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A Cross-Sectional Prospective Study of Asymptomatic Urinary Abnormalities, Blood Pressure, and Body Mass Index in Healthy School Children

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Introduction: Screening school children for urinary abnormalities is an inexpensive task but is not commonly undertaken in India. Although debated in western countries, its utility in early diagnosis of kidney disorders has been proved by studies from Asia. We examined the prevalence of asymptomatic urinary abnormalities (AUA), obesity, and hypertension in school children and analyzed data to identify potential risk factors among those detected with such abnormalities.

Methods: Children and adolescents 8 to 18 years of age of either gender, attending 14 public schools in West Bengal, were screened prospectively from July 2013 to July 2016 for detecting asymptomatic urinary abnormalities by a spot urine test using a dipstick. Sociodemographic profile, medical examination (weight, height, and blood pressure), and questionnaire-based data were recorded.

Results: A total of 11,000 children were screened. Of these, data from 9306 children were available for AUA, obesity, and hypertension. The prevalence rate was 7.44% (95% confidence interval [CI] = 6.91%–7.97%) for at least 1 AUA. Isolated hematuria was present in 5.2% (95% CI 4.75%–5.65%), whereas isolated proteinuria was present in 1.9% (95% CI = 1.62%–2.18%). The prevalence of prehypertension was 13.43% (95% CI = 12.74%–14.12%) and that of hypertension and abnormal body mass index was 4.05% (95% CI = 6.43%–7.47%) and 38.67 (95% CI = 37.68%–39.66%) respectively.

Discussion: The prevalence rates of AUA were comparable with those in some Asian countries but higher than in most developed countries. Of children and adolescents 8 to 18 years of age, those 13 to 18 years had significantly more high risk factors such as AUA, hypertension, and obesity.

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Screening for urinary abnormalities is generally considered important for adults, but there is no clear consensus with respect to children.[1] Asian countries such as Japan, Taiwan, and Korea have already established annual primary school screening programs for children. Published data from Japan have demonstrated a significant impact of population-based screening in children in the form of an increase in the mean age of end-stage renal disease (ESRD) mainly due to glomerulonephritis. However, in Japan, like India, diabetic nephropathy is now emerging as a leading cause of ESRD.[2] In India, population-based data on chronic kidney disease (CKD) is not very robust, but a high overall prevalence of 17.2% has been reported.[3] Among the causes of CKD, diabetic nephropathy (31%) has been reported as the most common, followed by CKD of unknown origin (16%), chronic glomerulonephritis (14%), and hypertensive nephrosclerosis (13%).[4] This is based on data obtained from the adult population. In pediatric and adolescent age groups, detection of early proteinuria, hematuria, proteinuria with hematuria, hypertension, body mass index (BMI) abnormalities, and a composite data analysis may be more helpful in diagnosing renal disease earlier and initiating measures to slow progression to advanced stages of CKD. The mean age at diagnosis of diabetes in India is lower than in other developed countries.

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Obesity plays a central role in the insulin resistance syndrome, which includes hyperinsulinemia, hypertension, hyperlipidemia, type 2 diabetes mellitus, and increased risk of atherosclerotic cardiovascular disease.[5,6] The incidence of type 2 diabetes reported in children has increased alarmingly. Screening programs for children in India must be tailored to the epidemiology of CKD in the country. This study is the first to take a multipronged approach to analyze the prevalence of asymptomatic urinary abnormalities, obesity, and hypertension in children as well as to identify the high-risk group among these children.

METHODS

This was prospective, cross-sectional, population-based, observational study conducted from July 2013 to July 2016 at 14 public schools of Kolkata district in the state of West Bengal and was coordinated from IPGMER Kolkata. After obtaining clearance from the institutional ethics committee and the concerned state and individual school authorities, we screened healthy junior and high school children and adolescents 8 to 18 years of age for clinical parameters and asymptomatic urinary abnormalities (AUA). Children already diagnosed with hypertension, diabetes, or any systemic diseases as per their medical records were excluded. We decided to screen about 11,000 children so that we would get a sample of 7000 evaluable participants, assuming a prevalence rate of 2.5% (results of a previous study from India) of isolated hematuria, with a 95% confidence interval [CI] and a 5% margin of error.

Study tools included urine dipsticks (as they have acceptable sensitivity ranging between 91% and 96% and are relatively inexpensive[7]), blood pressure (BP), height, body weight recordings, and questionnaire-based data. The BMI percentiles were recorded as per the growth charts of the Indian Academy of Pediatrics (2015) for 5- to 18-year-old Indian children and adolescents.[8] The categories of hypertension and BMI abnormalities were based on the definitions provided by the NHBPEP Classification of Prehypertension and Hypertension in Children and Adolescents[9] and Centers for Disease Control and Prevention (CDC) definitions of childhood obesity,[10] respectively. Further details of methods and statistical analyses used are given as Supplementary Methods.

RESULTS

Figure 1 depicts the study activity flow chart and the number of evaluable subjects. A total of 11,000 children were screened, and complete data of 9306 children were available, of whom 52% (n = 4841) were boys and 48% (n = 4465) were girls. Of the total, 51.4% (n = 4780) were in 8 to 12 years of age (younger age group) and the remaining 48.6% (n = 4526) were 13 to 18 years of age (adolescent age group).

Table 1 summarizes the data for asymptomatic urinary abnormalities in the entire study population as well as the age-stratified subgroups. A total of 692 subjects had at least 1 or more urinary abnormality (blood/protein/leukocytes/nitrite).The point prevalence rate of asymptomatic urinary abnormality in the study population was 7.44% (95% CI = 6.91%−7.97%).

Analysis of different types of urinary abnormalities showed that isolated hematuria (IH) was present in 5.2% (n = 483; 95% CI = 4.75%−5.65%, whereas isolated proteinuria (IP) was present in 1.9% (n = 175; 95% CI = 1.62%−2.18%, and proteinuria with hematuria (HP) were present in 0.23% (n = 22) of the study population. Age-stratified analysis showed that isolated proteinuria and leukocytes in urine were significantly higher in the adolescent age group compared to the younger age group and that the difference was statistically significant ($P < 0.05$), whereas isolated hematuria was significantly higher in the younger age group. Proteinuria with hematuria, which may be a signature of glomerular disease or obstructive uropathy, was seen in 0.23% of children (n = 22).

Tables 2 and 3 depict the blood pressure abnormalities in the study population. In all, 20.38% (n = 1897) participants had some BP abnormality, that is, prehypertension or stage 1 or stage 2 hypertension (as defined in Materials and Methods). A significantly greater number of participants in the adolescent age group had abnormal BP compared with the younger age group, as shown in Table 2. Almost 1 in 4 adolescents and 1 in 5 of the entire study population had abnormal BP. As shown in Supplementary Table S3, BP abnormality of any category, prehypertension, and stage 1 hypertension were significantly more common in boys compared to girls. Asymptomatic urinary abnormalities were more common in the participants with hypertension (n = 1.16%) compared to those with normal BP ($P = 0.00$). Compared to the younger age group, the adolescent age group had a higher prevalence of urinary abnormality with abnormal BP (4.24 vs. 11.82%, $P = 0.00$), as shown in Table 3.

BMI abnormalities in the 2 age groups and gender distribution are shown in Table 4 and Supplementary Table S4, respectively. High BMI was significantly more prevalent in the younger age group and in girls ($P < 0.05$).

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