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Body composition in the Study of Women Entering and in Endocrine Transition (SWEET): A perspective of African women who have a high prevalence of obesity and HIV infection

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ABSTRACT

Objectives. Little data are available for sub-Saharan African women on changes in body composition in menopause transition (MT). The study aimed to determine whether there are differences in body adiposity, lean muscle mass, and bone mineral density (BMD) across MT groups in urban African women, who have a high prevalence of obesity and HIV infection, and if this is related to an altered hormonal milieu.

Design. Participants were 702 black urban women. Menopause stage was defined using STRAW+10 criteria. Levels of follicle stimulating hormone (FSH), estradiol (E2), dehydroepiandrosterone (DHEA), dehydroepiandrosterone sulfate (DHEAS), testosterone (T) and sex hormone blinding globulin (SHBG) were measured. Body composition was measured with dual-energy X-ray absorptiometry (DXA) and ultrasound scans.

Results. Whole body lean mass ($p = 0.002$) and BMD ($p < 0.0005$) were significantly lower in postmenopausal compared to premenopausal groups. Estradiol ($p < 0.0005$), SHBG ($p < 0.0005$) and DHEAS ($p = 0007$) were significantly lower in post- than premenopausal groups, while FSH was higher ($p < 0.0005$). FSH correlated negatively ($\beta = -2.06$, $p < 0.0005$) with total lean mass while E2 correlated positively ($\beta = 20.0$, $p = 0.002$) with BMD. Use of antiretroviral therapy (ART) correlated negatively with total fat mass ($\beta = -2.92$, $p = 0.008$) and total bone mineral content (BMC; $\beta = -78.8$, $p = 0.003$).

Conclusions. The MT in this population is characterized by lower whole body lean mass and BMD in post- compared to premenopausal subjects but there are minimal differences in fat mass. Lower lean mass and BMD were associated with higher FSH and lower E2 serum levels, respectively. Use of ART was associated with lower fat mass and BMC.

Abbreviations: MT, menopause transition; BMD, bone mineral density; BMI, body mass index; BMC, bone mineral content; VAT, visceral adipose tissue; SAT, subcutaneous adipose tissue; FSH, follicle-stimulating hormone; E2, estradiol; DHEA, dehydroepiandrosterone; DHEAS, dehydroepiandrosterone sulfate; T, testosterone; SHBG, sex hormone-binding globulin; STRAW+10, stages of reproductive aging workshop; ART, antiretroviral therapy.

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1. Introduction

The menopause transition (MT) is closely associated with changes in body composition including lower bone mineral density (BMD) at many skeletal sites [1], an increase in obesity [2], a decrease in lean muscle mass [3], increases in body mass index (BMI) [2], and changes in body fat distribution (BFD) [4], particularly increased central adiposity [5]. Abdominal obesity is a principal risk factor for cardiometabolic disease [6]. Some studies suggest changes in the abdominal deposition of visceral (VAT) and subcutaneous adipose tissue (SAT) during the MT is related to chronological aging [7], while others find a strong association with reproductive aging [8], suggesting that central adiposity is a result of the changing hormonal milieu [5]. Other data show that both may explain changes in body adiposity and a decrease in lean muscle mass (sarcopenia) during the MT [9].

Obesity is widely prevalent among mid-life, black South African women [10]. The data from the Study of Women Entering and in Endocrine Transition (SWEET) show a high rate of obesity at menopause (68%) [11] and previous investigations have shown that diabetes and metabolic syndrome are very prevalent in these women [12]. The causes of this are not known, but given the strong association between MT and changes in BFD and lean muscle mass reported in non-African populations [13], the MT may play a role. The subject of central adiposity and its strong association with non-communicable diseases (NCDs) [14], the relationship between androgens and VAT deposition during MT [15], and the fall in BMD at various skeletal sites observed during the MT are well reported in women from high-income countries [1] but no such data appear to be available in sub-Saharan African menopausal women. A recent study from South Africa demonstrated a strong relationship between lean mass and BMD in African male and female subjects [16]. However, it is not known whether this relationship occurs across the MT and whether changes in lean mass during this period will affect BMD. In addition, the prevalence of HIV infection is high in populations of urban, mid-life black South African females [11], but it is not known whether this contributes to changes in body composition.

