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Outcome of structured health education intervention for obesity-risk reduction among junior high school students: Stratified cluster randomized controlled trial (RCT) in South India

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Abstract:

BACKGROUND: Obesity has been identified as a serious global health concern whose prevalence doubles almost every 10 years. Health education regarding physical activity and healthy diet imparted to adolescents could prove to be fruitful in reducing obesity-risk. Objectives of this study were to evaluate the effect of health education intervention on knowledge, attitude, and practices (KAP) regarding obesity-risk reduction and to estimate the postinterventional change in body mass index (BMI) and total body fat (%) among adolescent school children in South India.

MATERIALS AND METHODS: Stratified cluster randomized controlled trial was carried out among 398 students recruited at baseline including 206 and 192 participants in intervention and control group respectively selected through simple random sampling from eligible government aided and private schools to assess KAP regarding physical activity and diet using pretested and validated questionnaire by making three school visits 6 months apart. Anthropometric measurements were recorded in first and third visit only, while health education intervention was given in first visit to intervention and third visit to control group after taking their responses on the questionnaire. Data were entered and analyzed using SPSS version 15.

RESULTS: Overall dropout rate was 13.5% with dropout in intervention and control group being 12.6% and 14.5% respectively, making 180 participants in intervention and 164 in control group available for analysis. Mean physical activity KAP score improved significantly from 16.19 ± 4.61 to 19.46 ± 10.07 in intervention group. Mean dietary KAP score also improved significantly from 21.38 ± 4.07 to 23.43 ± 4.53 in intervention group ($p < 0.001$). Mean BMI decreased significantly within intervention group ($p < 0.001$) as compared to control group ($p = 0.908$). Based on cut-off level for total body fat (%) to categorize obesity-risk among participants, statistically significant decline in proportions from 26.1% to 13.3% was observed in intervention group ($p < 0.001$).

CONCLUSION: Results depicted better KAP in intervention group than control group in all the three visits while it improved significantly within both groups. Hence, the health education was found to be effective in improving the overall KAP regarding modifiable risk factors of obesity among the study participants. Further studies to screen the adolescents for obesity-risk and successive health education sessions must be carried within schools in order to bring about change in knowledge, attitude, and practices regarding obesity-risk.

Keywords:

Diet, obesity, overweight, physical activity, risk

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Introduction

Overweight, obesity and bad eating habits have increased epidemically in the last two decades, affecting almost all age groups but specifically younger individuals.[1] The prevalence of obesity is utmost in developed nations, despite the fact that two-thirds of obese people hail from developing nations.[2] Obese children and adolescents were more likely to suffer from serious health problems including cardiovascular, metabolic and psychosocial ailments; type 2 diabetes, hypertension, stroke, certain cancers, and arthritis as compared to their normal weight counterparts. Other health consequences of childhood obesity including eating disorders and mental health issues, such as depression and low self-esteem have also been reported.[3] Lifestyle changes including modifications in diet and physical activity remain the basis for optimal prevention strategies among overweight and obese children.[2,4] Adolescence has been considered as an ideal time to build up healthy lifestyles, influence learning programs and keep away from the risk factors that would stay in future.[5] Childhood obesity could be an indication of development of several noncommunicable diseases which could be tracked into adulthood. Body mass index (BMI) cut-offs suggested by the World Health Organization (WHO) and International Obesity Task Force (IOTF) for Asian adults for overweight and obesity, although not applicable for children and adolescents but could be used to assess forthcoming obesity-risk in adolescents.[6] Regional studies in Karnataka state of India have revealed prevalence rates of overweight and obesity among adolescent children ranging from 4% to 30%.[7,8] Intervention studies on obesity management were mostly from the western countries where school-based approach were used as more children enroll in school, making it an ideal setting to reach large number of children and adolescents.[9] Previous interventional studies done outside India have revealed that action taken to reduce adolescent obesity by promoting physical activity and healthy diet appeared to be encouraging.[4,10,11] However, despite of these positive results not many interventional studies were carried out in India for management of adolescent obesity.[12,13] With this background in mind, the current study was carried out with the objectives to assess the effect of health education intervention on knowledge, attitude, and practices (KAP) regarding obesity-risk reduction and to estimate the postinterventional change in BMI and total body fat (%) among adolescent school children.

