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Title: Fat mass changes during menopause: a meta-analysis

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Condensation: Attention should be paid to the accumulation of central fat after menopause, whereas increases in total fat mass should be monitored consistently across the lifespan.

Short Title: Fat mass changes during menopause

AJOG at a Glance:

A. Why was this study conducted?

- To determine how fat mass differs in quantity and distribution between premenopausal and postmenopausal women and whether age and/or menopausal status moderates any differences between groups.

B. What are the key findings?

- Fat mass increased between premenopausal and postmenopausal women across most measures (e.g. waist circumference), except for total leg fat percentage, which decreased. No interactive effects were observed between menopausal status and age.

C. What does this study add to what is already known?

- The change in fat mass quantity was predominantly attributable to increasing age with menopause having no significant additional influence. However, the decrease in total leg fat percentage and increase in measures of central fat are indicative of a possible change in fat distribution after menopause. Therefore, attention should be paid to the accumulation of central fat after menopause, whereas increases in total fat mass should be monitored consistently across the lifespan.

ABSTRACT

Background: Fat mass has been shown to increase in ageing women, however, the extent to which menopausal status mediates these changes remains unclear.

Objectives: To determine (i) how fat mass differs in quantity and distribution between premenopausal and postmenopausal women, (ii) whether and how age and/or menopausal status moderates any observed differences and (iii) which type of fat mass measure is best suited to detecting differences in fat mass between groups.

Study Design: This review with meta-analysis is reported according to MOOSE guidelines.

Data sources and populations: Studies (published up to May 2018) were identified via PubMed to provide fat mass measures in premenopausal and postmenopausal women. 201 cross-sectional studies were included in the meta-analysis, which provided a combined sample size of 1 049 919 individuals consisting of 478 734 premenopausal women and 571 185 postmenopausal women. 11 longitudinal studies were included in the meta-analyses, which provided a combined sample size of 2 472 women who were premenopausal at baseline and postmenopausal at follow up.

Results: The main findings of this review were that fat mass significantly increased between premenopausal and postmenopausal women across most measures, including body mass index (1.14 kg/m^2, 95 % confidence interval 0.95 to 1.32), body weight (1 kg, 0.44 to 1.57), body fat percentage (2.88 %, 2.13 to 3.63), waist circumference (4.63 cm, 3.90 to 5.35), hip circumference (2.01 cm, 1.36 to 2.65), waist to hip ratio (0.04, 0.03 to 0.05), visceral fat (26.90 cm^2, 13.12 to 40.68) and trunk fat percentage (5.49 %, 3.91 to 7.06), with the exception of total leg fat percentage, which significantly decreased (-3.19 %, -5.98 to -0.41). No interactive effects were observed between menopausal status and age across all fat mass measures.

Conclusions: The change in fat mass quantity between premenopausal and postmenopausal women was predominantly attributable to increasing age with menopause having no significant additional influence. However, the decrease in total leg fat percentage and increase in measures of central fat are indicative of a possible change in fat mass distribution after menopause. These changes are likely to, at least in part, be due to hormonal shifts that occur during midlife with women having a higher androgen (i.e. testosterone) to estradiol ratio after menopause, which has been linked to enhanced central adiposity deposition. Evidently, these findings suggest attention should be paid to the accumulation of central fat after menopause, whereas increases in total fat mass should be monitored consistently across the lifespan.

Key words: adiposity; BMI; body fat percentage; DEXA; fat distribution; fat mass; female; menopause; premenopausal women; postmenopausal women; waist circumference; sex

1. INTRODUCTION

Overweight and obesity are major societal problems that are associated with a number of deleterious health and wellbeing outcomes including type II diabetes[1], dementia[2] and cardiovascular disease (CVD)[3] resulting in a significant global economic burden[4] and poorer quality of life[5]. This is of particular importance for women as CVD is the leading cause of death in women worldwide[6]. Many potential factors/mechanisms have been implicated in the accumulation of fat mass at midlife, including ageing[7], decreased physical activity levels[8] and sarcopenia (i.e. loss of lean muscle mass), which can decrease the resting metabolic rate[9]. However, hormonal changes in middle aged women may also be particularly relevant in moderating increases in body fat[10, 11]. Given that the average age of menopause lies between 46 to 52 years[12] and the average life expectancy of women in developed countries lies around 81 years[13], women will on average spend almost 40 % of their lives in a postmenopausal state. It is therefore necessary to better understand whether and how menopause might predispose to increasing body fat to better target interventions and health policy responses.

Menopause is defined as the final menstrual period and is characterized by the progressive decline of endogenous estrogen levels[14]. Some studies have proposed that the decrease in endogenous estrogen levels may modulate body fat quantity and distribution resulting in greater overall body fat and an increased amount of central fat in postmenopausal women[10, 15-17]. However, there is a divide in the literature with some researchers suggesting that any observed differences in fat mass quantity or distribution in women at midlife are primarily due to ageing, with menopausal status having little to no effect[18-20]. The contradictory findings could be due to a number of factors including (i) the intertwined relationship between menopause and ageing, (ii) the heterogeneity in criteria used between studies when

defining premenopausal and postmenopausal women and (iii) the heterogeneity of measures used between studies when investigating fat mass changes in quantity and distribution.

Due to the inconsistent evidence, it is important to pool data from available studies to determine the differences in fat mass quantity and distribution between premenopausal and postmenopausal women. Moreover, confounding factors that may explain effects currently attributed to an altered hormonal profile in women, such as ageing, have not been adequately investigated. As far as we are aware, no study to date has comprehensively reviewed the evidence and precisely estimated the results through meta-analyses. Therefore, the current study aimed to determine (i) how fat mass differs in quantity and distribution between premenopausal and postmenopausal women, (ii) whether and how age and/or menopausal status moderates any observed differences and (iii) which type of fat mass measure is best suited to detecting differences in fat mass between groups.

2. METHODS

2.1 Reporting guidelines

This review with meta-analysis was reported according to MOOSE guidelines[21] and was prospectively registered in the PROSPERO database (CRD42018100643), which can be accessed online (http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42018100643).

2.2 Search string

A search was conducted, limited to the PubMed database, to retrieve both cross-sectional and longitudinal studies that reported fat mass differences in quantity or distribution between premenopausal and postmenopausal women. The following search string was used: ("adipose tissue" OR "adiposity" OR "subcutaneous fat" OR "obesity" OR "overweight" OR "body weight" OR "body fat distribution" OR "body mass index" OR "BMI" OR "DEXA" OR

"DXA" OR "dual energy x-ray absorptiometry" OR "waist to hip ratio" OR "waist-hip ratio" OR "waist circumference" OR "x-ray computed tomography" OR "computed tomography" OR "CT scan" OR "caliper" OR "skinfold" OR "skin fold" OR "abdominal MRI" OR "abdominal magnetic resonance imaging" OR "intra-abdominal fat") AND ("menarche" OR "pre-menopause" OR "premenopause" OR "pre-menopausal" OR "premenopausal" OR "reproductive" OR "menopausal transition") AND ("post-menopause" OR "postmenopause" OR "post-menopausal" OR "postmenopausal" OR "non-reproductive").
PubMed filters were used to exclude non-human and non-English studies. No time restrictions were applied to the literature search, which was conducted in May 2018.

2.3 Inclusion and exclusion criteria

The eligibility criteria for all included and excluded studies were predefined. Inclusion criteria were specified as follows: (i) peer-reviewed manuscripts written in English or translated from their original language of publication to English; (ii) studies which assessed human participants and (iii) studies that utilised continuous unadjusted measures that provide an estimate of fat mass for both healthy premenopausal and healthy postmenopausal women.

Exclusion criteria were specified as follows: (i) studies that exclusively investigated clinical/pathophysiological populations; (ii) studies that selectively recruited women based on specific fat mass ranges or reported differences in fat mass within a narrow predetermined fat mass range (i.e. only obese women); (iii) studies that matched participants on a measure of fat mass; (iv) cross-sectional studies with fewer than 40 participants to avoid extreme sampling bias and ensure that small studies, which are more likely to be methodologically less robust, are not included; (v) review articles, systematic reviews and meta-analyses; (vi) conference abstracts and (vii) animal studies.

2.4 Screening

Duplicate citations were removed from search results and the remaining entries were title screened by a single author (AA). All abstracts were then subdivided and independently double-screened by four authors (AA, NC, HT-J and EW) using the predetermined inclusion/exclusion criteria with any discrepancies resolved through consensus. Finally, full-text and supplementary materials of the remaining articles were double-screened against inclusion/exclusion criteria by three authors (AA, HT-J and EW), with data extracted from relevant articles. Where data was missing, authors were contacted via email to obtain relevant information required for inclusion in the review. A bibliographic search of available articles and reviews was also used to identify further studies that fit the inclusion criteria.

2.5 Data extraction

All data from included articles was double extracted by two authors (AA and EW) to avoid transcription errors with any disagreement resolved by consensus. Data extracted from each study included (i) sample size; (ii) age; (iii) relevant measures that provide an estimate of fat mass (Supplementary Table ST5) including body mass index (BMI), waist circumference (WC), hip circumference (HC), bodyweight (BW), total body fat (BF %;), trunk fat (TF %), waist to hip ratio (WTHR), total leg fat (LF %), abdominal (ASF) and suprailliac skinfold thickness (SISF), abdominal subcutaneous fat (AF) and visceral fat (VF); (iv) whether information such as menopausal status, WC and/or BMI was measured or self-reported; (v) definitions used for WC, HC, premenopausal women and postmenopausal women; (vi) whether follicle stimulating hormone (FSH) criteria were used; (vii) whether women were age matched and (viii) whether the following criteria were used in sample selection including smoking, surgical menopause, hormone replacement therapy (HRT), CVD and history of drug and alcohol abuse.

2.6 Definition of premenopause and postmenopause

The precise definition for 'premenopause' and 'postmenopause' are known to vary substantially within the literature, which has motivated a series of attempts by international experts to collaboratively develop a comprehensive standardised set of criteria to describe the terminology associated with menopause[14, 22-25]. The current gold standard for defining menopause nomenclature is the Stages of Reproductive Ageing (STRAW) + 10 criteria, which was established in 2012[14]. The requirement for papers to adhere to the STRAW + 10 criteria would have limited the scope of the current review and prevented the inclusion of relevant studies, particular those published prior to 2012. Therefore, all studies, which included premenopausal and postmenopausal women (as defined by the authors of those studies), were considered. Furthermore, women classified as perimenopausal were not included in the current meta-analysis, so that a clear comparison could be made between groups, with premenopausal women acting as controls for any effect observed after menopause.

2.7 Quality assessment

The quality of included studies was independently assessed by two authors (AA and EW), using an adapted version of the Newcastle-Ottawa Scale (NOS)[26] . In short, the NOS for cohort studies utilised three categories to evaluate individual study quality including (1) the selection of participants, (2) the comparability of groups and (3) the assessment/ascertainment of the outcome of interest. Notably, an item was removed from the selection and outcome sections of the NOS, which did not address the particular quality requirements of the present review (Supplementary Appendix SA1). Furthermore, given that all studies, which included premenopausal and postmenopausal women, were considered, two additional items were added to the comparability section to ensure that studies with better

suited designs for comparing these groups were scored accordingly. Any discrepancy in quality assessment was resolved by consensus. If consensus decisions were not possible a third rater was used.

2.8 Multiple reports

In the cases where multiple studies had used the same cohort and reported on the same fat mass measures, only one publication was used in any single analysis. Which study to include was based on the following criteria in order of importance: (i) availability of effect sizes in study (or effect sizes provided by authors after contact), (ii) sample size, (iii) methodology quality rating and (iv) publication date of the study (with more recent studies being prioritised). When multiple studies used the same cohort but reported on different fat mass measures, estimates from the same cohort but with different studies were used in separate analyses.

2.9 Statistical analysis

All statistical analyses were conducted using the open source software, R (version 3.3.3)[27], running in RStudio (version 1.0.143)[28], using the metafor package (version 2.0.0)[29] for the meta-analysis.

2.10 Summary measures

For both cross-sectional and longitudinal analyses, effect sizes were calculated using the raw (unstandardised) mean difference (D) for fat mass between postmenopausal and premenopausal women i.e.

$$D = \overline{X}_1 - \overline{X}_2$$

The use of raw mean differences was most appropriate, given that the outcome measure of interest (fat mass) was reported on meaningful scales that were consistently used across studies[30]. For cross-sectional studies, the variance of the effect sizes was calculated using the following formula:

$$V_{D_{cross-sectional}} = \frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}$$

where S_1 and S_2 is the standard deviation for independent groups (i.e. premenopausal and postmenopausal women) and n represents the number of women in each group.

For longitudinal studies, the variance of the effect sizes was calculated using the following formulas:

$$V_{D_{longitudinal}} = \frac{S_{diff}^2}{n}$$

$$S_{diff} = \sqrt{S_1^2 + S_2^2 - 2 \times r \times S_2 \times S_2}$$

where r is the correlation between premenopausal and postmenopausal fat mass means.

Where standard errors of the mean (SEM) or 95 % confidence intervals (CI) were reported, authors were first contacted and requested to provide the unstandardized means and standard deviations. If the requested information was not provided, the SEM and CI were converted to SD using the method outlined in Higgins and Green [31]. Furthermore, volume measurements (cm^3) for computed tomography (CT) scans were converted to surface area (cm^2) by dividing by the following: thickness of slices × number of slices.

2.11 Meta-analysis

Heterogeneity was assumed because sampling and methodology varied across studies resulting in a distribution of effect sizes[32]. Therefore, a Random Effects (RE) Model using the restricted maximum likelihood estimator was utilised in all analyses to estimate the mean of the distribution of these effect sizes.

Heterogeneity across studies was assessed with Cochran's Q statistic (with $p < 0.01$ indicative of significant heterogeneity) and the I^2 statistic (values 25 %, 50 % and 75 % suggestive of low, moderate and high heterogeneity respectively)[33]. To identify studies that excessively contributed to heterogeneity, sensitivity analyses were conducted using the leave-one-out-method. Meta-regression analyses using a mixed effect model were conducted to determine the influence of moderators, such as ageing. For cross-sectional studies comparisons of fat mass differences between premenopausal and postmenopausal women were made with a test of interaction.

2.12 Reporting bias

The possible impact of publication bias was assessed by visually inspecting funnel plots and with the Egger regression test[34]. The trim and fill method was also used to estimate the number of studies that may be missing from the meta-analysis and to estimate adjusted effect sizes[35, 36].

3. RESULTS

The search strategy identified 2994 unique citations, while bibliography searches identified an additional 11 records. After initial screening based on titles and abstracts, 586 publications remained for full-text assessment. After the application of inclusion and exclusion criteria, a

further 300 publications were excluded (Figure 1). Of the remaining 286 studies, 210 were eligible for inclusion in the quantitative analysis with 201 studies reporting cross-sectional data[15, 18-20, 35, 37-232] and 11 studies reporting longitudinal data[10, 38, 152, 233-240].

Some studies included multiple sub-cohorts of premenopausal and postmenopausal women based on factors such as age[233], ethnicity[45, 107], physical activity level[111, 213] and geographic location[96, 155, 167]. In these cases, the sub-cohorts were extracted separately and treated as discrete samples. Therefore, 217 cross-sectional (Supplementary Table ST1) and 13 longitudinal samples (Supplementary Table ST2) were included in the analyses.

3.1 Study quality rating

For cross-sectional studies, 101 studies were of high quality as demonstrated by their scores ranging from 7 to 9 stars on the adapted version of the Newcastle Ottawa Scale (maximum 9 stars), 78 studies were of moderate quality (4 to 6 stars) and 22 studies were of poor quality (0 to 3 stars; Supplementary Table ST3). Almost all longitudinal studies were of high quality, with the exception of one study[235], which was of moderate quality with a score of 4 (Supplementary Table ST4).

3.2 Summary estimates

The unstandardized mean differences (i.e. estimate) of each fat mass measure for both cross-sectional and longitudinal studies are presented in Table 1 and Table 2 respectively. Standardised estimates for cross-sectional and longitudinal studies are presented in Supplementary Tables ST6 and ST7, respectively. Cross-sectional studies compared separate premenopausal and postmenopausal groups, whereas for longitudinal studies, all women were premenopausal at baseline and postmenopausal at follow up.

3.3 Cross-sectional meta-analysis

3.3.1 Cross-sectional Body Mass Index

171 cross-sectional studies investigated the relationship between BMI and menopausal status. The analyses revealed that the mean BMI difference was 1.14 kg/m^2 (SE = 0.09), with a yearly mean age difference of 0.07 kg/m^2/year (Table 1).

