The association between socioeconomic status and subclinical atherosclerosis in a rural Bangladesh population

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ABSTRACT

Background. In Bangladesh, CVD accounts for the majority of non-communicable mortality. The purpose of this study was to determine the role of socioeconomic status (SES) on subclinical atherosclerosis measured as carotid intima-media thickness (IMT) in a rural Bangladesh population.

Methods. Carotid IMT was measured between 2010 and 2011 in 1022 participants (average age 46, 40% male) randomly selected from the Health Effects of Arsenic Longitudinal Study (HEALS), a population-based prospective cohort study based in rural Bangladesh. SES was measured as occupation type, land ownership, educational attainment, and television ownership.

Results. Half of the participants received formal education (53%) and under half owned land (48%) and a television (44%). Women were primarily homemakers (95%) and men worked as factory workers (24%), laborers (18%), or in business (55%). In univariate analysis, those owning greater than one acre of land (p = 0.03), owning a television (p = 0.02), or laborers and business owners compared to factory workers had higher levels of carotid IMT (p < 0.01). In multivariate analysis after adjustment for confounders, only men employed in the business sector had elevated carotid IMT compared to factory workers. The association was strongest in older men (58.7 μm, 95% CI 17.2–100.0, ≥50 years old) compared to younger men (13.7 μm, 95% CI −7.8–35.2, <50 years old).

Conclusion. Business sector employment was positively associated with subclinical atherosclerosis after adjustment for confounders. This finding is consistent with evidence from other developing nations suggesting that certain SES factors are independent predictors of CVD.

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1. Introduction

Cardiovascular disease (CVD) mortality in South Asian countries such as Bangladesh has risen 30 fold over the past 30 years (Ahsan Karar et al., 2009). CVD is now one of the leading causes of mortality (El-Saharty et al., 2013). The onset of CVD within the South Asian population occurs 5–10 year earlier in life with a 5–10 times higher rate of CVD death prior to the age of 40, compared with other populations (Enas and S., 2001). The mechanisms for this rise in CVD mortality are multifactorial. With regards to lifestyle changes, the increased rates of obesity, metabolic syndrome and change in dietary patterns all associated with progressive industrialization and urbanization has led to worsening cardiometabolic profiles and increased CVD death.

As South Asian populations such as the Bangladeshi population modernize, the contribution of socioeconomic status (SES) factors

leading to increased CVD requires more careful evaluation. In industrialized nations, CVD mortality is inversely related to SES (Kaplan and Keil, 1993). This relationship in low-income nations however is less clear and studies on the contribution of SES to CVD have shown mixed results. Furthermore, in low income countries, markers of SES may be different than in higher income ones (Vathesatogkit et al., 2014).

Typically, CVD takes decades to develop and presents sub-clinically prior to a cardiovascular event. The studying of subclinical atherosclerosis is one potential way to estimate the contribution of various risk factors towards the development of CVD. Carotid intima-media thickness (IMT) is a surrogate measure of atherosclerosis which predicts the risk of subsequent CVD events (Thurston et al., 2014).

In developing countries with limited resources such as Bangladesh, it is important to understand the demographics, risk factors and the development of CVD in order to focus preventive measures. Several studies in developed nations have explored the link between SES and carotid IMT and found that low education, low income, or manual occupation were associated with a thicker carotid arterial wall (Diez-Roux et al., 1995; Ebrahim et al., 1999; Lamont et al., 2000; Lynch et al., 1995; Nash et al., 2011; Rosvall et al., 2000) or with faster progression of carotid wall thickness (Lynch et al., 1997). These studies however, do not necessarily translate to underdeveloped or low-income countries. In addition, the contribution of SES within South Asian populations to subclinical atherosclerosis has not yet been described. The purpose of our study was to evaluate the association between SES and carotid IMT within the rural Bangladesh population.

2. Methods

2.1. Study population

The Health Effects of Arsenic Longitudinal Study (HEALS) is an ongoing population-based prospective cohort study in Araihazar, Bangladesh, a rural subdistrict of Dhaka (McClintock et al., 2014a). Briefly, between October 2000 and May of 2002 a total of 11,746 married (to reduce loss to follow-up) men and women were recruited between the ages of 18 to 75 years from a well-defined 25-km^2 geographical area where they had resided for at least 5 years. Between 2006 and 2008 the HEALS was expanded to include an additional 8287 participants using the same methodology. Study participants underwent demographic and lifestyle data collection using standardized questionnaires. A detailed description of the study protocol has been previously published and described (Ahsan et al., 2006). The overall study participation rate was 97%.

