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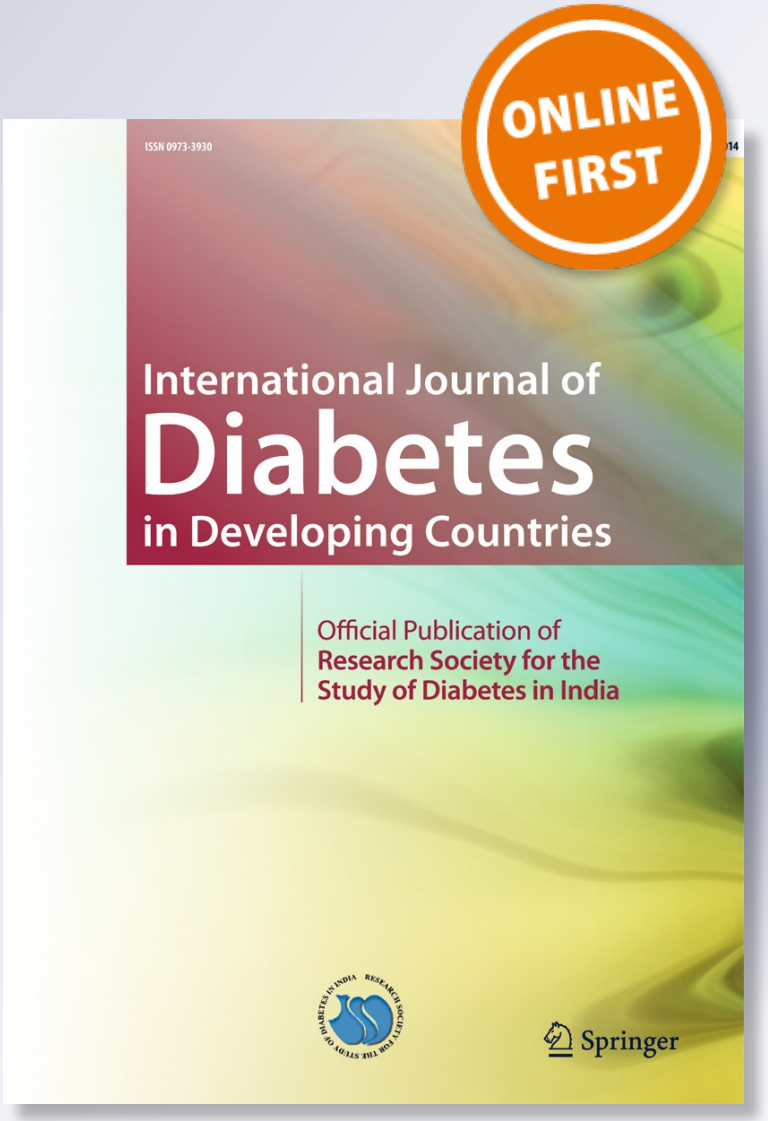

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ORIGINAL ARTICLE

Novel school-based health intervention program—a step toward early diabetes prevention

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Abstract The purpose of this study is to determine the existing knowledge, attitude, practices (KAP), and impact of intervention with diabetes awareness and prevention education among school students in New Delhi, India. The Diabetes Awareness and Prevention Education is a 2-year, school-based intervention, conducted with two cohorts of students who were in the sixth and seventh grade when the study started from six schools of Delhi (n=3 private and 3 government), India. These schools were purposively selected to represent socioeconomic strata and different geographies within Delhi. Students in these schools were surveyed before the intervention began and after 1-year intervention (n=1520). The intervention used strategies which included the following: orientation workshops for teacher coordinators and peer leaders, interactive classroom sessions (curriculum) led by trained teachers, peer-led small group activities (peer-led health activism), fun learning games, students' worksheets, and intraschool competitions, etc. After intervention, significantly more students reported that diabetes is high level of glucose in blood than at baseline. Consumption of junk food items significantly reduced among students post intervention. A total of 6.5 and 13.8 % more students in private and government schools, respectively, reported outdoor activities during leisure time. Teacher-led classroom discussions with active youth engagement and empowerment (peer-led health activism) can be an important strategy with potential long-term benefits for early diabetes prevention.

