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Effect of school based intervention regarding prevention of coronary artery disease on knowledge, lifestyle practices, and bio physiological parameters among adolescents in Kerala.

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ABSTRACT

Coronary artery disease is the most prevalent heart disease in India. It is estimated that by 2020 about one third of all deaths will be caused due to coronary artery disease. The present study aimed to evaluate the effect of school based intervention for the prevention of coronary artery disease on biophysiological parameters among adolescents. A quasi-experimental design was used and 252 adolescents were selected using convenient sampling. A school based intervention having a classroom component, family component, and physical activity component was administered for duration of 4 weeks to experimental group after pre-test. Collected data were analyzed using descriptive and inferential statistics using SPSS version 20.Majority of the adolescents were aged 12 years in both experimental (72.2%) and control group. At 6 months the school based intervention was effective in improving the knowledge ($p < 0.001$), dietary behavior (dietary consumption and dietary habits) ($p < 0.001$), physical activity ($p < 0.001$);and decreasing screen time ($p < 0.001$), and habit of viewing television during meals ($p < 0.001$)waist hip ratio ($p < 0.01$), waist height ratio($p < 0.05$), systolic blood pressure ($p < 0.001$), diastolic blood pressure($p <0.001$), and heart rate ($p <0.001$) to a statistically significant level among adolescents. The school-based intervention had beneficial effects on improving the knowledge, lifestyle practices and bio physiological parameters among adolescents. Over time, these programs can lower the prevalence of cardiovascular disease risk factors that track into adulthood thereby favorably altering coronary artery disease related morbidity and mortality in India.

Keywords: *Coronary artery disease, prevention, adolescents, school-based intervention, Knowledge, lifestyles practices, dietary behavior, physical activity, screen time, Biophysiological Parameters*

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INTRODUCTION

Cardiovascular diseases (CVDs) are the number 1 cause of death globally: more people die annually from CVDs than from any other cause. An estimated 17.9 million people died from CVDs in 2016, representing 31% of all global deaths. Of these deaths, 85% are due to heart attack and stroke [1]. It is projected that by 2030 almost 23.6 million people will die from CVDs, mainly from coronary artery disease, and stroke [2].

The burden of coronary artery disease (CAD) is rising remarkably to epidemic proportions in India. coronary artery disease has contributed to around one-third of mortality, with more deaths in males (64%) and that too in the economic productive age group of 30–69 years [2,3]. The mortality is lowest in Central Indian states of Rajasthan, Uttar Pradesh and Bihar. In both men, and women mortality is highest in South Indian states, Eastern and North-eastern states, and Punjab [4]. The prevalence rates estimated from several studies over the past several decades have ranged from 1.6% to 7.4% in rural population and 1% to 13.2% in urban population. Though the disease is more prevalent in urban population, it is progressively increasing in rural population in terms of absolute numbers [5]. The fact may be attributed to diverse risk factors distribution and control across various geographical locations in India [6].

The INTERHEART study the presence revealed that of eight established coronary risk factors namely; abnormal lipids, smoking, hypertension, diabetes, abdominal obesity, psychosocial factors, low fruit and vegetable consumption, and lack of physical activity accounted for 90% of the cases of acute myocardial infarction in Indians. All of them are lifestyle related and modifiable. Therefore, one of the crucial strategies in the primary prevention of CAD could be achieving the risk factors control, which has been emphasized even in recent clinical practice guidelines [7].

Although atherosclerosis clinically manifests in middle and late adulthood, it is well-known that it has a long asymptomatic phase of development which begins early in life often during childhood. There are convincing evidence between established potentially modifiable risk factors and accelerated atherosclerotic processes in adolescence. Recent studies show that the prevalence of coronary artery risk factors especially unhealthy diet, tobacco use, physical inactivity, sedentary lifestyle, metabolic syndrome, high blood pressure, and high blood sugar is high and on rise in Indian adolescent population. It is during adolescence individuals commonly initiate or engage in unhealthy behaviors, such as unhealthy diet, sedentary lifestyle, alcohol consumption, and tobacco use. These risk behaviors adopted during adolescence persist into adulthood too. At the same time, it may be easier to inculcate healthy behaviors at a younger age rather than to modify behaviors at later ages or after the onset of a disease [8, 9].

