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Hyperuricaemia is an independent factor for the metabolic syndrome in a sub-Saharan African population: A factor analysis

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Abstract

Objective: To assess the risk factor pattern of the metabolic syndrome and its association with insulin resistance and hyperuricaemia in a sub-Saharan African population with different levels of urbanisation.

Methods: Four hundred forty-eight black South African volunteers, men and women aged 15 years and older were investigated in a cross-sectional, comparative, population-based survey. Subjects were stratified into three groups representing different levels of urbanisation in rural and urban areas. The metabolic syndrome was defined according to IDF criteria. Factor analysis was used to examine the risk factor pattern of the metabolic syndrome.

Results: The prevalence of the metabolic syndrome was low and did not differ across the three groups. Factor analysis showed slight differences in the metabolic syndrome pattern between the groups. Hyperuricaemia–hypertriglyceridaemia was identified as distinct component in the rural and semiurban group whereas hyperinsulinaemia was loaded together with other risk factors. In the entire study population, five factors could be identified in the following sequence: obesity, hypertension, hyperuricaemia–hypertriglyceridaemia, hyperglycaemia and hyperinsulinaemia. Subjects with hyperuricaemia but not with insulin resistance exhibited an increased risk to develop the metabolic syndrome.

Conclusions: Hyperuricaemia was revealed as additional component of the metabolic syndrome in sub-Saharan Africans and should be given more attention in prevention settings.

Keywords: Metabolic syndrome; Factor analysis; Hyperuricaemia; Insulin resistance; Urbanisation

1. Introduction

Obesity and related disorders are a growing health problem with the metabolic syndrome affecting millions of people worldwide. The metabolic syndrome clusters a range of metabolic and clinical abnormalities featuring central obesity, dyslipidemia, hypertension, and glucose intolerance. In the late eighties it was proposed that insulin resistance played a crucial role in the aetiology of the metabolic syndrome but this remains controversial down to the present day [1]. Neither insulin nor insulin resistance is part of the latest definition of the metabolic syndrome [2]. Like insulin resistance, elevated uric acid (hyperuricaemia) forms another consistent feature of the metabolic syndrome what led to the suggestion of uric acid being a new component of the syndrome [3]. This claim was substantiated by several research reports providing convincing evidence of a close relationship between

Abbreviations: CPTV, cumulative percentage of the total variance; DBP, diastolic blood pressure; Glu_0, fasting glucose; Glu_{120}, postchallenge 2-h glucose; IDF, International Diabetes Federation; Ins_0, fasting insulin; SBP, systolic blood pressure; TG, triglycerides; UA, uric acid.

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hyperuricaemia and risk factors of the metabolic syndrome [4–6].

The multitude of clinical and biochemical alterations resembling the metabolic syndrome, the strong cross-linkage of involved pathways and multiple feedback mechanisms complicate the identification of the causal factor in the aetiology of the metabolic syndrome [2,7]. Strong intercorrelations between variables of the metabolic syndrome make it difficult to determine independent associations with common multivariate statistical methods [7]. Factor analysis is the method of choice to identify a concise subset of statistically independent variable clusters (factors) which explain most of the variance that is observed in a much larger number of manifest variables. Those subsets, however, represent distinct physiological phenotypes or patterns which may overlap in some cases. Factor analysis can also be used to identify a single dominant factor of risk variable clustering.

Studies in different ethnic groups revealed different patterns of risk variable clusters comprising in general two to four factors [7–12]. Despite marked differences between investigated populations, insulin resistance presented the major commonality between the distinct factors but was rarely identified as isolated component in the metabolic syndrome cluster [7–12]. So far, there exists only one study in a Chinese population where uric acid was included in the factor analysis. The investigators, however, did not find any significant contribution of uric acid to the metabolic syndrome in that specific Asian population [13]. No similar studies have been performed in black subjects from Africa but might be of importance since rapid urbanisation and the development of a westernised lifestyle entail a sharp increase of chronic diseases [14]. The aim of the present study was to examine the risk factor pattern of the metabolic syndrome and its association with insulin resistance and hyperuricaemia by means of factor analysis in a typical sub-Saharan African population with different levels of urbanisation.

2. Subjects, materials and methods

A sub-sample of 205 black South African men and 243 black South African women was drawn from the Transition and Health during Urbanisation in South Africa (THUSA) population based on their fasting status. The details of the methods used in the THUSA study are published elsewhere [14,15]. However, an abridgement of the methods will be given in the following.

2.1. Study design and subjects

The cross-sectional comparative THUSA study was designed to assess the effect of urbanisation on the health status in a black African population (aged 15–70 years). Subjects were selected according to predefined levels of urbanisation. The definitions of 'urban' and 'rural' used in epidemiological research should not be a universally prescribed definition, but rather a definition determined by the aim of the study [16]. In South African communities, the population of a city also includes people living in informal settlements in the peri-urban fringe area or the greater metropolitan area. In the THUSA study, besides two rural strata (people living in tribal areas, stratum 1 and people living on farms, stratum 2), three different strata of urbanisation were distinguished for urban subjects, namely stratum 3 for subjects living in informal settlements, stratum 4 for subjects living in established townships with full access to water and electricity and stratum 5 for fully Westernised subjects living in Western-type houses in upper-class suburbs. Given the aim of the THUSA study, subjects who stayed only temporarily in the city or a rural area were not included in the study sample. In total 1854 apparently healthy African volunteers were recruited from 37 randomly selected sites in the North-West Province from 1996 to 1998. Persons with known diseases, taking acute or chronic medication (e.g. diabetes, hypertension, dyslipidaemia) and with oral temperatures above 37 °C were excluded as well as pregnant or lactating women. 'Apparently healthy' refers to the fact that no clinical examination preceded the selection process and information on diseases and medication was fully based on auto-declaration of the volunteers. The number of unreported cases for several chronic or infectious diseases in the African population is probably very high due to low education levels and limited access to health care facilities.

Regular visits preceded the data collection in order to get permission from the government officials and tribal chiefs to work in the area and to notify the local community of the visit of the research team. Local Setswana-speaking and specifically trained fieldworkers assisted in the study to assure that each volunteer understood the explanations given to them prior to the measurements. They also helped to ensure that the subjects came in fasted on the day of the study. Fasting state was verified by means of a prick test for capillary glucose. Despite all precautions, only 448 subjects truly fasted overnight (i.e. $\geq$10 h) which were selected for the present data analysis. However, it is important to note that the subjects who were excluded from the present analysis on the basis of their capillary glucose may have been prediabetic rather than being unfasted. Considering the aim of the current study and the small sample size, three larger groups with increasing degree of urbanisation were formed. By doing so, strata 1 and 2 were merged to form the rural group, and strata 4 and 5 were combined to form the urban group. Stratum 3 remained unchanged representing the semiurban group.

The THUSA study complied with the Helsinki Declaration from 1975 and was approved by the local Ethics Committee of the Potchefstroom University. All volunteers (adolescents and their legal guardians/parents) obtained verbal and written information about the study aims and procedures in their home language and signed written informed consent (illiterate with a cross).