Keywords Diabetes · Awareness · Prevention · School-based intervention · Students · Peer-led health activism

Background

Noncommunicable diseases (NCDs) are imposing a very large health burden, worldwide. The problem is even graver in developing countries which face a serious dual public health crisis. In year 2010, there were 52·8 million deaths globally, and NCDs accounted for two of every three deaths (34·5 million), worldwide [1]. Unhealthy diet, physical inactivity, and alcohol use are major modifiable global determinants of NCDs [2, 3]. Poor dietary patterns with inadequate physical activity are often related to metabolic diseases such as type 2 diabetes, obesity, and cardiovascular diseases [4, 5]. Each year, physical inactivity and unhealthy diets cause approximately 3.2 million and 14 million deaths, respectively [2].

Diabetes, one of the most common NCDs, becomes a widespread epidemic and a significant cause of premature mortality and morbidity. Diabetes has developed together with rapid cultural and social changes, aging populations, increasing urbanization, dietary changes, reduced physical activity, etc. [6]. Diabetes with its devastating health consequences is expected to affect 552 million people by 2030, globally. India is home to over 61 million diabetic patients, and the numbers are expected to increase to 101 million by 2030. India's

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diabetes burden is second to China, which has 90 million people with diabetes (2011 figures) that will increase to about 130 million by 2030 [7]. In India, the negative health sequelae of diabetes occur at least a decade earlier than their western counterparts [8–10]. Type 2 diabetes has become increasingly more common in the pediatric and adolescent population with these cases having increased three times in the last three decades [11–13]. To stem this rising tide of diabetes, public health policies need to move upstream toward prevention and delay the onset of type 2 diabetes [14]. The risk of developing type 2 diabetes begins early in life; so, preventive strategies like health promotion to adapt the right lifestyle are urgently required to curb the anticipated 50 % increase in premature death due to diabetes in the next decade [15]. Treatment of diabetes in adult life through changes in lifestyle is difficult; therefore, school-based interventions during childhood could be a key strategy for prevention and delay type 2 diabetes. India has over 50 % of the population below 25 years of age [16]; this huge cohort of young people can become an advantage in dealing with the issue of type 2 diabetes.

The purpose of the study is to determine the existing knowledge, attitude, practices (KAP), and impact of intervention with diabetes awareness and prevention education, among school students in New Delhi, India. This article presents the results of the year 1 intervention of this school-based intervention.

Materials and methods

The Diabetes Awareness and Prevention Education is a 2-year, school-based intervention, conducted with two cohorts of students who were in the sixth and seventh grade when the study started (2011) from six schools (n=3 private and 3 government) of Delhi, India. These schools were purposively selected to represent a socioeconomic strata and different geographies within Delhi. Out of the selected schools, three were private (*middle to upper socioeconomic background*) schools and three were government schools (*lower socioeconomic background*). All students enrolled in sixth and seventh grades (11–13 years) in these six schools were eligible and asked to participate (n=2034).

The students were surveyed at baseline (before the intervention began, in September, 2011) and post intervention (after completing year 1 intervention, in March, 2012) to evaluate effectiveness of program intervention. The paper presents results from these two surveys. All the students enrolled in selected schools in the sixth and seventh grades in 2011 were eligible and invited to participate in both the surveys. The response rates were 85.79 % (n=1745) and 86.87 % (n=1767) at baseline and after 1-year intervention, respectively.

Knowledge, attitude, and practice assessment questionnaire

The Diabetes Awareness and Prevention Education program commenced with a baseline self-administered survey on students' KAP related to healthy lifestyles. The survey was a 40-item self-reported survey administered in school classrooms by trained project staff using standardized protocols and included themes on nutrition and foods eaten, physical activity, diseases (obesity and diabetes), etc. The survey was conducted during school hours and as per the convenience of the school authorities. The questionnaire was translated from English (and backtranslated to check for translation accuracy) into the local language, i.e., Hindi for the government schools. The survey underwent pilot testing before its administration with students in one government (n=110) and one private school (n=119) to obtain their insight on the following: length of the survey, time for survey completion, language, clarity and understanding ease, question relevance, offending, and repetitive questions. Results of the pretest were used to modify the questionnaire. The language of the questionnaire was kept simple keeping in mind that the students were from classes 6 and 7 and would have faced interpretation problems in case of a difficult language. Students were informed that taking part in the survey was voluntary. The confidentiality of student responses was assured. A unique identification number (not recognizable to students, teachers, or parents) was used to track the student over time. The student survey questionnaire used at post intervention was similar to that used during the baseline.

