RESEARCH ARTICLE

Does lifestyle behaviour trigger cardiovascular risk factors among school-going adolescents in Pakistan?

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Abstract

Objective: To explore the association of gender with risk factors for cardiovascular diseases among adolescents.

Method: The cross-sectional study was conducted 2016-2019 in low-income schools in Karachi after approval from the ethics review board of Dow University of Health Sciences, and comprised adolescents of both genders aged 11-17 years. Anthropometric measurements and lifestyle behaviours were used to generate risk profile for cardiovascular diseases. Data was analysed using SPSS 16.

Results: Of the 1195 subjects, 468(39.2%) were boys and 727(60.8%) were girls. The mean age was 13.9±1.6 years. Mean family size was 5.9±3.64. Overall, 989(91.3%) participants consumed soft drinks, 44(4%) were smokers, 340(48.4%) consumed betel nut, 215(32.9%) Pan, 125(21.2%) Gutka and 9(1.7%) Bidi. Of the total, 867(83.3%) participants were physically less active than recommended, and daily screen time was >2 hours among 513(45.7%) participants. Body mass index and body fat percentage were significantly higher among girls ($p<0.05$). Higher rates of diastolic and systolic blood pressure and hand grip strength were observed in boys compared to girls ($p<0.05$).

Conclusion: Interventional programmes in schools should emphasise the need for healthy lifestyle behaviours, increased physical activity, good eating habits and smoking cessation.

Keywords: CVD risk factors, Adolescents, Lifestyle behaviours, Micronutrients, Pakistan. (JPMA 73: 1393; 2023)

DOI: https://doi.org/10.47391/JPMA.6735

Submission completion date: 28-06-2022 **- Acceptance date:** 02-03-2023

Introduction

South Asians are known to have one of the highest susceptibilities to cardiovascular diseases (CVDs), causing approximately 27% of deaths in the entire region.[1] Both environmental and genetic factors may explain the vulnerability of this population to CVDs and may further exuberate the occurrence at a much younger age than other populations.[1] The Bogalusa Heart Study and the Pathobiological Determinants of Atherosclerosis in Youth (PDAY) have shown that atherosclerosis, including fibrous plaques, is present in adolescents and young adults. The progression of atherosclerotic process can be greatly accelerated among those with pre-established risk factors, such as unhealthy lifestyle habits, obesity, dyslipidaemia, hypertension (HTN), and a family history of coronary artery disease (CAD).[2,3]

Adolescence is a critical phase of the human lifecycle during which physical, psychosocial and behavioural development occurs.[4] The significance of developing healthy lifestyle behaviours is obvious, as these habits formed early in life may prevent chronic health problems, including CVDs. Studies have also shown that some of the CVD risk factors, including increased body mass index (BMI), high body fat percentage (BF%), high systolic blood pressure (SBP), high diastolic blood pressure (DBP), and high low-density lipoprotein (LDL) levels during childhood and adolescence years may predict full-blown disease during adulthood.[5]

Micronutrients can play an important role in the prevention of CVDs.[6] Evidence supporting a causal relationship between B-vitamins and heart disease comes from epidemiological studies. A biomarker profile of high vitamin B-12 and folate as well as low plasma homocysteine levels reduces the risk of coronary heart disease (CHD) and can be found associated with diet.[7] However, such studies in South Asian children and adolescents are very few and inconclusive in confirming the benefit of B-vitamins on CVD risk factors.[8]

Nutrition-related health statistics are grim in Pakistan, with both under-nutrition and over-nutrition highly prevalent among women and children. More than 40% of the population suffers from chronic malnutrition, which is often associated with underlying micronutrient deficiencies.[9] Knowledge of the micronutrient status and other predisposing risk factors for CVD can play a pivotal role in the reformation of lifestyle behaviours to have optimum cardiovascular health. However, there is limited information on the subject for the adolescent group in Pakistan, indicating the low recognition of their specific

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health and nutrition needs.

The current study was planned to fill the gap with a baseline survey to explore the association of gender with risk factors for CVDs among adolescents.

Subjects and Methods

The cross-sectional study was conducted from 2016-2019 in secondary schools in low-income areas of Karachi. After approval from the ethics review board of Dow University of Health Sciences (DUHS), Karachi, the sample size was calculated using OpenEpi calculator, taking micronutrient deficiencies as 30% in adolescents with increased CVD risk factors, confidence level 95% and power 80%.[10] The sample was inflated by over 30% to cover up for anticipated dropouts and cases with missing data. The sample was raised using multistage stratified sampling technique. A random selection of two schools was made from each of the six randomly chosen union councils (UC). After receiving permission from the school managements, students from grades 6th to 10th were enrolled based on probability proportional to the enrolment size of each class and school. Parental written consent was obtained before for the sample was finalised. Strict confidentiality was maintained for all data.

