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Socioeconomic differences in prevalence of biochemical, physiological, and metabolic risk factors for non-communicable diseases among urban youth in Delhi, India

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ABSTRACT

This study examined whether the distribution of biochemical, physiological, and metabolic risk factors for non-communicable diseases (NCDs) among children and youth in urban India vary by socioeconomic status (SES). Data were derived from a cross-sectional survey of students enrolled in the 2nd and 11th grades in 19 randomly selected schools in Delhi ($N = 1329$) in 2014–15. Mixed-effect regression models were used to determine the prevalence of risk factors for NCDs among private (higher SES) and government (lower SES) school students. After adjusting for age, gender, and grade we found the percentage of overweight (13.16% vs. 3.1%, p value < 0.01) and obese (8.7% vs. 0.3%, p value < 0.01) students was significantly higher among private relative to government school students. Similarly, significantly higher percentage of private school students had higher waist circumference values (7.72% vs. 0.58%, p value < 0.01) than government school students. Furthermore, similar trend was observed across schools in the distribution of other NCD risk factors: raised blood pressure, raised total cholesterol, and low-density lipoprotein. Surprisingly, despite a higher prevalence of all risk factors, significantly higher percentage of private school students had adequate/ideal levels of high-density lipoprotein. Overall, the risk profile of private school students suggests they are more vulnerable to future NCDs.

1. Introduction

With over 39 million deaths annually, non-communicable diseases (NCDs) account for 72% of global deaths (IHME, 2018). Moreover, the majority of NCD deaths occur in low-income and middle-income countries (WHO, 2018a; WHO, 2014) posing inequitable, health and economic burdens on individuals, societies, and health systems (WHO, 2011). NCDs that were more typically encountered in the West, appear to be rising in India, as it undergoes tremendous economic and epidemiologic transitions. NCDs, especially cardiovascular diseases, chronic obstructive pulmonary disease, cancers, diabetes mellitus and mental health disorders have emerged as major public health challenges for India (Mohan et al., 2011). Many of the NCD-attributable deaths occur in the most productive years of adult life as a consequence of risky behaviors acquired in youth.

In this era of globalization, India is experiencing an ever-increasing influence of Western culture, which is especially appealing to and accessible among populations belonging to higher socioeconomic status (SES) in this context (Singh, 1996). A lifestyle which promotes behaviors that escalate the risk for chronic diseases. Therefore, understanding the social class gradient in NCD risk factors is extremely important in halting the NCD epidemic in India. Pre-adolescence and adolescence represent a time for increased susceptibility to initiation and formation of long-term health behaviors (Perry, 2000). Behaviors such as unhealthy diet and physical inactivity could lead to raised blood pressure, blood glucose, blood cholesterol, and obesity, increasing their risk for NCDs. Most importantly, the multiplicity of the risk factors increases the risk of acquiring NCDs multifold (WHO, 2014).

Recent studies suggest that the prevalence of NCD risk factors is increasing rapidly among Indian youth. A study conducted with school

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children aged 10–16 years in Odisha (India) reported the prevalence of overweight and obesity to be 27.8% (Patnaik et al., 2015). Likewise, a second study conducted in Bangalore, India reported the prevalence of overweight and obesity among children aged 6–16 years to be 15.1% (Mishra et al., 2015). A study conducted in Kolkata, India with school children, aged 10–19 years found the prevalence of hypertension (systolic and/or diastolic blood pressure ≥ 95th percentile for gender, age and height) to be 10.1% (Maiti and Bandyopadhyay, 2016). Of note, in a study conducted with urban and rural school students at Karimnagar district, Telangana (India), 3.5% of students were reported to have diabetes mellitus (Kameswararao and Bachu, 2009). Additionally, in a study with type 2 diabetes patients in Chennai (India), 26% reported being diagnosed with diabetes mellitus before the age of 15 years (Amutha et al., 2012). However, to date, no published studies have explored the distribution of NCD risk factors among urban Indian youth, by SES.

As literature suggests that the prevalence of unhealthy behaviors among Indian youth is on the rise, it is important to gain a better understanding of the prevalence of risk behavior among this population. To address this gap in the literature, a school-based cross-sectional study was conducted to examine the distribution of NCD risk factors among youth in a large and socioeconomically diverse sample of private and government school students in Delhi. The study design includes two different types of schools- private and government which were used as a proxy for SES in this setting. Students from higher SES backgrounds generally study at the private schools, whereas those from lower SES backgrounds attend the government schools. Private schools generally cost several times more than the government schools, which either have a nominal fee or are offered free of cost (Sharma, 1999). Further, urban schools provide a sample of students of lower to higher SES and both sexes, whereas rural schools lack socioeconomic diversity.

