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Case report

Biomarkers of cardiovascular and metabolic diseases in otherwise healthy overweight subjects in Bangladesh

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ABSTRACT

Biomarkers of cardiovascular and metabolic diseases were assessed in Bangladeshi overweight subjects categorized by Asian BMI criteria. After screening 300 people, 90 apparently healthy subjects were enrolled and grouped into normal weight, overweight and obese. Compared to normal weight, the overweight and obese groups showed significant elevation of serum triglyceride, insulin, homocysteine, insulin resistance/sensitivity, and atherogenic index of plasma. Cardiometabolic biomarkers did not differ between overweight and obese groups. Some biomarkers showed correlation with BMI in overweight but not in obese group. It was concluded that cardiometabolic biomarkers are elevated in Bangladeshi overweight subjects categorized by Asian BMI criteria.

1. Introduction

Obesity has been officially recognized as a disease [1] and its prevalence is rapidly rising globally [2,4]. Overweight and obesity directly contribute to the development of cardiovascular diseases and type 2 diabetes mellitus [2]. Body mass index (BMI) is an important and easy measure of body fatness, and the standard BMI cut-off points (BMI 18.5–24.9 kg/m^2 for normal weight, 25.0–29.9 for overweight, and ≥30.0 for obese persons) are widely accepted all over the world [2]. However, the World Health Organization (WHO) has recommended lowering of BMI cut-off points (BMI 18.5–22.9 kg/m^2 for normal weight, 23.0–27.4 for overweight and ≥27.5 for obese persons) for Asian people considering the increased percentage of body fat and higher risk of cardiovascular and metabolic diseases for Asians compared to European populations (3). But this recommendation is not followed or rarely followed by the health care personnel including physicians in Bangladesh, a South Asian country in the Indian subcontinent. In fact, majority of the health care professionals including physicians are even unaware of the existence of different BMI cut-off points for the people of Bangladesh.

Bangladesh is a developing country where adequate food security is not yet ensured for all, and more than 20% men and 25% women are still underweight in Bangladesh [4]. Due to poverty, ignorance and lack of (health) education lean and thin persons in this society are usually considered by themselves and by others as having ill health. Thus, in this poor socioeconomic setting, both normal weight and underweight people have a tendency to gain weight by any means, mostly by overconsumption of processed carbohydrates and other unhealthy foods. At the same time, a large group of affluent people are also getting fatty since they lead a sedentary life and consume unhealthy foods with no regular exercise. The normal weight and underweight people who gain weight many of them eventually fall within the category of overweight. Since the BMI cut-off points have been lowered for Asians [3], many of those who fall in the category of overweight (BMI 23.0 to 27.4 kg/m^2) are actually normal weight according to standard BMI classification (BMI <25.0 kg/m^2), and many of them are considered as just healthy or in a state of good health rather than overweight. The present study was therefore designed to explore whether the otherwise healthy subjects who are overweight according to Asian BMI classification have altered levels of biomarkers of cardiovascular and metabolic diseases including triglyceride (TG), high density lipoprotein-cholesterol (HDL-C), homocysteine (Hcy), atherogenic index of plasma (AIP), insulin resistance (IR)/sensitivity and beta cell function.

Abbreviations: AIP, atherogenic index of plasma; BMI, body mass index; HDL-C, high density lipoprotein-cholesterol; HOMA-IR, homeostasis model assessment of insulin resistance; HOMA-%B, homeostasis model assessment of beta cell function; Hcy, Homocysteine; QUICKI, quantitative insulin sensitivity check index; tHcy, total homocysteine; TG, triglyceride; WHO, World Health Organization.

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2. Materials and methods

In this cross-sectional study, we screened 300 people who came as patients' attendant in the outpatient department at the Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh, after giving informed written consent. In the screening we excluded people with diabetes, hypertension, chronic liver and kidney diseases, pregnancy and history of regular medication, and selected 90 apparently healthy subjects and grouped them into normal weight (n = 22, BMI 18.5–22.9 kg/m^2), overweight (n = 24, BMI 23.0–27.5 kg/m^2) and obese (n = 44, BMI ≥ 27.5 kg/m^2) based on Asian BMI cut-off points [3]. The study was conducted according to the Declaration of Helsinki and was approved by the institutional ethical review board. A detailed medical history was taken, clinical examination was performed and a fasting blood sample was collected after an overnight fasting of >12 h from all subjects. Fasting glucose, TG and HDL-C levels were measured by enzymatic spectrophotometric method using Dimension® RxL Max® clinical chemistry analyzer (Siemens Healthcare Diagnostics Inc., Newark, DE, USA). Fasting serum insulin levels were measured by microparticle enzyme immunoassay technique and total homocysteine (tHcy) levels were measured by fluorescence polarization immunoassay method (Abbott Diagnostics, Wiesbaden, Germany) using an Abbott AxSYM system. The IR and beta cell function were calculated as homeostasis model assessment of IR (HOMA-IR) [(glucose × insulin)/22.5] and homeostasis model assessment of beta cell function (HOMA-%B) [(20× insulin)/(glucose − 3.5)], respectively, where glucose in mmol/L and insulin in μU/mL. Insulin sensitivity was assessed by calculating quantitative insulin sensitivity check index (QUICKI = 1/[log (insulin, μU/mL) + log (glucose, mg/dL)]), and atherogenic index of plasma (AIP) was calculated as log (TG/HDL-C)), where TG and HDL-C were in mmol/L. Data are presented as mean ± SD or median (interquartile range, IQR) and analyzed by one-way ANOVA followed by Bonferroni corrected *t*-test or Kruskal-Wallis test followed by Mann-Whitney *U* test depending on the pattern of data distribution. Categorical variables were analyzed by χ^2 test. Correlations were determined by Pearson's correlation analysis. A two-tailed value of $p < 0.05$ was considered statistically significant.