High prevalence of modifiable risk factors, huge population numbers and tendency towards initiation or adoption of various risk behaviors suggests the importance of focusing effort for the prevention of CAD among adolescents.

Children spend up to 8 hours per day at school for almost 40 weeks in a year. There is no other social institution that has as much continual contact with children and their families. Schools and other educational establishments can provide young people with information and the life-skills that are necessary to prevent CAD, and contribute to prevention. Schools can also promote a culture by increasing access to healthy foods, teaching healthy choices and ensuring daily vigorous physical activity. It is also possible that nutritional, physical activity/exercise, tobacco use, sedentary behaviors etc are also influenced by parents and family environment. Parental management and encouragement are essential to improve eating habits, physical activity, and other sedentary behaviors. Hence integrating family component into school interventions will enhance the benefits of interventions [10, 11].

When developing and testing an intervention, it is advisable to use population based approach than individual approach especially in a country like India since a small change in the risk factor levels in the direction of 'biological normality' in total population can significantly reduce total disease burden and mortality. Though few school based interventions have produced encouraging results in India, no comprehensive, multicomponent, cost effective, and school based intervention focusing all the main four modifiable risk factors of coronary artery disease, operating at individual, family and school levels have been reported so far from the state of Kerala.

MATERIAL AND METHODS

This school-based quasi experimental study was conducted from June 2015 to March 2016 in Kerala, a Southern state of India which had a registered population of more than 33.8 million in 2015. The intervention took place within Thrissur district, Kerala, South India. In 2012, there were a total 1162 schools in Thrissur district; 931 rural schools and 231 urban schools. When it comes to the type Thrissur district had about 1104 co-educational schools, 21 boys' schools, and 37 girls' schools.

Those Rural private aided schools with facilities for aerobic training and use English as a medium of instruction and willing to participate were included in the study. Schools providing regular aerobics training to students and had conducted any awareness program regarding cardiovascular disease within last 6 months were excluded from the study. From the list, two rural, private aided schools of Thrissur subdistrict were randomly allocated to each experimental and control group using lottery method. All the seventh graders in each of the selected schools were invited to participate in the study. Adolescents who are diagnosed as having some cardiovascular diseases and having chronic illnesses, severe malnutrition, physical and mental disabilities were excluded from the study.

The study approach was quantitative, using a longitudinal, quasi experimental pre - test post- test, design. Four selected rural, private aided schools of Thrissur subdistrict were randomly allocated to experimental and control group using lottery method (Two in each group). Intervention effectiveness was assessed by comparing between-group differences at 1 month, 3 months and 6 months primary and secondary outcome measures. Both baseline and follow-up measurements were conducted over one school academic year.

A pilot study was conducted in two selected schools of Chavakad Subdistrict, Thrissur, Kerala. A total of 70 (38 in the intervention and 32 control) adolescents were participated to know the adequacy of data collection instruments, feasibility of the recruitment process, intervention and measurements and, and to finalize the sample size for the study and plan for analysis. The pilot study revealed that adolescents are co-operative, study is feasible and acceptable, and practical. It also helped to clear ambiguity regarding the time, and cost of the study.

Sample size was estimated using Power analysis based on the findings of the pilot study. The calculated sample size was 61 in each group at 80% power and Type I error (alpha) of 0.05. To compensate attrition 10% drop out was added. Hence the required sample was 68 each in experimental and control group.

Ethical clearance was obtained from the Ethics committee of Jubilee Mission Medical College Research Institute Thrissur, Kerala. Written permission was sought from Directorate of Public instructions, Thriruvanthapuram to conduct the study in schools Thrissur district, and principals/Parent teacher association of selected schools. Written assent from adolescents and written consent was obtained from parents/students' guardians.