Using a pretested questionnaire, which was translated into the local language, information was obtained regarding the socio-demographic characteristics of the students and their parents/guardians. Data on age (years), gender, grade, number of siblings, parent's income and education, type of residence, adolescent's medical history and their parent's disease history were recorded. Participants' lifestyle behaviours, including diet, physical activity, screen time, sleeping pattern and tobacco and betel nut use, were also noted.

Information about dietary intake in adolescents was collected using the 80-item Food Frequency Questionnaire (FFQ).[11] A review of literature on FFQ[11] and information gathered through an informal dietary survey of children while visiting schools during the preliminary phase of the study were also accommodated. These food models were made with paper, plastic and foil by the team and taken to each school visit to help the participant recall the amount they were consuming. Food models were used to help estimate quantities of foods consumed. The responses were recorded as, 'never' or 'less than one per month', 'number of times per month', 'number of times per week', and 'number of times per day'.

Information on physical activity was obtained using data on the type and duration of physical activity during the day at school and at home, type of transport used to travel to school, type of sports or physical activity during physical education class in the school, activities during recess time, and the type of household chores they do at home during school days and on weekends. These questions were adapted from the validated Global School Health Survey (GSHS) Questionnaire and the Physical Activity Questionnaire (PAQ).[12]

To measure participants' total screen time, data on video games/computer/smartphone and television usage in hours and/or minutes were recorded. Participants' tobacco and smoking-related habits were also obtained through questions about the frequency and duration of use during the preceding 30 days.

For anthropometric measurements, the scale was set to zero before each measurement. Heavy outer clothing, shoes and belts were removed. A portable stadiometer (Seca 213) was used to measure height to the nearest 0.1cm. Participants stood on the stadiometer with their head kept at Frankfort plane position, arms beside them and heels, buttocks and upper back aligning the scale and parallel to the floor. Weight (to the nearest 0.1kg) along with BF% was measured using a portable bioelectric impedance analysis (BIA) machine (Omron BF508).

To prevent interference in electrical conductivity, the participants were requested to remove all metal-containing objects from their body prior to the measurement. The height, age (years) and gender of each participant was entered into the BIA machine individually, and the participants were asked to stand upright on the platform while holding the grip electrodes with their arms extended at a 90^{o} angle to the body.

The BMI was recorded using the World Health Organisation (WHO) criteria whereby BMI more than -1 standard deviation (SD) for children of the same age and gender, or less than the 5th percentile was classified as 'underweight'. For BMI equal to or more than +1 SD for similar age and gender, or more than 85th but less than 95th percentile was classified as 'overweight;. For BMI more than +2 SD for children of the same age and gender, or more than the 95th percentile were categorised as 'Obese'.[13] Moreover, visceral fat (VF) readings were obtained, using the same BIA machine (Omron), with the cutoffs 1-9 being taken as 'normal', 10-14 'high' and 15-30 'very high'. BF% was measured as a continuous variable and was recorded using the WHO criteria based on gender and age as 'low', 'normal', 'high' and 'very high'.[14] Waist circumference (WC) was measured with a measuring tape to the nearest 0.1cm that was placed midway between the lowest rib and the superior border of the iliac crest.[15,16] Also, hand grip strength (HGS) was measured using Hand Grip

Table-1: Baseline characteristics (n=1195).

Variable	n with Responses	n (%)
Gender	1195	
Male		468 (39.2)
Female		727 (60.8)
Age (years)	1195	
11-13 years (Pre-Adolescents)		498 (41.7)
>13-17 years (Adolescents)		697 (58.3)
Family members (no.)	1169	
1		5 (0.4)
2		47 (4.0)
3		111 (9.5)
4		246 (21.0)
≥5		760 (65.1)
Ethnicity (Type)	1132	
Urdu Speaking		829 (73.2)
Sindhi		56 (4.9)
Punjabi		48 (4.2)
Balochi		6 (0.5)
Pushto		21 (1.9)
Chitrali		82 (7.2)
Others		90 (8.1)
Father's Education	1177	
No Education		115 (9.8)
Literate		837 (71.1)
Don't Know		225 (19.1)
Mother's Education	1178	
No Education		185 (15.7)
Literate		813 (69.0)
Don't Know		180 (15.3)
Father's Occupation	1179	
No		133 (11.3)
Yes		1046 (88.7)
Mother's Occupation	1181	
No		482 (40.8)
Yes		699 (58.5)