2. Methods

2.1. Study design and setting

This school-based, cross-sectional study was conducted between 2013 and 2015, in 19 randomly selected (10 private and 9 government), co-educational senior secondary schools in New Delhi. These schools were randomly selected from the list of government and private schools governed by the Directorate of Education (DoE), Government of National Capital Territory (NCT) of Delhi (Directorate of Education, 2018). The school type (private and government) was used as a proxy measure for SES in this study in accordance with earlier similar studies from India (Mathur et al., 2008). Permissions for implementation of the study were obtained from the DoE and the School Health Scheme (SHS), Government of NCT of Delhi. Ethics approval for research involving human subjects for this study was obtained from the Public Health Foundation of India's (PHFI) Institutional Ethics Committee and Research Ethics Committee at London School of Hygiene and Tropical Medicine (LSHTM).

2.2. Study participants

A total of 1566 students (n = 729 from government and n = 837 from private schools) from the selected 19 schools were eligible to participate in the study. The sample size estimation was based on prevalence estimates of four major risk factors for NCDs (tobacco use, alcohol use, physical inactivity and overweight/obesity) in children from studies conducted in India (Tsering et al., 2010; Stigler et al., 2011; Mathur et al., 2008; Kameswararao and Bachu, 2009). An active informed consent procedure was followed in which informed consents from schools and parents along with students' assents were obtained after assuring confidentiality. The study sample was subdivided into two age groups: 6–7 years (*junior students from grade 2*) and 15–16 years (*senior students from grade 11*). Out of 1566 eligible students, 1329 (i.e., 85%) students who had complete data on all the anthropometric, biochemical, and physiologic measures, were included in our study.

2.3. Measures

The anthropometric, biochemical and physiological measurements of students were done by trained research staff, including a laboratory technician, using standardized protocols. Anthropometric measurements included height, weight and waist circumference (WC) measurement. Two readings for each student were obtained, using a protocol adapted to suit the Indian context (Lohman et al., 1988; Taylor et al., 2000). Omron Blood Pressure monitor (Model HEM-7120; with a pediatric cuff for junior students) was used to monitor the blood pressure of each student in sitting position (two readings per student, in resting condition and at an interval of 5 min). The biochemical analysis included lipid profile (total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C) using Cholestech LDX (Model P/N: 412 00008) portable blood analyzer (Reis et al., 2006).

Students were grouped into four weight categories using the World Health Organization (WHO) age- and gender-specific Body Mass Index (BMI) growth references (WHO, 2018b, 2018c). These groups were underweight (BMI below −2 standard deviations [SD] in the WHO reference population), normal (between -2SD and 1SD), overweight (between 1SD and 2SD) and obese (more than 2SD).

Students whose WC values were more than age- and gender-specific 70th percentile cut-off were categorized as high WC and were considered to be at increased risk of NCDs (Khadilkar et al., 2014). The WC was measured using a non-stretchable measuring tape, at a level midway between the lower rib margin and iliac crest with participants in standing position; the measurements were done to the nearest 0.1 cm (Lohman et al., 1988).

Blood pressure categories were formed based on systolic blood pressure (SBP) and diastolic blood pressure (DBP) values by percentiles of height in boys and girls of age 3 to 18 years using cut-offs provided by Krishna et al. (2006). Normal, pre-hypertensive and hypertensive categories were defined for values of SBP and DBP both < 90th percentile, between 90th to < 95th percentile and ≥95th percentile, respectively.

Guidelines from the National Cholesterol Education Program for Children and Adolescents, USA were used to report TC, LDL-C, and HDL-C (NHLBI, 2012). For TC, the acceptable value was < 170 mg/dl, the borderline value was between 170 and 199 mg/dl and the high value was ≥200 mg/dl. For LDL-C, the acceptable value was < 110 mg/dl, the borderline value was between 110 and 129 mg/dl and the high value was ≥130 mg/dl. For HDL-C the acceptable value was > 45 mg/dl, the borderline value was between 40 and 45 mg/dl and the low value was ≤40 mg/dl.

2.4. Statistical analysis

Mixed-effects regression models were used to investigate the prevalence of physiological, biochemical, and metabolic risk factors for NCDs among Indian youth. Mixed-effect models are used in cluster sample to minimize the Type I error rate and to ensure that the most conservative standard error is estimated (Raudenbush and Bryk, 2002). Models of the overall analysis were adjusted for age, gender and grade. Furthermore, the analyses were further stratified by gender and grade to better understand the distribution of these risk factors. The differences in the prevalence of NCD risk factors were considered to be statistically significant across government and private school students (and for the sub-group analyses) for a p-value < 0.05. All analyses were conducted using SAS for Windows (version 9.3; SAS Institute Inc.).

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