School-based intervention

The school-based intervention was carried out in all selected schools over a period of 5 months and used multipronged strategies to increase the knowledge and alter students' attitudes about healthy lifestyle practices. The program was based on social cognitive theory and recognized the influence of psychosocial, behavioral, and physical factors [17]. The intervention strategies included the following: training teachers to facilitate innovative classroom activities, training students to be peer leaders, interactive classroom sessions (curriculum), teacher-led discussions, peer-led small group activities, creative and age-appropriate components of the educational modules like fun learning games, students' worksheets, and intraschool competition like poster-making as an extension of the classroom activities. The students were encouraged to translate knowledge and skills into daily practice. The curriculum for these interventions was kept common for both grades—sixth and seventh. The classroom activities were conducted per the school's convenience, in small groups of 10 to 15, led by peer leaders. Implementation of the program began with training of project staff (n=6), teachers (n=29), and peer leaders (n=192) at the start of the school year (April, 2011). The trainings were conducted at school level and separately

for teachers and peer leaders. The trainings primarily involve an introduction to the curriculum, orienting about the objectives, content areas, and methodology of the program. The teachers and peer leaders were given comprehensive manuals that provided the background to each session, the steps in implementation, all necessary teaching material, games, and worksheets.

Measures

Knowledge about diabetes was measured through ten questions with three options for each, i.e., "yes," "no," and "don't know." Only the proportions of students who responded yes were reported in the results. Average serving per day of food items were calculated for ten items, namely, whole fruits, vegetables, fruit juices, carbonated drinks, fried snacks, traditional Indian sweets, non-Indian sweets, packed chips, egg and meat products, and milk and milk products. Students were asked "How often they eat these food items in a day/week/month/year." Average serving per day was calculated as number of servings reported divided by corresponding number of days. Students' self-reported behavior related to physical activity was assessed through five questions like "What do they mostly do, during their leisure time/during games period in school, " "How do they go to the market nearby their home," "How much time do they spend watching TV/using computer," and "How much time do they spend doing exercise/ playing."

Statistical analysis

Descriptive statistics were provided for sociodemographic distribution of students. Students' knowledge about diabetes and physical activity behavior post intervention was compared with that of baseline through Friedman's test. This test was used to compare related samples when no assumption about the data holds. The differences in knowledge among students post intervention and at baseline were calculated, and their associations were assessed with gender and school type through Chi-square test. Repeated measure analysis of covariance (ANCOVA) was applied to compare the difference of serving per day for all food groups over time. Again, for this analysis, gender and school type were tested and used as effect modifiers. Students who participated in both the surveys (n=1520) were considered for analysis. All the comparisons were considered significant at 5 % level of significance. All the analysis was done using SAS V9.1.

Results

Demographics

Overall, 1995 students participated in the study out of which 1520 students (boys=62.5 % and girls=37.3 %) participated in both the surveys (baseline and after 1-year intervention). Overall, 10.3 % were 10 years old or lower, 46.9 % were 11 years old, and 42.8 % were 12 years old or above. A total of 48.7 and 51.3 % of students were from classes 6th and 7th, respectively. A total of 62.8 % were from private and 37.2 % from government schools.

Knowledge about diabetes

Table 1 shows the change in knowledge about diabetes, its complications, and prevention by gender. Both boys as well as girls reported greater awareness of what diabetes is—high level of glucose in blood. After 1-year intervention, these percentages increased from 66.5 to 72.5 % and 64.5 to 71.4 %, respectively, $p<0.001$. After intervention, significantly, 12.4 % more boys and 10.9 % more girls reported that unhealthy eating habits can put one at risk for diabetes. Similarly, 10.2 % more boys and 13.3 % more girls post intervention than at baseline reported that being physically inactive can put one at risk for diabetes. A total of 43.6 % boys and 40.4 % girls at baseline reported that type 2 diabetes is preventable, but 52.3 % boys and 48.8 % girls reported so post intervention. More girls (from 48.9 to 58.2 %) post intervention reported that having a family history of diabetes increases the chance of getting diabetes, while less proportion of boys (from 49.0 to 51.1 %) reported this post intervention.

