Effect of Structured Behavior Intervention Program on Childhood Obesity

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Authors' contributions

This work was carried out in collaboration between all authors. Author VV planned the study and conducted the workshop on CSHM. Author VA designed the study protocol. Authors BAKSA and SK conducted the reinforcement training and data collection. Author RR designed the study protocol and supervised data management. Author SS did the statistical analysis and wrote the first draft of manuscript. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Background: Obesity is also attributed to environmental factors. Feasible and cost effective strategies to prevent childhood obesity are least explored in India. The purpose of the intervention is to evaluate the effectiveness of Comprehensive School Health Manual (CSHM) among children through a Training of Trainers programme for Central Board of Secondary Education (CBSE) school teachers.
Methods: The study was designed as a school-based intervention study adopting a cluster randomized design to recruit students of 3rd, 7th and 11th classes from 7 schools. The intervention and control arm had three and four schools respectively. Pre and post interventional anthropometric and behavioral measure were collected using standard methods.

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Results: The overall prevalence of obesity was 12.6%. There was no difference in the incidence of obesity (3.7% vs. 3.8%) at the end of study period. Among the participants who had a favorable shift in nutritional grade, 65.4% were in intervention arm. There was a significant reduction in BMI z score (-0.16) and body fat percentage (-2.02) in the experiment group. Both the group reduced their calorie intake but it was significantly lower in intervention arm -381.9 (95% CI -428.2 to -335.4)
Conclusion: A structured behavior intervention delivered through a Training of Trainers (ToT) empowered children to adopt healthy behaviors towards weight management. It is crucial to sustain these behaviors for positive impact.

ABBREVIATIONS

CBSE= Central Board of Secondary Education; CSHM= Comprehensive School Health Manual; WHO= World Health Organization; ToT=Training of Trainers; BMI= Body Mass Index; METs= Metabolic Equivalents; ITT= Intension to Treat Analysis.

1. INTRODUCTION

Childhood obesity is a major public health problem in India and across the world. Obesity is also attributed to environmental factors. Overweight and obesity in adolescents is defined according to the WHO growth reference for school-aged children and adolescents (overweight = one standard deviation ($\geq 85^{th}$ percentile < 97th) body mass index for age and sex, and obese = two standard deviations (>97th percentile) body mass index for age and sex). The prevalence of overweight and obesity varies based on the setting and diagnostic criteria used. Systematic review shows that globally the prevalence of overweight varies between 4.6 to 25.9% and the prevalence of obesity ranges between 2.7 to 20.1% [1]. Reports from various regional studies conducted in India showed that the prevalence of childhood obesity ranged between 7- 20% across the country [2-4]. Excess calorie intake and reduced physical activity are more rampant among Indian children and this feature accelerates the rate of obesity in children [5]. Higher prevalence of obesity was observed in children from urban region (14.6 vs. 12.3%) compared to rural area in India, where as the prevalence of underweight was significantly higher (13.6 vs. 4.6%) in rural areas [6].

Disparity in the prevalence of obesity within urban region due to variation in the socioeconomic condition was also reported [7]. Similarly, school based study conducted in Chennai reported that the children from the Central Board of Secondary Education (CBSE) schools were at higher risk of developing obesity and its associated co morbid conditions, compared to the children studying in government schools [8]. Another study conducted among private and government school children in Indore aged 7-14 years found a significantly higher prevalence of Obesity (35%) as compared to lower (13%) and Middle class (15.7%) [4].

Since obese children tend to remain obese in their adulthood [9] and considering the myriads of disorders associated with chronic obesity [10-11], World Health Organization (WHO) emphasized on the interventions to combat against childhood obesity [12]. An initiative from WHO to encourage positive health behaviors in school children was the development of Comprehensive School Health Manual (CSHM). This manual was an outcome of the collaborative effort of CBSE and WHO India to improve the general hygiene and well being of the growing children in India [13]. CSHM has been circulated to all CBSE schools. Hence, it is essential to sensitize the Indian children on this public health issue to improve their practice.

The current study was therefore conducted to evaluate the effectiveness of implementation of activities in the comprehensive health manual among children through a ToT (Training of Trainers) programme for CBSE school teachers to assess the changes in their BMI.

