International Journal of Community Medicine and Public Health
Manjula R et al. Int J Community Med Public Health. 2018 May;5(5):1828-1834
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: http://dx.doi.org/10.18203/2394-6040.ijcmph20181684

Original Research Article

Effectiveness of school based educational intervention for healthy body mass index and its association with academic performance among school children: a quasi-experimental study

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Received: 01 February 2018
Accepted: 01 March 2018

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ABSTRACT

Background: Childhood obesity is associated with a higher chance of premature death and disability in adulthood, according to the World Health Organization. More than two-thirds of the adolescents aged 11-17 years are physically inactive in India as per WHO standards. Hence, school based Healthy life style curriculum development is the need of the hour for school children. The objectives of the study were to promote healthy lifestyle, by implementing school based intervention program (physical activity and nutrition education) for healthy body mass index among school children; to study the correlation between the body mass index and academic performance (secondary objective).
Methods: A quasi-experimental study was conducted in the randomly selected schools of Bagalkot. A total of 598 students in intervention group and 575 students in control group participated in the study. Baseline information about demographic characteristics was obtained using pre-designed proforma. For intervention group, multicomponent programme was implemented based on child and adolescent trial for cardiovascular health model and the comprehensive school health programme model by the USA, centre for disease control. After 2 years, post-interventional data was collected.
Results: In pre-test intervention group majority of participants (37.4%) were having normal BMI, while 26.8% participants were obese. In post-test intervention group majority of participants (45.7%) were having normal BMI, while 23.1% participants were obese. In pre-test control group majority of participants (34.7%) were having normal BMI, while 27.1% participants were obese. In post-test control group majority of participants (38.7%) were having normal BMI, while 26.4% participants were obese. Majority of the students attained normal BMI after the intervention. BMI of the participants is negatively correlated to academic performance (r=-0.025).
Conclusions: The life style changes such as physical activity, yoga and meditation are the need of the hour among the schoolchildren, helps in maintenance of healthy BMI.

Keywords: Body mass index, School children, Academic performance, School-based education intervention

INTRODUCTION

The prevalence of obesity among the school-aged children and adolescents has considerably increased in many countries from less than 10% in Russia and East Europe to more than 30% in U.S.[1] Childhood obesity is associated with a higher chance of premature death and disability in adulthood, according to the World Health Organization. More than two-thirds of the adolescents aged 11-17 years are physically inactive in India as per WHO standards. The level of physical inactivity among adults is around 13%.[2] Prevalence of hypertension among adolescents is 40.1%, diabetes 14.3% overweight is 28.6% and obesity 12.8% as per Thakur et al.[3] A recent

study conducted among 24,000 school children in south India showed that the proportion of overweight children increased from 4.94 per cent of the total students in 2003 to 6.57 percent in 2005 demonstrating the time trend of this rapidly growing epidemic. Those with BMI equal to or exceeding the 85th but are below 95th percentiles are defined overweight and are at risk for obesity related co-morbidities.[4] Metabolic syndrome is defined as a constellation of risk factors, including obesity, dyslipidaemia, impaired glucose metabolism and elevated blood pressure, all major predictors for cardiovascular disease.[5] It has been proven by previous studies that cardio metabolic risk factors frequently cluster in obese children and adolescents. Goodman et al identified four clusters of risk factors in adolescents and found that obesity had the most substantial influence on cumulative cardio metabolic risk.[6] Four behavioural risk factors are responsible for significant proportions of these obesity among children and adolescents- unhealthy diet, physical inactivity, tobacco use, and harmful use of alcohol.

Also, students who have a low level of physical activity are more likely to be obese and also more likely to have a lower grade point average (GPA).[7] Academic performance is generally considered to be related to cognitive and memory functions.[8] Given the negative association of obesity with cognitive and memory functions, being overweight or obese might have a negative impact on the academic achievement of adolescents.[9] Many studies emphasized on positive relationship between obesity and poor school performance, while others has proved no significant correlation between these two issues.[10-15]

Hence this study was taken up to study the effect of education intervention for healthy body weight and its association with academic performance.

Objectives

- To promote healthy lifestyle, by implementing school based intervention program (physical activity and nutrition education) for healthy body mass index among school children.
- To study the correlation between the body mass index and academic performance (secondary objective).