3.3.2 Cross-sectional Body Weight

109 cross-sectional studies investigated the relationship between BW and menopausal status. The analyses revealed that the mean BW difference was 1.00 kg (SE = 0.29), with a yearly mean age difference of 0.07 kg/year (Table 1).

3.3.3 Cross-sectional Waist Circumference

70 cross-sectional studies investigated the relationship between WC and menopausal status. The analyses revealed that the mean WC difference was 4.63 cm (SE = 0.37), with a yearly mean age difference of 0.30 cm/year (Table 1).

3.3.4 Cross-sectional Waist to Hip Ratio

48 cross-sectional studies investigated the relationship between WTHR and menopausal status. The analyses revealed that the mean WTHR difference was 0.0421 (SE = 0.0045), with a yearly mean age difference of 0.0026/year (Table 1).

3.3.5 Cross-sectional Body Fat Percentage

46 cross-sectional studies investigated the relationship between BF % and menopausal status. The analyses revealed that the mean BF % difference was 2.88 % (SE = 0.38), with a yearly mean age difference of 0.21 %/year (Table 1).

3.3.6 Cross-sectional Hip Circumference

25 cross-sectional studies investigated the relationship between HC and menopausal status. The analyses revealed that the mean HC difference was 2.01 cm (SE = 0.33), with a yearly mean age difference of 0.13 cm/year (Table 1).

3.3.7 Cross-sectional Abdominal Fat and Visceral Fat

10 cross-sectional studies investigated the relationship between AF/VF and menopausal status using CT scans. The analyses revealed that the mean AF difference was 28.73 cm^2 (SE = 10.29), with a yearly mean age difference of 1.92 cm^2/year, however, the mean VF difference was 26.90 cm^2 (SE = 7.03), with a yearly mean age difference of 1.81 cm^2/year (Table 1).

3.3.8 Cross-sectional Suprailliac Skinfold Thickness

9 cross-sectional studies investigated the relationship between SISF and menopausal status. The analyses revealed that the mean SISF difference was 2.65 mm (SE = 1.12), with a yearly mean age difference of 0.13 mm/year (Table 1).

3.3.9 Cross-sectional Trunk Fat Percentage

7 cross-sectional studies investigated the relationship between TF % and menopausal status. The analyses revealed that the mean TF % difference was 5.49 % (SE = 0.80), with a yearly mean age difference of 0.40 %/year (Table 1).

3.3.10 Cross-sectional Abdominal Skinfold Thickness

4 cross-sectional studies investigated the relationship between ASF and menopausal status. The analyses revealed that the mean ASF difference was 6.46 mm (SE = 3.04), with a yearly mean age difference of 0.35 mm/year (Table 1).

3.3.11 Cross-sectional Total Leg Fat Percentage

3 cross-sectional studies investigated the relationship between LF % and menopausal status. The analyses revealed that the mean LF % difference was -3.19 % (SE = 1.42), with a yearly mean age difference of -0.17 %/year (Table 1).

3.4 Longitudinal meta-analysis

3.4.1 Longitudinal Body Mass Index

8 longitudinal studies investigated the relationship between BMI and menopausal status. The analyses revealed that the mean BMI change was 0.93 kg/m^2 (SE = 0.34), with an annual change of 0.14 kg/m^2/year (Table 2).

3.4.2 Longitudinal Body Weight

7 longitudinal studies investigated the relationship between BW and menopausal status. The analyses revealed that the mean BW change was 2.99 kg (SE = 0.83), with an annual change of 0.37 kg/year (Table 2).

3.4.3 Longitudinal Total Body Fat Percentage

4 longitudinal studies investigated the relationship between BF % and menopausal status. The analyses revealed that the mean BF % change was 2.18 % (SE = 1.01), with an annual change of 0.41 %/year (Table 2).

3.4.4 Longitudinal Waist Circumference

3 longitudinal studies investigated the relationship between WC and menopausal status. The analyses revealed that the mean WC change was 3.82 cm (SE = 1.51), with an annual change of 0.51 cm/year (Table 2).

3.4.5 Longitudinal Abdominal Fat and Visceral Fat

3 longitudinal studies investigated the relationship between AF/VF and menopausal status using CT scans. The analyses revealed that there was no significant mean AF difference, however a significant difference in VF of 12.95 cm^2 (SE = 2.20) was detected, with an annual change of 3.43 cm^2/year (Table 2).

3.5 Sensitivity analyses

Significant heterogeneity was found in all meta-analyses performed and the proportion of real observed variance (not related to random error) between studies (I^2) was high across all analyses (Supplementary Figures 1 to 18). The influence of single studies was investigated further wherever possible (i.e. k > 3) through leave-one-out analyses. The analyses predominantly demonstrated no particularly influential study and showed relative consistency in reported estimates, with a few notable exceptions. For TF % analyses, Guo et al. (2015)[106] was found to be influential, which could be due to the large sample size reported (see Figure 2) or because bioelectrical impedance analysis (BIA) was utilised in comparison to the other 6 studies that used dual-energy x-ray absorptiometry (DEXA) scans. When excluded from the analyses, the mean TF % difference between premenopausal and postmenopausal women increased from 5.49 % to 6.05 % (95 % CI 4.94 to 7.15), with I^2 decreasing from 89.90 % to 54.44 %.

For BF % analyses (cross-sectional), Sherk et al. (2011)[198] was identified as influential whereas for BMI and BW analyses (longitudinal), Soreca et al. (2009)[240] was identified as influential, which could be due to the relatively large mean age difference/follow-up period (41.2 years and 20 years respectively). When removed from analyses, all estimates decreased (BF %: 2.71, 95 % CI 2.02 to 3.40; BMI: 0.63, 95 % CI 0.32 to 0.94; BW: 2.39, 95 % CI 1.22

to 3.55), with I^2 remaining high. For AF analyses (cross-sectional), Hunter et al. (1996)[241] was found to be influential. Despite being a relatively older study (published over 20 years ago), meta-regression analyses revealed that year of publication had no effect on the overall estimate. When excluded from the analyses, the mean AF difference decreased from 28.73 cm^2 to 18.81 cm^2 (95 % CI 3.38 to 34.25) with I^2 remaining high.

One study, Franklin et al. (2009)[235], was found to be influential for BF % analyses (longitudinal), which could in part be because of (i) the relatively lower quality of the study (4 stars) when compared with other studies included in the analyses (8 stars); or (ii) BF % was measured using two different methods i.e hydrostatic weighing (at baseline) and air displacement plethysmograph (at follow up) compared with other studies that all used DEXA at baseline and follow up assessment or (iii) the very small sample size of the study (8 participants), comparatively to other studies which have a mean of 56 participants (range 48 – 69). When Franklin et al. (2009) was excluded from the analyses, there was no significant difference in mean BF %.

3.6 Publication bias

Funnel plot asymmetry diagnostics and the trim and fill test revealed some evidence of publication bias. Eggers regression test was significant for, ASF, TF % and LF % (cross-sectional analyses), BF % (both cross-sectional and longitudinal analyses) and VF (longitudinal analyses), indicating some degree of asymmetry for these groups. For cross-sectional studies the trim and fill analyses identified 30 missing studies for BMI and 2 for AF, producing larger estimates for both (Supplementary Figures 18 and 19). For longitudinal studies, however, 2 missing studies were identified for VF, producing a smaller estimate (Supplementary Figure 22).

3.7 Subgroup and meta-regression analyses

The influence of moderators such as ageing (represented as the mean age difference for cross-sectional analyses or length of follow up for longitudinal analyses) and study quality on pooled estimates was investigated by meta-regression analyses using a mixed effects model, where a sufficient number of studies were available to assess the effect of a single predictor (i.e. samples ≥ 10)[31, 242]. Where meta-regression was possible (i.e. longitudinal BMI and cross-sectional BMI, BW, WC, WTHR, BF %, HC, AF, VF and SSIF), ageing significantly predicted the unexplained variance (9.99 – 73.90 %) in fat mass estimates except for HC, AF and SSIF (Table 3). No interactive effects were observed between menopausal status and age across all fat mass measures. Furthermore, study quality had no significant effect on the overall estimate.

To examine whether the type of measure could influence the results, we performed subgroup analyses on cross-sectional studies that examined BF % to investigate the impact of DEXA scans versus other methods, such as BIA and hydrodensitometry, on quantifying total and regional body fat percentage. Interestingly BIA significantly underestimated the quantity of total body fat compared to DEXA (β = -2.64 %, 95 % CI -4.23 to -1.04, p-value = 0.0012), which supports previous findings[243]. Similarly, when investigating the effects of measured versus self-reported BMI in cross-sectional studies, self-report significantly underestimated BMI (β = -0.72 kg/m^2, 95 % CI -1.34 to -0.09, p-value = 0.0240) compared to direct measurement, which aligns with previous findings[244]. After adjusting for the effect of age however, self-report had no significant effect on the overall estimate for BMI. All longitudinal studies computed BMI based on objectively measured height and weight. For VF and AF analyses, the use of surface area estimates that were converted from volumes (which was conducted for one particular study[20]) had no significant effect on the overall estimate.

Notably, almost all subgroup analyses that included women using HRT had no significant effect on estimates, except for BF % (significantly increased; β = 2.46 %, CI 0.16 to 4.76, p-value = 0.0358) and TF % (significantly decreased; β = -3.65 %, CI -5.91 to -1.38, p-value = 0.0016).

4. COMMENT

This large scale, comprehensive review with meta-analyses investigated the differences in fat mass between healthy premenopausal and postmenopausal women in both cross-sectional and longitudinal studies. The main findings were that (1) there was an increase in fat mass between premenopausal and postmenopausal women across most measures, specifically BMI, BW, WC, WTHR, BF %, HC, ASF, SISF, VF and TF %, with the exception of LF %, which decreased; and (2) the change in fat mass quantity is largely attributable to increasing age with menopause having no detectable additional influence. These findings are important as they suggest attention should be paid to the accumulation of central fat after menopause, whereas increases in total fat mass should be monitored consistently across the lifespan.

The relationship between menopause and ageing can be difficult to disentangle, since both progress concurrently. Previous research indicates that for women aged 18-45 years the typical trends for BMI and BF % is an increase of 0.16 kg/m^2/year and 0.41 %/year respectively[245]. Interestingly, the longitudinal analyses presented in this paper reflect similar annual estimates for BMI (0.14 kg/m^2/year) and BF % (0.41 %/year), which indicates that the rates of change remain the same throughout early adulthood and middle age, with menopause having no detectable additional influence above and beyond the effect of ageing.

Furthermore, the meta-regression analyses revealed consistent but comparatively lower estimates for cross-sectional BMI (0.06 kg/m^2/year) and BF % (0.15 %/year). The reason for the relatively smaller estimates remains to be elucidated, however, it is possible that

unmeasured and/or unreported genetic and environmental factors (e.g. ethnicity, dietary changes, mood disorders and medications used in their treatment, physical activity levels, metabolic activity, and variation in sleep length and quality[8, 246-248]) that varied between groups in cross-sectional studies account for this. Alternatively, this may also be explained by the well-documented differences emerging from the less robust design of cross-sectional compared to longitudinal studies. As a result, the longitudinal study design is better suited to providing yearly rates of change in fat mass, which are more precise than cross-sectional estimates.

Too few longitudinal studies produced precise estimates of fat mass changes across multiple regions, however, the analysis of cross-sectional studies revealed that LF % decreased by 0.17 %/year, whereas fat mass increased in abdominal indexes, such as TF % by 0.40 %/year and WC (longitudinal) by 0.51 cm/year, indicative of a potential change in fat mass distribution after menopause. These changes are likely to, at least in part, be due to hormonal shifts that occur during midlife with women having a higher androgen (i.e. testosterone) to estradiol ratio after menopause, which has been linked to enhanced central adiposity deposition[249]. Importantly, the increased central deposition of fat has significant clinical implications given that a 1 cm increase in WC has been associated with a 2 % increase in risk of CVD[250]. Furthermore, a higher testosterone/estradiol ratio has also been associated with deleterious health consequences in women, such as CVD[251]. Taken together, these results may help explain the fact that premenopausal women have been found to have lower CVD incidence and mortality rates compared with men of the same age[252], whereas postmenopausal women experience higher mortality rates due to CVD compared to men of the same age[253]. The current analyses suggests that measures sensitive to detecting the central deposition of adiposity, such as TF % and WC would be preferable to BW and BMI, which

are commonly used indicators of overweight and obesity. This is of particular importance because of the multifactorial changes in body composition that occur in ageing women which can influence BW and/or BMI estimates, such as (i) a decrease in bone density[254, 255], (ii) sarcopenia[256] and (iii) shrinking[257], which indicate that measures less influenced by these changes, such as TF % and WC, would be preferable. Furthermore, when measures of fat mass were standardised (Supplementary Tables ST6 and ST7) cross-sectional analyses revealed that BF % had the largest magnitude of effect across estimates. However, when comparing the precision of confidence intervals, WTHR, WC and TF % produced comparatively more reliable estimates. These results should be interpreted with caution given that variability across measures, including different samples, sample sizes and measurement error, could not be accounted for.

4.1 Hormone replacement therapy and fat mass

Subgroup analyses revealed that the inclusion of women using HRT resulted in a significant increase in BF % (β = 2.46 %, CI 0.16 to 4.76, p-value = 0.0358) and a significant decrease in TF % (β = -3.65 %, CI -5.91 to -1.38, p-value = 0.0016), suggestive of a potential protective role of HRT in preventing/reducing trunk fat deposition although not in preventing overall fat mass gain. These results align with a previous meta-analysis of 8 randomized control trials, which found that postmenopausal women using HRT had less WC and TF % compared to placebo[258]. Taken together, these findings provide useful estimates for the potential protective effect of HRT on central adiposity given that, to our knowledge, the most recent systematic review on this topic was published almost 20 years ago[259] and had insufficient studies at the time to evaluate the effect of HRT on fat mass distribution. Moreover, since HRT use has complex interactions with the body and brain, with varying benefits and disadvantages depending on the time of initiation, type and duration of

treatment[260], it is important for this topic to be investigated systematically in future, using longitudinal studies.

4.2 Strengths and limitations

A key strength of the present study was that a large number of individuals were assessed for cross-sectional analyses, across a wide range of measures that estimated fat mass changes in quantity and distribution between premenopausal and postmenopausal women, resulting in a holistic understanding of body fat changes in women at midlife. Specifically, 201 cross-sectional studies were included in the meta-analysis, which provided a combined sample size of 1 049 919 individuals consisting of 478 734 premenopausal women and 571 185 postmenopausal women.

Notable limitations included the fact that only 11 longitudinal studies were available for inclusion in the meta-analysis, which provided a combined sample size of 2 472 women who were premenopausal at baseline and postmenopausal at follow up. Furthermore, it is possible that relevant studies may have been missed, given that our search was limited to the PubMed database. However, these relative weaknesses were somewhat counterbalanced by the large number of cross-sectional results, which facilitated richer and comprehensive analyses that led to very consistent findings. In addition, women classified as perimenopausal were not included in the current meta-analysis. This was done to ensure that a clear comparison could be made between groups, with premenopausal women acting as controls for any effect observed after menopause. Moreover, the criteria used to identify premenopausal and postmenopausal women varied substantially between studies and may have reduced the accuracy of the reported effects.

5. CONCLUSION

To our knowledge, this is the first comprehensive review with meta-analysis of both longitudinal and cross-sectional studies investigating changes in fat mass between premenopausal and postmenopausal women. The analyses revealed that fat mass was higher in postmenopausal compared to premenopausal women across most measures, with the exception of LF % which decreased, indicative of a potential change in fat mass distribution after menopause. However, the change in fat mass quantity was predominantly attributable to increasing age with menopause having no significant additional influence. Given that central fat accumulation is associated with an increase in CVD risk, these results may help explain the fact that premenopausal women have been found to have lower CVD incidence and mortality rates compared with men of the same age, whereas postmenopausal women experience higher mortality rates due to CVD compared to men of the same age. An important implication of these findings is that attention should be paid to the accumulation of central fat after menopause, whereas increases in total fat mass should be monitored consistently across the lifespan. Further investigation regarding the role of other potential moderators (e.g. genetics, ethnicity, dietary changes, physical activity levels, metabolic activity, mood disorders and medications used in their treatment, age of menopause onset and variation in sleep length and quality) is required to facilitate the development of targeted and effective intervention programs and heath policies aimed at mitigating the risk posed by increased central adiposity in women at midlife.

