Original Article

Burden of cardiovascular problem and their risk factors among adolescent school children in Kolkata : an introspection

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This cross-sectional study was conducted among the adolescent school children of 9th grade (14-16 years) studying in 21 schools of Kolkata which were selected by using stratified random sampling based on school types and socio-economic status (SES). Total number of participants was 1651. Overall 21% reported known cardiac deaths among their first-degree relatives. Total 36 students (2.29%) were detected with cardiac murmurs. Almost a quarter (23.75%) of the participants were overweight and had abnormal blood pressure including both prehypertension and hypertension. Proportion with over-nutrition was more among the upper socio-economic group. Unhealthy eating practice and physical inactivity might have contributed to childhood over-weight and obesity. Early implementation of school-based awareness development programme regarding cardiovascular disease and appropriate lifestyle modification might be useful in delaying development of atherosclerosis in at-risk school-children.

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Key words **: Adolescent, Cross-sectional study, overweight, hypertension, socio-economic status.**

Cardiovascular diseases (CVDs) especially coronary artery diseases (CADs) contribute largely to mortality and morbidity worldwide with significant impact on health financing[1]. According to WHO estimates, globally almost 18 million deaths each year are attributed to CVDs, involving 31% of all deaths worldwide. The overall situation appeared more alarming in low and middle-income countries (LMIC) where CVDsremained responsible for 80% of deaths and 85% of disabilities[2,3]. Among CVDs, 75% of the global deaths and 82% of Disability Adjusted Life Years (DALYs) resulted from CADs in LMICs[4]. Moreover, among all ethnic groups, the highest prevalence of death from CADhas been reported among South East Asians and Indians were no exception[5].

In India, growing urbanization has resulted in better availability of amenities, economic stability and some improvement in the quality of life but as the ramification: junk food intake, physical inactivity, tobacco use etc. raised simultaneously leading to increase in the prevalence of the risk factors for the non-communicable diseases (NCDs) especially CVDs[6]. Based on available evidences, CVDs appears to be one of the principalcause of mortality and disability across the country and early age onset of CVD has been found to be associated with higher case fatality[7]. With epidemiological transition from communicable to non-communicable diseases, India experienced a loss of around 9 million productive life years due to CVDs in the dawn of this millennium with an estimatedloss of 18 million of the same by 2030[8]. Young and middle-aged individuals are likely to account for a sizable proportion among those lost life years[9].

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Higher mortality associated with early age of onset and the magnitude of lost life years warrant for precautionary measures since adolescence. Although, CVDs may be apparent from middle age, the arteriosclerosis process usually startsduring early adolescencewith gradual progression accelerated by exposures like smoking or other tobacco exposure, unhealthy dietary habits, physical inactivity, family history, obesity, hypertension and stress. As most of these self-inflicted risk factors are modifiable, so proper recognition, prevention and modification of the determinants of CVDs may reduce the future risk of CVDsby minimising the burden of risk factors during adolescence , the age when experimentations change into lifetime habits[10].

Apart from the CVDs which are detected mostly duringlate adulthood but enrooted since much earlier age with some modifiable risk factors, some other CVDs are usually detected prettyearly in life. World Heart Federation reported congenital heart disease and acquired heart disease or rheumatic heart disease as the most common CVDs among the young aged[11]. Prevalence of congenital heart disease has increased in an alarming rate globally, from less than 1 per 1,000 live births in 1930 up to 9 per 1,000 live births in the latest years. Thus almost 1.35 million live births among 150 live births worldwide are affected by congenital heart diseases[12]. In Asia the prevalence of Congenital Heart disease is 9.3 out of 1000 live births[13]. In the developing world, prevalence of the same approximately is 8 per 1000 live births. India also experiences a high burden of congenital heart diseases. It is estimated that Around 1,80,000 children are born with congenital heart disease every year in India[14]. On the other hand, about 2.4 million children aged between 5-14 years suffer from RHD globally. In Asia, the number of children suffering from RHD range approximately between 1.96 and 2.21 million. A recent study showed that mainly in urban areas in India prevalence of RHD among children varies from 0.2 -1.1/1000[15].