Materials and Methods

Study design and setting

The stratified cluster randomized controlled trial (RCT) study was carried out between 2017 and 2018 among 8th grade students followed through 9th grade in the next year between 2018 and 2019 from English Medium Schools of Udupi district of Karnataka, India.

Study participants and sampling

Sample size for the RCT study was calculated considering standard deviation (σ) of 16.4, precision (d) as 8, design effect (DE) of 2 and nonresponse rate (NRR) as 20% and obtained by using the below equation.[12]

$$n = \frac{2(Z\alpha + Z\beta)^2 \sigma^2 \times \mathrm{DE} \div (1 - \mathrm{NRR})}{\mathrm{d}^2}$$

Where σ=16.4, d = 8, $Z\alpha$=1.96, $Z\beta$=0.84, DE = 2 and (1-NRR)=0.8. Hence, a total of 396 participants were required to be recruited. Total number of English medium high schools in Udupi district were 164 as per Deputy Director for Public Instruction (DDPI) office data. Out of the total 164 schools, only 19 Schools met the inclusion criteria of 30–40 students in 8th grade. Among the 19 Schools meeting inclusion criteria, 7 were government aided and 12 private schools. Total 12 schools were required to be selected to get the calculated sample size of 396. Out of 12 schools, six were randomly selected each from government aided and private management using simple random sampling. Further, three schools in each of the subgroups were randomly allocated to control and intervention groups. Consequently, a total of 398 participants were recruited at baseline including 206 and 192 participants in intervention and control group respectively. The sampling strategy to recruit the participants from baseline (first visit) to final analysis (third visit) is given in the flowchart [Figure 1].

Inclusion and exclusion criteria

English medium schools with strength ranging from 30 to 40 students in 8th grade were included. Residential schools as well as schools where students were ever exposed to health education program targeting obesity from other agencies were excluded from the study.

Data collection tools and intervention

A pretested and validated questionnaire adapted from PAQ-A and EJCN was used to assess knowledge, attitude, and practices regarding physical activity and diet.[14,15] A total of three school visits were made each at an interval of 6 months for data collection purpose and responses on questionnaire were recorded in all the three visits from participants of both the groups. Health education module that served as intervention was prepared by consulting the faculty of department of physical education, nutrition as well as local health guides. Health education module was finally organized in the form of power-point presentation including motivational pictures, phrases and videos to encourage participants to adapt a healthy lifestyle and was approved by scientific committee and the Institutional