The study was conducted during the academic year 2015-16. Data collection period was from 09-06-2015 to 27-03-2016. After obtaining permission from Directorate of Public Instructions, Thiruvananthapuram, schools were screened using for the eligibility criteria. The principal investigator discussed the details with the principal, vice principal, class teachers, and physical education teacher. This meeting also provided the opportunity to decide and set up the logistics of where, and when the study would be conducted. Once written approval was given by the principal and Parent Teacher Association, the investigator obtained assent from adolescents after explaining the nature, and objectives of the study.

Parents at the participating schools were sent invitation packs which included detailed information about the study and parental/guardian consent. Parents were asked to provide consent for their son/daughter to take part in the study. They were also given the opportunity to phone or email the principal investigator if they did not consent for their adolescent take part in the study or wanted to clarify or know more details about the study. Information about the study was additionally included in parent teacher meeting and the usual reminders sent from the school. Adolescents were screened according to the inclusion and exclusion criteria before obtaining assents.

The school based intervention was developed according to the set objectives. The factors such as time, independent learning, and level of understanding of adolescents were considered while preparing the draft. The following steps were taken in the preparation of school based intervention. Based on the suggestions of experts, content validity, and pretesting the final intervention was prepared in consultation with the Guide. The final school based intervention included 3 different components; a classroom component, a family component, and a physical activity component.

The current intervention multicomponent (three) school based intervention utilized all the approaches recommended by the World Health Organization for health promotion intervention; issue based, population based, and setting based. The main issue addressed was CAD, the population was adolescents, and the setting was school, thus maximizing the reach of advantages of health promotion by combining all three approaches. The factors such as time, independent learning, and level of understanding of adolescents were considered while preparing the intervention. The aim was to equip the adolescents with knowledge and skills for preventing coronary artery disease risk factors.

The classroom component included structured teaching programme and distribution of handbooks on prevention of coronary artery disease to adolescents. Structured teaching programme focused on coronary artery disease, risk factors, and various life style modification strategies needed for the prevention coronary artery disease, with specific emphasis to dietary intake, physical activity and exercise, tobacco use, and screen time. The aim was to improve knowledge, lifestyle practices, and biophysiological parameters related to CAD among adolescents. Adolescents received one 45 minutes' session each week for 4 continuous weeks. A total of 4 sessions were conducted, one in every week. Classroom component was administered by the investigator using power point presentation with the help of group discussion, lecture, and brainstorming sessions. They were given the opportunity to clarify any doubts as arise. It content included were facts about cad, meaning and concept of cad, risk factors, pathophysiology, and core strategies for prevention, concept of healthy weight, complications of obesity/overweight, heart healthy diet, physical activity and exercise, screen time, tobacco use, and their implications, and how to spot the hidden messages in tobacco advertisements.

The Family component included distribution handbook on coronary artery disease to parents/Guardians with an aim to ensure understanding about coronary artery diseases prevention and support children's healthy lifestyle practices especially on nutrition, physical activity and exercise, screen time and tobacco use. The aim of third physical activity component was to impart life skills and thus promote self efficacy in improving cardiovascular fitness. Physical activity component was administered to adolescents in addition to the already existing physical activity periods. It consisted of supervised aerobic training sessions for 3 days in a week for duration of 40-45 minutes by a certified physical education trainer according the schedule given by the investigator. Each session consisted of 5 minutes of warm up, 30 minutes of aerobic dance, and 5 minutes of cool down. All adolescents in the experimental group attended 4 weeks of regular aerobic training and three sessions were conducted in one week.(4 weeks X 3 sessions/Week =12 sessions). The control group received the 'usual care' and no-intervention. All adolescents in the control group completed all evaluation measures at each time point. The primary and secondary outcomes were measured at baseline, 1 month, and 6 months after intervention.

