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Body mass index, waist circumference, hip circumference, waist–hip-ratio and waist–height-ratio: Which is the better discriminator of prevalent screen-detected diabetes in a Cameroonian population?

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ABSTRACT

Background: The link between measures of adiposity and prevalent screen-detected diabetes (SDM) in Africa has been less well investigated. We assessed and compared the strength of association and discriminatory capability of measures of adiposity including body mass index (BMI), waist circumference (WC), hip circumference (HC), waist–hip-ratio (WHR) and waist–height-ratio (WHtR) for prevalent SDM risk in a sub-Saharan African population.
Methods: Participants were 8663 adults free of diagnosed type 2 diabetes, who took part in the nationally representative Cameroon Burden of Diabetes (CAMBoD) 2006 survey. Logistic regression models were used to compute the odd ratio (OR) and 95% confidence interval (95%CI) for a standard deviation (SD) higher level of BMI (7.3), WC (12.5), HC (11.7), WHR (0.19) and WHtR (0.08) with prevalent SDM risk. Assessment and comparison of discrimination used C-statistic and relative integrated discrimination improvement (RIDI, %).
Results: The adjusted OR and 95%CI for prevalent SDM with each SD higher adipometric variable were: 1.05 (0.98–1.13) for BMI, 1.30 (1.16–1.46) for WC, 1.18 (1.05–1.34) for HC, 1.05 (1.00–1.16) for WHR and 1.26 (1.11–1.39) for WHtR. C-statistic comparisons and RIDI analyses showed a trend toward a significant superiority of WC over other adipometric variables in multivariable models. Combining adiposity variables did not improve discrimination beyond multivariable models with WC alone.
Conclusion: WC was the best predictors and to some extent WHtR of prevalent SDM in this population, while BMI and WHR were less effective.

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Abbreviations: OR, odd ratio; SDM, screen detected diabetes mellitus; SD, standard deviation; BMI, body mass index; WC, waist circumference; WHR, waist–hip ratio; WHtR, waist–height ratio; HC, hip circumference; RIDI, relative integrated discrimination improvement.

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1. Introduction

More than one billion adults worldwide meet the definition for excess weight. It is well documented that overweight and obesity have been increasing in both developed and developing countries [1,2]. Body mass index (BMI) has been routinely used in clinical and public health practices for decades to identify individuals and populations at risk of future obesity related conditions such as cardiovascular disease and diabetes mellitus [3]. Other common surrogates of obesity include waist circumference (WC) and waist–hip-ratio (WHR). Waist circumference and WHR are the most common proxy measures of visceral adipose tissue (VAT), as they demonstrate a strong correlation with increased risk of numerous health outcomes as well as mortality in the majority of populations [4]. Accumulating evidence consistently shows that both a larger waist and narrow hip heighten risk of cardiovascular disease (CVD), coronary heart disease, diabetes and premature death [5,6]. The relationship between BMI and other indices of obesity with the risk of developing diabetes has been well established [7]. However, opinion is divided as to which is a more appropriate predictor of diabetes, and several studies have recommended the use of anthropometric measures which capture abdominal adiposity [WC, WHR, or waist–height-ratio (WHtR)] as alternatives to and in addition to BMI in assessing the prediction of diseases in clinical practice and public health in general [8–10]

Available studies on the comparative predictiveness of various indices of obesity, for the adverse health of obesity have been based on data from Europe, Northern America and parts of Asia. Little is available from the sub-Saharan Africa region while there are suggestions that the nature of the association between some obesity marker and disease risk could differ between Africans and other ethnic groups [11]. Accordingly, the present study aimed to assess and compare the strength and discriminatory power of BMI and other obesity indices in predicting screen-detected diabetes in a representative sample of Cameroonians.

2. Participants and methods

Participants were adult women and men with no history of diagnosed diabetes who took part in the Cameroon Burden of Diabetes (CAMBoD) 2006 survey. This survey was conducted in four ecological zones, purposefully chosen to be representative of the Cameroon population. The study sites were the health districts of Biyem-Assi (Yaoundé), Cite des palmiers (Douala), Bamenda and Garoua, with a target sample size of 2500 subjects per sites. The study was approved by the Cameroon National Ethical Committee and the Ministry of Public Health.

2.1. Inclusion and exclusion criteria

Those included in the study were 25 years and above, and those who were willing to participant and comply with instruction of the study (e.g. overnight fasting). Pregnant women, individuals suffering from psychiatric illness and those who were unable to walk unaided were not included in the study.

2.2. Sampling technique

The sampling scheme employed was a multistage systematic sampling stratified by age group. Each sentinel site constituted a cluster and the health area, within which the district hospital was implanted, constituted the area frame. The households of the selected health area were considered the final sampling unit. A census had been conducted in the entire selected health areas, where the households in the study site had been enlisted and all adults aged 25 years and above registered. The total number of subjects within each age group was determined. This was used to calculate the percentage contribution of each age group to the total population. This population percentage for each age group was then used to determine the number of households which was needed to achieve the desired sample size for each age group. The number of households obtained for each age group was then divided by the number of subjects in each group to obtain the sampling interval. The first household was selected randomly and individual age group sampling intervals were then used to obtain the households from which all the subjects were obtained. A household was defined as a group of people who share a common residence (live together) and partake in common meals.

2.3. Evaluation

During household visits, data were collected on the demographics, lifestyles/core behavioral profile, anthropometric and biochemical measures for each eligible participant, by trained medical personnel following the steps 1, 2 and 3 of the WHO STEPS instrument (Version 1.3) for Non-Communicable Diseases and their risk factor surveillance that was adapted for the CAMBoD project with respect to local specifications. The main sections included a self-reported information questionnaire (step 1), anthropometrical measurements (step 2) and the biochemical measurements (step 3).

2.4. Questionnaire

Basic core, expanded and optional variables with regard to socio-economic and demographic data, diabetes and its risk factors (tobacco, dietary habits and physical activity) were self-reported by the subjects. The type of last educational institution attended was used, assigning four categories: none (attended no educational institution), primary (1–7 years of education), secondary (8–14 years of education), and university (>14 years of education). The classification used for smoking was non-smoker (has never smoked + ex-smoker) and smokers (current smokers); fruits and vegetables: number of days eaten/week; physical activity; leisure time (standing or sitting for more than 10 min denoted as yes/no), moderate activity (days/week and time spent on each activity), vigorous activity (days/week and time spent on each activity).

2.5. Anthropometric measurements

Physical measurements were height, weight, waist and hip circumference (HC), diastolic and systolic blood pressure and pulse rate. All measurements were assessed using standardized