants lost to follow-up, hence 193 were included in final analysis (males=109, females=84).

Data collection, anthropometry measurements, meeting with parents and monthly review were planned in concordance with the school management without affecting the routine academic activity of the school. Anthropometry measurements were taken before and after the intervention by carefully following-up for a period of 12 months. The intervention was carried out by students as instructed by the medical team, and as a part of intervention meeting with their parents once in four months and meeting each adolescent one in two months to check their adherence to the interventions given. Main topics were education on nutrition, self-control techniques, social skills, physical activity, school based approach and family centered approach.

Initially, baseline screening was done and target population was selected. The questionnaire was distributed to students. The students were first briefed on how to fill the basic details in the questionnaire and were asked to fill the known details in it. The investigator verified the details on dietary habits and physical activities at the time of physical examination. After that each student was attended by the medical team individually so that the student could speak out freely without any inhibitions or limitations. Age was recorded in completed years of life and rounded to the nearest year.

Physical examination was conducted to measure height and weight. The investigator had supervised the measurements taken by a trained assistant. The study was carried out not only as a survey but also a service as general medical checkup which were conducted in all the schools. In all the schools, a session was held separately after the questionnaires were filled and measurements were taken to explain facts on obesity and clear the student's doubts about diet, type of food, exercise etc., not only to the overweight or obese children but also to the entire school as a part of health education.

### Height and Weight Measurement

The weights of the children were measured using a weighing machine with a precision of 0.1 kg. The children were asked to remove their footwear not in contact with any object and in erect posture. The height was measured using a wall mounted stadiometer with a precision of 0.1 cm. The adolescents were made to stand on a level

surface without shoes and were asked to stand upright on a wall with the headpiece of the stadiometer touching firmly on the head.

### Body Mass Index

BMI was calculated and values obtained were interpreted using IAP modified chart. Age specified IAP modified growth charts were used separately for boys and girls to categorise them into overweight/obese group based on their BMI.

The first meeting with the adolescents was done along with their parents and teachers (class head teacher and physical education teacher) at the school premises and parents were given information booklet regarding importance of conducting particular intervention study. Follow meetings were scheduled once in two months and students were asked to maintain a diary of daily food habits, physical activity, and spending patterns of leisure time and sleep time. The parents were instructed to check their children's diaries on regular basis. Meetings with parents were scheduled once in every four months and adherence of children to the planned intervention was cross-examined. Corrective measurements were taken immediately if there was any deviation found in the planned schedule. At the end of the intervention period, anthropometry was taken once again and results were interpreted using a modified growth chart.

### Data Collection

Written consent was obtained from parents and children and data collection was done on a semi-structured interview schedule. Data collection, anthropometry measurements, meeting with parents and monthly review were planned following school management as per convenience. The initial step of data collection was focused to locate the target population. The second step of data collection was done by distributing the questionnaires to the target population after supporting proper instructions. The investigator verified the details of dietary habits and physical activities, and the weight and height of the children were measured during the time of physical examination.

### The Structured Intervention Program

Authors adopted the intervention plan from various guidelines such as Rashtriya Kishor Swasthya Karyakram (RKSK) guidelines for overweight and obesity management, IAP obesity treatment guidelines and Endocrine Society Clinical Practice Guideline for Paediatric Obesity [13-15]. Intervention was planned and grouped under various categories such as education, stimulus control, dietary pattern, physical activity and behaviour changes with involvement of parents and school authorities.

**Education:** The first meeting with the adolescents was done along with their parents either mother or father and teachers (class head teacher and physical education teacher) at school premises. Parents were given information booklet regarding importance of conducting particular intervention study. Follow meetings were scheduled once in two months. The parents were instructed to check their children's activities on regular basis and meetings with parents were scheduled once in every four months.

**Stimulus control:** Stimulus control is one of the lifestyle intervention methods which is found to be easy to propagate but is difficult to follow. The parents were strictly instructed to avoid the snack and junk food eating and sugar sweetened liquor drinking habits of their children and instructed not to allow children to hire junk foods and aerated drinks from the school premises [16,17].