Primary outcome measures included body mass index, triceps skin fold thickness, waist circumference, waist hip ratio, waist height ratio, systolic blood pressure, diastolic blood pressure, and heart rate. Two trained research assistants collected all the measurements bases on the standard protocol. Anthropometric parameters measured included weight (kg), height (cm), triceps skin fold (mm), waist circumference (cm), and hip circumference (cm). Physiological measurements included systolic blood pressure (mm Hg), diastolic blood pressure (mm Hg), and heart rate (minute). All measures were conducted two times and the mean value of two measurements is calculated. The anthropometrics are measured to the nearest 0.1 kg or cm where appropriate. A third measure was taken where the second measure was not within 1cm for height. Average of the measurements was taken as final observation.

Height was measured by making them stand with the heels together, and the heels, buttocks, and upper part of the back touching the upright of the stadiometer keeping the head in the frankfort plane. Weights of all adolescents were taken using a calibrated and standardized portable electronic weighing scale. Weight was measured in light clothing, with shoes and coats removed. The scale was placed on a hard, even surface. The participants were asked to look straight and stand still on the centre of the scales without support and with the weight distributed evenly on both feet. Body mass index (BMI) is calculated as weight divided by the square of height (BMI=kg/m^2). Triceps skin fold thickness (TSFT) was measured using calibrated standardized skin fold calipers on the right side of the body. A vertical fold is measured on the posterior midline of the upper arm over the triceps muscle halfway between the acromion and the olecranon processes with the elbow extended and relaxed. Waist circumference (WC) was measured using a calibrated and standardized flexible, non-stretchable steel tape placing mid-way between the costal margin and iliac crest after expiration. Waist was measured in centimeters while students were asked to stand erect in a relaxed position with both feet together. One layer of clothing was accepted. Hip circumference (HC) was taken at the level of the widest circumference over the buttocks. BMI weight {(kg)/height (m^2)}, Waist Hip Ratio {Waist Circumference (cm) / Hip Circumference (cm)}, and Waist Height Ratio { Waist Circumference (cm) / Height (cm)} were calculated using the standard formula.

Blood pressure (BP) was measured using an electronic sphygmomanometer (OMRON machine, Omron Corporation Tokyo, Japan). BP was measured to the nearest 1 mmHg in a sitting posture with the hands resting on the examining table with the cubital fossa supported at the level of the heart. The BP measurement was done on the right arm for consistency. Pulse reading (Pulse rate/minute) was also noted from the electronic OMRON machine. A second reading was taken after 5 minutes interval. Average of the two measurements was taken as final observation.

Secondary outcomes were measured using a self-reported structured questionnaire collected data regarding the knowledge and lifestyle practices related CAD. Knowledge section consisted of 24 multiple choice questions with four options to evaluate the knowledge regarding CAD in three domains; meaning of coronary artery disease (6 items), its risk factors (6 items), and prevention (12 items). Each correct answer was given a score of one. The overall knowledge score was classified into three categories following Bloom's cut-off point criteria: above 80% (high level), 60% to 79% (moderately adequate and less than 60% (Inadequate)

The second section collected data on life style practices related to the prevention of coronary artery disease in four domains; diet, tobacco, physical activity and exercise, and screen time. Assessment of dietary behavior was studied under two domains; dietary habits and dietary consumption pattern of adolescents as compatible with Kerala culture and norms on diet preferences and consumption pattern. Participants were asked to report normal routine diet they had, not in marriages/parties. categories for dietary habits and dietary consumption pattern were classified as appropriate, moderate, and inappropriate. The summary score for dietary behavior was calculated by adding the responses of all 15 items. The minimum score was 15 (being unhealthy) and the maximum was 45(being healthy).

Physical activity behavior was assessed by using modified version of Physical Activity Questionnaire (PAQ) for adolescents. Transport related physical activity was captured by asking a question on mode of commute to school. The PAQ is a self administered, 7-day recall instrument. Though it is freely available and can be modified to the context, permission was obtained to do the same. The original PAQ has eight items each scored from 0 (no PA) – 5(high PA) with a summary score.