The aims of our study were to determine whether general body adiposity, lean muscle mass, BFD and BMD are associated with stages of the MT in these women, and if so, whether this association is related to differences in the serum concentrations of follicle stimulating hormone (FSH), estradiol (E2), androgens and sex hormone binding globulin (SHBG).

2. Methods

2.1. Subjects

The women in this cross sectional study are participants in SWEET and are the biological mothers and caregivers of the children in the Birth to Twenty Plus (BT20) cohort, the largest and longest-running longitudinal birth cohort study of child health and development in Africa [17]. After 21 years, 2200 of these women are still in contact with the study. From that group, we contacted a convenience sample of 902 women, ensuring that the minimum number of participants in the study cohort would be defined as that at which at least 100 women were present in each of the following four study subgroups (based on menopause staging using STRAW+10 guidelines (18)): late reproductive (stages −3b and −3a), the MT (stages −2 and −1), early postmenopause (stages 1a, 1b, and 1c), and late postmenopause (stage +2). Exclusion criteria were: <40 years and >60 years, pregnancy and ethnicity other than black African. Within this group of 902 women, 35 were older than 60 years, 37 were deceased, 3 were terminally ill, and 46 had become untraceable, or now lived outside the study area. Other women (n = 79) refused to participate for 2 main reasons; they were unable to take time off from work, or were no longer interested in the study and did not believe it would benefit them. Therefore 702 women took part in the study. All participants signed informed consent forms. The Human Research Ethics Committee (Medical) of the University of the Witwatersrand approved the protocol (ethics certificate number M090620).

2.2. Questionnaires and Menopausal Transition Stage

There are 11 official languages in South Africa, and English is the language most commonly used though it is not the first language of the majority of the participants. Questionnaires were administered in English by a single researcher, with members of our research team whose first language corresponded with those of the participants being available to help those women who were unable to understand any question. Reproductive health, menstrual history, educational level and tobacco and smokeless tobacco (snuff) use were determined and questions were derived from the general health questionnaire formulated and validated in a previous study of the same population group [19]. The STRAW+10 questionnaire derived from STRAW+ 10 criteria [18] and was used to ascertain menopause stage. These stages are late reproductive (−3b, −3b); early menopausal transition (−2); late menopausal transition (−1); early postmenopause (+1a, +1b, +1c) and late postmenopause (stage +2). This questionnaire has not previously been used on African females but a previous publication has shown that it is valid for staging menopause in this population [11].

2.3. Hormone Assays

Fasting blood samples were obtained in the morning before 11 am, during the 4-h data collection period. Serum and plasma samples were collected and aliquoted into corresponding cryovials and immediately stored at −80°C until the assays were performed. Levels of FSH, E2, dehydroepiandrosterone (DHEA), dehydroepiandrosterone sulfate (DHEAS), testosterone and SHBG were measured in serum samples. Immunoassays were performed for E2 and FSH as per manufacturer's instructions (ADVIA Centaur XP Systems, Siemens Healthcare Diagnostics, Tarrytown, NY). The E2 assay is a competitive chemiluminescent immunoassay and assay range is 43.6–11,010 pmol/L. Intra- and interassay coefficients of variation (CVs) for E2 averaged 4.2% and 1.9% respectively. The FSH assay is a two-site sandwich chemiluminometric immunoassay and the assay range is 0.3–200 IU/L, with the intra- and interassay CVs averaging 2.4% and 1.5% respectively. The immunoassays for SHBG and DHEAS were performed on the Immulite 2000 Systems