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Contributors

AA contributed to the design of the study, data screening and extraction, conducted all statistical analyses and managed all aspects of manuscript preparation and submission. EW contributed to data screening, data extraction and editing of the manuscript. HT-J contributed to data screening and provided methodological input and contributed to the editing of the manuscript. NC contributed to the design of the study, data screening, provided methodological input, theoretical expertise and contributed to the editing of the manuscript. All authors meet the criteria for authorship. AA is the guarantor for this study.

Data sharing

AA accepts to provide access to the data on request.

Transparency statement

This manuscript is an honest, accurate, and transparent review with meta-analysis. No important aspects of the study have been omitted and any discrepancies have been disclosed.

References

1. GUH DP, ZHANG W, BANSBACK N, AMARSI Z, BIRMINGHAM CL, ANIS AH. The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis. BMC public health 2009;9:88.

2. ANSTEY K, CHERBUIN N, BUDGE M, YOUNG J. Body mass index in midlife and late‐life as a risk factor for dementia: a meta‐analysis of prospective studies. Obesity Reviews 2011;12:e426-e37.

3. WILSON PF, D'AGOSTINO RB, SULLIVAN L, PARISE H, KANNEL WB. Overweight and obesity as determinants of cardiovascular risk: The framingham experience. Archives of Internal Medicine 2002;162:1867-72.

4. WITHROW D, ALTER D. The economic burden of obesity worldwide: a systematic review of the direct costs of obesity. Obesity reviews 2011;12:131-41.

5. LARSSON U, KARLSSON J, SULLIVAN M. Impact of overweight and obesity on health-related quality of life—a Swedish population study. International Journal Of Obesity 2002;26:417.

6. WORLD HEALTH ORGANIZATION. Women's Health, 2013.

7. KUK JL, SAUNDERS TJ, DAVIDSON LE, ROSS R. Age-related changes in total and regional fat distribution. Ageing research reviews 2009;8:339-48.

8. STERNFELD B, WANG H, QUESENBERRY JR CP, et al. Physical activity and changes in weight and waist circumference in midlife women: findings from the Study of Women's Health Across the Nation. 2004;160:912-22.

9. KARAKELIDES H, NAIR KS. Sarcopenia of Aging and Its Metabolic Impact. *Current Topics in Developmental Biology*: Academic Press, 2005 (vol 68).

10. RAZMJOU S, ABDULNOUR J, BASTARD J-P, et al. Body composition, cardiometabolic risk factors, physical activity, and inflammatory markers in premenopausal women after a 10-year follow-up: a MONET study. Menopause (New York, NY) 2018;25:89-97.

11. KARVONEN-GUTIERREZ C, KIM C. Association of mid-life changes in body size, body composition and obesity status with the menopausal transition*Healthcare*: Multidisciplinary Digital Publishing Institute, 2016 (vol 4).

12. SCHOENAKER DA, JACKSON CA, ROWLANDS JV, MISHRA GD. Socioeconomic position, lifestyle factors and age at natural menopause: a systematic review and meta-analyses of studies across six continents. International journal of epidemiology 2014;43:1542-62.

13. MURRAY CJ, BARBER RM, FOREMAN KJ, et al. Global, regional, and national disability-adjusted life years (DALYs) for 306 diseases and injuries and healthy life expectancy (HALE) for 188 countries, 1990–2013: quantifying the epidemiological transition. The Lancet 2015;386:2145-91.

14. HARLOW SD, GASS M, HALL JE, et al. Executive Summary of the Stages of Reproductive Aging Workshop + 10: Addressing the Unfinished Agenda of Staging Reproductive Aging. The Journal of Clinical Endocrinology & Metabolism 2012;97:1159-68.

15. TREMOLLIERES FA, POUILLES JM, RIBOT CA. Relative influence of age and menopause on total and regional body composition changes in postmenopausal women. American journal of obstetrics and gynecology 1996;175:1594-600.

16. PARK JK, LIM YH, KIM KS, et al. Body fat distribution after menopause and cardiovascular disease risk factors: Korean National Health and Nutrition Examination Survey 2010. Journal of women's health (2002) 2013;22:587-94.

17. SOWERS M, ZHENG H, TOMEY K, et al. Changes in body composition in women over six years at midlife: ovarian and chronological aging. The Journal of Clinical Endocrinology & Metabolism 2007;92:895-901.

18. SORIGUER F, MORCILLO S, HERNANDO V, et al. Type 2 diabetes mellitus and other cardiovascular risk factors are no more common during menopause: longitudinal study. Menopause (New York, NY) 2009;16:817-21.

19. DOUCHI T, YONEHARA Y, KAWAMURA Y, KUWAHATA A, KUWAHATA T, IWAMOTO I. Difference in segmental lean and fat mass components between pre- and postmenopausal women. Menopause (New York, NY) 2007;14:875-8.

20. TRIKUDANATHAN S, PEDLEY A, MASSARO JM, et al. Association of female reproductive factors with body composition: the Framingham Heart Study. The Journal of clinical endocrinology and metabolism 2013;98:236-44.

21. STROUP DF, BERLIN JA, MORTON SC, et al. Meta-analysis of observational studies in epidemiology: a proposal for reporting. 2000;283:2008-12.

22. WORLD HEALTH ORGANIZATION. Research on the menopause in the 1990s: report of a WHO scientific group. 1996.

23. WORLD HEALTH ORGANIZATION. Research on the menopause: report of a WHO scientific group [meeting held in Geneva from 8 to 12 December 1980]. 1981.

24. SOULES MR, SHERMAN S, PARROTT E, et al. Executive summary: stages of reproductive aging workshop (STRAW). Climacteric 2001;4:267-72.

25. UTIAN WH. The International Menopause menopause-related terminology definitions. Climacteric 1999;2:284-86.

26. WELLS G, SHEA B, O'CONNELL D, et al. Newcastle-Ottawa quality assessment scale cohort studies, 2014.

27. R CORE TEAM. R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; 2016, 2017.

28. RSTUDIO TEAM. RStudio: integrated development for R. RStudio, Inc, Boston, MA URL http://wwwrstudiocom 2015;42.

29. VIECHTBAUER W. Conducting meta-analyses in R with the metafor. Journal of Statistical Software 2010;36:1-48.

30. BORENSTEIN M, HEDGES LV, HIGGINS JP, ROTHSTEIN HR. *Introduction to meta-analysis*. John Wiley & Sons; Number of pages.

31. HIGGINS J, GREEN S. Cochrane handbook for systematic reviews of interventions Version 5.1. 0. The Cochrane Collaboration. Confidence intervals 2011.

32. BORENSTEIN M, HEDGES LV, HIGGINS JP, ROTHSTEIN HR. A basic introduction to fixed‐effect and random‐effects models for meta‐analysis. Research synthesis methods 2010;1:97-111.

33. HIGGINS JP, THOMPSON SG, DEEKS JJ, ALTMAN DG. Measuring inconsistency in meta-analyses. BMJ: British Medical Journal 2003;327:557.

34. EGGER M, SMITH GD, SCHNEIDER M, MINDER C. Bias in meta-analysis detected by a simple, graphical test. BMJ (Clinical research ed) 1997;315:629-34.

35. BHAGAT M, MUKHERJEE S, DE P, et al. Clustering of cardiometabolic risk factors in Asian Indian women: Santiniketan women study. Menopause (New York, NY) 2010;17:359-64.

36. DUVAL S, TWEEDIE R. A nonparametric “trim and fill” method of accounting for publication bias in meta-analysis. Journal of the American Statistical Association 2000;95:89-98.

37. ABATE M, SCHIAVONE C, DI CARLO L, SALINI V. Prevalence of and risk factors for asymptomatic rotator cuff tears in postmenopausal women Menopause (New York, NY) 2014;21:275-80.

38. ABDULNOUR J, DOUCET E, BROCHU M, et al. The effect of the menopausal transition on body composition and cardiometabolic risk factors: a Montreal-Ottawa New Emerging Team group study. Menopause (New York, NY) 2012;19:760-7.

39. ABILDGAARD J, PEDERSEN AT, GREEN CJ, et al. Menopause is associated with decreased whole body fat oxidation during exercise. American journal of physiology Endocrinology and metabolism 2013;304:E1227-36.

40. ADAMS-CAMPBELL LL, KIM KS, DUNSTON G, LAING AE, BONNEY G, DEMENAIS F. The relationship of body mass index to reproductive factors in pre- and postmenopausal African-American women with and without breast cancer. Obesity research 1996;4:451-6.

41. AGRINIER N, COURNOT M, DALLONGEVILLE J, et al. Menopause and modifiable coronary heart disease risk factors: a population based study. Maturitas 2010;65:237-43.

42. AGUADO F, REVILLA M, HERNANDEZ ER, VILLA LF, RICO H. Behavior of bone mass measurements. Dual energy x-ray absorptiometry total body bone mineral content, ultrasound bone velocity, and computed metacarpal radiogrammetry, with age, gonadal status, and weight in healthy women. Investigative radiology 1996;31:218-22.

43. ALBANESE CV, CEPOLLARO C, DE TERLIZZI F, BRANDI ML, PASSARIELLO R. Performance of five phalangeal QUS parameters in the evaluation of gonadal-status, age and vertebral fracture risk compared with DXA. Ultrasound in medicine & biology 2009;35:537-44.

44. ALLALI F, EL MANSOURI L, ABOURAZZAK F, et al. The effect of past use of oral contraceptive on bone mineral density, bone biochemical markers and muscle strength in healthy pre and post menopausal women. BMC women's health 2009;9:31.

45. ALOIA JF, VASWANI A, MA R, FLASTER E. To what extent is bone mass determined by fat-free or fat mass? Am J Clin Nutr 1995;61:1110-4.

46. AMANKWAH EK, FRIEDENREICH CM, MAGLIOCCO AM, et al. Anthropometric measures and the risk of endometrial cancer, overall and by tumor microsatellite status and histological subtype. American journal of epidemiology 2013;177:1378-87.

47. AMARANTE F, VILODRE LC, MATURANA MA, SPRITZER PM. Women with primary ovarian insufficiency have lower bone mineral density. Brazilian journal of medical and biological research = Revista brasileira de pesquisas medicas e biologicas 2011;44:78-83.

48. AMIRI P, DEIHIM T, NAKHODA K, HASHEMINIA M, MONTAZERI A, AZIZI F. Metabolic syndrome and health-related quality of life in reproductive age and post-menopausal women: Tehran Lipid and Glucose Study. Archives of Iranian medicine 2014;17:423-8.

49. ANGSUWATHANA S, LEERASIRI P, RATTANACHAIYANONT M, et al. Health check-up program for pre/postmenopausal women at Siriraj Menopause Clinic. Journal of the Medical Association of Thailand = Chotmaihet thangphaet 2007;90:1-8.

50. ARMELLINI F, ZAMBONI M, PERDICHIZZI G, et al. Computed tomography visceral adipose tissue volume measurements of Italians. Predictive equations. European journal of clinical nutrition 1996;50:290-4.

51. ARTHUR FK, ADU-FRIMPONG M, OSEI-YEBOAH J, MENSAH FO, OWUSU L. The prevalence of metabolic syndrome and its predominant components among pre-and postmenopausal Ghanaian women. BMC research notes 2013;6:446.

52. AYDIN ZD. Determinants of age at natural menopause in the Isparta Menopause and Health Study: premenopausal body mass index gain rate and episodic weight loss. Menopause (New York, NY) 2010;17:494-505.

53. AYUB N, KHAN SR, SYED F. Leptin levels in pre and post menopausal Pakistani women. JPMA The Journal of the Pakistan Medical Association 2006;56:3-5.

54. BANCROFT J, CAWOOD EH. Androgens and the menopause; a study of 40-60-year-old women. Clinical endocrinology 1996;45:577-87.

55. BEDNAREK-TUPIKOWSKA G, FILUS A, KULICZKOWSKA-PLAKSEJ J, TUPIKOWSKI K, BOHDANOWICZ-PAWLAK A, MILEWICZ A. Serum leptin concentrations in pre- and postmenopausal women on sex hormone therapy. Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology 2006;22:207-12.

56. BELL RJ, DAVISON SL, PAPALIA MA, MCKENZIE DP, DAVIS SR. Endogenous androgen levels and cardiovascular risk profile in women across the adult life span. Menopause (New York, NY) 2007;14:630-8.

57. BEN ALI S, BELFKI-BENALI H, AHMED DB, et al. Postmenopausal hypertension, abdominal obesity, apolipoprotein and insulin resistance. Clinical and experimental hypertension (New York, NY : 1993) 2016;38:370-4.

58. BEN ALI S, BELFKI-BENALI H, AOUNALLAH-SKHIRI H, et al. Menopause and metabolic syndrome in tunisian women. BioMed research international 2014;2014:457131.

59. BEN ALI S, JEMAA R, FTOUHI B, et al. Relationship of plasma leptin and adiponectin concentrations with menopausal status in Tunisian women. Cytokine 2011;56:338-42.

60. BERG G, MESCH V, BOERO L, et al. Lipid and lipoprotein profile in menopausal transition. Effects of hormones, age and fat distribution. Hormone and metabolic research = Hormon- und Stoffwechselforschung = Hormones et metabolisme 2004;36:215-20.

61. BERGE LN, BONAA KH, NORDOY A. Serum ferritin, sex hormones, and cardiovascular risk factors in healthy women. Arteriosclerosis and thrombosis : a journal of vascular biology 1994;14:857-61.

62. BERGER GM, NAIDOO J, GOUNDEN N, GOUWS E. Marked hyperinsulinaemia in postmenopausal, healthy Indian (Asian) women. Diabetic medicine : a journal of the British Diabetic Association 1995;12:788-95.

63. BERSTAD P, COATES RJ, BERNSTEIN L, et al. A case-control study of body mass index and breast cancer risk in white and African-American women. Cancer epidemiology, biomarkers & prevention : a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology 2010;19:1532-44.

64. BHUROSY T, JEEWON R. Food habits, socioeconomic status and body mass index among premenopausal and post-menopausal women in Mauritius. Journal of human nutrition and dietetics : the official journal of the British Dietetic Association 2013;26 Suppl 1:114-22.

65. BLUMENTHAL JA, FREDRIKSON M, MATTHEWS KA, et al. Stress reactivity and exercise training in premenopausal and postmenopausal women. Health psychology : official journal of the Division of Health Psychology, American Psychological Association 1991;10:384-91.

66. BONITHON-KOPP C, SCARABIN PY, DARNE B, MALMEJAC A, GUIZE L. Menopause-related changes in lipoproteins and some other cardiovascular risk factors. International journal of epidemiology 1990;19:42-8.

67. CAIRE-JUVERA G, ARENDELL LA, MASKARINEC G, THOMSON CA, CHEN Z. Associations between mammographic density and body composition in Hispanic and non-Hispanic white women by menopause status. Menopause (New York, NY) 2008;15:319-25.

68. CAMPESI I, OCCHIONI S, TONOLO G, et al. Ageing/Menopausal Status in Healthy Women and Ageing in Healthy Men Differently Affect Cardiometabolic Parameters. International journal of medical sciences 2016;13:124-32.

69. CARR MC, KIM KH, ZAMBON A, et al. Changes in LDL density across the menopausal transition. Journal of investigative medicine : the official publication of the American Federation for Clinical Research 2000;48:245-50.

70. CASTRACANE VD, KRAEMER RR, FRANKEN MA, KRAEMER GR, GIMPEL T. Serum leptin concentration in women: effect of age, obesity, and estrogen administration. Fertility and sterility 1998;70:472-7.

71. CATSBURG C, KIRSH VA, SOSKOLNE CL, et al. Associations between anthropometric characteristics, physical activity, and breast cancer risk in a Canadian cohort. Breast cancer research and treatment 2014;145:545-52.

72. CECCHINI RS, COSTANTINO JP, CAULEY JA, et al. Body mass index and the risk for developing invasive breast cancer among high-risk women in NSABP P-1 and STAR breast cancer prevention trials. Cancer prevention research (Philadelphia, Pa) 2012;5:583-92.

73. CERVELLATI C, PANSINI FS, BONACCORSI G, et al. Body mass index is a major determinant of abdominal fat accumulation in pre-, peri- and post-menopausal women. Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology 2009;25:413-7.

74. CHAIN A, CRIVELLI M, FAERSTEIN E, BEZERRA FF. Association between fat mass and bone mineral density among Brazilian women differs by menopausal status: The Pro-Saude Study. Nutrition (Burbank, Los Angeles County, Calif) 2017;33:14-19.

