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ABSTRACT

Background and objectives: India is the second most populous country in the world and two-thirds of its population is less than 35 years old. This survey was conducted to assess the level of health awareness of cardiovascular disease in adolescent school-aged children 14–16 years old, with the goal of establishing school-based health education and development of heart-healthy lifestyle practices.

Methods: A school-based survey was conducted in the rural district of West Midnapore, India between June and July of 2014. This involved a pre-evaluation of cardiovascular disease (CVD) health awareness, a short presentation on CVD, and a post-evaluation of CVD health awareness.

Results: A total of 2995 students (48% response rate) from 20 schools participated in the survey. The mean age of the students in the study sample was 14.7 years, 46% were male, 53% were in the 9th grade, and the rest were in the 10th grade. After assessing students' awareness in six domains with 20 multiple-choice questions with a maximum score of 100, the mean pre-test score was 41.1 (SD ± 10.5) and the mean post-test score was 48.1 (SD ± 16.9) ($p < 0.001$).

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Abbreviations: CVD, cardiovascular disease; WHO, World Health Organization.
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Conclusions: Awareness of CVD and its risk factors was far from optimal among the adolescent school-aged children in this study. A school-based educational program may help improve awareness of CVD and reduce the future disease burden in the community. The results of this study may be useful in formulating a nationwide school health program to deal with the emerging epidemic of CVD in countries such as India.

1. Introduction

Cardiovascular disease (CVD) is the leading cause of death in industrialized nations.[1,2] In the developing world, infectious diseases have long been considered to be the most common cause of death. However, with increasing economic development and adoption of Western lifestyles, CVD is becoming an important health concern in many developing countries.

Several studies[3–5] have demonstrated that health knowledge and awareness are key factors in preventing many chronic diseases, including CVD. Since atherosclerosis begins in the second decade of life, and many of the contributory factors are better controlled if addressed early, health awareness of CVD and its precursors among school-aged children is of considerable importance for the primary prevention of CVD.[6–9]

India is the second most populous country in the world and two-thirds of its population is under age 35.[10] With all the features of a rapidly developing country, accompanied by changes in dietary habits and increasingly sedentary lifestyles, many people in India will be affected by CVD in the future. Currently, there is no established school health program in India to promote health education and awareness about CVD and its risk factors. To understand the potential opportunity for a school-based education program about the early detection of risk factors for CVD and the development of heart healthy lifestyle practices, we performed a questionnaire survey to assess the level of health awareness and knowledge of CVD and its risk factors among adolescent school-aged children.

2. Methods

A school-based survey was conducted in Garbeta II block in the district of West Midnapore, West Bengal, India from the middle of June until the middle of July 2014. This is a large rural district with a population of 5,943,300, and population density of 636 per square kilometer (1650 per square mile). By population, its size ranks 14th out of 640 districts in India. The overall literacy rate in the district is 70% (male 81%, female 59%) and the majority of residents work in agriculture. There were 20 high schools in Garbeta II block that taught adolescent children in the 9th and 10th grades; approximately 200 students in each school were eligible for our questionnaire survey.

2.1. *Recruitment of students*

Headmasters from the 20 schools were contacted by the study team and all agreed to participate in the study. One month prior to the survey, an announcement was made in each of the classes involved about the survey to be conducted. Information was provided on the school notice boards and pamphlets about the study were made available through the school's common room and classes. Participation in the survey was entirely voluntary. Attending the session for the survey was taken as assent for study participation. This was explained at the time of the initial announcement and also in the pamphlets. There was an option to leave the class if any student chose not to participate in the survey. Students in 9th and 10th grades who were present in school on the day of the study (a total of 2995 students with a 48% response rate from 20 schools) participated in the survey. Among the students present in the school, not a single student opted out from the survey.

2.2. *Ethical issues*

The study was a joint venture of Tufts University, Boston, USA and Kolkata Medical College, India and it had approval from the IRB of Tufts University and the local ethics committee.

2.3. *Survey administration*

The survey followed a three-step process: a pre-test, a short lecture covering the essential elements under study, and a post-test using the same questions as in the pre-test. A total of 90 minutes was allocated to conduct the survey. This included time spent on seating arrangements, announcements about the study and the survey's objectives and methods, the answering of any queries from the students, and collection of the answer sheets. Instructions about completing the answer sheet for the questionnaire were read aloud and explained so that every student understood the total number of questions asked, the stems under each question, and the total time allotted. It was also emphasized that the questionnaire for the survey was not a test of their school performance and would not affect their school grades.

Prior to conducting the survey, a questionnaire containing 20 questions was developed and validated in the index study population. Six domains were assessed including: (1) the concept and definition of coronary artery disease; (2) its prevalence and impact on individuals and society; (3) modifiable and non-modifiable risk factors for CVD including age, sex, family history, diabetes, hypertension, high cholesterol, and smoking; (4) the role of a heart healthy life style; (5) the importance of a multidisciplinary approach to CVD prevention; and (6) the benefits of the multidisciplinary lifestyle approach beyond CVD.