2. METHODOLOGY

2.1 Subjects and Methods

A cluster randomized study design was followed to recruit children of 3rd, 7th and 11th classes from 7 schools in Chennai. The principal of all seven schools were invited to participate in stakeholder meeting and explained about the methodology of implementing school health manual, ToT programme and the responsibilities of trained

teachers. Three schools were randomly allocated to intervention arm. As CSHM has separate Volumes [13] for classes 1-5, 6-8 & 9-12, children of classes third, seventh & eleventh were invited to participate.

Two teachers from each school were identified by school authorities. Teachers participated in the one day workshop on implementation of the activities illustrated in food and nutrition and physical activity of CSHM. This training of trainers program (ToT) was carried out by an expert team comprised of a medical officer, public health specialist, nutritionist, physiotherapist and a psychologist. Schools in both arms were provided with charts on basic food constituents, diet pyramid, and a diary for recording the food consumed and activity pattern of the children.

Reinforcement training was given to the teachers in the intervention arm by nutritionist and a physiotherapist during their visit to the school for pre evaluation of the children. In addition, the intervention arm received Power point Presentation regarding Diet and physical activity based on the CSH manual for class 4, 7 & 11. These presentation copies were given to the schools. The intervention schools also conducted practical classes at least 2 days per month and

ensured children participation in the activities mentioned in CSHM, while teachers in control arm were advised to continue with standard practice in educating the children on these issues.

Anthropometric measures were assessed at baseline (T0) before the intervention, and completion of 12 months intervention (T1) to evaluate the effectiveness of program. The primary study outcome was age- and sex-adjusted Body Mass Index z-score (BMI z-score). Anthropometric and blood pressure measurements such as height, weight and waist circumferences were recorded using standard procedure. BMI z score were computed using WHO anthro plus software and score greater than 97th percentile were classified as obese. Similarly, a field dietician and physiotherapist administered 24 hour recall questionnaire to record the diet pattern, physical activities of two weekdays and one day in weekend, respectively. The total calorie consumed per day was calculated for three days and the average was considered for pre and post intervention comparisons. The data were excluded from the analysis if the estimated average calories consumed per day was less than 500 kcal or more than 3000 kcal.
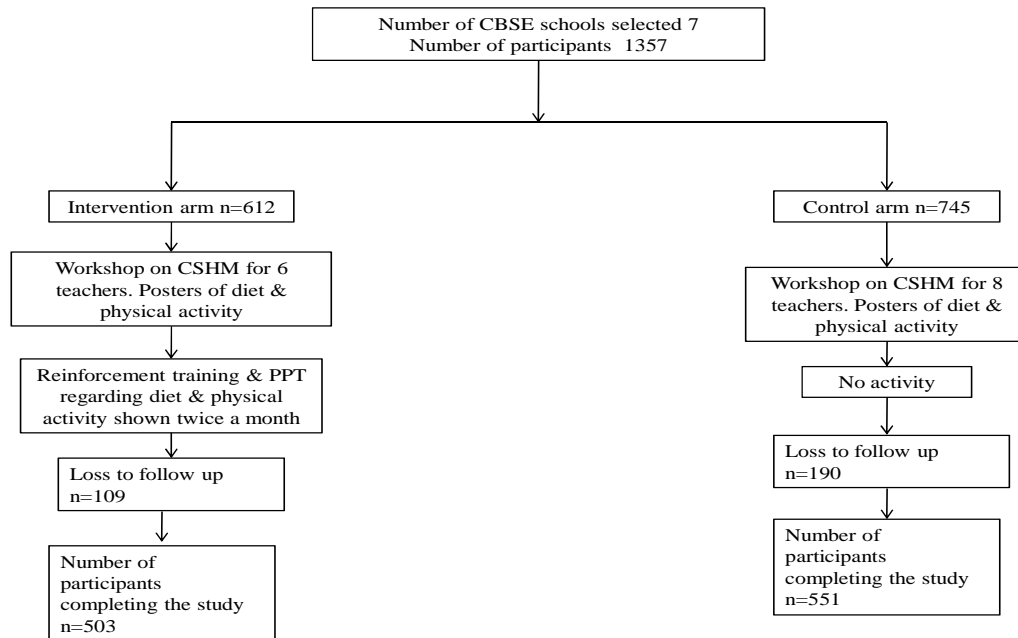
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                    ┌─────────────────────────────────────┐
                    │  Number of CBSE schools selected 7  │
                    │  Number of participants  1357       │
                    └─────────────────────────────────────┘
              ┌───────────────────────┴───────────────────────┐
    ┌──────────────────────────┐                 ┌──────────────────────────┐
    │  Intervention arm n=612  │                 │    Control arm n=745     │
    └──────────────────────────┘                 └──────────────────────────┘
    ┌──────────────────────────┐                 ┌──────────────────────────┐
    │  Workshop on CSHM for 6  │                 │  Workshop on CSHM for 8  │
    │  teachers. Posters of    │                 │  teachers. Posters of    │
    │  diet & physical activity│                 │  diet & physical activity│
    └──────────────────────────┘                 └──────────────────────────┘
    ┌──────────────────────────┐                 ┌──────────────────────────┐
    │  Reinforcement training  │                 │       No activity        │
    │  & PPT regarding diet &  │                 └──────────────────────────┘
    │  physical activity shown │                 ┌──────────────────────────┐
    │  twice a month           │                 │   Loss to follow up      │
    └──────────────────────────┘                 │   n=190                  │
    ┌──────────────────────────┐                 └──────────────────────────┘
    │   Loss to follow up      │                 ┌──────────────────────────┐
    │   n=109                  │                 │   Number of participants │
    └──────────────────────────┘                 │   completing the study   │
    ┌──────────────────────────┐                 │   n=551                  │
    │   Number of participants │                 └──────────────────────────┘
    │   completing the study   │
    │   n=503                  │
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Fig. 1. Flow diagram of enrollment & follow up