Dynamometer (Camry Model # EH101).[17]

Clinical assessment was also done. Blood pressure (BP) was measured with a calibrated automated device (Omron M3 Intellisense Blood Pressure Monitor). The average of three seated BP readings 10 minutes apart were recorded for each subject. HTN was defined as the 95th percentile or more of SBP and/or DBP for age and gender according to the reference standards for children and adolescents.[18]

Data was analysed using SPSS 16. Descriptive statistics were expressed as mean±standard deviation and as frequencies and percentages for continuous and categorical variables, respectively. Independent sample t-test was performed to test the association of gender with continuous measures of CVD risk factors, including BMI percentiles, WC (cm), BF%, pulse/min, SBP (mmHg), DBP (mmHg) and HGS. P<0.05 was considered statistically significant.

Table-2: Lifestyle behaviours of the subjects (n=1195).

Variables	n with Responses	n (%)
Physical Activity (minutes/day)	1041	
<60		867 (83.3)
≥ 60		174 (16.7)
Sedentary Lifestyle (screen time: hour/day)	1122	
< 1		190 (16.9)
1 - 2		419 (37.3)
> 2		513 (45.7)
Smoking status		
Cigarette	1099	44 (4)
Shisha	542	11 (2)
Hukka	542	7 (1.3)
Smokeless Tobacco		
Pan	654	215 (32.9)
Bidi	543	9 (1.7)
Gutka	589	125 (21.2)
Chaliya	703	340 (48.4)
Naswar	571	80 (14)
Fast food consumption	999	
Daily		72 (7.2)
Weekly		440 (44)
Monthly		487 (48.8)
Carbonated drink	1084	
No		95 (8.8)
Daily		135 (12.5)
Weekly		552 (50.9)
Monthly		302 (27.9)

†Smoking status: Those who had smoked during the preceding 30 days; ‡Smokeless tobacco: Those who had used any other form of tobacco during the preceding 30 days, like Pan, Bidi, Gutka, Chaliya and Naswar; §Fast food consumption: Those who had been consuming fast foods, like burgers, pizza, etc., on daily, weekly or monthly basis; ||Carbonated drinks: Those who had been consumed such drinks on daily, weekly or monthly basis.

Results

Of the 1195 subjects, 468(39.2%) were boys and 727(60.8%) were girls. The mean age was 13.9±1.6 years. Mean family size was 5.9±3.64. In terms of ethnicity, most of the students belonged to the Urdu-speaking community 829(73.2%) (Table 1).

Overall, 989(91.3%) participants consumed soft drinks,

Table-3: Gender differences for NCD risk factors among the subjects (n=1195).

Risk Factors	Total Mean±SD	Males Mean±SD	Females Mean±SD	*p*-value*
BMI (Kg/m^2)	18.87±4.60	18.53±3.47	19.11±5.23	0.037
Waist Circumference (cm)	62.79±19.93	64.18±11.70	61.84±23.94	0.052
Fat mass	23.29±14.52	16.72±18.71	25.83±11.58	<0.001
Pulse/min	67.74±37.87	84.83±16.90	82.54±23.92	<0.001
Systolic blood Pressure (mmHg)	77.53±42.49	103.72±17.19	89.17±24.00	<0.001
Diastolic blood pressure (mmHg)	52.67±28.95	68.35±12.52	62.21±16.94	<0.001
Hand Grip Strength	14.53±9.15	18.31±11.22	13.87±5.19	<0.001

NCD: Non-communicable disease, BMI: Body mass index; SD: Standard deviation; * level of significance <0.05).

44(4%) were smokers, 340(48.4%) consumed betel nut, 215(32.9%) Pan, 125(21.2%) Gutka and 9(1.7%) Bidi.

Of the total, 867(83.3%) participants were physically less active than recommended, and daily screen time was >2 hours among 513(45.7%) participants (Table 2).

There were significant difference between the genders in the mean values of BMI (p=0.037), WC (p=0.052) BF% (p=0.001), fat mass (p=0.001), BP (p=0.001) pulse/min (p=0.001) and HGS (p=0.001) (Table 3).

Discussion

The current study described various lifestyle behaviours and CVD risk factors among school-going adolescents from low- and middle-income communities in a major urban centre. The results showed adolescents with high BMI, increased BF%, low muscular strength and increased DBP were likely to develop increased CVD risk during adulthood.