75. CHANG CJ, WU CH, YAO WJ, YANG YC, WU JS, LU FH. Relationships of age, menopause and central obesity on cardiovascular disease risk factors in Chinese women. International journal of obesity and related metabolic disorders : journal of the International Association for the Study of Obesity 2000;24:1699-704.

76. CHO GJ, LEE JH, PARK HT, et al. Postmenopausal status according to years since menopause as an independent risk factor for the metabolic syndrome. Menopause (New York, NY) 2008;15:524-9.

77. CIFKOVA R, PITHA J, LEJSKOVA M, LANSKA V, ZECOVA S. Blood pressure around the menopause: a population study. Journal of hypertension 2008;26:1976-82.

78. COPELAND AL, MARTIN PD, GEISELMAN PJ, RASH CJ, KENDZOR DE. Predictors of pretreatment attrition from smoking cessation among pre- and postmenopausal, weight-concerned women. Eating behaviors 2006;7:243-51.

79. CREMONINI E, BONACCORSI G, BERGAMINI CM, et al. Metabolic transitions at menopause: in post-menopausal women the increase in serum uric acid correlates with abdominal adiposity as assessed by DXA. Maturitas 2013;75:62-6.

80. CUI LH, SHIN MH, KWEON SS, et al. Relative contribution of body composition to bone mineral density at different sites in men and women of South Korea. Journal of bone and mineral metabolism 2007;25:165-71.

81. D'HAESELEER E, DEPYPERE H, CLAEYS S, VAN LIERDE KM. The relation between body mass index and speaking fundamental frequency in premenopausal and postmenopausal women. Menopause (New York, NY) 2011;18:754-8.

82. DA CAMARA SM, ZUNZUNEGUI MV, PIRKLE C, MOREIRA MA, MACIEL AC. Menopausal status and physical performance in middle aged women: a cross-sectional community-based study in Northeast Brazil. PLoS One 2015;10:e0119480.

83. DALLONGEVILLE J, MARECAUX N, ISOREZ D, ZYLBERGBERG G, FRUCHART JC, AMOUYEL P. Multiple coronary heart disease risk factors are associated with menopause and influenced by substitutive hormonal therapy in a cohort of French women. Atherosclerosis 1995;118:123-33.

84. DANCEY DR, HANLY PJ, SOONG C, LEE B, HOFFSTEIN V. Impact of menopause on the prevalence and severity of sleep apnea. Chest 2001;120:151-5.

85. DAVIS CE, PAJAK A, RYWIK S, et al. Natural menopause and cardiovascular disease risk factors. The Poland and US Collaborative Study on Cardiovascular Disease Epidemiology. Annals of epidemiology 1994;4:445-8.

86. DE KAT AC, DAM V, ONLAND-MORET NC, EIJKEMANS MJ, BROEKMANS FJ, VAN DER SCHOUW YT. Unraveling the associations of age and menopause with cardiovascular risk factors in a large population-based study. BMC medicine 2017;15:2.

87. DEN TONKELAAR I, SEIDELL JC, VAN NOORD PA, BAANDERS-VAN HALEWIJN EA, OUWEHAND IJ. Fat distribution in relation to age, degree of obesity, smoking habits, parity and estrogen use: a cross-sectional study in 11,825 Dutch women participating in the DOM-project. Int J Obes 1990;14:753-61.

88. DMITRUK A, CZECZELEWSKI J, CZECZELEWSKA E, GOLACH J, PARNICKA U. Body composition and fatty tissue distribution in women with various menstrual status. Roczniki Panstwowego Zakladu Higieny 2018;69:95-101.

89. DONATO GB, FUCHS SC, OPPERMANN K, BASTOS C, SPRITZER PM. Association between menopause status and central adiposity measured at different cutoffs of waist circumference and waist-to-hip ratio. Menopause (New York, NY) 2006;13:280-5.

90. DOUCHI T, OKI T, NAKAMURA S, IJUIN H, YAMAMOTO S, NAGATA Y. The effect of body composition on bone density in pre- and postmenopausal women. Maturitas 1997;27:55-60.

91. DOUCHI T, YAMAMOTO S, YOSHIMITSU N, ANDOH T, MATSUO T, NAGATA Y. Relative contribution of aging and menopause to changes in lean and fat mass in segmental regions. Maturitas 2002;42:301-6.

92. DUBOIS EF, VAN DEN BERGH JP, SMALS AG, VAN DE MEERENDONK CW, ZWINDERMAN AH, SCHWEITZER DH. Comparison of quantitative ultrasound parameters with dual energy X-ray absorptiometry in pre- and postmenopausal women. The Netherlands journal of medicine 2001;58:62-70.

93. ENGMANN NJ, GOLMAKANI MK, MIGLIORETTI DL, SPRAGUE BL, KERLIKOWSKE K. Population-Attributable Risk Proportion of Clinical Risk Factors for Breast Cancer. JAMA oncology 2017;3:1228-36.

94. ERTUNGEALP E, SEYISOGLU H, EREL CT, SENTURK LM, GEZER A. Changes in bone mineral density with age, menopausal status and body mass index in Turkish women. Climacteric : the journal of the International Menopause Society 1999;2:45-51.

95. FENG Y, HONG X, WILKER E, et al. Effects of age at menarche, reproductive years, and menopause on metabolic risk factors for cardiovascular diseases. Atherosclerosis 2008;196:590-7.

96. FORMICA C, LORO ML, GILSANZ V, SEEMAN E. Inhomogeneity in body fat distribution may result in inaccuracy in the measurement of vertebral bone mass. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 1995;10:1504-11.

97. FRIEDENREICH C, CUST A, LAHMANN PH, et al. Anthropometric factors and risk of endometrial cancer: the European prospective investigation into cancer and nutrition. Cancer causes & control : CCC 2007;18:399-413.

98. FRIEDENREICH CM, COURNEYA KS, BRYANT HE. Case-control study of anthropometric measures and breast cancer risk. International journal of cancer 2002;99:445-52.

99. FU X, MA X, LU H, HE W, WANG Z, ZHU S. Associations of fat mass and fat distribution with bone mineral density in pre- and postmenopausal Chinese women. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2011;22:113-9.

100. FUH JL, WANG SJ, LEE SJ, LU SR, JUANG KD. Quality of life and menopausal transition for middle-aged women on Kinmen island. Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation 2003;12:53-61.

101. GAMBACCIANI M, CIAPONI M, CAPPAGLI B, BENUSSI C, DE SIMONE L, GENAZZANI AR. Climacteric modifications in body weight and fat tissue distribution. Climacteric 1999;2:37-44.

102. GENAZZANI AR, GAMBACCIANI M. Effect of climacteric transition and hormone replacement therapy on body weight and body fat distribution. Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology 2006;22:145-50.

103. GHOSH A. Comparison of risk variables associated with the metabolic syndrome in pre- and postmenopausal Bengalee women. Cardiovascular journal of Africa 2008;19:183-7.

104. GHOSH A, BHAGAT M. Anthropometric and body composition characteristics in pre- and postmenopausal Asian Indian women: Santiniketan women study. Anthropologischer Anzeiger; Bericht uber die biologisch-anthropologische Literatur 2010;68:1-10.

105. GRAM IT, FUNKHOUSER E, TABAR L. Anthropometric indices in relation to mammographic patterns among peri-menopausal women. International journal of cancer 1997;73:323-6.

106. GUO W, BRADBURY KE, REEVES GK, KEY TJ. Physical activity in relation to body size and composition in women in UK Biobank. Annals of epidemiology 2015;25:406-13.e6.

107. GURKA MJ, VISHNU A, SANTEN RJ, DEBOER MD. Progression of Metabolic Syndrome Severity During the Menopausal Transition. Journal of the American Heart Association 2016;5.

108. HADJI P, HARS O, BOCK K, et al. The influence of menopause and body mass index on serum leptin concentrations. European journal of endocrinology 2000;143:55-60.

109. HAGNER W, HAGNER-DERENGOWSKA M, WIACEK M, ZUBRZYCKI IZ. Changes in level of VO2max, blood lipids, and waist circumference in the response to moderate endurance training as a function of ovarian aging. Menopause (New York, NY) 2009;16:1009-13.

110. HAN D, NIE J, BONNER MR, et al. Lifetime adult weight gain, central adiposity, and the risk of pre- and postmenopausal breast cancer in the Western New York exposures and breast cancer study. International journal of cancer 2006;119:2931-7.

111. HARTING GH, MOORE CE, MITCHELL R, KAPPUS CM. Relationship of menopausal status and exercise level to HDL-cholesterol in women. Experimental aging research 1984;10:13-8.

112. HE L, TANG X, LI N, et al. Menopause with cardiovascular disease and its risk factors among rural Chinese women in Beijing: a population-based study. Maturitas 2012;72:132-8.

113. HIROSE K, TAJIMA K, HAMAJIMA N, et al. Impact of established risk factors for breast cancer in nulligravid Japanese women. Breast cancer (Tokyo, Japan) 2003;10:45-53.

114. HJARTAKER A, ADAMI HO, LUND E, WEIDERPASS E. Body mass index and mortality in a prospectively studied cohort of Scandinavian women: the women's lifestyle and health cohort study. European journal of epidemiology 2005;20:747-54.

115. HO S, WU S, CHAN S, SHAM A. Menopausal transition and changes of body composition: a prospective study in Chinese perimenopausal women. International Journal of Obesity 2010;34:1265.

116. HSU YH, VENNERS SA, TERWEDOW HA, et al. Relation of body composition, fat mass, and serum lipids to osteoporotic fractures and bone mineral density in Chinese men and women. Am J Clin Nutr 2006;83:146-54.

117. HU X, PAN X, MA X, et al. Contribution of a first-degree family history of diabetes to increased serum adipocyte fatty acid binding protein levels independent of body fat content and distribution. International journal of obesity (2005) 2016;40:1649-54.

118. HUNTER G, KEKES-SZABO T, TREUTH M, WILLIAMS M, GORAN M, PICHON C. Intra-abdominal adipose tissue, physical activity and cardiovascular risk in pre-and post-menopausal women. International journal of obesity and related metabolic disorders: journal of the International Association for the Study of Obesity 1996;20:860-65.

119. IIDA T, DOMOTO T, TAKIGAWA A, et al. Relationships among blood leptin and adiponectin levels, fat mass, and bone mineral density in Japanese pre-and postmenopausal women. Hiroshima J Med Sci 2011;60:71-8.

120. ILICH-ERNST J, BROWNBILL RA, LUDEMANN MA, FU R. Critical factors for bone health in women across the age span: how important is muscle mass? Medscape women's health 2002;7:2.

121. ITO M, HAYASHI K, UETANI M, YAMADA M, OHKI M, NAKAMURA T. Association between anthropometric measures and spinal bone mineral density. Investigative radiology 1994;29:812-6.

122. JAFF NG, NORRIS SA, SNYMAN T, TOMAN M, CROWTHER NJ. 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. Metabolism: clinical and experimental 2015;64:1031-41.

123. JASIENSKA G, ZIOMKIEWICZ A, GORKIEWICZ M, PAJAK A. Body mass, depressive symptoms and menopausal status: an examination of the "Jolly Fat" hypothesis. Women's health issues : official publication of the Jacobs Institute of Women's Health 2005;15:145-51.

124. JEENDUANG N, TRONGSAKUL R, INHONGSA P, CHAIDACH P. The prevalence of metabolic syndrome in premenopausal and postmenopausal women in Southern Thailand.

Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology 2014;30:573-6.

125. JEON YK, LEE JG, KIM SS, et al. Association between bone mineral density and metabolic syndrome in pre- and postmenopausal women. Endocrine journal 2011;58:87-93.

126. JURIMAE J, JURIMAE T. Plasma adiponectin concentration in healthy pre- and postmenopausal women: relationship with body composition, bone mineral, and metabolic variables. American journal of physiology Endocrinology and metabolism 2007;293:E42-7.

127. KADAM N, CHIPLONKAR S, KHADILKAR A, DIVATE U, KHADILKAR V. Low bone mass in urban Indian women above 40 years of age: prevalence and risk factors. Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology 2010;26:909-17.

128. KANG EK, PARK HW, BAEK S, LIM JY. The Association between Trunk Body Composition and Spinal Bone Mineral Density in Korean Males versus Females: a Farmers' Cohort for Agricultural Work-Related Musculoskeletal Disorders (FARM) Study. Journal of Korean medical science 2016;31:1595-603.

129. KAUFER-HORWITZ M, PELAEZ-ROBLES K, LAZZERI-ARTEAGA P, GOTI-RODRIGUEZ LM, AVILA-ROSAS H. Hypertension, overweight and abdominal adiposity in women. An analytical perspective. Archives of medical research 2005;36:404-11.

130. KIM HM, PARK J, RYU SY, KIM J. The effect of menopause on the metabolic syndrome among Korean women: the Korean National Health and Nutrition Examination Survey, 2001. Diabetes care 2007;30:701-6.

131. KIM JH, CHOI HJ, KIM MJ, SHIN CS, CHO NH. Fat mass is negatively associated with bone mineral content in Koreans. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2012;23:2009-16.

132. KIM S, LEE JY, IM JA, et al. Association between serum osteocalcin and insulin resistance in postmenopausal, but not premenopausal, women in Korea. Menopause (New York, NY) 2013;20:1061-6.

133. KIM YM, KIM SH, KIM S, YOO JS, CHOE EY, WON YJ. Variations in fat mass contribution to bone mineral density by gender, age, and body mass index: the Korea National Health and Nutrition Examination Survey (KNHANES) 2008-2011. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2016;27:2543-54.

134. KIRCHENGAST S, GRUBER D, SATOR M, HUBER J. Impact of the age at menarche on adult body composition in healthy pre- and postmenopausal women. American journal of physical anthropology 1998;105:9-20.

135. KIRCHENGAST S, HARTMANN B, HUBER J. Serum levels of sex hormones, thyroid hormones, growth hormone, IGF I, and cortisol and their relations to body fat distribution in healthy women dependent on their menopausal status. Zeitschrift fur Morphologie und Anthropologie 1996;81:223-34.

136. KNAPP KM, BLAKE GM, SPECTOR TD, FOGELMAN I. Multisite quantitative ultrasound: precision, age- and menopause-related changes, fracture discrimination, and T-score equivalence with dual-energy X-ray absorptiometry. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2001;12:456-64.

137. KOH SJ, HYUN YJ, CHOI SY, et al. Influence of age and visceral fat area on plasma adiponectin concentrations in women with normal glucose tolerance. Clinica chimica acta; international journal of clinical chemistry 2008;389:45-50.

138. KONRAD T, BÄR F, SCHNEIDER F, et al. Factors influencing endothelial function in healthy pre-and post-menopausal women of the EU-RISC study. Diabetes and Vascular Disease Research 2011;8:229-36.

139. KONTOGIANNI MD, DAFNI UG, ROUTSIAS JG, SKOPOULI FN. Blood leptin and adiponectin as possible mediators of the relation between fat mass and BMD in perimenopausal women. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 2004;19:546-51.

140. KONUKOGLU D, SERIN O, ERCAN M. Plasma leptin levels in obese and non-obese postmenopausal women before and after hormone replacement therapy. Maturitas 2000;36:203-7.

141. KOSKOVA I, PETRASEK R, VONDRA K, et al. Weight, body composition and fat distribution of Czech women in relation with reproductive phase: a cross-sectional study. Prague medical report 2007;108:13-26.

142. KOTANI K, CHEN JT, TANIGUCHI N. The relationship between adiponectin and blood pressure in premenopausal and postmenopausal women. Clinical and investigative medicine Medecine clinique et experimentale 2011;34:E125-30.

143. KRAEMER RR, SYNOVITZ LB, GIMPEL T, KRAEMER GR, JOHNSON LG, CASTRACANE VD. Effect of estrogen on serum DHEA in younger and older women and the relationship of DHEA to adiposity and gender. Metabolism: clinical and experimental 2001;50:488-93.

144. KUK JL, LEE S, HEYMSFIELD SB, ROSS R. Waist circumference and abdominal adipose tissue distribution: influence of age and sex. Am J Clin Nutr 2005;81:1330-4.

145. LAITINEN K, VALIMAKI M, KETO P. Bone mineral density measured by dual-energy X-ray absorptiometry in healthy Finnish women. Calcified tissue international 1991;48:224-31.