Similarly, the calories spent for each activity was calculated using the formula [MET value of the activity x body weight (kg)] x (duration of the activity in minutes/60) [14-15] for two week days and one day in the weekend. Thus average calories spent per day was calculated. The study was conducted between August-2011 to December 2013. The period of intervention was one year. The study was approved by the Institutional Ethics Committee and written permission was obtained before initiating data collection. Fig. 1 above shows the flowchart for Enrollment, Randomization, and Follow-Up of Study Participants.

2.2 Statistical Analysis

All data were tabulated and analyzed by the SPSS package version 16 and the level of significance was set at 0.05. Chi-square test and independent *t*-test were used to assess for between-group differences in intervention and control groups during baseline. Intention to Treat (ITT) was used for the calculation of incidence of obesity & the shift in nutritional grade. ITT & Completer analysis was performed for anthropometry measure remission & changes in diet consumption, using only intervention and control participants who attended the end line evaluation. Paired sample t test was used to assess post interventional difference within group and independent sample t test for between group differences.

3. RESULTS

Among the seven schools selected, three were allocated to intervention arm and four were

chosen as controls. The numbers of children included in experiment and control arm were 612 and 745 respectively. The mean age of the children in intervention and control arm was 11.47 & 12.06 respectively. The proportions of boys in the intervention and control arm were 60 & 59.6% respectively. The prevalence of obesity at baseline (T0) in the control and intervention group was 12.1 (9.76-14.44) and 13.2% (10.52-15.88) respectively. Baseline socio-demographic and anthropometry measure of the two groups are depicted in Table 1.

The numbers of participants lost to follow up were 190 & 109 in the control and experiment arm respectively. No differences were found between study groups in terms of socio-demographic and anthropometric characteristics at baseline except the intervention had higher calorie intake than controls. Table 2 shows the anthropometry & calorie consumption pattern for both groups at baseline and for the completers. The incidence of obesity during the end of the study was similar in both the arm with 3.8 (1.8-5.4) in control arm and 3.7% (1.6-5.7) in intervention arm. However, among the participants with a favorable shift in nutritional grade 65.4% belonged to intervention arm as shown in Fig. 2.

Table 3 shows the changes in anthropometry and calorie consumption between groups and within groups at the completion of active intervention program. 117 (19.1%) in the intervention arm and 126 (16.9%) in the control arm reduced the excess intake of junk foods, this difference was not statistically significant.
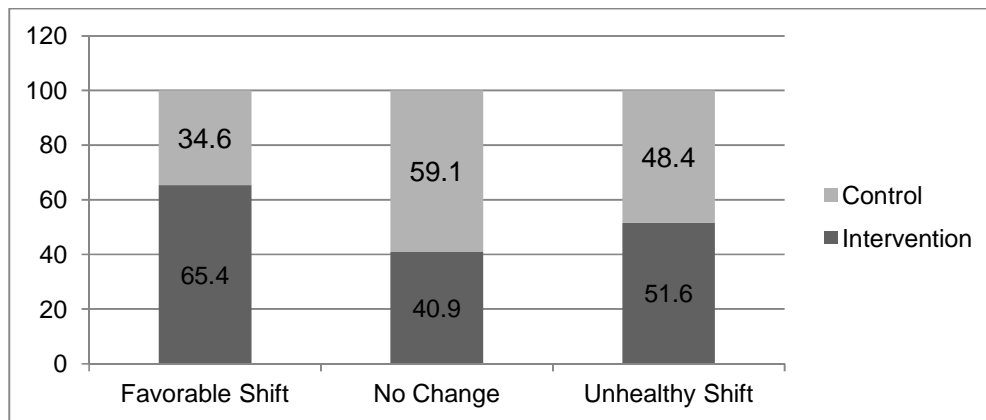