**Dietary pattern:** The main aim of this intervention part was to promote the importance of following a diet that is rich in food with a low caloric density such as vegetables, fruits, whole grains, low fat dairy products, lean meats, lean fishes and legumes. A light diet concept was given to all children based on regional and community concepts [18].

**Physical activity:** Adolescents can achieve significant improvements in cardio-respiratory fitness if they participate in muscle strengthening activities at least two or three times per week and can perform activities in multiple shorter bouts spread throughout the day (e.g., two bouts of 30 minutes) [19]. Additionally, they were advised to follow vigorous-intensity activity at least three times per week for strengthening of muscle and bone such as playing on playground and climbing trees.

#### Behaviour changes:

- Sleep duration- Minimum of 8-10 hours of sleep per day was recommended for children and instructed them to avoid watching visual entertainment during bedtime [20].
- Avoiding the habit of skipping breakfast
- On-screen time- Children were advised to limit on-screen spending time to less than two hours per day based on AAP guidelines to avoid obesity related health problems [21].

#### Family Based Intervention

In this intervention, parents and other family members were strongly encouraged to implement the same behaviour pattern which was asked to follow by the children [22]. The parents were also asked to create a certain environment in their family such as being together while having their meals and should be away from the television while doing so.

#### STATISTICAL ANALYSIS

Statistical analysis was done using Statistical Package for the Social Sciences (SPSS) statistical package version 16.0. Paired t-test was used to analyse the significance of the outcome based on their BMI taken at the beginning before start of any intervention and BMI taken after the end of interventional period that is one year. Power of 80% with confidence interval of 95% with p-value <0.5 was taken as significant. Cohen's Kappa was used to find out agreement between pre intervention and post intervention.

#### RESULTS

Majority of the parents were of age between 40-45 years 78 (40.5%) and most of them had basic college education 110 (56.9%). According to Modified Kuppusamy Scale, upper middle 75 (38.8%) class was predominant. Adolescents had a mean height of 153.2±8.33 cm while weight was 58.95±12.83 kg. The mean BMI was 25.86±3.64 kg/m<sup>2</sup> and males were predominant 109 (56.5%). Majority of students was in age group of 10-12 years 44 (22.7%) [Table/Fig-1].

Variables		Numbers-N (%)
Parents' age (years)	30-35	41 (21.2)
	>35-40	54 (27.9)
	>40-45	78 (40.5)
	>45-50	20 (10.4)
Parents' education status	School education	56 (29)
	Basic college education	110 (56.9)
	Higher studies	27 (14)
Socio-economic status (Modified kuppusamy scale) [23]	Upper lower	52 (26.9)
	Lower middle	24 (12.5)
	Upper middle	75 (38.8)
	Upper	42 (21.7)
Adolescents' Height (cm) (Mean±SD)		153.2±8.33
Adolescents' Weight (kg) (Mean±SD)		58.95±12.83
Adolescents' BMI (kg/m <sup>2</sup> ) (Mean±SD)		25.86±3.64
Gender of participants	Male	109 (56.5)
	Female	84 (43.5)

Family history of diabetes mellitus/hypertension (present)	41 (21.2)	
Age distribution of adolescents (years)	10-12	44 (22.7)
	>12-13	35 (18.1)
	>13-14	27 (13.9)
	>14-15	42 (21.7)
	>15-16	24 (12.4)
	>16-17	21 (10.9)

[Table/Fig-1]: Demographic characters.

After lifestyle intervention there were marked changes in day today habits of adolescents. A major change was seen in percentage of adolescents not consuming junk foods rose from 2 (1%) to 134 (69.4%). Habit of not having snacks in between meals rose from 4 (2%) to 126 (65.3%). After educating the importance of breakfast to students and to their parents there was a considerable fall in percentage with 160 (82.9%) adolescents had given up the habit of skipping breakfast. Families having meal together also increased to 87 (45.1%) [Table/Fig-2].