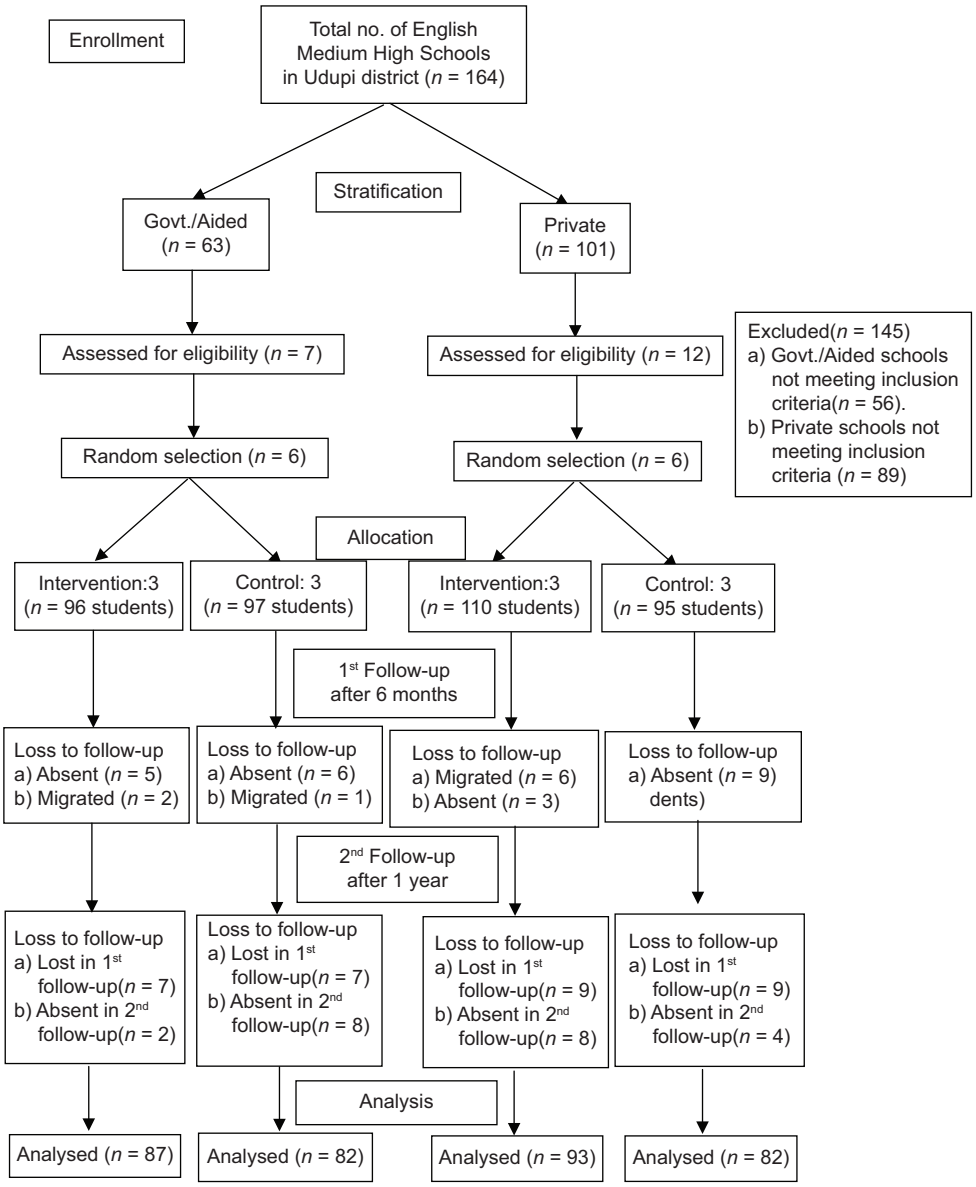

Figure 1: Sampling strategy for participant enrolment

Ethics Committee (IEC) before it was provided to the participants. The module prepared was imparted in the classroom setting to the intervention group during first visit and was reinforced during the second visit by distributing handouts and showing posters that included ways of living a healthy lifestyle to prevent obesity, while the control group was imparted with the same health education module during the third visit only after taking their responses on the questionnaire. Anthropometric measurements were recorded in first and third visit for both the groups. Height was recorded using a stadiometer to the nearest 0.5 cm. Weight, BMI, and body fat (%) was recorded using a validated body fat analyzer kept on a firm horizontal surface. Revised IAP guideline-2015 was used to classify overweight children with BMI >23 - <27 kg/m^2 (≥85th percentile) and obese children with BMI ≥27 kg/m^2 (≥95thpercentile).[16] Furthermore, participants with total body fat percentage >25%–30% (≥85thpercentile) were classified as overweight and those with total body fat percentage >30% (≥95th percentile) were classified as obese.[17] Qualitative assessment was done based on their responses on the pretested and validated questionnaire on physical activity and diet. Scores were assigned as 1 for correct response (low risk) and 0 for incorrect response (high risk). Furthermore, 50% of the maximum score from each domain that is, physical activity, diet and overall KAP was taken as cut-off to categorize participants as high or low obesity-risk.

Ethical consideration

Ethical committee approval was obtained from IEC vide letter Ref. no. IEC-631/2016 before commencement of

data collection. Permission from DDPI office and school principals, written informed consent from parents/guardian and assent of Grade 8th students was taken prior to data collection.

Data analysis

To compare the difference in proportions between intervention and control groups with respect to baseline characteristics, we applied Chi-square test and Fisher's exact test. Mc Nemar's test was applied to compare the change in status of the categorical variables within the group. Repeated measure analysis of variance (ANOVA) was applied to find the change in mean scores for knowledge, attitude, and practice regarding risk factors of obesity from first to third visit. Data were summarized using percentage with confidence interval of 95%. Data were entered and analyzed using IBM SPSS statistics version 15.0.