The initial survey questionnaire (pre-test) was administered over a period of 20 minutes. This was followed by a 20-minute standardized presentation by a physician from the study team

on cardiovascular health that addressed the six domains of the study. After the presentation, the second component of the survey (post-test) was conducted using the same questionnaire over a period of 15 minutes. Data were collected from each participant on an answer sheet separate from the questionnaire in a paper format. A free booklet on cardiovascular health was distributed at the end of the survey. For those choosing not to participate, the booklet was made available free of cost through the school library services.

2.4. *Statistical analysis*

We collected information on the baseline characteristics of study participants including their age, sex, and school grade. Relevant data were also collected about their parents' level of education and history of CVD, hypertension, diabetes, hyperlipidemia, and current smoking status. Pre-test and post-test scoring was done for each participant and was analyzed according to the six domains assessed by cluster sample design using the survey package in R. Changes in the test scores were evaluated by the Wilcoxon paired sample signed-rank test. Subgroup analysis was performed by grade of study (9th vs. 10th), sex (boys vs. girls), parental educational level, and whether a close family member had CVD or risk factors.

3. Results

A total of 2995 students (48% response rate) in the 9th and 10th grades participated in the survey out of a target population of 6205 students from the 20 schools. The mean age of the responding students was 14.7 years, 46% were boys, and 53% were in the 9th grade (Table 1). The prevalence of known coronary artery disease among the parents (as reported by the students) was 3% and the current history of smoking (27%) was the predominant risk factor in parents. Other identified risk factors were less common.

In the pre-test evaluation, the mean score was 41.1/100 with SD ± 10.5. Students improved their baseline scores by an average of 7.0 points in the absolute score in the post-test results (mean = 48.1, SD ± 16.9; Table 2). In terms of change in the different domains assessed, there was a 27% improvement in the score for domain 1 which involved the concept of coronary artery disease. This was followed by domain 2 which examined the prevalence of CVD and its impact on the individual and society. Varying degrees of improvement were also noted in other domains that assessed the multifactorial nature of the disease, the ability to modify the risk factors for CVD, the importance of a multidisciplinary approach to CVD, and the benefits of this approach on other conditions beyond CVD. These improvements were highly significant in each of the domains tested ($p < 0.001$).

Table 1 – Baseline characteristics of the students.

Age (mean)		14.7 years
Male		46%
Grade	9	53%
	10	47%
Parental education level	Elementary school	34%
	Middle school	40%
	High school	15%
	College	8%
	University	3%
Family history	CVD	3%
	Hypertension	4%
	Diabetes	3%
	Hyperlipidemia	2%
	Smoking	27%
	Not reported	61%

CVD – cardiovascular disease.

Subgroup analyses were performed according to the students' grade level, sex, parental level of education, presence or absence of CVD in the parents, or presence of multiple (≥2) risk factors in the parents. These analyses showed no evidence of heterogeneity.

4. Discussion

There are presently no data on cardiovascular health awareness among school-aged children in rural India. Our study found the level of this awareness, as assessed by our survey questionnaire, was only 41% among high school children and there was a modest improvement in the level of awareness of CVD with the use of a single, simple, and inexpensive educational intervention.

There are limitations to this study. India is very diverse in a variety of parameters including socioeconomic strata, cultural and dietary habits, extent of education, and ethnicity, and therefore, it is difficult to make generalizations based on results from a single block of one rural district. Future and possibly long-term studies will be needed to determine if these effects are sustained or translated into positive lifestyle practices.

Table 2 – Performance on the six domains of the study questionnaire.

Domain	Maximum score	Pre-test	Post-test	Absolute change	Standard error	Relative change in %	*p* Value
Concept of CVD	20	5.5	7.0	1.5	0.3	27.1	<0.001
Prevalence of CVD	10	4.2	5.2	1.0	0.2	22.9	<0.001
Risk factors for CVD	35	16.8	18.5	1.7	0.3	10.1	<0.001
Role of healthy lifestyle practices	25	11.1	13.5	2.4	0.3	21.7	<0.001
Multidisciplinary approach	5	1.8	2.1	0.3	0.1	18.5	<0.001
Benefits of such an approach	5	1.7	1.8	0.1	0.1	8.4	<0.001
Total	100	41.1	48.1	7.0	0.8	17.0	<0.001

CVD – cardiovascular disease.