146. LEJSKOVA M, ALUSIK S, VALENTA Z, ADAMKOVA S, PITHA J. Natural postmenopause is associated with an increase in combined cardiovascular risk factors. Physiological research 2012;61:587-96.

147. LEON GUERRERO RT, NOVOTNY R, WILKENS LR, et al. Risk factors for breast cancer in the breast cancer risk model study of Guam and Saipan. Cancer epidemiology 2017;50:221-33.

148. LEY CJ, LEES B, STEVENSON JC. Sex- and menopause-associated changes in body-fat distribution. The American journal of clinical nutrition 1992;55:950-4.

149. LIN WY, YANG WS, LEE LT, et al. Insulin resistance, obesity, and metabolic syndrome among non-diabetic pre- and post-menopausal women in North Taiwan. International journal of obesity (2005) 2006;30:912-7.

150. LINDQUIST O, BENGTSSON C. Serum lipids, arterial blood pressure and body weight in relation to the menopause: results from a population study of women in Goteborg, Sweden. Scandinavian journal of clinical and laboratory investigation 1980;40:629-36.

151. LINDSAY R, COSMAN F, HERRINGTON BS, HIMMELSTEIN S. Bone mass and body composition in normal women. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 1992;7:55-63.

152. LOVEJOY JC, CHAMPAGNE CM, DE JONGE L, XIE H, SMITH SR. Increased visceral fat and decreased energy expenditure during the menopausal transition. International journal of obesity (2005) 2008;32:949-58.

153. LYU LC, YEH CY, LICHTENSTEIN AH, LI Z, ORDOVAS JM, SCHAEFER EJ. Association of sex, adiposity, and diet with HDL subclasses in middle-aged Chinese. Am J Clin Nutr 2001;74:64-71.

154. MAHARLOUEI N, BELLISSIMO N, AHMADI SM, LANKARANI KB. Prevalence of metabolic syndrome in pre- and postmenopausal Iranian women. Climacteric 2013;16:561-7.

155. MALACARA JM, CANTO DE CETINA T, BASSOL S, et al. Symptoms at pre- and postmenopause in rural and urban women from three States of Mexico. Maturitas 2002;43:11-9.

156. MANABE E, AOYAGI K, TACHIBANA H, TAKEMOTO T. Relationship of intra-abdominal adiposity and peripheral fat distribution to lipid metabolism in an island population in western Japan: gender differences and effect of menopause. The Tohoku journal of experimental medicine 1999;188:189-202.

157. MANJER J, KAAKS R, RIBOLI E, BERGLUND G. Risk of breast cancer in relation to anthropometry, blood pressure, blood lipids and glucose metabolism: a prospective study within the Malmo Preventive Project. European journal of cancer prevention : the official journal of the European Cancer Prevention Organisation (ECP) 2001;10:33-42.

158. MANNISTO S, PIETINEN P, PYY M, PALMGREN J, ESKELINEN M, UUSITUPA M. Body-size indicators and risk of breast cancer according to menopause and estrogen-receptor status. International journal of cancer 1996;68:8-13.

159. MARTINI G, VALENTI R, GIOVANI S, NUTI R. Age-related changes in body composition of healthy and osteoporotic women. Maturitas 1997;27:25-33.

160. MARWAHA RK, GARG MK, TANDON N, MEHAN N, SASTRY A, BHADRA K. Relationship of body fat and its distribution with bone mineral density in Indian population. Journal of clinical densitometry : the official journal of the International Society for Clinical Densitometry 2013;16:353-9.

161. MATSUSHITA H, KURABAYASHI T, TOMITA M, KATO N, TANAKA K. Effects of uncoupling protein 1 and beta3-adrenergic receptor gene polymorphisms on body size and serum lipid concentrations in Japanese women. Maturitas 2003;45:39-45.

162. MATSUZAKI M, KULKARNI B, KUPER H, et al. Association of Hip Bone Mineral Density and Body Composition in a Rural Indian Population: The Andhra Pradesh Children and Parents Study (APCAPS). PLoS One 2017;12:e0167114.

163. MATTHEWS KA, MEILAHN E, KULLER LH, KELSEY SF, CAGGIULA AW, WING RR. Menopause and risk factors for coronary heart disease. The New England journal of medicine 1989;321:641-6.

164. MESCH VR, BOERO LE, SISELES NO, et al. Metabolic syndrome throughout the menopausal transition: influence of age and menopausal status. Climacteric 2006;9:40-8.

165. MEZA-MUNOZ DE, FAJARDO ME, PEREZ-LUQUE EL, MALACARA JM. Factors associated with estrogen receptors-alpha (ER-alpha) and -beta (ER-beta) and progesterone receptor abundance in obese and non obese pre- and post-menopausal women. Steroids 2006;71:498-503.

166. MINATOYA M, KUTOMI G, SHIMA H, et al. Relation of serum adiponectin levels and obesity with breast cancer: a Japanese case-control study. Asian Pacific journal of cancer prevention : APJCP 2014;15:8325-30.

167. MO D, HSIEH P, YU H, et al. The relationship between osteoporosis and body composition in pre- and postmenopausal women from different ethnic groups in China. Ethnicity & health 2017;22:295-310.

168. MUCHANGA SIFA MJ, LEPIRA FB, LONGO AL, et al. Prevalence and predictors of metabolic syndrome among Congolese pre- and postmenopausal women. Climacteric 2014;17:442-8.

169. MUTI P, STANULLA M, MICHELI A, et al. Markers of insulin resistance and sex steroid hormone activity in relation to breast cancer risk: a prospective analysis of abdominal adiposity, sebum production, and hirsutism (Italy). Cancer causes & control : CCC 2000;11:721-30.

170. NITTA J, NOJIMA M, OHNISHI H, et al. Weight Gain and Alcohol Drinking Associations with Breast Cancer Risk in Japanese Postmenopausal Women - Results from the Japan Collaborative Cohort (JACC) Study. Asian Pacific journal of cancer prevention : APJCP 2016;17:1437-43.

171. NOH HM, SONG YM, PARK JH, KIM BK, CHOI YH. Metabolic factors and breast cancer risk in Korean women. Cancer causes & control : CCC 2013;24:1061-8.

172. NORDIN BE, NEED AG, BRIDGES A, HOROWITZ M. Relative contributions of years since menopause, age, and weight to vertebral density in postmenopausal women. The Journal of clinical endocrinology and metabolism 1992;74:20-3.

173. OHTA H, KURODA T, ONOE Y, et al. Familial correlation of bone mineral density, birth data and lifestyle factors among adolescent daughters, mothers and grandmothers. Journal of bone and mineral metabolism 2010;28:690-5.

174. OLDROYD B, STEWART SP, TRUSCOTT JG, WESTMACOTT CF, SMITH MA. Age related changes in body composition. Applied radiation and isotopes : including data, instrumentation and methods for use in agriculture, industry and medicine 1998;49:589-90.

175. PACHOLCZAK R, KLIMEK-PIOTROWSKA W, KUSZMIERSZ P. Associations of anthropometric measures on breast cancer risk in pre- and postmenopausal women--a case-control study. Journal of physiological anthropology 2016;35:7.

176. PARK JH, SONG YM, SUNG J, et al. The association between fat and lean mass and bone mineral density: the Healthy Twin Study. Bone 2012;50:1006-11.

177. PARK YM, WHITE AJ, NICHOLS HB, O'BRIEN KM, WEINBERG CR, SANDLER DP. The association between metabolic health, obesity phenotype and the risk of breast cancer. International journal of cancer 2017;140:2657-66.

178. PAVICIC ZEZELJ S, CVIJANOVIC O, MICOVIC V, BOBINAC D, CRNCEVIC-ORLIC Z, MALATESTINIC G. Effect of menopause, anthropometry, nutrition and lifestyle on bone status of women in the northern Mediterranean. The West Indian medical journal 2010;59:494-502.

179. PAVLICA T, MIKALACKI M, MATIC R, et al. Relationship between BMI and skinfold thicknesses to risk factors in premenopausal and postmenopausal women. Collegium antropologicum 2013;37 Suppl 2:119-24.

180. PHILLIPS GB, JING T, HEYMSFIELD SB. Does insulin resistance, visceral adiposity, or a sex hormone alteration underlie the metabolic syndrome? Studies in women. Metabolism: clinical and experimental 2008;57:838-44.

181. POLESEL DN, HIROTSU C, NOZOE KT, et al. Waist circumference and postmenopause stages as the main associated factors for sleep apnea in women: a cross-sectional population-based study. Menopause (New York, NY) 2015;22:835-44.

182. POLLAN M, LOPE V, MIRANDA-GARCIA J, et al. Adult weight gain, fat distribution and mammographic density in Spanish pre- and post-menopausal women (DDM-Spain). Breast cancer research and treatment 2012;134:823-38.

183. PORTALUPPI F, PANSINI F, MANFREDINI R, MOLLICA G. Relative influence of menopausal status, age, and body mass index on blood pressure. Hypertension (Dallas, Tex : 1979) 1997;29:976-9.

184. PRIYA T, CHOWDHURY MG, VASANTH K, et al. Assessment of serum leptin and resistin levels in association with the metabolic risk factors of pre- and post-menopausal rural women in South India. Diabetes & metabolic syndrome 2013;7:233-7.

185. RANTALAINEN T, NIKANDER R, HEINONEN A, et al. Neuromuscular performance and body mass as indices of bone loading in premenopausal and postmenopausal women. Bone 2010;46:964-9.

186. REINA P, COINTRY GR, NOCCIOLINO L, et al. Analysis of the independent power of age-related, anthropometric and mechanical factors as determinants of the structure of radius and tibia in normal adults. A pQCT study. Journal of musculoskeletal & neuronal interactions 2015;15:10-22.

187. REVILLA M, VILLA LF, HERNANDEZ ER, SANCHEZ-ATRIO A, CORTES J, RICO H. Influence of weight and gonadal status on total and regional bone mineral content and on weight-bearing and non-weight-bearing bones, measured by dual-energy X-ray absosorptiometry. Maturitas 1997;28:69-74.

188. REVILLA M, VILLA LF, SANCHEZ-ATRIO A, HERNANDEZ ER, RICO H. Influence of body mass index on the age-related slope of total and regional bone mineral content. Calcified tissue international 1997;61:134-8.

189. RICE MS, BERTRAND KA, LAJOUS M, et al. Reproductive and lifestyle risk factors and mammographic density in Mexican women. Annals of epidemiology 2015;25:868-73.

190. RICO H, AGUADO F, ARRIBAS I, et al. Behavior of phalangeal bone ultrasound in normal women with relation to gonadal status and body mass index. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2001;12:450-5.

191. RICO H, ARRIBAS I, CASANOVA FJ, DUCE AM, HERNANDEZ ER, CORTES-PRIETO J. Bone mass, bone metabolism, gonadal status and body mass index. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2002;13:379-87.

192. ROELFSEMA F, VELDHUIS JD. Growth Hormone Dynamics in Healthy Adults Are Related to Age and Sex and Strongly Dependent on Body Mass Index. Neuroendocrinology 2016;103:335-44.

193. ROSENBAUM M, NICOLSON M, HIRSCH J, et al. Effects of gender, body composition, and menopause on plasma concentrations of leptin. The Journal of clinical endocrinology and metabolism 1996;81:3424-7.

194. SALOMAA V, RASI V, PEKKANEN J, et al. Association of hormone replacement therapy with hemostatic and other cardiovascular risk factors. The FINRISK Hemostasis Study. Arteriosclerosis, thrombosis, and vascular biology 1995;15:1549-55.

195. SARRAFZADEGAN N, KHOSRAVI-BOROUJENI H, ESMAILLZADEH A, SADEGHI M, RAFIEIAN-KOPAEI M, ASGARY S. The association between hypertriglyceridemic waist phenotype, menopause, and cardiovascular risk factors. Archives of Iranian medicine 2013;16:161-6.

196. SCHABERG-LOREI G, BALLARD JE, MCKEOWN BC, ZINKGRAF SA. Body composition alterations consequent to an exercise program for pre and postmenopausal women. The Journal of sports medicine and physical fitness 1990;30:426-33.

197. SCHWARZ S, VOLZKE H, ALTE D, et al. Menopause and determinants of quality of life in women at midlife and beyond: the study of health in pomerania (SHIP). Menopause (New York, NY) 2007;14:123-34.

198. SHERK VD, MALONE SP, BEMBEN MG, KNEHANS AW, PALMER IJ, BEMBEN DA. Leptin, fat mass, and bone mineral density in healthy pre- and postmenopausal women. Journal of clinical densitometry : the official journal of the International Society for Clinical Densitometry 2011;14:321-5.

199. SHIBATA H, MATSUZAKI T, HATANO S. Relationship of relevant factors of atherosclerosis to menopause in Japanese women. American journal of epidemiology 1979;109:420-4.

200. SIEMINSKA L, WOJCIECHOWSKA C, FOLTYN W, et al. The relation of serum adiponectin and leptin levels to metabolic syndrome in women before and after the menopause. Endokrynologia Polska 2006;57:15-22.

201. SKRZYPCZAK M, SZWED A. Assessment of the body mass index and selected physiological parameters in pre- and post-menopausal women. Homo : internationale Zeitschrift fur die vergleichende Forschung am Menschen 2005;56:141-52.

202. SKRZYPCZAK M, SZWED A, PAWLIŃSKA-CHMARA R, SKRZYPULEC V. Assessment of the BMI, WHR and W/Ht in pre-and postmenopausal women. Anthropological Review 2007;70:3-13.

203. SODERBERG S, AHREN B, ELIASSON M, DINESEN B, OLSSON T. The association between leptin and proinsulin is lost with central obesity. Journal of internal medicine 2002;252:140-8.

204. SON MK, LIM NK, LIM JY, et al. Difference in blood pressure between early and late menopausal transition was significant in healthy Korean women. BMC women's health 2015;15:64.

205. STAESSEN J, BULPITT CJ, FAGARD R, LIJNEN P, AMERY A. The influence of menopause on blood pressure. Journal of human hypertension 1989;3:427-33.

206. SUAREZ-ORTEGON MF, ARBELAEZ A, MOSQUERA M, MENDEZ F, AGUILAR-DE PLATA C. C-reactive protein, waist circumference, and family history of heart attack are independent predictors of body iron stores in apparently healthy premenopausal women. Biological trace element research 2012;148:135-8.

207. SULIGA E, KOZIEL D, CIESLA E, REBAK D, GLUSZEK S. Factors Associated with Adiposity, Lipid Profile Disorders and the Metabolic Syndrome Occurrence in Premenopausal and Postmenopausal Women. PLoS One 2016;11:e0154511.

208. SUMNER AE, FALKNER B, KUSHNER H, CONSIDINE RV. Relationship of leptin concentration to gender, menopause, age, diabetes, and fat mass in African Americans. Obesity research 1998;6:128-33.

209. TANAKA NI, HANAWA S, MURAKAMI H, et al. Accuracy of segmental bioelectrical impedance analysis for predicting body composition in pre- and postmenopausal women. Journal of clinical densitometry : the official journal of the International Society for Clinical Densitometry 2015;18:252-9.

210. THOMAS T, BURGUERA B, MELTON LJ, 3RD, et al. Relationship of serum leptin levels with body composition and sex steroid and insulin levels in men and women. Metabolism: clinical and experimental 2000;49:1278-84.

211. TORNG PL, SU TC, SUNG FC, et al. Effects of menopause and obesity on lipid profiles in middle-aged Taiwanese women: the Chin-Shan Community Cardiovascular Cohort Study. Atherosclerosis 2000;153:413-21.

212. TOTH MJ, TCHERNOF A, SITES CK, POEHLMAN ET. Effect of menopausal status on body composition and abdominal fat distribution. International journal of obesity and related metabolic disorders : journal of the International Association for the Study of Obesity 2000;24:226-31.

213. VAN PELT RE, DAVY KP, STEVENSON ET, et al. Smaller differences in total and regional adiposity with age in women who regularly perform endurance exercise. The American journal of physiology 1998;275:E626-34.

214. VELDHUIS JD, DYER RB, TRUSHIN SA, BONDAR OP, SINGH RJ, KLEE GG. Interleukins 6 and 8 and abdominal fat depots are distinct correlates of lipid moieties in healthy pre- and postmenopausal women. Endocrine 2016;54:671-80.

215. WANG F, MA X, HAO Y, et al. Serum glycated albumin is inversely influenced by fat mass and visceral adipose tissue in Chinese with normal glucose tolerance. PLoS One 2012;7:e51098.