Results

Participants were almost equally distributed among the public aided (48.5%) and private schools (51.5%). Participants in intervention and control groups were similar with regard to their baseline characteristics viz. type of school, gender, father's education, father's occupation, and mother's occupation [Table 1]. The overall dropout rate from baseline (first visit) to 1-year postintervention (third visit) was 13.5% with dropout rate in intervention and control group being 12.6% and 14.5%, respectively as derived from sampling strategy [Figure 1]. Statistically significant difference in mean physical activity knowledge, attitude, and practice scores between the two groups was observed. Also, significantly higher improvement in intervention group was seen with respect to change in mean knowledge score from first to third visit. Mean overall (KAP) score for physical activity in each group was also found to be statistically significant ($p < 0.001$). Similarly, with regard to mean dietary knowledge and practice scores, statistically significant improvement was observed within both the groups but with respect to mean dietary attitude score, statistically significant ($p = 0.043$) improvement was seen in intervention group only [Table 2]. There was improvement in the mean overall, KAP score in the intervention group from first to third visit which may be explained by the reinforced health education in the second visit [Figure 2]. Also, mean of anthropometric measures including weight and height of the participants revealed statistically significant difference within each group but no significant difference was seen between the groups [Table 3]. Furthermore, the mean BMI reduced significantly in the intervention group whereas it remained almost constant in the control group [Figure 3]. Based on cut-off scores of physical activity KAP and overall KAP, statistically significant increase in proportions was observed depicting participants moving from high to low obesity-risk within each group. Further, no significant difference in obesity-risk was found between the two groups with respect to overall KAP cut-off score both during first and third visit. In first visit, there was statistically significant difference ($p = 0.030$) in obesity-risk between the two groups with regard to BMI cut-off but no significant difference between the two groups was seen in the third visit. Moreover, participants with high obesity-risk based on BMI and total body fat (%) cut-off values, no significant difference in proportions was observed in each group with respect to BMI cut-off but the same was found to be significant with respect to total body fat (%) cut-off [Table 4].

Table 1: Baseline characteristics of the total recruited participants (*n*=398)

Baseline characteristics	Control *n* (%) (*n*=192)	Intervention *n* (%) (*n*=206)	*P*
Type of school			
Government aided	97 (50.5)	96 (46.6)	
Private	95 (49.5)	110 (53.4)	0.434
Gender			
Male	100 (52.1)	106 (51.5)	
Female	92 (47.9)	100 (48.5)	0.900
Father's education			
Illiterate	12 (6.2)	6 (2.9)	
Can Read	6 (3.1)	5 (2.4)	0.448
Upto 12th Std	153 (79.7)	170 (82.5)	
Upto postgraduate	19 (9.9)	20 (9.7)	
Professional	2 (1.0)	5 (2.4)	
Father's occupation			
Unemployed	2 (1.0)	1 (0.5)	
Semiskilled and unskilled	106 (55.2)	91 (44.2)	0.127
Skilled	31 (16.1)	41 (19.9)	
White collar	17 (8.9)	17 (8.3)	
Business	33 (17.2)	46 (22.3)	
Professional	3 (1.6)	10 (4.9)	
Mother's education			
Illiterate	17 (8.9)	10 (4.9)	0.014
Can Read	8 (4.2)	5 (2.4)	
Upto 12th Std.	152 (79.2)	157 (76.2)	
Upto postgraduate	15 (7.8)	28 (13.6)	
Professional	0 (0.0)	6 (2.9)	
Mother's occupation			
Homemaker	143 (74.5)	149 (72.3)	
Semiskilled and unskilled	36 (18.8)	28 (13.6)	0.110
Skilled	5 (2.6)	7 (3.4)	
White collar	6 (3.1)	16 (7.8)	
Professional	2 (1.0)	6 (2.9)	

Discussion

Schools are known to be a natural place to spot health-related issues and offer solutions. The established infrastructure of school makes school-based intervention efforts one of the most cost-effective methods for

Table 2: Comparison of physical activity, diet and overall knowledge, attitude and practice (KAP) scores among study participants (*n*=344)