Physical activity questionnaire was adapted to the context and further modified to capture physical activity related to physical education, lunch, evening, and weekends. The lowest activity response being a one and the highest activity response being a five. It also had 11 listed spare time /leisure time activity like skipping, bicycling, aerobics, dancing ; “no” activity being a 1, “7 times or more” being a 5. It had one question to identify students who had unusual activity during the previous week, but this question was not used as part of the summary activity score. Once we have a value from 1 to 5 for each of the 6 items used in the physical activity composite score, the mean of these 6 items formed the final physical activity summary score. A score of 1 indicates low physical activity, whereas a score of 5 indicates high physical activity. Assessment of screen time included 2 items capturing screen time, and habit of consuming food in front of television.

Completed questionnaires were sorted out, and cleaned. Cross validation, and consistency checks were done. The data was analyzed in terms of descriptive (mean, median, standard deviation, frequency and percentage), and inferential statistics (independent and paired t- test, chi-sqaure test, Mcnemer’s test). A p value of <0.05 was taken as statistically significant.

RESULTS

The sociodemogrpahic personal characteristics of adolescents participated in the study is given in Table 1and 2. The mean age (years) of adolescents in the experimental and control group was 12.28 ±0.5 and 12.3±0.49 respectively. There were no significant differences in the knowledge, lifestyle practices and bio physiological parameters at pretest between experimental and control group.

At 1 months measurement, the school based intervention was effective in increasing the knowledge (p<0.001), dietary behavior (p<0.001), physical activity (p<0.001), and decreasing screen time (p<0.001), habit of viewing television during meals (p<0.001), and SBP (p<0.001) to a statistically significant level.

There was a statistically significant increase in the knowledge (p < 0.001), dietary behavior (dietary consumption and dietary habits) (p < 0.001), physical activity (p < 0.001), and decreasing screen time (p < 0.001), habit of viewing television during meals (p < 0.001), waist hip ratio (p < 0.01), waist height ratio(p < 0.05), systolic blood pressure (p < 0.001), diastolic blood pressure(p < 0.001), and heart rate (p < 0.001) among adolescents 6 months after implementation of school based intervention.

Table 1: Distribution of study participants based on age, gender, area of living, sources of information, and number of siblings.

n=252

Variable	Experimental group (n_1=169)	Control group (n_2=83)	Test value	df	p-value
	Frequency (%)	**Frequency %)**			
Age (Years)				3	
11	1 (0.6)	0 (0.0)			
12	122 (72.2)	59 (71.1)			
13	43 (25.4)	23 (27.7)			
14	3 (1.8)	1 (1.2)			
Gender				1	0.084 ns
Male	122 (72.2)	51(61.4)			
Female	47 (27.8)	32 (38.6)			
Area of living				2	0.057 ns
Urban	10 (5.9)	1 (1.2)			
Rural	119 (70.4)	69 (83.1)			
Periurban	40 (23.7)	13(15.7)			
Sources of information regarding CAD				3	0.573 ns
School Curriculum	2 (1.2)	1 (1.2)			
Media	2 (1.2)	0 (0.0)			
Health personnel	2 (1.2)	0 (0.0)			
None	163 (96.4)	82 (98.8)			
Number of siblings					
≤ 2	121(71.6)	54 (65.1)	1.121	1	0.290 ns
>2	48 (28.4)	29 (34.9)			

ns Not significant, Chi-square/fishers exact test.