Dearth of information about the risk factors of CVD samong adolescentsin this part of the world, as well as insufficient data about CHDs and RHDs among the same population called for a study to estimate the burden of cardio vascular morbidity and associated risk factors among adolescent school-children of Kolkata, India.The effort had the potential for developing important insights that could contributeto the planningof interventions to reduce the future risk of CVDs among the adolescents.

Methodology :

Study design :

This cross-sectional study was conducted among the adolescent school children of 9th grade (14-16 years), studying in selected schools Kolkata during January to December, 2014.

Sampling :

Cluster random sampling was employed assuming school as cluster. To determine the sample size, the design effect was calculated to be 13.8, using a Rate of homogeneity (roh, presumed to be equal to the intra-cluster correlations) of 0.2 (according to the standard recommendation)[16-18], and an average cluster size of 75 (average number of students in the 9th grade/school). Using this and assuming a Type-I error of 0.05, assuming a non-response of 10%, 1755 students and their parents (preferably mother) were to be invited to have most conservative number of study subjects to be invited

Selection of schools :

At first, a comprehensive list of 426 schools in Kolkata metropolitan area was prepared. The schools were classified according to socio-economic status, higher/middle/ low, as well as the types of student's enrolment i.e. boys only/girls only/ co-educational. Next, 21 schools were selected by using stratified random sampling based on school types and socio-economic status (SES) with probability proportion to size and by selecting at least two schools from each group. These 21 schools were invited with the help from the Department of School Education, Government of West Bengal. In 19 schools agreed to participate. To confirm the maximum attendance of the participants, time date and venue of the data collection were finalized and necessary formalities were completed. Written letters were sent to all students of the selected schools and their parents, preferably mother for the participation in the study.

Study population :

All the 9th grade students, present on the day of interview and accompanied by their guardians (preferably mother), were recruited for the study if agreed by signing written voluntary assent and their guardians if accorded by signing written informed consents. Students suffering from physical or mental illness that prevented them from normal communication were excluded from the study.

Data collection and variable definitions :

A structured, self-administered questionnaire was used for gathering information. The questionnaire was pre-tested for internal validation and consistency[19] in a sample of 160 students of the same grade appointed through random selection of school within the study area. Information related to age, sex, family income was collected. Based on the distribution of reported family income, relative socio-economic (SE) classes (lower/middle/higher) were constructed. Data regarding family history of cardiovascular morbidities among first degree relative of the participants, individual ailments including fatigue and shortness of breath over the last six months were recorded along with frequency of visit to a doctor in last one year. Reported physical ailments were categorised based on its intensity

of occurrence (occurring at rest, with regular activities and with more than regular activities). Participants also asked about any specific history of cardiovascular morbidity, surgery and regular medicine intake. All the students were clinically examined by cardiologists for detection of cardiac murmurs or other abnormal cardiac signs (if any). Individual height and weight were measured and using them, body mass index (BMI) was calculated based on standard formula and categorised as per WHO guideline for BMI for age to normal weight, overweight and obese[20]. Blood pressure (BP) was measured in two separate occasions, half an hour apart with appropriate cuff size by an electronic BP recording machine. Based on average systolic BP (SBP) and diastolic BP (DBP) students were categorised as non-hypertensive, prehypertensive and hypertensive based on age specific percentile cut off of SBP and DBP values.

Statistical analysis :

Data was entered in Microsoft excel software with the help of a predesigned codebook. Logical data cleaning and recoding employed. Variables were described with mean (numerical variable) or proportions (categorical variables) with associated 95% confidence interval (CI). Stratified analysis performed across gender and SE groups. Significant differences between stratum specific values were assessed based on the non-overlapping of CI values of a variable between two different strata.For all statistical analysis SAS 9.3.2 was used.