METHODS

This quasi-experimental study was conducted in the randomly selected high schools of Bagalkot from June 2015 to July 2017. Sample size was calculated based on the study conducted by Warren et al, using Open Epi software version 2.3.1 taking 95% confidence level and 80% power of the study, there was reduction of obesity from 8% to 4% following intervention, which is taken as P1 and P2.[6] Minimum sample size required for the present study was 556. A total of 598 students in intervention group and 575 students in control group participated in the study. After obtaining informed consent from institutional ethical committee, baseline information about demographic characteristics was obtained using pre-designed proforma. For intervention group, multicomponent programme was implemented based on CATCH (Child and Adolescent trial for Cardiovascular Health) Model and The Comprehensive School health programme Model by the USA, Centre For Disease Control (CDC).[16,17] Module was prepared, which was the tool for our intervention programme. Here the peer educators and teachers were trained by our team in various aspects of health promotion measures which includes nutrition education (healthy eating habits) and physical activity. After 2 years, post-interventional data was collected.

Statistical analysis

Data collected were entered in the Microsoft excel sheet and later analysed using SPSS software. Chi-square test for proportions and student t-test for quantitative data was applied. $P<0.05$ was considered as statistically significant.

RESULTS

In the present study, intervention group has 598 children and control group has 575 children (Table 1). Mean Academic performance in post-test intervention was found to increase from pre-test ($p=0.142$), though statistically not significant. Calorie intake in post-test intervention group was found to be significantly more as compared to pre-test group. Duration of physical activity per week was found to be more in post-test group (Table 2). In pre-test and post-test intervention group a good proportion of participants (41.5% and 36.8% respectively) are doing at least one physical activity. But in pre-test and post-test control group, majority of participants (68.5% and 64.9% respectively) are not involved in any physical activity. Overall majority of participants (51.5%) are not doing any physical activity (Table 3). In pre-test and post-test intervention group, majority of participants play outdoor sports (62.4% and 45.1% respectively). While in both the control groups majority of participants does not play any kind of sports, i.e. 67.8% in pre-test control and 87.3% in post-test control (Table 4). In pre-test intervention group majority of participants (37.4%) were having normal BMI, while 26.8% participants were obese. In post-test intervention group majority of participants (45.7%) were having normal BMI, while 23.1% participants were obese. In pre-test control group majority of participants (34.7%) were having normal BMI, while 27.1% participants were obese. In post-test control group majority of participants (38.7%) were having normal BMI, while 26.4% participants were obese. Therefore, most of the participants were having normal BMI, although the frequency of obese participants was found to be next highest as compared overweight, thin and severely thin (Table 5). In pre-test intervention group, 22.3% male participants were obese and 31.7% female participants

were obese. And just 7.4% male and 1.1% females were severely thin. In post-test intervention group, 23.7% male participants were obese and 22.4% female participants were obese. And 14.4% male and 22% females were overweight. And 5% males and 1.1% females were severely thin. In pre-test control group, 22% male participants were obese and 31.7% female participants were obese. And 15.3% male and 7.6% females were severely thin. In post-test control group, 23.8% male participants and 32% female participants were obese. And 8.1% male and 5.4% females were severely thin. And overall overweight and obesity is reduced in post-test intervention group as compared to pre-test group and even thinness is also reduced. While in both the control groups, the proportion of participants that are overweight and obese have increased in post-test group as compared to pre-test (Table 6). BMI of the participants is negatively correlated to academic performance (Table 7).

Table 1: Table showing the number of study subjects in the intervention and control group.

Group	Number	Percentage (%)
Intervention	598	50.9
Control	575	49.1
Total	1173	100.0

Table 2: Effect of intervention of different parameters in intervention group.

Parameters	Group	Mean	SD	t	P value
Academic performance	Pretest-intervention	80.64	11.162	-1.470	0.142
	Postest-intervention	81.57	10.405		
Calorie intake per day	Pretest-intervention	1375.70	414.145	-3.599	0.000
	Postest-intervention	1469.31	471.240		
Duration of physical activity per week	Pretest-intervention	41.81	47.135	-2.17	0.02
	Postest-intervention	46.8	28.2		

Table 3: Physical activity in the study subjects before and after intervention.