Out of the original and expanded cohort members, 800 were randomly selected from the original cohort and 700 participants from the expansion cohort (total n = 1500) to undergo carotid IMT measurements (Chen et al., 2013a). Two hundred and ninety four participants originally selected were unable to complete carotid IMT measurements due to death, move, serious illness (20%) or time constraints (80%). From previously published data on analysis of carotid IMT within this group, the distribution of demographic and lifestyle variables in the study population and in the overall cohort were similar (McClintock et al., 2014a). In total, IMT was measured for 1206 individuals consisting of 600 from the original cohort and 606 from the expansion cohort (McClintock et al., 2014). Informed consent was obtained from study participants and the procedures were approved by the Ethical Committee of the Bangladesh Medical Research Council and the Institutional Review Boards of Columbia University and the University of Chicago.

2.2. Anthropometric and socioeconomic assessment

Baseline in-person interviews were performed by trained personnel with detailed questionnaires on lifestyle characteristics. Participants were asked to provide information on demographics, medical co-morbidities (including self-reporting of diabetes mellitus type II, DM II),

cigarette smoking, and betel-nut usage. Questions were also answered on SES as defined by television ownership, land ownership, years of education and occupation. In the original dataset occupation status was recorded as daily laborers or farmers, factory workers, business workers or other similar jobs, homemaker, and unemployed for a total of 5 categories of occupation status. The specific occupations of individuals reporting 'business workers' or 'other similar jobs' were heterogeneous but primarily included merchants, store or factory owners or contractors. Anthropometric measurements including height, weight and blood pressure were performed using standard techniques (Chen et al., 2007; Pierce et al., 2010; Chen et al., 2006).

2.3. Measurement of carotid IMT

Carotid IMT measurements were performed between April 2010 and September of 2011 (on average 7.2 years after baseline demographic information was obtained). Detailed methodology for carotid IMT measurements used in this study have been described elsewhere (McClintock et al., 2014a). Briefly, all measurements were obtained by 1 physician trained in sonography on a SonoSite MicroMaxx ultrasound machine (SonoSite, Bothell, WA) equipped with an L38e/10-5 MHz transducer. The protocol used was designed and implemented in the Oral Infections and Vascular Disease Epidemiology Study (INVEST) (Desvarieux et al., 2005). The carotid arteries were scanned longitudinally in 3 segments using the lateral extent of each carotid segment as defined relative to the tip of the flow divider, which is typically the most well defined anatomical reference in the proximity of the carotid bifurcation. The mean of the near and far walls of the maximum common carotid artery IMT of both sides of the neck (mean of twelve measurements) was used as the main outcome variable which is similar to previous reported studies (O'Leary et al., 1999; Kitamura et al., 2004; Touboul et al., 2012). Carotid IMT values are reported in this paper in thousandths of a millimeter (typically reported in tenths of a millimeter) to remain consistent with previously published studies using this same cohort (Chen, et al., 2013a).

2.4. Statistical analysis

Of the 1206 participants, we excluded those who were missing data on SES (n = 2), systolic blood pressure (SBP) (n = 172), body mass index (BMI) (n = 180), cigarette use (past and present) (n = 172), and betel nut use (n = 174). The final analysis included a total of 1022 participants. We first conducted descriptive analysis of population characteristics and socioeconomic status across interquartile carotid IMT. Occupation status was divided into 5 categories as described above. Land ownership was modeled as a yes/no variable as well as split into no land, less than or equal to 1 acre and >1 acre. Education status was similarly broken down into yes/no and split into no education, 1 to 5 years of schooling or 6 or greater years, according to the Bangladeshi education system. Interquartile differences were analyzed using a one-way analysis of variance (ANOVA) for continuous variables and chi-squared for categorical variables. Then, we conducted linear regression models with carotid IMT modeled as a continuous dependent variable and each SES attribute modeled as an independent variable. Assumptions of linear regression were checked and none was violated. Next carotid IMT was modeled using multivariable analysis adjusting firstly for age and sex (model 1), and then BMI, SBP, smoking (never, past and present smokers), and betel nut use (never, past and present users) additionally (model 2). These factors are known independent predictors of carotid IMT. The comparison of the two models can help assess to what extent the association between SES and cIMT can be explained by other variables, including potential mediators. Multivariable regression analysis was performed for the overall cohort and stratified for men and women separately. Stratified analysis was also conducted by age within men in an attempt to further assess whether the association between occupation and IMT differed by age. Because in our cohort