Result :

Among the participants (n=1651),almost half of the girls (n= 427, 57.86%, 95%CI=54.29-61.43) and two-third of the boys[n=585, 66.10%(62.98-69.23)] were from middle SE status. Lower SE group was relatively less represented among girl students [n= 106, 14.36%(11.83-16.90)] compared to the boys (n=170, 19.21%(16.61-21.81)]. However, proportion of upperSE class appeared significantly more among the girls [n_{girls}=205, 27.78% (24.54-31.02) *versus* n_{boys}=130, 14.69% (12.35-17.03)].

Overall 21% [n=230, 21.12%(18.69-23.55)] reported known cardiac deaths among their first-degree relatives. History of heart attack affecting any first-degree male relative before the age of 55 years [n=135, 11.56%(9.72-13.39)] and female relative before her age of 65 years [n= 111, 9.66%(7.95-11.37)] were also noted.

For the treatment of any ailment, majority[n= 1169, 70.89% (68.70-73.09)] visited a doctor twice or less over the last one year. However, around 7% [n=108, 6.55% (5.35-7.74) reported visiting a doctor once or more in a month. Similar proportion reported about fatigue on rest (n= 101, 6.14% (4.98-7.30)]. Altogether almost 10% of the students had shortness of breath at rest [n=55, 3.34% (2.47-4.21)] or with some routine activities [n= 110, 6.68% (5.47-7.89)]. Almost a quarter of the participants were overweight [n= 389, 23.75% (21.69-25.81)] and had abnormal blood pressure including both prehypertension [n =245, 15.01%(13.28-16.75)]and hypertension [n = 207, 12.68%(11.07-14.30)]. Girls (n=766) had higher systolic [GirlsSBP 107.44(106.64-108.23) *versus* BoysSBP 103.12(102.31-103.93)] and diastolic blood pressure [GirlsDBP 71.09(70.55-71.63) *versus* Boys DBP 68.47(67.91-69.03)] as opposed to boys.

History of cardiovascular ailments [n= 49, 3.05%(2.21-3.89)], cardiovascular surgery [n= 4, 0.25%(0.01-0.49)] and regular intake of some cardiac medication (n= 46, 2.87% (2.05-3.69)] were observed in few students. Total 36 students were detected with cardiac murmurs [2.29% (1.55-3.03)]. Involvement of mitral valve was maximum [n= 14, 0.89%(0.43-1.35)] followed by murmurs originating from pulmonary valve [n= 10, 0.64%(0.24-1.03)].

The distribution of cardiovascular risk factors in the population across gender appeared more or less similar in stratified analysis. Although among the study participants proportion of overweight was more among the boys, whereas proportion with abnormal blood pressure was more among the girls.

Stratified analysis across the SE groups indicated a pattern of declining family risk of cardiovascular ailments from lower to higher socioeconomic status. Death due to cardiac reason among first degree relatives appeared significantly more among the lower [n= 54, 32.93%(25.66-40.20)] and middle [n= 150, 23.73%(20.41-27.06)]SE group compared to the upper SE class (n= 23, 8.49%(5.15-11.83)].

Similarly,proportionof first-degree male and female relative with heart attack before 55th / 65th birthdaywas more in the lower [$n_{male\ relative}$= 29, 16.86%(11.21-22.51) and $n_{female\ relative}$= 29, 17.79%(11.86-23.72)] and middle [$n_{male\ relative}$= 88, 12.79%(10.29-15.29) and $n_{female\ relative}$= 74, 10.96%(8.60-13.33)] SE class compared to the upper SE group [$n_{male\ relative}$ = 15, 5.26%(2.66-7.87) and $n_{female\ relative}$= 8, 2.78%(0.87-4.69)]. Proportion with over nutrition was more among the upper SE group [$n_{overweight}$= 89, 26.57%(21.81-31.32) and n_{obese}= 29, 8.66%(5.63-11.68)] compared to lower SE class [$n_{overweight}$= 41, 14.96%(10.71-19.21) and n_{obese}= 9, 3.28%(1.16-5.41)]. More prehypertensive individuals were found to belong to upper SE class [n= 75, 22.39%(17.90-26.87)]as opposed to those from lower SE class (n= 33, 12.04%(8.17-15.92)].