Habits	Before intervention N (%)	After intervention N (%)	Statistical significance
Meat consumption less than once a week	128 (66.3)	182 (94.3)	Kappa value 0.247
Non consumption of aerated drinks	22 (11.4)	87 (45.1)	Kappa value 0.300
Non consumption of Junk foods	2 (1)	134 (69.4)	Kappa value was 0.060
Avoidance of snacks in between meals	4 (2)	126 (65.3)	Kappa value was 0.044
Avoidance of mid-time snacking	86 (44.6)	193 (100)	Kappa value 0.033
Avoidance of skipping breakfast	33 (17.1)	160 (82.9)	Kappa value was 0.081
Meal together with families	16 (8.3)	87 (45.1)	Kappa value was 0.131

[Table/Fig-2]: Change in nutritional habits before and after intervention.

\*Cohens Kappa was used to find out agreement between pre intervention and post intervention

There was a significant increase in the number of students using bicycle from 11 (5.7%) to 88 (45.6%) after intervention, all participants 193 (100%) were engaged in daily physical activity for a minimum of one hour without fail. Before the intervention, 182 (94.3%) adolescents were identified with the habit of spending more than two hours per day in front of the screen either with television or with laptops, post intervention this decreased to 18 (9.3%). However, after spreading awareness on lifestyle intervention 176 (91.2%) children were reported to have sleeping period for minimum of 8-10 hours per day [Table/Fig-3].

Habits	Before intervention N (%)	After intervention N (%)	Statistical significance
Cycling	11 (5.7)	88 (45.6)	Kappa value 0.252
Moderate to vigorous physical activity	9 (4.7)	193 (100)	Kappa value 0.044
Screen time decreased to <2 hours per day	182 (94.3)	18 (9.3)	Kappa value 0.081
Optimum sleep time of more than 8-10 hours per day	17 (8.8)	176 (91.2)	Kappa value 0.030

[Table/Fig-3]: Changes in physical performance, leisure and sleeping time spending before and after the intervention program.

Statistical analysis (Paired t-test) was done to find the differences in BMI of the participants before and after the intervention program. BMI was marginally reduced from 25.863±3.644 to 25.048±3.50 after intervention. In males and females BMI reduced significantly [Table/Fig-4].

Sex	N	Pre intervention	Post intervention	Reduction in BMI	p-value
Females	84	26.104±3.33	25.235±3.11	0.8690	0.0001
Males	109	25.677±3.86	24.904±3.787	0.7734	0.0002
Both males and females	193	25.863±3.644	25.048±3.50	0.8150	0.0004

**[Table/Fig-4]:** Impact of the intervention program on the BMI of the participants.

## DISCUSSION

Childhood obesity is a multifactorial pathology that increases the risk of diabetes, hypertension and CAD in adolescent period. Initiation of multidisciplinary lifestyle intervention at younger age plays a major role in preventing morbidity and mortality at a younger age. The aim of the study was to examine effect of a multidisciplinary lifestyle intervention program executed with the support of parents and teachers to treat overweight/obese in school going adolescents. After lifestyle intervention, there was marked changes in day-to-day habits of adolescents and the BMI marginally reduced from 25.863±3.644 to 25.048±3.50 kg/m<sup>2</sup> after intervention.

This study was framed in such a way to involve not only the study population but also to involve their parents for a family-based approach and physical education teacher to monitor physical activity, and a class teacher for a school based approach. Since, the interventions planned were lifestyle modifications without any medication or surgery we had a good level of acceptance from the students, their family and school. The researchers conducted frequent reviews to motivate them, reassure and correct them if they were deviating from the planned mode of intervention. A meeting was organised once in two months and there were counseling sessions too.

The population, being in their teen ages, had problem in controlling their stimulus and their peer group had a major impact on their eating habits. Though, they were instructed well about the adverse outcome on their health due to aerated or sweetened drinks, junk foods and mid time snacking, the participants confessed that they could not resist the temptation and occasionally used to consume these foods; but there was a significant drop when compared with the pre interventional period with statistical significance. (Kappa value significant).

Family played a major role in most of the interventions. Some of the families had a routine of consuming meat more frequently. After intervention, the habit was changed significantly and the meat consumption in the family decreased.

Excellent response was seen in increase of physical activity. Physical activity was individualised for each student based on their physic, sport of interest and capacity in consultation with their physical education teacher. It was successful because of the school based approach and due to involvement of dedicated physical education teachers of the school.