Fig. 2. Shift in nutritional grade (n= 1058)

Table 1. Comparison of demographic characteristics between control & intervention arm (n= 1357)

Demographic characteristics	Control n (%)	Experiment n (%)	P value
Male	444 (59.6%)	367 (60%)	.934
Religion			
Hindu	622(83.5)	501(81.9)	
Muslim	65(8.7)	43(7.0)	.135
Christian	29(3.9)	31(5.1)	
Others	29(3.9)	37(6.0)	
Father's occupation			
Government	55(7.4)	74(12.3)	
Business	316(42.8)	280(46.4)	.232
Professional	119(16.1)	71(11.8)	
Private	249(33.7)	180(30.3)	
Mother's working status			
Working	229(31.7)	126(21.4)	.003
Homemaker	509(68.3)	481(78.6)	
H/O DM in parents			
Yes	125(16.8)	93(15.2)	.474
No	620(83.2)	519(84.8)	
H/O HT in parents			
Yes	108(14.5)	77(12.6)	.345
No	637(85.5)	535(87.4)	
H/O Heart disease in parents			
Yes	8(1.1)	7(1.1)	1.00
No	737(98.9)	605(98.9)	

4. DISCUSSION AND CONCLUSION

The combined prevalence of obesity at baseline was 12.6% (95% CI 10.8-14.7), similarly high prevalence was also observed in a school based study conducted in Indore which reported a prevalence of 14.9% (95% CI13.4-16.4) [4]. The present intervention study among urban school children showed that the structural implementation of CSHM among school children through a ToT program for teachers had a significant positive impact. There was significant reduction in the BMI z score (-0.16) of children in interventional while there was no difference in control arm. There was also a significant reduction in body fat percentage within the intervention group (-1.42%); this difference was also significant between groups. Similar results were found in a randomized controlled trial of overweight and obese children, which reported a mean reduction of -0.19 in BMI z score and -2.67% in body fat [16]. The proportion of children shifting to favorable nutritional grade was significantly higher in intervention than control (19.9% vs. 9.5%). The proportion of boys and girls having a favorable shift in intervention arm was similar, 65.3% and 65.5%.

There was a significant reduction in calorie intake in both the groups, but the reduction in intervention arm was significantly higher (-130.9 kcal). 19.1% of children in intervention arm reduced their excess intake of junk foods. Similar to the present study, a school based education program on nutrition conducted in Southwest England had reported that there was reduction in the proportion of overweight and obese children and had also shown reduction in the habit of consuming aerated drinks in the intervention group [17].

There was significant increase in the waist circumference of children in the control arm (3.6 cm), while there was no change in intervention arm. The mean increase in waist circumference among boys and girls in the control arm was 3.85 and 3.37 respectively. A similar intervention program delivered through the teachers in obese preschool children in New South Wales showed significant reduction in waist circumference and BMI as well coupled with positive changes in movement skills and food intake [18].

There was a slight but significant decrease in diastolic blood pressure (-1.8) in the intervention arm, however there was trend of increasing diastolic BP (7.16) in control arm (p0.082). Similarly a randomized controlled trial with 44 pre-pubertal obese children has shown that regular physical exercise reduces BP, arterial stiffness, and abdominal fat; increases cardio respiratory fitness; and delays arterial wall remodeling in pre-pubertal obese children [19].

