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Patterns and correlates of adult height in Sri Lanka

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ABSTRACT

The present study examines patterns and socioeconomic and demographic correlates of adult height among Sri Lankan adults. Data were available for height and socio-demographic factors from a nationally representative cross-sectional sample of 4477 subjects above 18 years. Recruitment was between 2005 and 2006. Mean age of all subjects was 46.1 ± 15.1 years. Mean height of males and females were 163.6 ± 6.9 cm and 151.4 ± 6.4 cm respectively. Mean height showed a significant negative correlation with age ($p < 0.001$, $r = -0.207$). Highest mean height in females 154.0 ± 5.9 cm and males 165.6 ± 6.9 cm were observed in those born after 1977. Rural females (151.4 ± 6.2 cm) were significantly taller than the urban (151.3 ± 7.2 cm). However, this was not observed in males. In multivariate analysis, year of birth, level of education and household income were significantly associated with height. Height demonstrated a significant negative correlation with systolic blood pressure ($r = -0.032$), presence of diabetes ($r = -0.069$), total cholesterol ($r = -0.106$), HDL cholesterol ($r = -0.142$) and LDL cholesterol ($r = -0.104$). Height was associated with household income and level of education in Sri Lanka and demonstrated a distinct increasing trend over successive generations.

1. Introduction

Height is considered an important indicator of nutrition and health of a population (Akachi and Canning, 2007; Deaton, 2007). In the last century, a consistent increase in mean height of adults has been found both in the developed and developing countries mirroring the improvements in nutritional (Hoppa and Garlie, 1998) and socio-economic status (Prebeg, 1998; Thomas and Frankenberg, 2002; Li et al., 2004). In Europe, height has been increasing in most populations (Garcia and Quintana-Domeque, 2007). However, recent studies have reported that the increase in height has reached a plateau in Germany (Zellner et al., 2004) and Poland (Krawczynski et al., 2003).

An increase in height has been reported from developing countries such as Brazil (Marmo et al., 2004), India (Virani, 2005), Cook Islands (Ulijaszek, 2001), Iran (Ayatollahi et al., 2006), and Mexico (Malina et al., 2004). Studies on secular changes in height in populations are useful for providing information on nutritional status in early life and updating reference standards on growth. It would also provide an insight to the epidemiological trends of cardiovascular disease (Wannamethee et al., 1998; Silventoinen et al., 2006). To our knowledge, there are no published data on adult height in Sri Lanka. Previous studies have been limited to adolescents.

In addition to the secular trends, height has also been known to be associated with the socio-economic status (Mascie-Taylor and Lasker, 2005) and higher intellectual performance (Tuvemoa et al., 1999). Height, a marker of

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childhood growth, is associated with lower mortality and morbidity from ischemic heart disease (Williams et al., 1997; McCarron et al., 2002) and associated risk factors (Brown et al., 1991; Langenberg et al., 2003). It is thought that better childhood conditions, such as improved nutrition and fewer respiratory infections, result in both greater adult height and lower rates of ischemic heart disease (Davey Smith et al., 2000).

The present study aims to describe the patterns of height and the underlying socioeconomic and demographic correlates among Sri Lankan adults. We also report the relationship of height with presence of diabetes mellitus, fasting blood glucose, systolic and diastolic blood pressure, lipid parameters and metabolic syndrome.

2. Materials and methods

2.1. Study population and sampling

Sri Lanka (previously known as Ceylon) is an island nation in South Asia, located about 31 km off the southern coast of the Indian Subcontinent. It has a population of about nineteen million people (Department of Census and Statistics Sri Lanka, 2001). Data on height and its correlates were collected as part of a wider national study on diabetes and cardiovascular disease. This cross-sectional study was conducted in seven of the nine provinces (Government of Sri Lanka, 2005) in Sri Lanka between August 2005 and September 2006. The Western, Southern, Sabaragamuwa, Uva, North-Western, Central and North-Central provinces were included while the Northern and Eastern provinces of the country affected by the war at that time had to be excluded from the study. Detailed sampling has been previously reported (Katulanda et al., 2008).

We recruited a nationally representative sample of 5000 non-institutionalized adults $\geq$18 years-of-age, using a multi-stage random-cluster-sampling technique. Those who were pregnant, acutely ill or declined participation were excluded. The selected households were visited by the study team. Informed consent was obtained from all study participants in each household after providing information before random selection. An eligible adult of age $\geq$ 18 years satisfying inclusion criterion was randomly selected from all eligible adults in each consenting household by simple random selection.

2.2. Data collection

Data collection was carried out by a field team of medical graduates and nurses who were trained in research methodology before commencing data collection. Temporary data collection centres were established within each cluster. Height was measured using Harpenden pocket stadiometers (Chasmors Ltd., London, UK) to the nearest 0.1 cm according to the standard methods (World Health Organization, 1995). The data collectors were regularly trained on the measurement techniques to ensure consistency over time and between centres. Stadiometers were checked for accuracy at regular intervals.

Urban and rural sectors were defined according to the classification of the Sri Lanka Department of Census and Statistics, where the urban sector comprised of all municipal and urban council areas (Department of Census and Statistics Sri Lanka, 2001). These areas generally comprise of towns or cities in individual districts closer to major highways with many important government institutions and trade. This classification does not necessarily depend upon the population size although the population density is generally higher in most urban areas compared to rural. Subjects were considered to have 'diagnosed diabetes' if they had been previously diagnosed at a government hospital or by a registered medical practitioner. New cases ('undiagnosed diabetes') were diagnosed according to the American Diabetes Association (American Diabetes Association, 1997) and World Health Organization criteria (World Health Organization, 1999). Metabolic syndrome was diagnosed based on International Diabetes Federation criteria (Alberti et al., 2006). Details of blood sample collection and biochemical analysis have been previously described (Katulanda et al., 2008). Seated blood pressure was recorded on two occasions after at least a 10-min rest using an Omron IA2 digital blood pressure monitor (Omron Healthcare, Asia-Pacific Region, Singapore).

2.3. Statistical analyses

All data were double-entered and cross checked for consistency. Data were analysed using SPSS version 14 (SPSS Inc., Chicago, IL, USA) and Stata/SE 10.0 (Stata Corporation, College Station, TX, USA) statistical software packages. Height is reported according to the year of birth, gender, household income, level of education and sector of residence. The significance of the differences between proportions (%) and means were tested using z-test and Student's t-test or ANOVA, respectively.

A multivariate analysis was performed in both males and females with 'height' as the dependent variable and year of birth (stratified in to birth decades), level of education, household income and sector of residence (Urban/Rural) as the independent variables (co-variates). For each independent variable with more than two categories, dummy variables were created. The first category was taken as the reference category for these variables (year of birth – 'Before 1936', level of education – 'no formal education', household income – '<LKR 6999/ <US$ 61.9'). In all statistical analyses P values <0.05 were considered significant.

3. Results

Out of the 5000 invited subjects, 4532 participated in the study (response rate 91%). This report is based on 4477 subjects excluding 55 subjects with incomplete data. In our sample 39.5% were males and 17.6% were from the urban population (21% of Sri Lankans are urban). The highest mean height ($\pm$SD) in males and females was observed in those born after 1977 (youngest age group). The mean height showed a significant negative correlation with year of birth in both males ($p < 0.001$, $r = -0.258$) and females ($p < 0.001$, $r = -0.310$).