216. WANG W, ZHAO LJ, LIU YZ, RECKER RR, DENG HW. Genetic and environmental correlations between obesity phenotypes and age at menarche. International journal of obesity (2005) 2006;30:1595-600.

217. WANG WS, WAHLQVIST ML, HSU CC, CHANG HY, CHANG WC, CHEN CC. Age- and gender-specific population attributable risks of metabolic disorders on all-cause and cardiovascular mortality in Taiwan. BMC public health 2012;12:111.

218. WEE J, SNG BY, SHEN L, LIM CT, SINGH G, DAS DE S. The relationship between body mass index and physical activity levels in relation to bone mineral density in premenopausal and postmenopausal women. Archives of osteoporosis 2013;8:162.

219. WILLIAMS PT, KRAUSS RM. Associations of age, adiposity, menopause, and alcohol intake with low-density lipoprotein subclasses. Arteriosclerosis, thrombosis, and vascular biology 1997;17:1082-90.

220. WING RR, MATTHEWS KA, KULLER LH, MEILAHN EN, PLANTINGA PL. Weight gain at the time of menopause. Archives of internal medicine 1991;151:97-102.

221. XU L, NICHOLSON P, WANG QJ, WANG Q, ALEN M, CHENG S. Fat mass accumulation compromises bone adaptation to load in Finnish women: a cross-sectional study spanning three generations. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 2010;25:2341-9.

222. YAMATANI H, TAKAHASHI K, YOSHIDA T, TAKATA K, KURACHI H. Association of estrogen with glucocorticoid levels in visceral fat in postmenopausal women. Menopause (New York, NY) 2013;20:437-42.

223. YANNAKOULIA M, MELISTAS L, SOLOMOU E, YIANNAKOURIS N. Association of eating frequency with body fatness in pre- and postmenopausal women. Obesity (Silver Spring, Md) 2007;15:100-6.

224. YOLDEMIR T, ERENUS M. The prevalence of metabolic syndrome in pre- and post-menopausal women attending a tertiary clinic in Turkey. European journal of obstetrics, gynecology, and reproductive biology 2012;164:172-5.

225. YOO HJ, PARK MS, YANG SJ, et al. The differential relationship between fat mass and bone mineral density by gender and menopausal status. Journal of bone and mineral metabolism 2012;30:47-53.

226. YOO KY, KIM H, SHIN HR, et al. Female sex hormones and body mass in adolescent and postmenopausal Korean women. Journal of Korean medical science 1998;13:241-6.

227. YOSHIMOTO N, NISHIYAMA T, TOYAMA T, et al. Genetic and environmental predictors, endogenous hormones and growth factors, and risk of estrogen receptor-positive breast cancer in Japanese women. Cancer science 2011;102:2065-72.

228. ZHONG N, WU XP, XU ZR, et al. Relationship of serum leptin with age, body weight, body mass index, and bone mineral density in healthy mainland Chinese women. Clinica chimica acta; international journal of clinical chemistry 2005;351:161-8.

229. ZHOU JL, LIN SQ, SHEN Y, CHEN Y, ZHANG Y, CHEN FL. Serum lipid profile changes during the menopausal transition in Chinese women: a community-based cohort study. Menopause (New York, NY) 2010;17:997-1003.

230. ZHOU Y, ZHOU X, GUO X, et al. Prevalence and risk factors of hypertension among pre- and post-menopausal women: a cross-sectional study in a rural area of northeast China. Maturitas 2015;80:282-7.

231. ZIVKOVIC TB, VUKSANOVIC M, JELIC MA, et al. Obesity and metabolic syndrome during the menopause transition in Serbian women. Climacteric 2011;14:643-8.

232. SHAKIR YA, SAMSIOE G, NYBERG P, LIDFELDT J, NERBRAND C. Cardiovascular risk factors in middle-aged women and the association with use of hormone therapy: results from a population-based study of Swedish women. The Women's Health in the Lund Area (WHILA) Study. Climacteric 2004;7:274-83.

233. AKAHOSHI M, SODA M, NAKASHIMA E, et al. Effects of age at menopause on serum cholesterol, body mass index, and blood pressure. Atherosclerosis 2001;156:157-63.

234. FORD K, SOWERS M, CRUTCHFIELD M, WILSON A, JANNAUSCH M. A longitudinal study of the predictors of prevalence and severity of symptoms commonly associated with menopause. Menopause (New York, NY) 2005;12:308-17.

235. FRANKLIN RM, PLOUTZ-SNYDER L, KANALEY JA. Longitudinal changes in abdominal fat distribution with menopause. Metabolism: clinical and experimental 2009;58:311-5.

236. JANSSEN I, POWELL LH, CRAWFORD S, LASLEY B, SUTTON-TYRRELL K. Menopause and the metabolic syndrome: the Study of Women's Health Across the Nation. Arch Intern Med 2008;168:1568-75.

237. LEE CG, CARR MC, MURDOCH SJ, et al. Adipokines, inflammation, and visceral adiposity across the menopausal transition: a prospective study. The Journal of clinical endocrinology and metabolism 2009;94:1104-10.

238. LIU-AMBROSE T, KRAVETSKY L, BAILEY D, et al. Change in lean body mass is a major determinant of change in areal bone mineral density of the proximal femur: a 12-year observational study. Calcified tissue international 2006;79:145-51.

239. MACDONALD HM, NEW SA, CAMPBELL MK, REID DM. Influence of weight and weight change on bone loss in perimenopausal and early postmenopausal Scottish women. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2005;16:163-71.

240. SORECA I, ROSANO C, JENNINGS JR, et al. Gain in adiposity across 15 years is associated with reduced gray matter volume in healthy women. Psychosomatic medicine 2009;71:485-90.

241. WILLIAMS MJ, HUNTER GR, KEKES-SZABO T, et al. Intra-abdominal adipose tissue cut-points related to elevated cardiovascular risk in women. International journal of obesity and related metabolic disorders : journal of the International Association for the Study of Obesity 1996;20:613-7.

242. FIELD A, MILES J, FIELD Z. *Discovering statistics using R.* Sage publications; Number of pages.

243. BOLANOWSKI M, NILSSON BE. Assessment of human body composition using dual-energy x-ray absorptiometry and bioelectrical impedance analysis. Medical Science Monitor 2001;7:1029-33.

244. NG SP, KORDA R, CLEMENTS M, et al. Validity of self‐reported height and weight and derived body mass index in middle‐aged and elderly individuals in Australia. 2011;35:557-63.

245. SIERVOGEL RM, WISEMANDLE W, MAYNARD LM, et al. Serial changes in body composition throughout adulthood and their relationships to changes in lipid and lipoprotein levels: The Fels Longitudinal Study. Arteriosclerosis, thrombosis, and vascular biology 1998;18:1759-64.

246. PATEL SR, MALHOTRA A, WHITE DP, GOTTLIEB DJ, HU FB. Association between reduced sleep and weight gain in women. American journal of epidemiology 2006;164:947-54.

247. DAVIS SR, CASTELO-BRANCO C, CHEDRAUI P, et al. Understanding weight gain at menopause. Climacteric 2012;15:419-29.

248. DEMERATH EW, ROGERS NL, REED D, et al. Significant associations of age, menopausal status and lifestyle factors with visceral adiposity in African-American and European-American women. Annals of human biology 2011;38:247-56.

249. JANSSEN I, POWELL LH, JASIELEC MS, KAZLAUSKAITE R. Covariation of change in bioavailable testosterone and adiposity in midlife women. Obesity 2015;23:488-94.

250. DE KONING L, MERCHANT AT, POGUE J, ANAND SS. Waist circumference and waist-to-hip ratio as predictors of cardiovascular events: meta-regression analysis of prospective studies. European heart journal 2007;28:850-56.

251. ZHAO D, GUALLAR E, OUYANG P, et al. Endogenous Sex Hormones and Incident Cardiovascular Disease in Post-Menopausal Women. Journal of the American College of Cardiology 2018;71:2555-66.

252. MIKKOLA TS, GISSLER M, MERIKUKKA M, TUOMIKOSKI P, YLIKORKALA O. Sex differences in age-related cardiovascular mortality. PloS one 2013;8:e63347.

253. MCALOON CJ, BOYLAN LM, HAMBORG T, et al. The changing face of cardiovascular disease 2000–2012: An analysis of the world health organisation global health estimates data. International journal of cardiology 2016;224:256-64.

254. STEIGER P, CUMMINGS SR, BLACK DM, SPENCER NE, GENANT HK. Age‐related decrements in bone mineral density in women over 65. Journal of Bone and Mineral research 1992;7:625-32.

255. DOUCHI T, KOSHA S, UTO H, et al. Precedence of bone loss over changes in body composition and body fat distribution within a few years after menopause. Maturitas 2003;46:133-8.

256. SHAFIEE G, KESHTKAR A, SOLTANI A, AHADI Z, LARIJANI B, HESHMAT R. Prevalence of sarcopenia in the world: a systematic review and meta-analysis of general population studies. Journal of Diabetes & Metabolic Disorders 2017;16:21.

257. PERISSINOTTO E, PISENT C, SERGI G, GRIGOLETTO F, ENZI G, GROUP IW. Anthropometric measurements in the elderly: age and gender differences. British Journal of nutrition 2002;87:177-86.

258. SALPETER S, WALSH J, ORMISTON T, et al. Meta‐analysis: effect of hormone‐replacement therapy on components of the metabolic syndrome in postmenopausal women. 2006;8:538-54.

259. KONGNYUY EJ, NORMAN RJ, FLIGHT IH, REES MC. Oestrogen and progestogen hormone replacement therapy for peri‐menopausal and post‐menopausal women: weight and body fat distribution. The Cochrane Library 1999.

260. NELSON HD, HUMPHREY LL, NYGREN P, TEUTSCH SM, ALLAN JD. Postmenopausal hormone replacement therapy: scientific review. Jama 2002;288:872-81.

Table 1 Output for cross-sectional studies

Fat Mass Measure	k (Samples)	Total PreM Sample Size	Total PostM Sample Size	PreM Mean Age (SD)	PostM Mean Age (SD)	Age Mean Difference (SD)	PreM Mean Fat Mass (SD)	PostM Mean Fat Mass (SD)	Unstandardised Estimate (95 % CI)	p-value
BMI	171 (181)	453 036	523 796	41.96 (3.69)	59.42 (3.06)	14.82 (5.36)	24.75 (1.60)	26.64 (1.25)	**1.14 (0.95, 1.32)**	<0.0001
BW	109 (122)	113 603	204 845	43.36 (4.71)	59.55 (3.27)	15.00 (5.37)	64.82 (7.91)	66.12 (9.17)	**1.00 (0.44, 1.57)**	0.0005
WC	70 (72)	214 712	326 639	42.28 (3.65)	59.07 (1.91)	16.23 (4.24)	78.58 (4.24)	83.61 (3.19)	**4.63 (3.90, 5.35)**	<0.0001
WTHR	47 (50)	199 140	309 797	42.39 (3.44)	59.09 (1.42)	16.17 (3.20)	0.78 (0.03)	0.81 (0.03)	**0.04 (0.03, 0.05)**	<0.0001
BF %	46 (52)	58 605	113 226	43.81 (4.67)	59.55 (3.81)	14.83 (6.56)	32.44 (3.47)	35.69 (3.84)	**2.88 (2.13, 3.63)**	<0.0001
HC	25 (25)	185 885	297 189	42.48 (3.08)	59.15 (0.95)	16.22 (2.61)	100.30 (2.66)	102.73 (2.25)	**2.01 (1.36, 2.65)**	<0.0001
AF	10 (10)	696	833	41.01 (6.96)	57.48 (5.36)	15.00 (10.70)	194.05 (23.65)	221.21 (32.09)	**28.73 (8.56, 48.91)**	0.0053
VF	10 (10)	696	833	41.01 (6.96)	57.48 (5.36)	15.00 (10.70)	69.22 (15.75)	104.36 (13.92)	**26.90 (13.12, 40.68)**	0.0001
SISF	9 (10)	1103	745	39.76 (4.41)	61.89 (4.77)	21.46 (6.49)	22.16 (7.04)	24.55 (9.90)	**2.65 (0.45, 4.85)**	0.0181
TF %	7 (7)	39 335	95 756	45.28 (6.61)	59.68 (3.41)	14.32 (6.21)	31.27 (4.78)	33.74 (5.36)	**5.49 (3.91, 7.06)**	<0.0001
ASF	4 (5)	199	359	40.64 (6.32)	62.99 (5.16)	21.04 (5.00)	26.65 (8.14)	29.43 (9.82)	**6.46 (0.51, 12.42)**	0.0335
LF %	3(3)	991	524	36.96 (1.13)	55.18 (5.17)	19.41 (5.87)	36.33 (5.47)	36.00 (2.62)	**-3.19 (-5.98, -0.41)**	0.0246

Abbreviations: PreM, Premenopausal; PostM, Postmenopausal; BMI, Body Mass Index; BW, Body Weight; WC, Waist Circumference; WTHR, Waist to Hip Ratio; BF %, Total Body Fat Percentage; HC, Hip Circumference; AF, Subcutaneous Abdominal Fat; VF, Visceral Fat; SSIF, Suprailliac Skinfold Thickness; TF %, Trunk Fat Percentage; AF, Abdominal Skinfold Thickness; LF %, Total Leg Fat Percentage; k = number of studies; SD, Standard Deviation; CI, Confidence Interval.

Note: Bolded estimates indicate significance at the p <0.05 level. Means and standard deviations are computed as weighted means and weighted standard deviations, taking into account sample size.

Table 2 Output for longitudinal studies

Fat Mass Measure	k (Samples)	Total Sample Size	PreM Mean Age (SD)	PostM Mean Age (SD)	Mean Follow Up Period (SD)	PreM Mean Fat Mass (SD)	PostM Mean Fat Mass (SD)	Estimate (95 % CI)	p-value
BMI	8 (10)	2 355	46.67 (2.53)	52.80 (3.71)	6.68 (2.38)	24.30 (1.97)	25.03 (2.37)	**0.93 (0.26, 1.59)**	0.0061
BW	7 (7)	525	47.64 (3.06)	55.76 (5.08)	7.82 (5.35)	66.11 (3.89)	69.19 (3.71)	**2.99 (1.36, 4.63)**	0.0003
BF%	4 (4)	176	49.59 (1.24)	55.49 (3.65)	5.82 (3.25)	36.29 (4.88)	37.84 (3.33)	**2.18 (0.21, 4.16)**	0.0299
WC	3 (3)	915	46.99 (2.04)	52.73 (5.17)	7.17 (1.98)	80.79 (3.62)	84.06 (2.61)	**3.82 (0.87, 6.77)**	0.0111
AF	3 (3)	133	49.65 (1.61)	53.51 (1.64)	3.90 (0.39)	215.14 (66.15)	242.28 (77.34)	18.53 (-3.64, 40.69)	0.1014
VF	3 (3)	133	49.65 (1.61)	53.51 (1.64)	3.90 (0.39)	78.63 (14.45)	92.23 (12.77)	**12.95 (8.65, 17.25)**	<0.0001

Abbreviations: PreM, Premenopausal; PostM, Postmenopausal; BMI, Body Mass Index; BW, Body Weight; BF %, Total Body Fat Percentage; WC, Waist Circumference; AF, Abdominal Fat; VF, Visceral Fat; k = number of studies; SD, Standard Deviation; CI, Confidence Interval.

Note: Bolded estimates indicate significance at the $p < 0.05$ level. Means and standard deviations are computed as weighted means and weighted standard deviations, taking into account sample size.

Table 3 Meta-regression analyses after removing the effect attributable to normal ageing

Analyses	Samples	Fat Mass Measure	R^2	Unstandardised β Estimate (95 % CI)	p-value
Longitudinal					
	10	BMI	73.88	**0.20 (0.12, 0.29)**	<0.0001
Cross-sectional					
	176	BMI	21.61	**0.06 (0.04, 0.08)**	<0.0001
	119	BW	9.99	**0.10 (0.04, 0.16)**	0.0008
	71	WC	40.13	**0.24 (0.16, 0.32)**	<0.0001
	51	WTHR	24.87	**0.0025 (0.0013, 0.0037)**	<0.0001
	50	BF %	24.75	**0.15 (0.07, 0.24)**	0.0005
	25	HC	15.74	0.09 (-0.02, 0.21)	0.1201
	10	AF	9.03	1.29 (-0.70, 3.28)	0.2035
	10	VF	73.90	**1.85 (1.04, 2.67)**	<0.0001
	10	SSIF	0.00	0.21 (-0.19, 0.60)	0.3033

Abbreviations: BMI, Body Mass Index; BW, Body Weight; WC, Waist Circumference; WTHR, Waist to Hip Ratio; BF %, Total Body Fat Percentage; HC, Hip Circumference; AF, Abdominal Fat; VF, Visceral Fat; SSIF, Suprailliac Skinfold Thickness; R^2, proportion of observed variance explained by the model; CI, Confidence Interval.