Table 2 shows the change in knowledge about diabetes by school type. At baseline, lower proportion of students from government schools than in private schools had knowledge about diabetes. After intervention, 59.9 % government school students as compared to 44.5 % at baseline ($p<0.001$) reported that diabetes is high glucose level in blood while in private schools, 79.3 % at post intervention as compared to 78.3 % at baseline reported the same. Post intervention as compared to baseline, 8.1 and 18.1 % more students from private and government schools, respectively, reported that unhealthy eating habit can put one at risk of diabetes and 2.7 % lesser students in private schools and 13.6 % lesser students in government schools reported that eating too much sweets/sugars causes diabetes ($p<0.05$ only for government school students). The proportion of students who reported that being physically inactive can put one at risk of diabetes increased from 52.3 to 61.6 % ($p<0.001$) among private school students and from 46.9 to 61.7 % ($p<0.001$) among government school students. A total of 65.7 % government school students, post intervention as compared to 51.2 % at baseline ($p=0.001$) and 42.2 % private school students as compared to 37.2 % at baseline, reported that type 2 diabetes is preventable.

Dietary habits

Table 3 describes the difference in daily consumption of food items post intervention by gender and school type. Among

Table 1 Changes in knowledge related to diabetes among the study participants by gender

	Boys (n=953)			Girls (n=567)			p value[a]
	Baseline n (%)	After 1-year intervention n (%)	% Diff.	Baseline n (%)	After 1-year intervention n (%)	% Change	
Eating too much of sugars/sweets causes diabetes	829(87.4)	764(80.5)	−6.9***	496(87.6)	459(81.0)	−6.6**	0.293
Diabetes is a condition in which the blood glucose level is too high	631(66.5)	686(72.5)	6.0**	363(64.5)	404(71.4)	5.9*	0.533
Diabetes does not only affect adults	711(74.8)	782(82.4)	7.6	447(79.1)	484(85.4)	6.3**	0.549
Unhealthy eating habits can put one at risk for diabetes	615(64.7)	732(77.1)	12.4***	379(67.2)	442(78.1)	10.9***	0.664
Being overweight/obese in the present is related to getting diabetes in the future	457(48.2)	483(50.9)	2.7**	283(50.4)	313(55.3)	4.9*	0.018*
Being physically inactive or not doing regular exercise can put one at risk of diabetes	471(49.6)	566(59.8)	10.2***	291(51.4)	366(64.7)	13.3***	0.032*
Having a family history of diabetes increases the chances of getting diabetes	464(49.0)	484(51.1)	2.1	276(48.9)	330(58.2)	9.3**	0.185
People who use tobacco, have a higher risk of getting diabetes	451(47.6)	498(52.6)	5.0	258(45.6)	291(51.3)	5.7	0.052*
Type 2 diabetes is preventable	413(43.6)	495(52.3)	8.7**	227(40.4)	276(48.8)	8.4**	0.387
Exercise and healthy eating can prevent diabetes	669(70.6)	728(76.9)	6.3***	392(69.5)	449(79.2)	9.7***	0.084
People with diabetes are more likely to develop heart disease, stroke, kidney and eye problems	633(67.1)	674(71.0)	3.9	390(69.1)	438(77.2)	8.1*	0.344

*p<0.05, **p<0.001, ***p<0.001. p value obtained through Chi-square test

[a] Freidman's test was used to test the difference of change in knowledge between boys and girls

boys, consumption of carbonated drinks reduced from 0.60 servings per day at baseline to 0.37 servings per day post intervention (p<0.001) while among girls, it reduced from 0.33 servings per day to 0.20 servings per day (p<0.001). Consumption of Indian sweets reduced from 0.52 servings per day to 0.34 servings per day (<0.001) among boys and from 0.38 servings per day to 0.24 servings per day among girls (<0.001). Packed chips consumption reduced from 0.71