Group	Physical activity				Total
	None	1 physical activity	2 physical activity	3 and >3 physical activity	
Pretest-intervention	252	248	51	47	598
	42.1%	41.5%	8.5%	7.9%	100.0%
Posttest-intervention*	177	210	92	91	570
	31.1%	36.8%	16.1%	16.0%	100.0%
Pretest-control	394	107	31	43	575
	68.5%	18.6%	5.4%	7.5%	100.0%
Posttest-control**	362	94	11	91	558
	64.9%	16.8%	2.0%	16.3%	100.0%
Total	1185	659	185	272	2301
	51.5%	28.6%	8.0%	11.8%	100.0%

*P=0.004; **p=0.45.

Table 4: Indoor and outdoor sports in the study subjects before and after intervention.

Group	Sports				Total
	None	Indoor	Outdoor	Both	
Pretest-intervention	151	70	373	4	598
	25.3%	11.7%	62.4%	0.7%	100.0%
Posttest-intervention	88	37	257	188	570
	15.4%	6.5%	45.1%	33.0%	100.0%
Pretest-control	390	13	171	1	575
	67.8%	2.3%	29.7%	.2%	100.0%
Posttest-control	487	3	46	22	558
	87.3%	.5%	8.2%	3.9%	100.0%
Total	1116	123	847	215	2301
	48.5%	5.3%	36.8%	9.3%	100.0%

Table 5: Body mass index in the study subjects before and after intervention.

	BMI classification (WHO classification of z scores)					Total
	Normal	Overweight	Obesity	Thinness	Severe thinness	
Pretest-intervention	223	117	160	71	27	598
	37.4%	19.6%	26.8%	11.8%	4.4%	100.0%
Posttest-intervention	259	102	132	58	19	570
	45.7%	18.0%	23.1%	10.1%	3.2%	100.0%
Pretest-control	198	92	156	64	65	575
	34.7%	15.9%	27.1%	11.0%	11.2%	100.0%
Posttest-control	206	110	160	45	37	558
	37.0%	19.7%	28.7%	8.1%	6.5%	100.0%
Total	886	421	608	238	148	2301
	38.7%	18.3%	26.4%	10.3%	6.3%	100.0%

Table 6: Body mass index in the different gender before and after intervention.

Group	Gender	BMI classification (WHO classification of z scores)					Total
		Normal	Overweight	Obesity	Thinness	Severe thinness	
Pretest-intervention	Male	126	39	69	54	24	312
		40.8%	12.3%	22.3%	17.2%	7.4%	100.0%
	Female	97	79	90	17	3	286
		33.8%	27.5%	31.7%	6.0%	1.1%	100.0%
	Total	223	118	159	71	27	598
		37.4%	19.6%	26.8%	11.8%	4.4%	100.0%
Posttest-intervention	Male	139	43	71	31	15	299
		46.5%	14.4%	23.7%	10.4%	5.0%	100.0%
	Female	120	59	60	26	3	268
		44.8%	22.0%	22.4%	9.7%	1.1%	100.0%
	Total	259	102	131	57	18	567
		45.7%	18.0%	23.1%	10.1%	3.2%	100.0%
Pretest-control	Male	99	32	59	37	42	269
		36.9%	11.9%	22.0%	13.8%	15.3%	100.0%
	Female	99	59	97	26	25	306
		32.7%	19.5%	31.7%	8.6%	7.6%	100.0%
	Total	198	91	156	63	67	575
		34.7%	15.9%	27.1%	11.0%	11.2%	100.0%
Posttest-control	Male	95	37	53	20	18	223
		42.6%	16.6%	23.8%	9.0%	8.1%	100.0%
	Female	111	73	107	25	18	334
		33.2%	21.9%	32.0%	7.5%	5.4%	100.0%
	Total	206	110	160	45	36	557
		37.0%	19.7%	28.7%	8.1%	6.5%	100.0%

Table 7: Correlation between BMI and academic performance.

		Academic performance
BMI class	r	-0.025
	p	0.224

DISCUSSION

The present study was conducted to promote healthy lifestyle, by implementing school based intervention program (physical activity and nutrition education) for healthy body mass index among school children, with a secondary objective of finding the correlation between BMI and academic performance. In the present study, intervention group has 598 children and control group has 575 children.