3. Results

As shown in Table 1, the age (41.9 ± 9.9; 21–58 years), sex (m = 45, f = 45) and fasting blood glucose levels (4.76 ± 0.65 mmol/L) were found similar among subjects with normal weight, overweight and obesity. As expected, BMI was significantly higher in overweight and obese groups compared to normal weight group, and in obese group compared to overweight group ($p < 0.001$). Among the biomarkers of cardiovascular and metabolic diseases the HDL-C levels were found similar among the 3 groups. However, as shown in Table 1, compared to normal weight group the obese group showed significantly higher levels of serum TG, insulin, Hcy, insulin resistance and sensitivity, beta cell function and atherogenic index of plasma. Importantly, the overweight group compared to the normal weight group also showed significant elevation in most of the cardiometabolic biomarkers including serum TG, insulin, Hcy, IR and insulin sensitivity, and AIP. Furthermore, the overweight group did not show any significant difference in any of those cardiometabolic biomarkers compared to obese group (individual p values are shown in Table 1). Importantly, as shown in Table 2, BMI showed significant correlation with TG ($p < 0.001$), Hcy ($p = 0.001$), AIP ($p < 0.001$), IR ($p = 0.037$) and insulin sensitivity ($p = 0.011$) in overweight group but not in normal weight or obese group. As expected, all the biomarkers showed significant correlation with BMI when 3 groups of the study subjects were considered together (Table 2).

4. Discussion

The WHO recommended to adopt lower BMI cut points for the Asians considering the increased percentage of body fat in Asian people compared to European whites of same age, sex and BMI, as well as the higher risk of cardiovascular disease and type 2 diabetes in Asians even at low BMI (<25.0 kg/m^2) [3]. Subsequently, several studies emphasized the clinical utility of using lower BMI cut points for Asian peoples including South Asians living abroad

Table 1
Clinical and biochemical characteristics of the study subjects.

Variables	Normal weight (BMI 18.5–22.9 kg/m^2)	Overweight (BMI 23–27.49 kg/m^2)	Obese (BMI ≥27.50 kg/m^2)
N	22	24	44
Age (years)	40.86 ± 10.26	43.67 ± 9.87	41.43 ± 9.84
Sex, m/f (n)	11/11	13/11	21/23
BMI (kg/m^2)	21.21 ± 1.15	25.46 ± 1.38[b]	31.10 ± 2.28[b,c]
Glucose	4.7 ± 0.6	4.8 ± 0.7	4.7 ± 0.6
TG (mg/dL)	96 ± 32	160 ± 75[d]	167 ± 53[b]
HDL-C	39.3 ± 8.7	36.1 ± 7.7	34.8 ± 7.9
Insulin[a]	6.5 (5.2–10.9)	11.00(8.3–15.6)[e]	13.6 (10.2–18.6)[b]
Homocysteine	12.3 ± 3.0	18.2 ± 6.1[b]	18.5 ± 5.4[b]
HOMA-IR[a]	1.31 (1.03–2.07)	2.55 (1.91–3.26)[d]	2.81 (2.32–4.25)[b]
HOMA-%B[a]	121 (84–245)	149 (87–360)	227 (144–382)[d]
QUICKI	0.36 ± 0.03	0.34 ± 0.03[f]	0.33 ± 0.02[b]
AIP[a]	0.053 (−0.091–0.120)	0.281 (0.038–0.476)[d]	0.331 (0.167–0.448)[b]

Data are mean ± SD, number and median (interquartile range). BMI, body mass index; TG, triglyceride; HDL-C, high density lipoprotein-cholesterol; HOMA-IR, homeostasis model assessment of insulin resistance; HOMA-%B, homeostasis model assessment of beta cell function; QUICKI, quantitative insulin sensitivity check index; AIP, atherogenic index of plasma.
[a] Data distribution is not normal and expressed as median (interquartile range).
[b] $p < 0.001$ versus normal weight group.
[c] $p < 0.001$ versus overweight group.
[d] $p < 0.01$versus normal weight group.
[e] $p = 0.011$ versus normal weight group.
[f] $p = 0.028$ versus normal weight group.

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