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Urbanization of black South African women may increase risk of low bone mass due to low vitamin D status, low calcium intake, and high bone turnover

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Abstract

Globally, rural to urban migration is accompanied by changes in dietary patterns and lifestyle that have serious health implications, including development of low bone mass. We hypothesized that serum 25 (OH) vitamin D3 (25[OH]D3) levels will be lower, bone turnover higher, and nutrition inadequate in urban postmenopausal black women, increasing risk for low bone mass. We aimed to assess the prevalence of risk factors for low bone mass in 1261 black women from rural and urban areas in the North West Province of South Africa (Prospective Urban and Rural Epidemiology–South Africa project). Fasting blood samples were taken; and participants were interviewed to complete questionnaires on self-reported diseases, fractures, and dietary intakes. Bone health markers were assessed in a subgroup of 658 women older than 45 years. Specific lifestyle risk factors identified were inactivity, smoking, injectable progestin contraception use, and high alcohol consumption. Dietary risk factors identified were low calcium and high animal protein, phosphorous, and sodium intakes. The 25(OH)D3 and C-terminal telopeptide (CTX) levels were significantly higher in the rural vs the urban women older than 50 years. Parathyroid hormone (PTH) levels increased with age in both groups. The 25(OH)D levels were inversely correlated with CTX and PTH in rural women. In urban women, PTH and CTX were correlated while dietary calcium was inversely correlated with CTX and PTH with 25(OH)D3. The combination of low dietary calcium (<230 mg/d), marginally insufficient 25(OH)D3 status, and raised PTH may result in increased bone resorption. Further research is required to assess bone health and fracture risk in black African women.

Keywords: Bone health; Nutrition; Transition; Black South African women; Parathyroid hormone; C-telopeptide of type I collagen; Vitamin D status

Abbreviations: 25(OH)D3, 25 dihydroxyvitamin D3; BMD, bone mineral density; BMI, body mass index; CDT, carbohydrate-deficient transferrin; CTX, C-telopeptides of type I collagen; GGT, γ-glutamyl transferase; HIV, human immunodeficiency virus; PTH, parathyroid hormone; PURE, Prospective Urban and Rural Epidemiology study.

1. Introduction

Globally, and especially in developing countries, populations are migrating from rural to urban areas because of availability of work and better opportunities

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for the young. The accompanying changes in dietary patterns and lifestyle of populations have major health consequences. Several risk factors increase for many noncommunicable diseases such as obesity, hypertension, coronary heart disease (CHD), stroke, type 2 diabetes mellitus, and some forms of cancer [1,2]. The increased risk for noncommunicable diseases is associated with changes in health behaviors during this transition. Recent work has identified that some of these demographic and lifestyle changes may also affect bone health outcomes [3,4].

South Africa is experiencing rapid urbanization. Two substudies were conducted on bone health [3,4] as part of Transition and Health during Urbanization, a cross-sectional survey conducted in 1854 healthy men and women. These 2 studies indicated that urban black and white women have similar bone turnover as measured using osteocalcin and urinary N-telopeptides of Type I collagen (NTX). However, the urban black women had low bone mass measured using quantitative ultrasound of the calcaneus and were more exposed to lifestyle risk factors such as smoking, alcohol abuse, and an unhealthy diet, increasing the risk for the development of bone disease, compared with the white women. This was a departure from reported information that black women have a heavier bone structure [5,6], with a low risk of fractures. Consequently, South African black women may increasingly represent a population at risk for osteoporosis due to urbanization and changing lifestyles.

In the present study, we aimed to assess the prevalence of risk factors for low bone mass and their relationship with serum markers of bone resorption in a group of 1261 black women from rural and urban areas in the North West Province of South Africa. The process of migration from rural to urban areas introduces a number of lifestyle and nutritional factors that can affect risk for disease. We hypothesized that serum vitamin D levels will be lower, bone turnover higher, and nutritional intakes inadequate in urban postmenopausal women, increasing risk for low bone mass. We therefore considered the relationships between markers of bone turnover and calcium homeostasis as well as lifestyle factors that might have an impact on bone health outcomes. The selected biomarkers of bone turnover and calcium homeostasis were analyzed in a subgroup of 658 women 45 years and older.

2. Methods and materials

This cross-sectional survey was part of the South African arm of the Prospective Urban and Rural Epidemiology study (PURE). The PURE study, coordinated from the Population Health Research Institute, Ontario, Canada, is a longitudinal study designed to track the development of chronic diseases of lifestyle in urban and rural subjects in approximately 20 developing countries. Baseline data for the PURE-South Africa study in the North West Province (PURE-SA-NWP) of South Africa were collected in 2005.

2.1. Subjects and research setting

A total of 1006 rural and 1003 urban, apparently healthy, men and women older than 35 years, from the North West Province of South Africa, were randomly selected and participated voluntarily in the PURE-SA-NWP study. Inclusion criteria were older than 35 years, not pregnant, not using any chronic medication for known diseases, and willing to be tested for human immunodeficiency virus (HIV) infection. Of these 2009 participants, the results of the 1261 women (658 rural and 603 urban) older than 35 years were used to describe the risk factors for low bone mass in this population.

2.2. Questionnaires

Eight field workers selected from the communities being researched administered all questionnaires in the language of choice for each participant. Field workers were given extensive training so that administration of questionnaires was standardized.

Data on physical activity were obtained making use of a questionnaire validated for use in this population [7] and were assessed according to the criteria set by Kruger et al (2003) [8]. An index with any value from 1 to 3.3 was taken as low physical activity, an index with a value from 3.34 to 6.67 was taken as moderate physical activity, and an index with a value higher than 6.67 was taken as high physical activity. Data on socioeconomic and health status were obtained by a questionnaire used and adopted for all countries participating in the PURE study. A culturally sensitive quantitative food frequency questionnaire, developed and validated for use in this population, was used to obtain the dietary (including alcohol) intake of respondents [9,10]. Portion sizes were estimated using a food portion photograph book developed for use in the African population in the North West Province [11]. Portion sizes were reported in household measures and were converted to weights using standard tables [12]. The food intake was coded using the new food codes of the South African food composition database, developed by the Nutritional Intervention Research Unit of the South African Medical Research Council and expressed as average amounts consumed per day (http://www.sahealthinfo.org/nutrition/nutrition.htm).

2.3. Measurements

For anthropometric measurements, the guidelines adopted at the National Institutes of Health–sponsored Arlie Conference [13] were applied using standardized and calibrated apparatus and overseen by a level 3 anthropometrist. Measurements included weight (kilograms), height (meters), and body mass index (BMI).