Discussion :

The study demonstrated the prevalence of modifiable and non-modifiable risk factors of CVDs among the adolescent school children. Early identification of the population at risk and effective intervention at early age might

help in controlling the potential upsurge of CVDsduring late adulthood.

Worldwide, early age obesity emerged as major health problem inviting high risk of CVDs in adulthood. Prior evidence from Lithuaniareported around 12% overweight and 2% obesity among the adolescent 21. Finding from Saudi Arabia reportedeven higherprevalence of overweight and obesity among the both male (20.6%) and female (29.4%) adolescent[22]. Another study held in Delhi among the adolescents school children aged 4-17 years, reported that overall prevalence of obesity was 6%[10]. Alike other studies, the current investigation also revealed considerably high prevalence of overweight and obesity among adolescent school-students of Kolkata. Unlike previous findings[21], in the present study, adolescent girls appeared to have higher average bodyweight, although they did not differ significantly in their nutritional status. Effective intervention in the form of lifestyle modification and motivation for bringing sustainable changes in dietary habits of adolescents might help in curbing the potential future risk down.

Alike obesity hypertension is also emerged as major public health problem of the world[23]. Increasing prevalence of hypertension among the adolescents being observed worldwide[24]. A study conducted in Londrina among the children and adolescents reported 11.8% of the study population with high blood pressure[1]. Around 6% of the male and 4% of the female adolescents were estimated as hypertensive in a study in Saudi Arabia[22]. Estimates from India reported around 9% hypertension among boys and 7% among girls[10]. Present studywas in line with the previous findings and reported even more alarming situation. Unlike before, both the systolic and diastolic pressures were more among the girls[21]. Although proportion of hypertensives did not vary in between different SE classes, but the findings of having significantly more prehypertensive among upper SE class perhaps indicated towards the negative effect of socio-economic affluence on the lifestyle of the adolescents belonging to those families.

According to World Heart Federation Report, if both the parents of an individual had experienced heart disease before the age of 55 then the risk of developing cardiovascular disease would ascend to 50% compared to the rest of the population. Also if a first degree male relative of an individual had suffered a heart attack before the age of 55 or a first degree female relative of an individual was affected by the same then that individual was found to be at a higher risk of being affected by heart disease[25]. A study conducted in Kerala showed 2.9% participants had positive family history of CVD[26]. Another study organized in Delhi exhibited that one-fifth of the study participants had family history of CVD[10]. Compatible with earlier findings, this present study also reported sizable proportion of participants with first degree male and female relatives who had a heart attack at an early age. Findings of having more adverse family cardiac events in lower SE groups could be seen as proxy of evidences showing more CVD events in lower SE class[27]. Prior identification of these students at risk and effective targeted intervention may reduce the burden of CVDs.

Alike any observational study, the findings from the study should be extrapolated beyond the study sample with caution. Being of self-reported nature the information always had the potential for recall and social desirability issues. Residual confounding could be another potential limitation. Despite these shortcomings, it appears that the current research could generate interesting and useful insights in to the cardiovascular risk factors and their distribution among urban adults.

Conclusions :

Non-modifiable risk factors like positive Family history of CVD found in a good magnitude among the participants. Singling out the participants at risk at the early stage and generating awareness among them would be worthwhile. Unhealthy eating practice and physical inactivity might have contributed to childhood overweight and obesity. Lifestyle modification and implementation of the CVD related awareness in practice might be advantageous in delaying the arteriosclerosis process at the early stage among the at-risk population. In addition, school based screening of existing cardiac abnormalities would help in early identification of morbidities among the adolescent and specific intervention for them.

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