Despite the evidences of pediatric roots of CVD,[11–13] there have been few studies examining the effect of different school-based programs on preventing the development of modifiable risk factors for CVD and encouraging the development of heart healthy lifestyle practices. Using a school-based approach, Killen and colleagues demonstrated the feasibility of providing CVD risk-reduction training for tenth graders in a school in Northern California.[5] After a special 20-session risk reduction intervention, students in the intervention group adopted a program of regular exercise more often than students in the control group, and smokers in the intervention group were more likely to quit smoking compared with those in the control group.

Using a classroom-based approach, Harrel et al. reported a significant improvement in the knowledge of CVD and its risk factors (7.9%) and physical activity score (3.7%) in elementary school children when the intervention group was provided with 8 weeks of an exercise program together with classes on nutrition and smoking. In this Cardiovascular Health in Children study conducted in 12 schools in North Carolina, where the prevalence of CVD is high, the intervention group demonstrated trends of reduced total cholesterol values, body fat, systolic blood pressure, and increases in aerobic capacity compared with the control group.[6] In comparison, our study found a modest improvement in high school children's awareness of CVD with the use of a single, simple, and inexpensive educational intervention.

India is currently in an economic and epidemiological transition.[14] Recent studies[15,16] suggest that cardiovascular diseases constitute the leading cause of death in India and it is projected that by the year 2020, India will have the highest burden of CVD compared to other countries.[17] Studies conducted in North America have shown that Asian Indians have one of the highest prevalence rates of CVD. In addition to a high prevalence of the traditional risk factors for CVD, insulin resistance, abdominal obesity, and elevated lipoprotein levels have been shown to be additional important risk factors in this population.[18] Asian Indians are prone to develop CVD early,[18] often before the age of 40 years in men, and have higher mortality compared to individuals of Caucasian or Chinese descent.[19]

Although no nationwide study has been recently conducted to study the prevalence of CVD or its risk factors in India, a systemic review by Rao et al.[20] suggests that there have been three- to four-fold increases in the prevalence of coronary artery disease (urban 3.2–12.6% and rural 1.4–4.0%) over the last two decades with accompanying increases of the traditional risk factors. Because most of those affected by CVD and its risk factors are in low and middle income groups with limited access to modern medical management and secondary prevention, the morbidity and mortality from CVD will likely continue to grow and be considerably higher than that observed in industrialized nations.[21]

Since India, with a population of 1.2 billion, is facing a major epidemic of CVD with two-thirds of the population below age 35 and more than two-thirds living in the rural areas, our study may have important implications for the majority of the population living in India. The results of this study may be useful in formulating a nationwide study directed toward better school health education to deal with the emerging epidemic of CVD in India.

5. Conclusions

The overall awareness of CVD among school-aged children in the study population was modest. Many of the students were not aware of the multifactorial nature of CVD and awareness of individual risk factors was limited. The ability to modify or control risk factors for CVD was a learning point for the students. Children also gained awareness of the importance of following a balanced diet, avoiding smoking, and participating in regular physical exercise. One of the main teaching points emphasized to these students was that atherosclerosis has pediatric roots and that the adoption of heart healthy lifestyle practices was central to maintain optimal cardiovascular health status. The results of this study may be useful in formulating a nationwide school health program to deal with the emerging epidemic of CVD in countries such as India.

Conflicts of interest

Dr. Deepak L. Bhatt discloses the following relationships – Advisory Board: Cardax, Elsevier Practice Update Cardiology, Medscape Cardiology, Regado Biosciences; Board of Directors: Boston VA Research Institute, Society of Cardiovascular Patient Care; Chair: American Heart Association Get With The Guidelines Steering Committee; Data Monitoring Committees: Duke Clinical Research Institute, Harvard Clinical Research Institute, Mayo Clinic, Population Health Research Institute; Honoraria: American College of Cardiology (Senior Associate Editor, Clinical Trials and News, ACC.org), Belvoir Publications (Editor in Chief, Harvard Heart Letter), Duke Clinical Research Institute (clinical trial steering committees), Harvard Clinical Research Institute (clinical trial steering committee), HMP Communications (Editor in Chief, Journal of Invasive Cardiology), Journal of the American College of Cardiology (Associate Editor), Population Health Research Institute (clinical trial steering committee), Slack Publications (Chief Medical Editor, Cardiology Today's Intervention), WebMD (CME steering committees); Other: Clinical Cardiology (Deputy Editor); Research Funding: Amarin, AstraZeneca, Bristol-Myers Squibb, Eisai, Ethicon, Forest Laboratories, Ischemix, Medtronic, Pfizer, Roche, Sanofi Aventis, St. Jude Medical, The Medicines Company; Trustee: American College of Cardiology; Unfunded Research: FlowCo, PLx Pharma, Takeda.

Key messages

What is already known?
Cardiovascular health awareness among school children is extremely important for primary prevention of the disease.

What this study adds?
A relatively brief and inexpensive intervention can help improve the awareness of cardiovascular health in this student population.

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