Table 2 Changes in knowledge related to diabetes among students by school type

	Private school (n=954)			Government school (n=566)			p value[a]
	Baseline n (%)	After 1-year intervention n (%)	% Diff.	Baseline n (%)	After 1-year intervention n (%)	% Change	
Eating too much of sugars/sweets causes diabetes	868(91.1)	840(88.4)	−2.7	457(81.3)	383(67.7)	−13.6***	<0.001***
Diabetes is a condition in which the level of glucose in blood is too high	745(78.3)	752(79.3)	1.0	249(44.5)	338(59.9)	15.4***	<0.001***
Diabetes does not affect only adults	757(79.6)	800(84.2)	4.6	401(71.1)	466(82.3)	11.2***	<0.001***
Unhealthy eating habits can put one at risk for diabetes	668(70.2)	744(78.3)	8.1***	326(58.0)	430(76.1)	18.1***	<0.001***
Being overweight or obese in the present is related to getting diabetes in the future	543(57.2)	549(57.9)	0.7	197(35.2)	247(43.6)	8.4	<0.001***
Being physically inactive or not doing regular exercise can put one at risk of diabetes	498(52.3)	583(61.6)	9.3***	264(46.9)	349(61.7)	14.8***	<0.001***
Having a family history of diabetes increases the chances of getting diabetes	456(48.1)	535(56.4)	8.3***	284(50.4)	279(49.3)	-1.1	0.043*
People who use tobacco, have a higher risk of getting diabetes	487(51.2)	552(58.2)	7.0*	222(39.6)	237(41.9)	2.3	<0.001***
Type 2 diabetes is preventable	353(37.2)	400(42.2)	5	287(51.2)	371(65.7)	14.5***	0.001***
Exercise and healthy eating can prevent diabetes	611(64.4)	692(73.0)	8.6***	450(79.9)	485(85.7)	5.8**	0.016*
People with diabetes are more likely to develop heart disease, stroke, kidney and eye problems	705(74.4)	736(77.5)	3.1	318(56.8)	376(66.4)	9.6**	<0.001***

*p<0.05, **p<0.001, ***p<0.001. p value obtained through Chi-square test

[a] Freidman's test was used to test the difference of change in knowledge between private and government school students

Table 3 Changes in mean daily consumption of food items among students by gender and school type

Food items (serving per day)	Baseline mean (SD)	After 1-year intervention *n* (%)	Mean diff. (SE)	*p* value[a]	Baseline mean (SD)	After 1-year intervention *n* (%)	Mean diff. (SE)	*p* value[a]	*p* value to compare the mean differences[a]
	Gender								
	Boys				Girls				
Whole fruits	1.56 (1.49)	1.40 (0.98)	−0.16 (0.05)	0.003	1.63 (1.39)	1.51 (0.94)	−0.11 (0.06)	0.054	0.603
Vegetables	1.42 (1.30)	1.52 (1.46)	0.10 (0.06)	0.126	2.17 (13.58)	1.71 (1.07)	−0.45 (0.60)	0.449	0.251
Fruit juices	1.01 (0.04)	0.86 (0.03)	−0.15 (0.05)	0.004	1.65 (18.5)	0.78 (0.83)	−0.86 (0.82)	0.294	0.278
Carbonated drinks	0.60 (1.08)	0.37 (0.61)	−0.23 (0.04)	<0.001	0.33 (0.58)	0.20 (0.34)	−0.12 (0.57)	<0.001	0.063
Fried snacks	0.38 (0.72)	0.33 (0.56)	−0.04 (0.02)	0.081	0.29 (0.25)	0.23 (0.31)	−0.06 (0.02)	0.007	0.701
Traditional Indian sweets	0.52 (1.36)	0.34 (0.59)	−0.18 (0.04)	<0.001	0.38 (0.82)	0.24 (0.40)	−0.14 (0.04)	<0.001	0.572
Non-Indian sweets	0.51 (1.04)	0.41 (0.81)	−0.10 (0.04)	0.016	0.41 (0.75)	0.35 (0.67)	−0.06 (0.03)	0.108	0.524
Packed chips	0.71 (1.31)	0.58 (0.86)	−0.13 (0.05)	0.007	0.54 (1.00)	0.41 (0.63)	−0.13 (0.04)	0.002	0.984
Egg and meat products	0.57 ()1.02	0.52 (0.79)	−0.05 (0.05)	0.285	0.45 (1.14)	0.37 (0.61)	−0.08 (0.07)	0.289	0.778
Milk and milk products	1.87 (4.39)	1.50 (1.22)	−0.37 (0.15)	0.017	1.53 (1.31)	1.54 (1.13)	0.01 (0.06)	0.901	0.064
	School type								
	Private				Government				
Whole fruits	1.67 (1.46)	1.50 (0.90)	−0.17 (0.04)	0.001	1.43 (1.43)	1.33 (1.06)	−0.10(0.07)	0.166	0.411
Vegetables	1.95 (10.55)	1.70 (1.38)	−0.24 (0.36)	0.495	1.27 (1.23)	1.39 (1.20)	0.12 (0.07)	0.086	0.450
Fruit juices	1.53 (14.45)	0.93 (0.92)	−0.60 (0.50)	0.230	0.80 (1.03)	0.67 (1.06)	−0.13 (0.64)	0.047	0.470
Carbonated drinks	0.44 (0.86)	0.34 (0.58)	−0.10 (0.03)	0.002	0.63 (1.04)	0.27 (0.43)	−0.36 (0.04)	<0.001	<0.001
Fried snacks	0.29 (0.57)	0.27 (0.40)	−0.02 (0.02)	0.371	0.45 (0.80)	0.33 (0.60)	−0.12 (0.04)	0.003	0.013
Traditional Indian sweets	0.42 (1.16)	0.32 (0.49)	−0.10 (0.04)	0.017	0.56 (1.23)	0.28 (0.58)	−0.28 (0.06)	<0.001	0.010
Non-Indian sweets	0.40 (0.72)	0.36 (0.62)	−0.04 (0.03)	0.268	0.62 (1.23)	0.43 (0.97)	−0.18 (0.03)	0.005	0.016
Packed chips	0.54 (0.84)	0.48 (0.65)	−0.06 (0.02)	0.044	0.85 (1.66)	0.59 (0.99)	−0.26 (0.08)	0.001	0.004
Egg and meat products	0.55 (0.80)	0.57 (0.77)	0.02 (0.03)	0.598	0.51 (1.48)	0.27 (0.61)	−0.23 (0.09)	0.016	0.004
Milk and milk products	1.87 (4.22)	1.70 (1.16)	−0.17 (0.14)	0.234	1.50 (1.82)	1.19 (1.16)	−0.31 (0.09)	<0.001	0.488