Domain	Category	Visits	Control (*n*=164) (Mean±SD)	Intervention (*n*=180) (Mean±SD)	*P*
Physical activity	Knowledge score (0-13)	1st visit	4.15±1.98	5.23±1.43	
		2nd visit	4.99±1.97	6.32±2.13	<0.001
		3rd visit	6.14±2.75	8.30±2.47	
	P		<0.001	<0.001	
	Attitude score (0-2)	1st visit	1.34±0.65	1.39±0.68	
		2nd visit	1.59±0.61	1.18±0.70	<0.001
		3rd visit	1.07±0.73	1.08±0.77	
	P		<0.001	<0.001	
	Practice score (0-22)	1st visit	8.98±3.80	9.56±3.90	
		2nd visit	10.52±4.31	9.93±3.62	0.003
		3rd visit	9.37±4.29	10.07±3.62	
	P		<0.001	0.203	
	KAP score (0-37)	1st visit	14.48±4.31	16.19±4.61	
		2nd visit	17.11±5.06	17.44±4.68	<0.001
		3rd visit	16.59±4.70	19.46±5.00	
	P		<0.001	<0.001	
DIET	Knowledge score (0-12)	1st visit	3.34±1.96	4.44±1.93	
		2nd visit	4.59±1.87	4.93±2.06	0.001
		3rd visit	5.28±2.23	6.61±2.42	
	P		<0.001	<0.001	
	Attitude score (0-5)	1st visit	3.16±1.24	2.98±1.32	
		2nd visit	2.98±1.34	2.72±1.36	0.007
		3rd visit	2.97±1.32	3.22±1.31	
	P		0.247	<0.001	
	Practice score (0-21)	1st visit	13.09±2.59	13.95±2.90	
		2nd visit	12.79±2.75	13.61±3.04	0.817
		3rd visit	12.92±3.02	13.60±2.93	
	P		0.416	0.182	
	KAP score (0-38)	1st visit	19.60±4.06	21.38±4.07	
		2nd visit	20.37±3.90	21.27±4.36	0.014
		3rd visit	21.18±4.67	23.43±4.53	
	P		<0.001	<0.001	
	Overall KAP score (0-75)	1st visit	34.08±6.26	37.57±6.72	
		2nd visit	37.48±7.07	38.71±6.99	<0.001
		3rd visit	37.77±7.08	42.90±7.94	
	P		<0.001	<0.001	

Table 3: Anthropometry and body fat analysis in first and third/final visits (*n*=344)

Anthropometric parameters	Visits	Control (*n*=164) (Mean±SD)	Intervention (*n*=180) (Mean±SD)	*P*
Weight (kg)	1st visit	39.16±10.73	41.95±9.77	0.829
	3rd visit	43.31±10.84	46.02±10.20	
P		<0.001	<0.001	
Height (cm)	1st visit	147.25±14.94	147.60±8.22	0.859
	3rd visit	156.10±8.48	156.67±13.35	
P		<0.001	<0.001	
BMI (kg/m^2)	1st visit	17.67±3.67	19.15±3.53	<0.001
	3rd visit	17.69±3.49	18.48±3.33	
P		0.908	<0.001	
Total body fat (%)	1st visit	19.98±5.43	21.55±5.10	0.568
	3rd visit	16.75±6.10	18.06±6.38	
P		<0.001	<0.001	

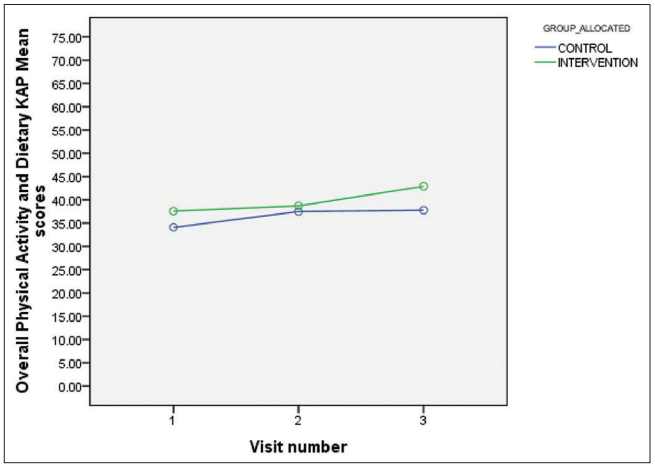

Figure 2: Change in mean overall KAP score (range = 0–75) from first to third visit (*n* = 344)