In the present study, the mean Academic performance in post-test intervention group was improved from pre-test (p=0.142). Physical activity & healthy nutritious diet enhances healthy growth and development, increases concentration and better academic scores. It improves social skills and brain development and helps children feel confident about themselves to do better in school.

Jessie-Lee et al, in a cross-sectional study showed that unhealthy lifestyle behaviors are positively associated with poor in elementary school students in a school board in Nova Scotia, Canada during 2014.[18] The associations were statistically significant. Consumption of ≥1 sugar-sweetened beverage, breakfast skipping and not being physically active were the reasons for poor academic performance.

In this study, it was also found that duration of physical activity per week was found to be more in post-test intervention group when compared to pre-test. There was increase of about 35 hours of physical activity/week following intervention. This difference of physical activity after intervention was statistically found to be significant. When we compare different parameters between intervention and control group, the duration of physical activity/week is more in post-test intervention group as compared to post-test control group and is statistically significant. Similar finding was observed in a study by Russell et al those in the intervention schools engaged in significantly more among medium to vigorous physical activity than children in control schools.[19] This difference remained significant.

In pre-test and post-test intervention group a good proportion of participants (41.5% and 36.8% respectively) are doing at least one physical activity. Three types of physical activities were found in 16% of the individuals in posttest intervention when compared to pretest intervention (7.9%). That means the intervention group subjects increased the number of physical activities from one to two and three. This could be the effect of training of peer educators & teachers monitoring of the students for physical activity by the teachers and project management team. But in pre-test and post-test control group, majority of participants (68.5% and 64.9% respectively) are not involved in any physical activity. In the control group there was not much change in the physical activity during posttest.

In the post test intervention group, both indoor & outdoor activities were increased from 0.7 to 33% of the subjects whereas in the post test control group there was a slight increase i.e., from 0.2 to 3.9%.

In the present study, the mean academic performance in post-test intervention group was improved from pre-test (p=0.142). Physical activity and healthy nutritious diet enhances healthy growth and development, increases concentration and better academic scores. It improves social skills and brain development and helps children feel confident about themselves to do better in school.

A study conducted in Saudi Arabia, found that students who achieved >90% in the overall GPA (Grade Point Average) have a mean BMI mean±standard deviation= 22.75±5.4 and those who achieved <90% in the overall GPA have a BMI of mean±SD= 22.4±6.0, thus, showing that there is no significant differences between being overweight, obese, normal weight, or underweight. On the other hand, students who were obese achieved poor result in physics. Some studies have demonstrated that cognitive ability is influenced by obesity and the likelihood of being obese is influenced by the quality of nutrition.[20] The obesity has also proven to lead to mental and emotional problems, such as anxiety and depression.[21] There are some potential explanation for reveres association between student grades average and BMI: firstly, as proven in previous studies there is a significant correlation between high BMI and depression, that could strongly affect student performance.[22,23] Noting that, a study in North Korea on 405 students confirmed that, psychological problems in overweight and obese student are the major cause of poor school performance rather than their body image.[24] In addition, the obese students are mostly less physically activate which lead them to experience the lower school performance compared with normal BMI students.[25-28]

Numerous studies have been performed across the United States on whether or not physical fitness levels have a significant positive correlation with academic achievement.[29-31] These studies have been performed on a wide range of ages, from as young as five to age eighteen. The results of these studies have been fairly conclusive that there is indeed a positive correlation, although the correlational coefficient varies from study to study, generally between 0.07-0.34.[32]

CONCLUSION

The life style changes such as physical activity, yoga & Meditation are the need of the hour among the schoolchildren. The study results showed that regular physical activities and yoga and meditation helps in maintenance of good health as well as prevents the cardiovascular diseases in the future life. Regular physical activity, yoga and meditation should be included and implemented strictly in the school curriculum. Nutrition education should start from the home and there should be continued nutritional education in the school curriculum.

Funding: This study was funded by Rajiv Gandhi university of Health sciences, Karnataka
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Manjula R, Dorle AS, Mannapur BS, Desai S, Mallapur A. Effectiveness of school based educational intervention for healthy body mass index and its association with academic performance among school children: a quasi-experimental study. Int J Community Med Public Health 2018;5:1828-34.