Adopting an alternate mode of transport to reach school other than motor vehicle was advocated. Students who had the possibility of adopting alternates like walking, cycling and using public mode of transport adopted, whichever mode was feasible for them. It indirectly increased their physical activity duration in a day to 100% post intervention.

A recent advancement in the few decades is the habit of spending time sedentarily in front of screen which includes television, laptop, desk top, cell phones and video games. In this study, parents were asked to restrict the on-screen time strictly and to remove all entertainment screens from the sleeping area. It had a good impact on both reducing the on-screen time to less than two hours per day (94.3%) and increasing the sleep duration for minimum of eight hours per day (91.2%).

In this study, at the end of one year of intervention a reduction in BMI was documented. Reduction in BMI was 0.7734 in males

and 0.869 in females with an overall reduction by 0.815. This was similar to studies done by Nayak BS and Bhat VH, who conducted a multicomponent intervention study for obesity. At six months and at the end of intervention there was a reduction in BMI by 2.1 in intervention group compared to rise in BMI by 0.9 in control group [24]. Another randomised clinical trial among 40 adolescents in intervention and 40 in control group was conducted for two years. At the end of intensive treatment, intervention group there was a significantly lower BMI compared to control group [25].

Wang Z et al., conducted a community based physical activity intervention program for 12 months, and at the end of intervention there was a small increase in mean BMI by 0.22 in the intervention group vs increase in mean BMI by 0.46 (0.02) in the control group (p=0.01) [26]. Taylor RW et al., conducted a RCT and showed BMI at 24 months was significantly lower in intervention group compared with children on usual care [27].

The study received excellent support from the participating adolescents, their parents, school principals and physical education teachers who had to be actively involved in delivering and supporting the program. The study also showed that if physical education teachers are properly trained, and motivated they can promote significant change in the physical activity of the children. Schools are the ideal ways of communication as they are central to children's lives and information can be quickly passed through this channel.

With available resources in the country, help from Government schemes like National Health Mission, Rashtriya Kishor Swasthya Karyakram and Rashtriya Bal Swasthya Karyakram health promotional activities can be easily implemented at the school level and can extract excellent results in dealing the problem of overweight and obesity and can built a healthier nation.

## Limitation(s)

The intervention period was limited just to 12 months and long term effects were not measured. The physical activities performed by the adolescents were supervised by physical education teachers only on working days of the school and they could not have any control during holidays. Recall bias among adolescents especially about the diet and dietary habits may have confounded some of the results. Since, the meeting with students were conducted in the school it was difficult to meet students during long leave periods like summer vacation, term holidays. The anthropometric measurements were objective and reliable, but there was no proper means to verify the truthfulness of the answers given by students for the questioners except for the diary the student maintained.

## CONCLUSION(S)

Present study illustrates the benefits of multidisciplinary intervention approach with support of family and school management for weight reduction in obese and overweight school going adolescents. With the help of available health promotional activities, we could easily implement multidisciplinary intervention program with the support of parents and teachers at the school level and can extract excellent results in dealing with the problem of overweight and obesity in younger ones and can build a healthier nation.

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#### PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Paediatrics, Chengalpattu Medical College, Chengalpattu, Tamil Nadu, India.
2. Resident, Department of Paediatrics, Chengalpattu Medical College, Chengalpattu, Tamil Nadu, India.
3. Associate Professor, Department of Paediatrics, Chengalpattu Medical College, Chengalpattu, Tamil Nadu, India.
4. Assistant Professor, Department of Neonatology, Chengalpattu Medical College, Chengalpattu, Tamil Nadu, India.
5. Clinical Associate, Department of Multidisciplinary Research Unit, Chengalpattu Medical College, Chengalpattu, Tamil Nadu, India.
6. Professor, Department of Paediatrics, Chengalpattu Medical College, Chengalpattu, Tamil Nadu, India.

#### NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Narayanan Ethirajan,  
15/8, Mig, Senganthal Flats, Ayappakkam, Chennai-77, Tamil Nadu, India.  
E-mail: kaalatraya@yahoo.in

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