preventing childhood obesity. Therefore, majority of childhood obesity prevention curricula have been conducted within schools, with many of these programs focusing on obese rather than nonobese children.[4,18] In the current study, total 12 schools were finally selected with six randomly selected schools in each intervention and control group. The overall dropout rate was 13.5%with dropout rate in intervention and control group being 12.6% and 14.5%, respectively which was much lesser compared to a study conducted by Nayak BS *et al.*[13]in which attrition rate was 25% and 20.61% in the intervention and control group respectively. In the present study, semiskilled and unskilled was found to be the most common occupation among fathers in both control (55.2%) and intervention group (44.2%) and approximately 81% fathers and 78% mothers of the participants from both the groups were educated up to 12th grade. The baseline characteristics of our study participants were previously published as a school-based cross-sectional survey.[19] In the current study, there was a lesser change (3.07) in mean physical activity knowledge score in the intervention group from first to third visit as compared to a study conducted by Rajan JK where mean pre- and posttest change was 8.21 which could be because the posttest was carried out on the seventh day as compared to 1 year in the current study.[20] The results of our study were similar to other global studies which also have shown higher improvement in intervention group with respect to change in mean knowledge score postintervention.[21] Our study showed significant improvement in mean scores for dietary attitude ($p < 0.001$) within the intervention group from baseline to 1-year postintervention in comparison to a study done by Bahreynian M *et al.*[22]among overweight and obese children in which the mean of attitude score

Table 4: Distribution of participants with obesity-risk based on cut-off levels for KAP, BMI, and total body fat (%) (*n*=344)

Domain	Cut-off/risk category	Visits	Control *n* (%) (*n*=164)	Intervention *n* (%) (*n*=180)	*P*
Physical activity KAP score (Range: 0-37)	Score ≥18 (Low risk)	1st visit	38 (23.2)	74 (41.1)	<0.001
		2nd visit	76 (46.3)	89 (49.4)	0.565
		3rd visit	65 (39.6)	117 (65.0)	<0.001
P				0.002	0.021
Dietary KAP score (Range: 0-38)	Score ≥19 (Low risk)	1st visit	101 (61.6)	140 (77.8)	0.001
		2nd visit	114 (69.5)	134 (74.4)	0.308
		3rd visit	120 (73.2)	156 (86.7)	0.002
P				0.281	0.627
Overall KAP score (Range: 0-75)	Score ≥37 (Low risk)	1st visit	61 (37.2)	104 (57.8)	<0.001
		2nd visit	98 (59.8)	115 (63.9)	0.430
		3rd visit	84 (51.2)	141 (78.3)	<0.001
P				<0.001	0.029
BMI	≥23 kg/m^2 (High risk)	1st visit	11 (6.7)	25 (13.9)	0.030
		3rd visit	11 (6.7)	19 (10.6)	0.206
P				1.000	0.070
Total body fat (%)	≥25% (High risk)	1st visit	31 (18.9)	47 (26.1)	0.111
		3rd visit	10 (6.1)	24 (13.3)	0.025
P				<0.001	<0.001

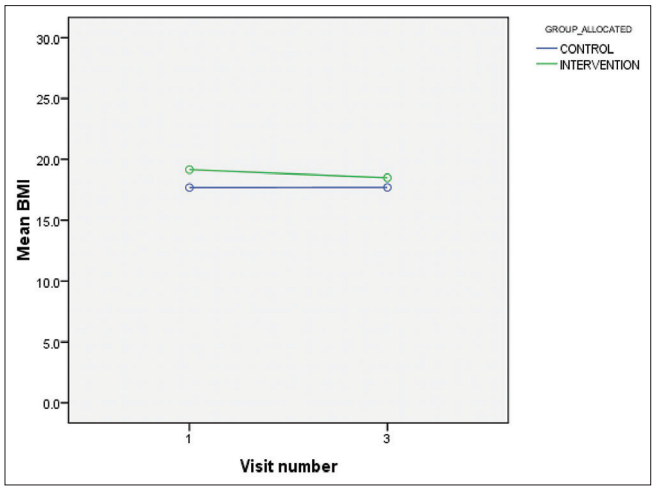

Figure 3: Change in mean BMI from first to third visit (*n* = 344)