Note: Bolded estimates indicate significance at the $p < 0.05$ level. Studies that did not report age were omitted from model fitting.

In Text Figure Legends:

Figure 1 Flow chart of search, screening and selection process for studies included in the review and meta-analyses.

Figure 2 Forest plot of the cross-sectional raw mean trunk fat percentage difference between premenopausal and postmenopausal women. Studies are ordered by mean age difference. Abbreviations: TF %, Trunk Fat Percentage; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure Legends:

Supplementary Figure 1 Forest plot of the cross-sectional raw mean body mass index difference between premenopausal and postmenopausal women. Studies are ordered by mean age difference. Abbreviations: BMI, Body Mass Index; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 2 Forest plot of the cross-sectional raw mean body weight difference between premenopausal and postmenopausal women. Studies are ordered by mean age difference. Abbreviations: BW, Body Weight; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 3 Forest plot of the cross-sectional raw mean waist circumference difference between premenopausal and postmenopausal women. Studies are ordered by mean age difference. Abbreviations: WC, Waist Circumference; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 4 Forest plot of the cross-sectional standardised mean waist to hip ratio difference between premenopausal and postmenopausal women. Studies are ordered by mean age difference. Abbreviations: WTHR, Waist to Hip Ratio; Std, Standardised; CI, Confidence Interval; RE Model, Random Effects Model. Note: Standardised units have been used, due to the amount of (residual) heterogeneity with non-positive sampling variances.

Supplementary Figure 5 Forest plot of the cross-sectional raw mean body fat percentage difference between premenopausal and postmenopausal women. Studies are ordered by mean age difference. Abbreviations: BF %, Total Body Fat Percentage; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 6 Forest plot of the cross-sectional raw mean hip circumference difference between premenopausal and postmenopausal women. Studies are ordered by mean age difference. Abbreviations: HC, Hip Circumference; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 7 Forest plot of the cross-sectional raw mean abdominal fat difference between premenopausal and postmenopausal women. Studies are ordered by mean age difference. Abbreviations: AF, Abdominal Fat; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 8 Forest plot of the cross-sectional raw mean visceral fat difference between premenopausal and postmenopausal women. Studies are ordered by mean age

difference. Abbreviations: VF, Visceral Fat; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 9 Forest plot of the cross-sectional raw mean suprailliac skinfold thickness difference between premenopausal and postmenopausal women. Studies are ordered by mean age difference. Abbreviations: SISF, Suprailliac Skinfold Thickness; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 10 Forest plot of the cross-sectional raw mean abdominal skinfold thickness difference between premenopausal and postmenopausal women. Studies are ordered by mean age difference. Abbreviations: ASF, Abdominal Skinfold Thickness; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 11 Forest plot of the cross-sectional raw mean leg fat percentage difference between premenopausal and postmenopausal women. Studies are ordered by mean age difference. Abbreviations: LF %, Total Leg Fat Percentage; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 12 Forest plot of the longitudinal body mass index change for postmenopausal women who were premenopausal at baseline. Studies are ordered by follow up period. Abbreviations: BMI, Body Mass Index; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 13 Forest plot of the longitudinal body weight change for postmenopausal women who were premenopausal at baseline. Studies are ordered by follow

up period. Abbreviations: BW, Body Weight; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 14 Forest plot of the longitudinal body fat percentage change for postmenopausal women who were premenopausal at baseline. Studies are ordered by follow up period. Abbreviations: BF %, Total Body Fat Percentage; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 15 Forest plot of the longitudinal waist circumference change for postmenopausal women who were premenopausal at baseline. Studies are ordered by follow up period. Abbreviations: WC, Waist Circumference; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 16 Forest plot of the longitudinal abdominal fat change for postmenopausal women who were premenopausal at baseline. Studies are ordered by follow up period. Abbreviations: AF, Abdominal Fat; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 17 Forest plot of the longitudinal visceral fat change for postmenopausal women who were premenopausal at baseline. Studies are ordered by follow up period. Abbreviations: VF, Visceral Fat; CI, Confidence Interval; RE Model, Random Effects Model.

Supplementary Figure 18 Funnel plots for cross-sectional studies using a random effects model (left column) and the trim and fill method (right column). Filled circles represent

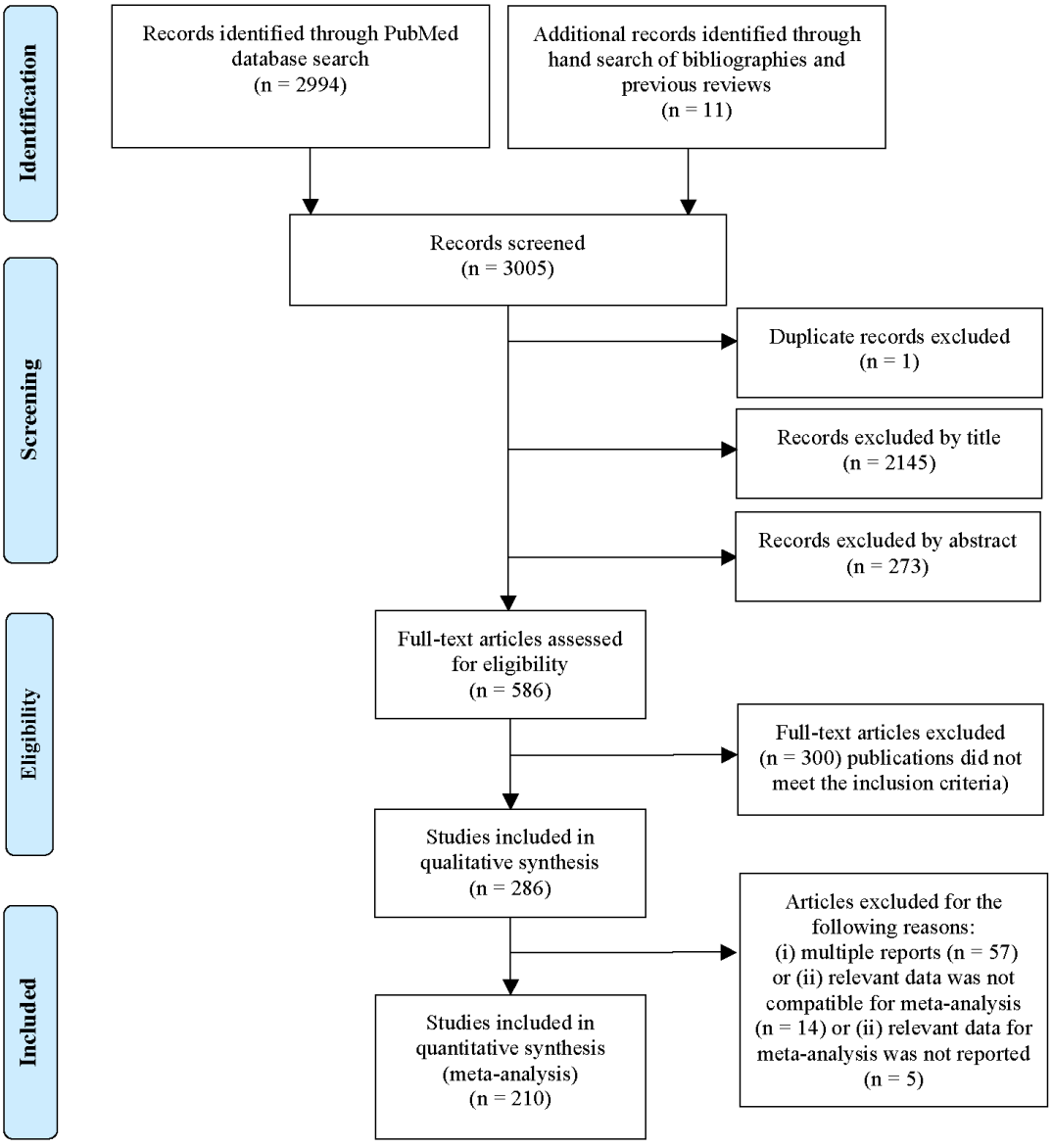
included studies in the meta-analyses and open circles represent possible missing studies. BMI, Body Mass Index; BW, Body Weight; WC, Waist Circumference; WTHR, Waist to Hip Ratio; BF %, Total Body Fat Percentage; T&F, trim and fill.

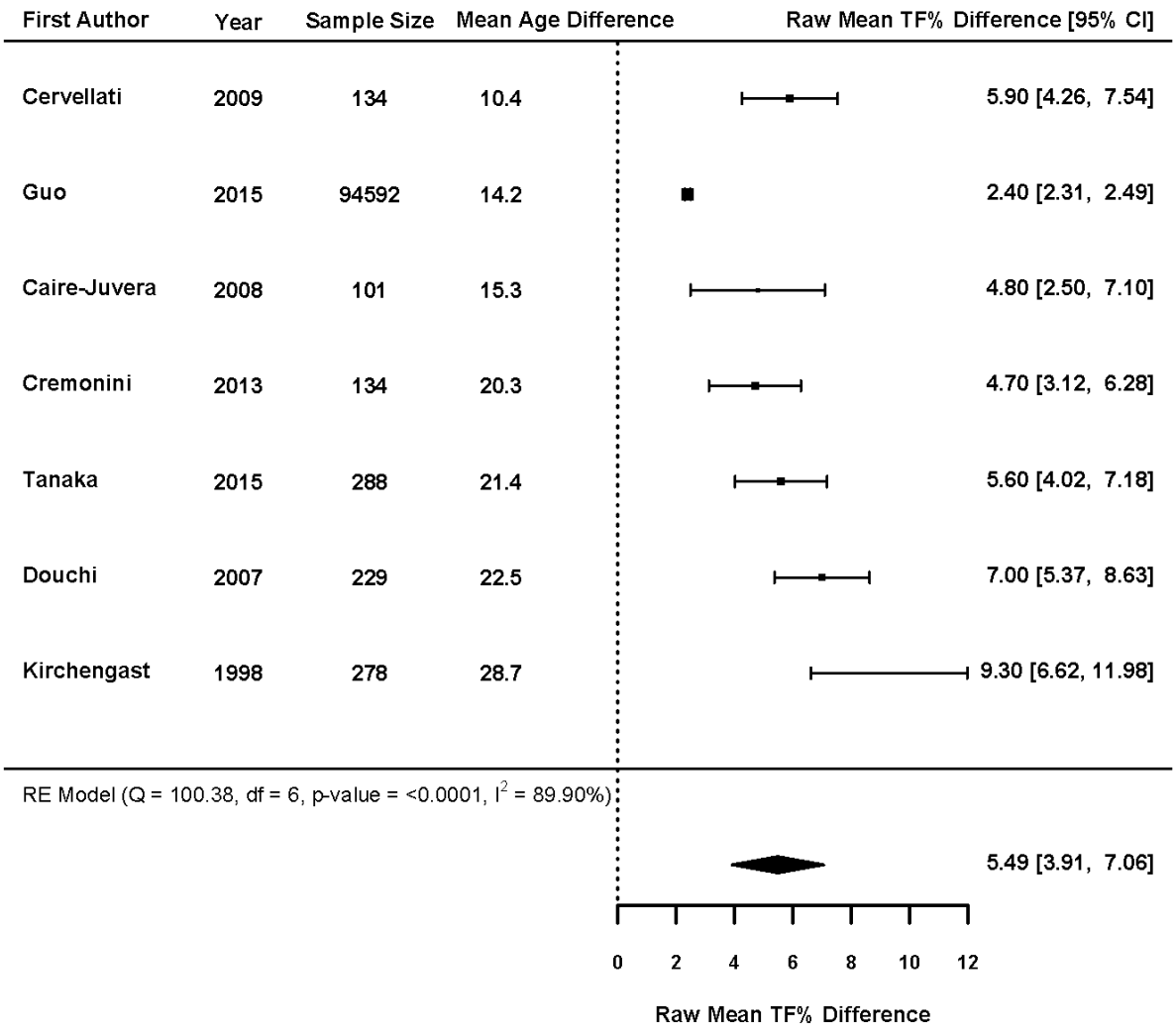
Supplementary Figure 19 Funnel plots for cross-sectional studies using a random effects model (left column) and the trim and fill method (right column). Filled circles represent included studies in the meta-analyses and open circles represent possible missing studies. HC, Hip Circumference; AF, Abdominal Fat; VF, Visceral Fat; SISF, Suprailliac Skinfold Thickness; TF %, Trunk Fat Percentage; T&F, trim and fill.

Supplementary Figure 20 Funnel plots for cross-sectional studies using a random effects model (left column) and the trim and fill method (right column). Filled circles represent included studies in the meta-analyses and open circles represent possible missing studies. ASF, Abdominal Skinfold Thickness; LF %, Total Leg Fat Percentage; T&F, trim and fill.

Supplementary Figure 21 Funnel plots for longitudinal studies using a random effects model (left column) and the trim and fill method (right column). Filled circles represent included studies in the meta-analyses and open circles represent possible missing studies. BMI, Body Mass Index; BW, Body Weight; BF %, Total Body Fat Percentage; WC, Waist Circumference; AF, Abdominal Fat; T&F, trim and fill.

Supplementary Figure 22 Funnel plot for a longitudinal study using a random effects model (left column) and the trim and fill method (right column). Filled circles represent included studies in the meta-analyses and open circles represent possible missing studies. VF, Visceral Fat; T&F, trim and fill.





Supplementary Appendix 1

Adapted Newcastle-Ottawa Quality Assessment Form for Cohort Studies

Note: A study can be given a maximum of one star for each numbered item within the Selection and Outcome categories. The exception to this is for the Comparability section.

COHORT STUDIES

Selection of Premenopausal and Postmenopausal women

1) Representativeness of the postmenopausal cohort
   a) Truly representative of the average postmenopausal woman in the community ✸
   b) Somewhat representative of the average postmenopausal woman in the community ✸
   c) Selected group of users eg nurses, volunteers
   d) No description of the derivation of the cohort

2) Selection of the premenopausal cohort
   a) Drawn from the same or similar community as the postmenopausal cohort ✸
   b) Drawn from a different source
   c) No description of the derivation of the premenopausal cohort

3) Ascertainment of menopausal status
   a) Secure record (e.g. surgical records) ✵
   b) Structured interview ✵
   c) Written self report
   d) No description
   e) Other

Comparability of Premenopausal and Postmenopausal women

4) Comparability of premenopausal and postmenopausal women on the basis of the study design
   a) Lifestyle/demographic characteristics of premenopausal and postmenopausal women recorded and reported, with age as a minimum. ✸
   b) The mean difference in age between premenopausal and postmenopausal women enables a reasonable comparison which is not highly confounded by age (i.e. approximately 10 years or less for cross-sectional studies). Note: For longitudinal studies, an appropriate follow up period is required (i.e. premenopausal at baseline and postmenopausal at follow up).✸

5) Was a clear definition used to describe premenopausal women
   a) Yes ✵
   b) No

6) Was a clear definition used to describe postmenopausal women
   a) Yes ✵
   b) No

Outcome

7) Assessment of fat mass
   a) Measured ✸
   b) Self report
   c) No description

8) Was the same method of measuring fat mass conducted for both premenopausal and postmenopausal women
   a) Yes ✸
   b) No
   c) No description

SELECTION	/3
COMPARABILITY	/4
OUTCOME	/2
TOTAL	/9
Rater #1 Initials:	

SELECTION	/3
COMPARABILITY	/4
OUTCOME	/2
TOTAL	/9
Rater #2 Initials:	