[a] Analysis of covariance (ANCOVA) was used to test the difference of mean serving per day between baseline and post intervention

to 0.58 serving per day among boys ($p<0.01$) and from 0.54 to 0.41 servings per day among girls ($p<0.01$). Results segregated by school type show that carbonated drinks significantly reduced in both private (from 0.44 to 0.34 servings per day) and government school students (from 0.63 to 0.27 servings per day) post intervention. Indian sweets and packed chips consumption also reduced significantly in both types of schools. Among government school students, mean serving per day of fruit juices, fried snacks, non-Indian sweets, egg, and meat products were significantly reduced post intervention.

Physical activity

Table 4 depicts difference in physical and leisure time activity between baseline and post intervention among boys and girls, in private and government schools. Significantly, more boys post intervention (49.5 %) started going out and playing with friends during leisure time than at baseline (36.5 %), $p<0.001$. The proportion of girls who went out and played during leisure time increased too (from 33.5 % at baseline to 36.5 % post intervention). More boys as well as girls post intervention (67.5 % boys and 80.9 % girls) reported that they mostly walked to nearby markets, than at baseline (62.0 % boys and 76.4 % girls), $p<0.05$. More girls started physical activity/exercise/playing for 60 min (40.4 %) or more (28.9 %) daily post intervention than at baseline (37.7 and 28.0 %, respectively). Similarly, more boys started physical activity/exercise/play for more than 60 min (43.7 %) daily post intervention than at baseline (38.3 %), though this result was not statistically significant. A total of 6.5 and 13.8 % more students in private and government schools, respectively, reported outdoor activities during leisure time. A total of 10.4 % more

Table 4 Changes in physical activity and leisure time activity among students by gender and school type