Table 2: Distribution of adolescents based on education and occupation of parents, family history of cardiovascular diseases ,distance from home to school and hours of attending tuition
n=252

Variable	Experimental group (n1=169)	Control group (n2=83)	Test value	df	p-value
	Frequency (%)	Frequency %)			
Education of mother					
Post graduate	6 (3.6)	4 (4.8)			
Graduate	42 (24.9)	27 (32.5)			
Up to metric	110 (65.1)	45 (54.2)			
Literate	7 (4.1)	7 (8.4)			
Illiterate	4 (2.4)	0 (0.0)			
Education of father			1.695	3	0.638^{ns}
Post graduate	12(7.1)	5(6.0)			
Graduate	22 (13.0)	13 (15.7)			
Up to metric	120 (71.0)	54 (65.1)			
Literate	15 (8.9)	11(13.3)			
Illiterate	0 (0.0)	0 (0.0)			
Occupation of mother			0.167	4	0.134^{ns}
Farmer	0 (0.0)	1(1.2)			
Own business	10 (5.9)	2 (2.4)			
Private job	30 (17.8)	20 (24.1)			
Government job	22 (13.0)	16 (19.3)			
Homemaker/unemployed	107 (63.3)	44 (53.0)			
Occupation of father			0.146	4	0.250^{ns}
Farmer	7 (4.1)	8 (9.6)			
Own business	52 (30.8)	25 (30.1)			
Private job	96 (56.8)	44 (53.0)			
Government job	14 (8.3)	5 (6.0)			
Unemployed		1(1.2)			
Family history of cardiovascular diseases					
Diabetes	54 (32.0)	22 (26.5)	0.784	1	0.376^{ns}
Hypertension	29 (17.2)	14 (16.9)	0.003	1	0.954^{ns}
Heart trouble	21(12.4)	12 (14.5)	0.202	1	0.653^{ns}
Stroke	9 (5.3)	5 (6.0)	0.014	1	0.820^{ns}
Distance from home to school (km)					
0-5	92 (54.4)	49 (59.0)	2.517	2	0.284^{ns}
<5-10	48 (28.4)	26 (31.3)			
>10	29 (17.2)	8 (9.6)			
Tuition					
≥1hour/day	77 (45.6)	46 (55.4)	2.166	1	0.141^{ns}
<1hour/day	92(54.4)	37(44.6)			

^{ns} Not significant, Chi-square/fishers exact test.

Table 3: Comparison of knowledge regarding coronary artery disease between experimental and control group at pretest, 1month, and 6months.
n=252

	Experimental group (n_1=169)	Control group	Test value		
	Mean (SD)	Mean (SD)			
Pre test	11.13(2.92)	11.9(2.85)	1.989	250	0.053^{ns}
1month	21.33(1.32)	11.41(3.28)	26.480	250	0.000***
6 months	21.43(1.28)	11.58(3.3)	26.251	250	0.000***

ns Not significant, *** Significant at the 0.001 level, Independent t- probability test

Table 4: Comparison of dietary behavior among adolescents between experimental, and control group at pretest, 1month, and 6 months [n=252]

Period	Domain	Experimental group (n_1=169)	Control group (n_2=83)	Test value	df	p- value
		Mean (SD)	Mean (SD)			
Pre-test	Dietary habits	11.42 (1.81)	11.78 (1.58)	1.556	250	0.121 ns
	Dietary consumption	21.03 (2.70)	21.46 (2.62)	1.194	250	0.234 ns
	Total dietary behavior	32.45(3.27)	33.24 (3.37)	1.788	250	0.075 ns
1month	Dietary habits	13.93 (0.88)	11.99 (1.96)	10.865	250	0.000***
	Dietary consumption	24.11 (2.66)	22.01 (2.69)	1.788	250	0.075 ns
	Total dietary behavior	38.04 (2.81)	33.75(3.71)	9.626	250	0.000***
6months	Dietary habits	14.09 (0.73)	11.84 (1.44)	16.425	250	0.000***
	Dietary consumption	25.76 (2.02)	21.60 (2.70)	13.663	250	0.000***
	Total dietary behavior	39.85(2.25)	33.45(3.19)	18.417	250	0.000***

ns Not significant, ***Significant at 0.001 level, Independent t- probability test