Table 2. Baseline characteristics of study participants according to group[a]

Variable	All participants			Completers		
	Intervention (n=612)	Control (n=745)	P value	Intervention (n=503)	Control (n=555)	P value
Male (%)	367 (60%)	444 (59.6%)	.934	338 (61.3)	305 (60.6)	.864
Obese (%)	81(13.2)	90 (12.1)	.600	24 (12.6)	9 (8.3)	.265
Excess Junk food (%) (>3 times/week)	246(40.2)	364(48.9)	.001	205(40.8)	256(46.1)	.082
Waist circumference	67.44 (11.4)	67.92 (11.7)	.433	66.1 (10.6)	66.2 (11.1)	.905
Hip circumference	77.01 (12.1)	77.64 (12.8)	.351	75.4(11.3)	75(11.6)	.585
WHR	0.87 (0.4)	0.87 (0.5)	.986	.87(0.4)	.88(0.4)	.056
BMI z score	0.30 (1.4)	0.22 (1.4)	.334	.34(1.4)	.18(1.5)	.076
Height z score	0.02 (1.0)	0.11 (2.2)	.341	.00 (1.0)	.02 (1.1)	.683
Body fat percentage	24.14 (7.4)	24.03 (7.1)	.852	23.9 (7.5)	23.3(7.1)	.318
Total calorie	1835.9(495.39)	1709.6(462.7)	.000	1811.9 (492.5)	1662.2 (447.4)	.000
Daily average METS	1430.7(561.8)	1450.7(800.3)	.677	1338.8 (473.9)	1421.9 (768.9)	.129

[a] *Data are presented as mean (standard deviation) unless otherwise indicated*

Table 3. Changes in primary outcomes at 12 months from baseline

Variable	All participants (ITT)			Completers		
	Intervention (n=612)	Control (n=745)	Group difference	Intervention (n=503)	Control (n=555)	Group difference
BMI z score	-.16(-0.27 to -0.06)*	-.00(-0.04 to 0.04)	-0.16*	-0.19(-0.33 to -0.06)*	-0.0(-0.05 to 0.05)	-0.19*
Body fat percentage	-1.4(-2 to -0.86)*	0.58(-0.29 to 1.4)	-2.02*	-1.8(-2.5 to -1.1)*	0.8(-0.4 to 2.03)	-2.7*
Systolic BP	-0.38(-1.6 to 0.83)	-0.55(-1.4 to 0.25)	0.18	-0.47(-1.9 to 1.03)	-0.77(-1.8 to 0.34)	0.29
Diastolic BP	-1.8(-2.8 to -0.89)*	7.16(-0.91 to 15.2)	-9.05*	-2.3(-3.5 to -1.1)*	9.6(-1.2 to 20.5)	-11.9*
Waist circumference	-0.3(-1 to 0.3)	2.7(2.4 to 3.03)*	-3.04*	-0.4(-1.2 to 0.4)	3.6(3.2 to 4.03)*	-4.04*
Total calorie	-381.9(-428.2 to -335.4)*	-250.9(-286.9 to -215.1)*	-130.9*	-465.9(-519.7 to 412.1)*	-299.5(-341.2 to 257.9)*	-166.4*
Hip circumference	-1.8(-2.5 to -1.1)*	1.4(1.1 to 1.72)*	-3.27*	-2.2(-3 to -1.3)*	1.9(1.5 to 2.3)*	-4.2*

P < 0.05, Group differences are unadjusted

The process evaluation of this program showed most of schools in the intervention arm rarely encountered difficulties in implementing the program except for one of the school which was able to conduct a practical session only one time in a month for children. Systematic review on the intervention for preventing obesity in children have found strong evidence to support beneficial effects of child obesity prevention programmes on BMI, particularly for programmes targeted to children aged six to 12 years [20].

In conclusion, a structured behavior intervention as mentioned in CBSE School Health Manual delivered through Training of the school teachers over a period of one year showed a positive impact. The training program empowered children to adopt healthy behaviors – increasing the physical activity level and intake of balanced diet. Policy amendments to sustain such feasible behavior intervention in children and providing a facilitating environment to them are essential to combat against childhood obesity in India.

5. LIMITATIONS

Our study is not without its limitation. There was higher number of lost to follow up in the control arm (190 vs. 109). However, there was no difference in baseline measure of those lost to follow up in both the arm. Another limitation is perhaps the duration of follow up of one year. A longer follow up may have shown more positive outcomes and also would have helped in studying the sustainability of the intervention.

INSTITUTIONAL ETHICS CLEARANCE AND CONSENT

The study was approved by the institutional Ethics Committee and formal written permission was obtained from the Heads of each school.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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