for nutrition was found to be greater than before, but was not significant (p = 0.094).However, unlike our study, the mean of attitude score for physical activity in the reviewed study showed significant improvement (p = 0.017) than before.[22]In a study conducted by Ochoa-Avilés*et al.*[11]among adolescents, there was improvement in dietary practice in both intervention and control group from baseline to end point which could be due to longer study duration and period of intervention than the current study. Also, in the present study, there was significant difference between the two groups 1-year postintervention with regard to dietary KAP score (p = 0.002) similar to a study done by Vardanjani AE *et al.*[23]among students of female primary schools in which after intervention significant differences were observed in levels of nutritional knowledge, attitude, and performance between the two groups ($p < 0.001$).Further, in a study done by Rahimi A *et al.*,[24] the mean nutritional awareness score improved significantly in the intervention group ($p = 0.01$) than the experimental group ($p = 0.67$) whereas in our study there was significant improvement in both the groups with higher improvement in the mean dietary score within the intervention group ($p < 0.001$). Further, our study showed statistically significant reduction in mean total body fat (%) within each group. However, significant reduction in mean BMI was found within intervention group only. The change in mean BMI within intervention group ($p < 0.001$) in the current study was similar to a pre- and postintervention feasibility study conducted by Teder M *et al.*[25] among 26 obese children between 8 and 12 years of age. However, findings were contrary to another study conducted by Adab *P et al.*[26]among primary school children between 6 and 7 years of age in which no significant difference was observed within the intervention group ($p = 0.63$) after 30 months from baseline. In another pre-post study done by Farris JW *et al.*[27] among obese children, significant reductions were seen in mean BMI ($p < 0.001$) as well as mean body fat (%) ($p = 0.012$) which was similar to our study results found within intervention group participants. In the current study, the proportion of participants in the intervention group with high obesity-risk based on BMI cut-off group showed nonsignificant reduction from 13.9% in first visit to 10.6% ($p = 0.070$) in third visit whereas in an interventional study conducted by Wang Z *et al.*[10]among school children in China the proportion of overweight/obese (35%) remained constant ($p = 0.31$) from baseline to 1-year postintervention among the intervention group. In our study, three schools visits were made in both the groups each at a gap of 6 months

from baseline and data were analyzed after 1 year. The results of our study in terms of improvement in KAP and reduction in obesity-risk with regard to total body fat (%) cut-off were exciting.

Limitations and recommendations

Since the students were assessed in the classrooms, there could have been a possibility of exchange of thoughts while answering the questionnaire. The possibility of mixing of participants between intervention and control groups could be responsible for improvement in KAP scores within control group. Further, curiosity level of students in control schools was probably higher which could have led to better KAP scores in subsequent visits. Moreover, the teachers in control schools seemed to educate the participants prior to the scheduled visit in order to reflect the school in better light. Also, due to resource constraints parents were not involved in the Health education programme which otherwise would have enhanced the impact of intervention.

Conclusion

The results showed that the participants in the intervention group had better knowledge regarding physical activity and diet in all the three visits as compared to control group. However, the knowledge under each domain improved significantly within both groups. The attitude of participants regarding physical activity decreased but improved toward diet within the intervention group. However, the practice regarding physical activity and diet remained almost constant throughout the study within intervention group. The overall KAP regarding physical activity and diet improved significantly within both the groups but the change was found to be higher within the intervention group. Significant reduction was observed in the mean BMI of the participants within the intervention group. Hence, the Health education was found to be effective in improving the overall knowledge, attitude and practices regarding modifiable risk factors of obesity among the study participants. Further studies to screen the adolescents for the risk of obesity and subsequent health education should be carried out as an ongoing school based programme in order to bring about change in knowledge, attitude, and practices regarding obesity risk.

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Ethical approval

The research was carried out after approval from the Institutional Ethics Committee (IEC), Kasturba Hospital, Manipal, Karnataka, India vide letter reference no. 631/2016.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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