Table 5: Comparison of physical activity and active commute to school between experimental and control group at pretest, 1month and 6 months [n=252]

Variable	Period	Experimental group (n_1=169)	Control group (n_2=83)	Test value	df	p value
Physical activity Mean(SD)	Pretest	1.75 (0.30)	1.76(0.29)	0.162	250	0.871 ns
	1month	2.39(0.27)	1.78(0.29)	16.588	250	0.000 ***
	6months	2.46 (0.25)	1.71(0.23)	22.587	250	0.000***
Active commute to school f (%)	Pretest	121 (71.6)	53(63.9)	1.561	1	0.211 ns
	1month	116 (68.6)	51 (61.4)	1.288	1	0.256 ns
	6months	116 (68.6)	48 (57.8)	1.053	1	0.305 ns
Tobacco exposure f (%)	Pretest	44(26)	18(21.7)	0.567	1	0.45 ns
	1month	46 (27.2)	18(21.7)	0.899	1	0.343ns
	6months	44(26)	20(24.1)	0.110	1	0.740ns
Current tobacco use f (%)	Pretest	1(0.6)	0(0.0)	0.493	1	0.483 ns
	1month	0(0.0)	1(1.2)	2.044	1	0.153 ns
	6months	0(0.0)	0(0.0)	-	-	-
Screen time /day (mts) Mean(SD)	Pretest	199.4 (51.0)	106.8 (55.2)	1.778	250	0.077 ns
	1month	82.2(27)	108(90)	4.328		0.000***
	6months	76.8(27)	127.2(58.8)	9.354		0.000***
TV viewing during meals at least once daily (%)	Baseline	71(42)	27 (32.5)	2.106	1	0.147 ns
	1month	22(13.0)	32(39.8)	23.329	1	0.000***
	6months	11(6.5)	28(33.7)	34.045	1	0.000***

ns Not significant, ***Significant at 0.001 level, Independent t- probability test for quantitative variables. Chi-square probability test for categorical variables.

Table 6: Comparison of BMI, TSFT, WC, WHR, and WHtR among adolescents between experimental and control group at pretest, 1month, and 6 month [n=252]

Variable	Period	Experimental group (n_1=169)	Control group (n_2=83)	Test value	df	p value
		Mean(SD)				
BMI (kg/m²)	Pretest	17.34 (3.13)	17.7(3.27)	0.835	250	0.405 ns
	1month	17.40 (3.12)	17.7(3.21)	0.687	250	0.493 ns
	6months	17.19(2.61)	17.71(3.52)	1.323	250	0.187 ns
TSFT (mm)	Pretest	4.93(1.43)	4.08(1.08)	4.763	250	0.000***
	1month	4.93(1.42)	4.13(1.08)	4.496	250	0.000***
	6months	4.92(1.30)	4.36(1.1)	3.345	250	0.001**
WC (cm)	Pretest	65(8.59)	68.53(8.34)	3.095	250	0.002**
	1month	65.05(8.53)	68.45(8.52)	2.974	250	0.003**
	6months	65.0(7.77)	69.25(8.63)	3.941	250	0.000***
WHR	Pretest	0.85(0.07)	0.87(0.06)	1.760	250	0.080 ns
	1month	0.85(0.07)	0.87(0.06)	1.530	250	0.127 ns
	6months	0.84(0.06)	0.86(0.06)	2.781	250	0.006**
WHtR	Pretest	0.44 (0.05)	0.45 (0.05)	1.762	250	0.079 ns
	1month	0.44 (0.05)	0.45 (0.06)	1.760	250	0.080 ns
	6months	0.43 (0.05)	0.45 (0.06)	2.768	250	0.006**

ns Not significant, *Significant at 0.05 level, **Significant at 0.01 level, ***Significant at 0.001 level, Independent t- probability test for quantitative variables.