	Gender				School type			
	Boys		Girls		Private		Government	
	Baseline *n* (%)	After 1-year Intervention *n* (%)	Baseline *n* (%)	After 1-year Intervention *n* (%)	Baseline *n* (%)	After 1-year Intervention *n* (%)	Baseline *n* (%)	After 1-year Intervention *n* (%)
Activity during leisure time								
Go out and play with friends	346(36.5)	466(49.5)	188(33.5)	205(36.5)	460(48.8)	401(42.3)	133(23.7)	211(37.5)
Watch TV/use computer/play videogames(more than two hours/day)	302(31.8)	249(26.4)	112(20.0)	104(18.5)	207(22.0)	222(23.4)	192(34.2)	146(26.0)
Speak to friends/relatives over the phone	16(1.7)	9(1.0)	23(4.1)	27(4.8)	30(3.2)	28(3.0)	11(2.0)	6(1.1)
Read books	253(26.7)	188(20.0)	206(36.7)	198(35.2)	199(21.1)	246(25.9)	213(37.9)	187(33.3)
Any other	32(3.4)	30(3.2)	32(5.7)	28(5.0)	46(4.9)	51(5.4)	13(2.3)	12(2.1)
p value[a]	<0.001		0.855		<0.001		0.010	
Activity during games period in school								
Sit and talk with friends	64(6.7)	57(6.0)	55(9.7)	41(7.2)	31(3.2)	53(5.6)	88(15.6)	45(8.0)
Play games in the playground	760(79.8)	787(82.8)	401(70.8)	402(71.0)	819(85.8)	787(82.7)	343(60.8)	402(71.2)
Play a little bit/walk with friends	-	58(6.1)	1(0.2)	91(16.1)	82(8.6)	94(9.9)	58(10.3)	55(9.7)
Finish homework/read	65(6.8)	49(5.2)	75(13.3)	32(5.7)	22(2.3)	18(1.8)	75(13.3)	63(11.2)
p value[a]	0.197		0.167		0.310		0.400	
While going to a market nearby house, I mostly?								
Walk	590(62.0)	640(67.5)	431(76.4)	457(80.9)	637(66.9)	669(70.5)	384(68.2)	428(75.9)
Cycle	262(27.5)	218(23.0)	79(14.0)	65(11.5)	220(23.1)	185(19.5)	121(21.5)	98(17.4)
Go by car/Bike	76(8.0)	63(6.6)	41(7.3)	30(5.3)	81(8.5)	72(7.6)	36(6.4)	21(3.7)
Use public transport	3(0.3)	6(0.6)	3(0.5)	4(0.7)	-	6(0.6)	6(1.1)	4(0.7)
Go by an auto	9(0.9)	12(1.3)	7(1.2)	7(1.2)	4(0.4)	7(0.7)	12(2.1)	12(2.1)
Any other	11(1.2)	9(0.9)	3(0.5)	2(0.4)	10(1.1)	10(1.1)	4(0.7)	1(0.2)
p value[a]	0.019		0.018		0.120		0.001	
Every day, I watch TV/use computer/play videogames for?								
More than 4 hours	52(5.5)	51(5.4)	8(1.4)	8(1.4)	38(4.0)	47(4.9)	22(3.9)	12(2.1)
2–4 hours	150(15.9)	162(17.1)	64(11.4)	87(15.4)	137(14.5)	172(18.1)	77(13.7)	77(13.6)
1–2 hours	675(71.5)	688(72.5)	442(78.6)	444(78.4)	712(75.6)	684(72.0)	405(71.8)	448(79.3)
I don't do these	67(7.1)	48(5.1)	48(8.5)	27(4.8)	55(5.8)	47(4.9)	60(10.6)	28(5.0)
p value[a]	0.143		0.002		0.003		0.285	
Every day I do physical activity/exercise or play for:								
More than 60 minutes	362(38.3)	415(43.7)	158(28.0)	164(28.9)	433(45.7)	474(49.8)	87(15.5)	105(18.6)
For 60 minutes	345(36.5)	261(27.5)	213(37.7)	229(40.4)	308(32.5)	253(26.6)	250(44.4)	237(41.9)
For 30 minutes	154(16.3)	189(19.9)	122(21.6)	118(20.8)	135(14.3)	140(14.7)	141(25.0)	167(29.6)
Less than 30 minutes	60(6.3)	58(6.1)	49(8.7)	45(7.9)	56(5.9)	60(6.3)	53(9.4)	43(7.6)
Never	24(2.5)	26(2.7)	23(4.1)	11(1.9)	15(1.6)	24(2.5)	32(5.7)	13(2.3)
p value[a]	0.152		0.064		0.278		0.024	

[a] Chi-square test was use used to test the between group differences

government school students post intervention compared to baseline (60.8 %) reported that they play games in the playground during game period, though the result was not significant.

Proportion of students reported healthy food choices increased post intervention (results not shown in table). More students post intervention reported that they prefer lemonade over cold drinks (62.6 % at baseline to 75.1 % post intervention, $p<0.001$), whole fruit over fruit juice (47.6 % at baseline to 51.6 % post intervention, $p<0.05$), fruit chat over aloo tikki (60.3 % at baseline to 68.9 % post intervention, $p<0.001$), vegetable poha over samosa (50.8 % at baseline to 63.0 %

post intervention, $p<0.001$), and rajma rice over chhole bhature (57.0 % at baseline to 64.3 % post intervention, $p<0.05$).