Generally, BMI is often used to indicate the total amount of body fat, whereas WC and waist-to-height ratio (WHR) have been studied for central obesity which has a stronger association with CVD risk factors.[19] It has been recorded that the presence of abdominal fat mass can vary considerably among individuals despite having similar BMI levels. This has been evident, particularly among Asian populations, that individuals may exhibit a 'normal' BMI, but have a disproportionately large WC.[16] This was true in the current results where adolescents were found with normal BMI but moderate to high fat mass, suggesting an increased risk for early development of CVDs. In the Bogalusa Heart Study, there was an indirect relationship between abnormal WHR and the risk of CVDs.[20] Though the current study showed a smaller proportion of participants with increased WHR, since we had many participants who had increased BF%, there is a need to explore more of these risk factors within the specific context. Mushtaq et al. also found that more than 11% of 1,860 Pakistani children had a high WHR.[21] The fact that WHR is age- and gender-specific makes it a good tool for central obesity assessment in children, especially if BF% cannot be measured for identifying CVD risk .[22]

High BP among adolescents has been known to be an atherogenic precursor for CVD development in later life. Adolescents in the current study had a lower mean SBP value compared to children from other countries. A cross-sectional study conducted in Columbian public schools with adolescents from grade 5 to 11 examined the association between physical fitness and cardiometabolic risk factors, and found that adolescents with unhealthy habits had an average SBP of 110.4 mmHg, which is higher compared to the current study's average of 103mmHg. However, the DBP was higher (70 mmHg) in the current population compared to Columbian study (67.5mmHg).[17] Many other factors, such as unhealthy dietary patterns, physical inactivity, and poor sleeping habits, can also increase the risk of high BP among the youths and subsequent progression to CVDs.[23]

Another important predictive factor known to correlate with CVD mortality includes muscular strength, and there is evidence of poor metabolic outcomes in adulthood with low muscular strength.[24] In the current study, the average muscular strength was much lower (17.49 kg) compared to children in Columbia 22.65kg.[16] Research has shown that lower levels of muscular strength can be linked to several metabolic risk factors, such as obesity and high BP.[25] Since the current study was one of the first to assess HGS by measuring muscle mass in adolescents, comparable data was not found for assessment in a similar population. Therefore, it can be speculated that there could be some other factors, including age, gender, lifestyle and diet, that influence muscle strength.

Another important factor influencing adolescent health is their physical activity level. The majority of adolescents had an inactive lifestyle in the current study. The rates were much higher compared to other studies. For example, in a similar population in Italy, physical inactivity was only 20.4% versus 84% in the current study. A study in Peru also observed similar findings.[5] One of the major reasons for this could be the lack of public playgrounds, less space and reduced sports activities in schools in Pakistan.

Although, tobacco smoking, Gutka and Supari-chewing are not allowed in schools and are strongly discouraged by parents, the use of smokeless tobacco (Gutka/Supari) has increased in young adolescents, as was found in the current study. Similar findings have been reported in Southeast Asia though many of these studies have found smokeless tobacco to be more common than smoking.[26]

The strengths of the current study comprise having a population-based multi-stage random sample and collection of data related to sociodemographic, anthropometric and lifestyle characteristics that may influence CVD risk factors among adolescents. Moreover, assessing body fat and muscle strength was an additional parameter to relate to adolescent health. However, like any other cross-sectional study, the nature of the research limits the ability to determine any causation between the participant characteristics and risk factors of CVD. Secondly, the study only included school-going adolescents (only 35% of Pakistani adolescents attend school), and any observations may not be generalisable to the larger adolescent population. Also, some schools did not grant permission for the survey, so some other school had to be selected which compromised the randomisation process.

However, the major limitation was the self-reporting nature of data, and it is possible that some respondents might have under- or over-reported food items. The assessment of cigarette smoking among adolescents did not distinguish between regular and experimental smokers. which may have allowed an overestimation of the actual prevalence of substance use among adolescents.

Conclusion

Findings support the initiation of interventional programmes in schools to promote healthy lifestyle behaviours, good eating habits and prevention of smoking and use of various tobacco products. Besides, playgrounds in schools are very important to encourage physical activity among children. Preventive measures can help ease the high financial burden associated with the management of CVDs in adulthood.

Acknowledgement: We are grateful to the volunteer undergraduate and postgraduate medical students of the School of Public Health, Dow University of Health Sciences, Karachi, for their assistance in data-collection process. Thanks are also due to the relevant school authorities and all the study participants.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: The National Research Programme for Universities (NRPU) of the Higher Education Commission (HEC) of Pakistan.

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