Table 4: Comparison of SBP, DBP, and HR among adolescents between experimental and control group at pretest, 1month, and 6 months [n=252]

Variables	Period	Experimental group (n_1=169)	Control group (n_2=83)	Test value	df	p value
		Mean(SD)	**Mean(SD)**			
SBP	Pretest	105.87 (10.27)	108.11(11.08)	1.584	250	0.114 ns
	1month	102.42(10.13)	108.17(9.85)	4.272	250	0.000***
	6months	101.3(8.82)	107.78(10.11)	5.220	250	0.000***
DBP	PRETEST	62.82(7.59)	61.23(6.51)	1.639	250	0.103 NS
	1month	60.15(7.34)	60.53(6.66)	0.400	250	0.689 ns
	6months	57.85(7.04)	61.58(7.2)	3.916	250	0.000***
HR	Pretest	78.73(8.36)	77.23(7.82)	1.366	250	0.173 ns
	1month	77.43(7.75)	78.46(8.02)	0.976	250	0.330 ns
	6months	73.36(5.72)	77.84(6.07)	5.731	250	0.000***

ns Not significant, ***Significant at 0.001 level, Independent t- probability test

Discussion

Similar results have been reported by Saraf DS et al [9] and Harrabi [10]. They found significant improvements in the knowledge of healthy lifestyles including physical activity, diet, and tobacco after school intervention in the experimental group compared to the control group. Significant improvements in the dietary behaviors observed in the experimental group compared to the control group in the present study have been supported by studies conducted by Singhal N, [11] while testing the effectiveness of school intervention in improving the dietary habits and dietary consumption of school children. But the Active Program Promoting Lifestyle Education in School (APPLES) study by Sahota et al showed only modest increase in dietary behavior in contrast to the above findings [12]. Join the Healthy Boat' programme conducted in Germany among 1943 children aged 7.1(0.6) years by Kobel S et al revealed significant effects in the intervention group for screen media use. Tendencies but no significant differences were found for physical activity, and consumption of soft drinks [13].

Aravindalochanan V *et al*, [14] found no significant changes in anthropometric, and biochemical parameters after implementation of a school based intervention at 6 month follow up. They recommended longer duration of intervention for change in anthropometry and biochemical profile. Kaufman F et al reported a 4% reduction in BMI in students of 6th to 8th grades with national-level awareness creation on childhood obesity [15]. The results of this study suggest that the intervention had significant effect on SBP, DBP, and HR in the experimental group compared to control group. Studies conducted by Bayne-Smith M *et al* [16] have indicated that interventions can successfully improve systolic and diastolic blood pressure among school children.

As an intervention study this provides strong evidence for a causal relation between school based intervention and tested outcomes. Studies focusing multicomponent (diet, physical activity and exercise, screen time, and tobacco use) interventions for adolescents are very few in numbers, especially from India. To the best of our knowledge, our study is the first to use a multicomponent intervention addressing CAD risk among rural adolescents' population of Kerala. Hence this study finding can be utilized as a preliminary step for school based interventions in rural setting. The school based intervention used in this study utilized all the approaches recommended by the WHO for health promotion intervention; issue based (CAD), population based (adolescents), and setting (school) based, maximizing the advantages of health promotion.

It should be noted that the current study contained a few limitations which should be taken into account when interpreting the findings. A major limitation of the study was the lack of qualitative methodology to provide additional insights into the study dynamics. The design in the current study was quasi-experimental. However we did match the schools on key variables and comparison of baseline data revealed homogeneity of both experimental and control group characteristics.

CONCLUSION

There is an estimated 190 million adolescents in India. School based interventions when planned and executed can significantly decrease the staggering burden of coronary artery disease prevalence and its risk factors. The added advantage of school interventions is that through school parents and teachers and thus the whole community can be reached as well. But the strategies implemented to promote lifestyle changes must be specific to a group or community and not to the population as a whole, especially in a country like India where a geographical area may include different language and culturally distinct groups.

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CONFLICT OF INTEREST
None

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