Discussion

Achieving an adequate evidence-based on the role of school-based lifestyle intervention for prevention and delay the risk for type 2 diabetes among youth will require appropriately designed lifestyle interventions. Research suggests that well designed and effectively implemented programs are effective in changing dietary behavior and can provide young people with the knowledge and skills to make healthy food choices and increase physical activity [18, 19]. Schools are critical settings for health promotion activities [20, 21], and school-based health interventions resulted in a significant improvement in the knowledge, attitudes, and behavior of students [22–24]. Adolescent behavior is shaped more by peers and social influences than by parental or other adult influences [25]. Much research in both developed and developing countries have been conducted on school-based obesity prevention and healthy eating and physical activity promotion [26] and on interventions targeting individuals disproportionately affected with diabetes [27]. To date, there is limited data focusing on school-based lifestyle interventions for prevention or risk reduction of type 2 diabetes [28, 29].

In this study, a significant increase in the knowledge level about diabetes and its risk factors was noted for the overall study participants (when analyzed on the basis of gender, school type, age, and class). The knowledge that unhealthy eating habits and being physically inactive can put one at risk for diabetes increased post intervention significantly. The intervention appears to have been successful irrespective of the type of school (private or government) or gender of the students. The findings also highlighted that students from government schools compared to private schools had low baseline knowledge about diabetes and its risk factors; post intervention significant increase in knowledge level were observed. The gain in the knowledge level among government school students was higher than those of private school students. This could be due to the reasons that the students from private schools have better access to health education information through informative mass media. Post intervention students also reported that type 2 diabetes is preventable. These results can also be attributed to the fact that the program intervention helped in giving a better understanding to comprehend the difference between healthy and unhealthy habits, understand about diabetes, and learn the ways to prevent the onset of diabetes.

The current program revealed that post intervention, the daily consumption of fruit juices, carbonated beverages, fried snacks, sweets, packed chips decreased for the government school students, while in private schools, decreased consumption was noticed for carbonated drinks, traditional Indian sweets and chips. The daily consumption of vegetables among government school students increased postprogram intervention. These findings are consistent with prior literature from developed and developing countries, which indicated an increase intake of vegetables and reduced consumption of carbonated drinks [28–31] as a result of school-based interventions. The intervention did not generate any gender-specific changes in daily consumption of these food items. There is convincing evidence that increased consumption of vegetables and fruits reduces risk of chronic diseases like diabetes and obesity [32].

The preference to walk while going to a nearby market increased as an outcome of the intervention. Post intervention, more students reported to do physical activity/exercise/play for more than 60 min. The average mean time spent daily on playing outdoor games increased post intervention. There was increase in the physical activity like going out for play in both private and government schools while there was a decrease in sedentary activities like watching television, reading books, sitting, and talking to friends. Studies have shown a positive association between consumption of unhealthy foods while watching television among adolescents [33]. Llargues et al. reported that post intervention, there was an increase in the physical activity patterns like walking to school. There was reduction in the daily hours spent in sedentary activities such as watching television, playing video games post intervention [31].

Limitations

The sample size was small as it was a pilot study, and the inclusion of only six schools limits generalizability of the results. The schools were not randomly selected to participate in the study but were selected to be representative of the mix of types of schools in Delhi. The self-reported method utilized also may have led to skewed estimates of dietary intake and physical activity pattern. Given budgetary constraints, no anthropometric or biochemical measurements were carried, which is also one of the drawback of this study.

Strengths

Though this may be a pilot effort, the cocurriculum developed as part of this school-based, age-specific health intervention program, to our knowledge, is one of the first to be developed in India. This study provides a lot of scope for replicability in other parts of India where with adequate budget, anthropometric and blood samples may be drawn to investigate a direct link with diabetes and its risk factors.

Conclusion

The study indicates significant impact of the educative intervention which has resulted in the improvement of knowledge and behavioral changes related to diabetes among school children. Teacher-led classroom discussions with active youth engagement and empowerment (peer-led health activism) are an important strategy with potential long-term benefits. The information gathered here might help in the future design of a realistic school-based primary prevention program for diabetes in India and other developing countries. Given that type 2 diabetes is at epidemic proportions in the Indian subcontinent, these results are important in generating hypothesis for future studies highlighting these relationships, using a more prospective design and a larger sample size. The findings of the study can be used for scalability for a public health program in India. Future reports from our team will examine the efficacy of this component in more depth and provide results from our last survey, to show whether this intervention, its entirety, is effective for adopting healthy lifestyle practices among adolescents.

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