ST1 Table of study characteristics for cross-sectional studies

Study	Year	Sample Size	PreM mean age (SD)	PostM mean age (SD)	BMI	BW	WC	WTHR	BF %	HC	AF	VF	SISF	TF %	ASF	LF %
Abate et al.[1]	2014	205	46.7 (1.9)	52.7 (3.4)	*	-	-	-	-	-	-	-	-	-	-	-
Abdulnour et al.[2]	2012	65	52.3 (0.5)	54.4 (2)	*	*	*	-	*	-	-	-	-	-	-	-
Abdulnour et al.[2]	2012	31	50.95 (1.31)	52.76 (2.16)	*	*	*	-	*	-	*	*	-	-	-	-
Abildgaard et al.[3]	2013	33	49.6 (1.8)	52 (2)	-	*	-	-	-	-	-	-	-	-	-	-
Adams-Campbell et al.[4]	1996	164	39.3 (6.9)	58.9 (10.1)	*	*	-	-	-	-	-	-	-	-	-	-
Agrinier et al.[5]	2010	1355	42.8 (4.4)	57.4 (5.4)	*	-	*	-	-	-	-	-	-	-	-	-
Aguado et al.[6]	1996	80	38.8 (8.4)	60.6 (9.6)	*	*	-	-	-	-	-	-	-	-	-	-
Albanese et al.[7]	2009	289	48.8 (3.8)	53.6 (3.7)	*	*	-	-	-	-	-	-	-	-	-	-
Allali et al.[8]	2009	200	43.9 (6.3)	61.5 (8.8)	*	-	-	-	-	-	-	-	-	-	-	-
Aloia et al.[9]	1995	39	37.5 (5.82)	54.1 (7.96)	*	*	-	-	-	-	-	-	-	-	-	-
Aloia et al.[9]	1995	125	40.2 (7.2)	62.5 (7.81)	*	*	-	-	-	-	-	-	-	-	-	-

Amankwah et al.[10]	2013	1031	46.3 (6.5)	62.7 (7.2)	*	-	*	*	-	*	-	-	-	-	-	-
Amarante et al.[11]	2011	80	43.96 (7.08)	52.16 (3.65)	*	-	-	-	-	-	-	-	-	-	-	-
Amiri et al.[12]	2014	340	36.8 (11.52)	59 (7.48)	*	-	*	-	-	-	-	-	-	-	-	-
Angsuwanthana et al.[13]	2007	697	49.4 (3.39)	53.19 (5.94)	*	*	-	-	-	-	-	-	-	-	-	-
Armellini et al.[14]	1996	72	NA (NA)	NA (NA)	-	-	*	-	-	-	-	-	-	-	-	-
Arthur et al.[15]	2013	250	34.48 (8.85)	57.25 (8.28)	*	-	*	*	-	-	-	-	-	-	-	-
Aydin et al.[16]	2010	1106	48.7 (2.6)	54 (3.4)	*	-	-	-	-	-	-	-	-	-	-	-
Ayub et al.[17]	2006	80	42.46 (7.3)	51.15 (7.71)	*	*	-	*	-	-	-	-	-	-	-	-
Bancroft et al.[18]	1996	103	47.6 (3.7)	55.4 (3.05)	*	-	-	-	-	-	-	-	-	-	-	-
Bednarek-Tupikowska et al.[19]	2006	94	48.3 (2.3)	50.5 (3)	*	*	-	*	-	-	-	-	-	-	-	-
Bell et al.[20]	2007	587	38.9 (7.9)	62.8 (8.3)	*	*	-	-	-	-	-	-	-	-	-	-
Ben-Ali et al.[21]	2016	242	39.48 (7.79)	57.87 (7.65)	*	-	*	-	-	-	-	-	-	-	-	-

Ben-Ali et al.[22]	2014	2680	42.9 (5)	57.5 (7.3)	*	-	*	-	-	-	-	-	-	-	-	-
Ben-Ali et al.[23]	2011	376	35.3 (7.6)	53.4 (6.2)	*	-	-	-	-	-	-	-	-	-	-	-
Berg et al.[24]	2004	50	36.9 (4.1)	57 (5.3)	*	-	*	-	-	-	-	-	-	-	-	-
Berge et al.[25]	1994	159	38.9 (7.2)	55.3 (6.1)	*	-	-	-	-	-	-	-	-	-	-	-
Berger et al.[26]	1995	177	38.2 (5)	47.7 (3.8)	*	*	*	*	-	*	-	-	-	-	-	-
Berstad et al.[27]	2010	4041	42.83 (5.1)	56.42 (5.46)	*	-	-	-	-	-	-	-	-	-	-	-
Bhagat et al.[28]	2010	214	33.77 (6.57)	52.16 (6.27)	-	-	*	-	-	-	-	-	-	-	-	-
Bhurosy et al.[29]	2013	400	34 (NA)	53 (NA)	*	-	*	*	-	*	-	-	-	-	-	-
Blumenthal et al.[30]	1991	46	47 (2)	52 (3)	-	*	-	-	-	-	-	-	-	-	-	-
Bonithon-Kopp et al.[31]	1990	416	47.8 (2.2)	52.3 (1.8)	*	-	-	-	-	-	-	-	-	-	-	-
Caire-Juvera et al.[32]	2008	238	44.8 (2.39)	60.1 (3.59)	*	*	-	-	*	-	-	-	-	*	-	-
Campesi et al.[33]	2016	79	36.2 (7.6)	55.4 (5.1)	-	*	-	-	-	-	-	-	-	-	-	-
Carr et al.[34]	2000	56	35.4 (8.6)	61 (4.1)	*	-	-	-	-	-	-	-	-	-	-	-

Castracane et al.[35]	1998	76	27.3 (0.63)	55.8 (0.85)	*	-	-	-	-	-	-	-	-	-	-	-
Catsburg et al.[36]	2014	3320	45.8 (8.9)	67.9 (11.2)	*	-	-	-	-	-	-	-	-	-	-	-
Cecchini et al.[37]	2012	12243	46.34 (4.28)	60.81 (7.51)	*	-	-	-	-	-	-	-	-	-	-	-
Cervellati et al.[38]	2009	260	38.1 (6.73)	48.5 (6.95)	*	-	-	*	*	-	-	-	-	*	-	*
Chain et al.[39]	2017	266	47 (5)	57 (7)	*	*	*	*	*	*	-	-	-	-	-	-
Chang et al.[40]	2000	329	36.1 (6.5)	61.2 (6.2)	*	-	*	*	*	*	-	-	-	-	-	-
Cho et al.[41]	2008	1002	40.5 (7.8)	59 (6.6)	*	*	*	-	-	-	-	-	-	-	-	-
Cifkova et al.[42]	2008	662	48.9 (2.39)	52.1 (1.92)	*	-	-	-	-	-	-	-	-	-	-	-
Copeland et al.[43]	2006	411	36 (8.5)	51.5 (7.7)	*	-	-	-	-	-	-	-	-	-	-	-
Cremonini et al.[44]	2013	235	35.2 (10.7)	55.5 (4.8)	*	-	*	*	*	-	-	-	-	*	-	*
Cui et al.[45]	2007	703	38.4 (8.6)	63.3 (6.5)	-	*	-	-	-	-	-	-	-	-	-	-
D'haeseleer et al.[46]	2011	75	48.3 (2.3)	58.8 (5.4)	*	-	-	-	-	-	-	-	-	-	-	-
Da Camara et al.[47]	2015	237	44.63 (3.36)	54.47 (5.24)	*	-	-	-	-	-	-	-	-	-	-	-
Dallongeville et	1995	2167	48.3 (3.4)	57.4 (3.9)	*	-	-	-	-	-	-	-	-	-	-	-

al.[48]																
Dancey et al.[49]	2001	1315	35 (5.65)	65 (6.83)	*	-	-	-	-	-	-	-	-	-	-	-
Davis et al.[50]	1994	729	48.1 (1.7)	50.2 (1.7)	*	-	-	-	-	-	-	-	-	-	-	-
De Kat et al.[51]	2017	53911	36.9 (8.1)	55.3 (7.4)	*	-	-	-	-	-	-	-	-	-	-	-
Den Tonkelaar et al.[52]	1990	9491	44 (3.6)	57.8 (7.4)	*	*	*	*	-	*	-	-	-	-	-	-
Dmitruk et al.[53]	2018	267	44.48 (2.22)	66.59 (6.69)	-	*	*	-	*	*	-	-	*	-	*	-
Donato et al.[54]	2006	168	44.3 (3.6)	53.3 (3.8)	*	*	*	*	-	-	-	-	-	-	-	-
Douchi et al.[55]	1997	324	36.6 (9.4)	62.1 (7.7)	*	*	-	-	*	-	-	-	-	-	-	-
Douchi et al.[56]	2002	566	39.1 (9.1)	61.5 (7.2)	*	*	-	-	*	-	-	-	-	-	-	-
Douchi et al.[57]	2007	642	39 (9)	61.5 (7.4)	*	*	-	-	*	-	-	-	-	*	-	-
Dubois et al.[58]	2001	217	39 (9)	63 (8)	*	*	-	-	-	-	-	-	-	-	-	-
Engmann et al.[59]	2017	184309	46.27 (3.75)	61.72 (7.2)	*	-	-	-	-	-	-	-	-	-	-	-
Ertungealp et al.[60]	1999	185	NA (NA)	NA (NA)	*	-	-	-	-	-	-	-	-	-	-	-

Feng et al.[61]	2008	3820	43.7 (3)	51 (2.6)	*	*	*	*	*	-	-	-	-	-	-	-
Formica et al.[62]	1995	54	26.3 (3.64)	69 (4.68)	-	*	-	-	-	-	-	-	-	-	-	-
Formica et al.[62]	1995	46	26.5 (3.82)	64.9 (4.23)	-	*	-	-	-	-	-	-	-	-	-	-
Friedenreich et al.[63]	2007	285685	41.11 (6.9)	58.76 (6.25)	*	-	*	*	-	*	-	-	-	-	-	-
Friedenreich et al.[64]	2002	1237	44.3 (5.9)	62.8 (9)	*	*	*	*	-	*	-	-	-	-	-	-
Fu et al.[65]	2011	527	38 (8.6)	61 (7.2)	*	*	-	-	*	-	-	-	-	-	-	-
Fuh et al.[66]	2003	997	43.6 (2.9)	49.4 (3.8)	*	-	-	-	-	-	-	-	-	-	-	-
Gambacciani et al.[67]	1999	812	41.3 (7.8)	55 (4.16)	*	*	-	-	-	-	-	-	-	-	-	-
Genazzani et al.[68]	2006	1425	42.3 (9.3)	53 (5.95)	*	*	-	-	-	-	-	-	-	-	-	-
Ghosh et al.[69]	2008	200	40.2 (6.5)	55.4 (5.2)	*	-	*	*	-	-	-	-	-	-	-	-
Ghosh et al.[70]	2010	245	32.66 (5.75)	52.72 (5.62)	*	-	*	*	*	-	-	-	-	-	-	-
Gram et al.[71]	1997	3076	44.3 (3.5)	51.7 (3.6)	*	*	-	-	-	-	-	-	-	-	-	-
Guo et al.[72]	2015	132793	45.5 (3.4)	59.7 (5.5)	*	*	*	*	*	*	-	-	-	*	-	-

Gurka et al.[73]	2016	2177	47.6 (3.4)	54.3 (3.6)	-	-	*	-	-	-	-	-	-	-	-	-
Gurka et al.[73]	2016	779	47.4 (2.1)	53.1 (4.1)	-	-	*	-	-	-	-	-	-	-	-	-
Hadji et al.[74]	2000	434	36.5 (10.4)	61.8 (8.9)	*	*	-	-	-	-	-	-	-	-	-	-
Hagner et al.[75]	2009	118	36.5 (5.17)	62.5 (5.43)	*	-	-	-	-	-	-	-	-	-	-	-
Han et al.[76]	2006	2105	44.1 (4.6)	63.4 (8.9)	-	*	*	-	-	-	-	-	-	-	-	-
Harting et al.[77]	1984	45	33.8 (8.2)	50.4 (3.8)	-	*	-	-	*	-	-	-	-	-	-	-
Harting et al.[77]	1984	47	37.9 (8.2)	46.1 (8.2)	-	*	-	-	*	-	-	-	-	-	-	-
Harting et al.[77]	1984	44	36.9 (8.1)	47 (7.3)	-	*	-	-	*	-	-	-	-	-	-	-
He et al.[78]	2012	4743	45.8 (3.6)	54 (3.6)	*	-	*	*	-	-	-	-	-	-	-	-
Hirose et al.[79]	2003	16132	42.2 (NA)	60 (NA)	*	*	-	-	-	-	-	-	-	-	-	-
Hirose et al.[79]	2003	1716	38 (NA)	61.4 (NA)	*	*	-	-	-	-	-	-	-	-	-	-
Hjartaker et al.[80]	2005	102469	40.7 (5)	45.4 (4.1)	*	-	-	-	-	-	-	-	-	-	-	-
Ho et al.[81]	2010	161	NA (NA)	NA (NA)	-	-	-	-	*	-	-	-	-	-	-	-
Hsu et al.[82]	2006	6833	41.5 (5.3)	52.6 (4.7)	*	*	-	-	*	-	-	-	-	-	-	-

Hu et al.[83]	2016	887	NA (NA)	NA (NA)	-	-	-	-	*	-	-	-	-	-	-	-
Hunter et al.[84]	1996	220	36.2 (9)	51.5 (10.2)	-	*	-	-	*	-	*	*	-	-	-	-
Iida et al.[85]	2011	111	47.6 (3.8)	61.3 (6.6)	*	*	-	-	*	-	-	-	-	-	-	-
Ilich-Ernst et al.[86]	2002	51	33 (9.2)	61.9 (3.3)	*	*	-	-	*	-	-	-	-	-	-	-
Ito et al.[87]	1994	251	38.8 (10)	58.6 (5.8)	-	*	-	-	-	-	-	-	-	-	-	-
Jaff et al.[88]	2015	338	45.1 (3.3)	51.8 (3.86)	*	-	*	-	-	*	-	-	-	-	-	-
Jasienska et al.[89]	2005	1003	48.5 (2.81)	57.4 (4.41)	*	-	-	-	-	-	-	-	-	-	-	-
Jeenduang et al.[90]	2014	361	42.58 (6.62)	58.17 (9.65)	*	-	*	-	-	-	-	-	-	-	-	-
Jeon et al.[91]	2011	1971	49.3 (8.5)	51.2 (9)	*	*	*	-	-	-	-	-	-	-	-	-
Jurimae et al.[92]	2007	91	40.8 (5.7)	56.7 (3.6)	*	*	-	*	*	-	-	-	-	-	-	-
Kadam et al.[93]	2010	172	45.6 (4.8)	54 (7.1)	-	-	*	-	-	*	-	-	*	-	-	-
Kang et al.[94]	2016	264	47.9 (3.3)	60.8 (6)	*	*	-	-	-	-	*	*	-	-	-	-
Kaufer-Horwitz et al.[95]	2005	980	33.7 (8.4)	58.3 (6.9)	*	*	*	*	-	*	-	-	-	-	-	-

Kim et al.[96]	2007	2671	35.4 (8.1)	65.1 (9.3)	*	-	*	-	-	-	-	-	-	-	-	-
Kim et al.[97]	2012	1758	50.7 (2.8)	65 (7.4)	*	*	*	*	*	-	-	-	-	-	-	-
Kim et al.[98]	2013	617	42.12 (6.22)	56.48 (6.55)	*	-	*	-	-	-	-	-	-	-	-	-
Kim et al.[99]	2016	10088	36.9 (8.7)	64 (9.7)	*	*	*	-	*	-	-	-	-	-	-	-
Kirchengast et al.[100]	1998	77	27.1 (NA)	55.8 (NA)	*	*	-	-	*	-	-	-	-	*	-	-
Kirchengast et al.[101]	1996	459	26.8 (NA)	52.1 (NA)	-	*	*	-	-	*	-	-	-	-	-	-
Knapp et al.[102]	2001	409	40.3 (9.5)	59.9 (7.5)	*	*	-	-	-	-	-	-	-	-	-	-
Koh et al.[103]	2008	160	44.2 (2.92)	54.5 (4.35)	*	-	*	*	*	-	*	*	-	-	-	-
Konrad et al.[104]	2011	51	43 (5)	53 (4)	*	*	*	-	-	*	-	-	-	-	-	-
Kontogianni et al.[105]	2004	80	47.8 (3.14)	54.47 (5.36)	*	-	-	*	*	-	-	-	-	-	-	-
Konukoglu et al.[106]	2000	75	35.4 (8.3)	49.5 (4.7)	*	-	-	-	-	-	-	-	-	-	-	-
Koskova et al.[107]	2007	93	42.54 (2.5)	59.53 (2.71)	*	*	*	*	-	*	-	-	*	-	*	-
Kotani et al.[108]	2011	262	44.7 (4.9)	64.6 (4.4)	*	-	-	-	-	-	-	-	-	-	-	-

Kraemer et al.[109]	2001	141	26.8 (4.9)	57.63 (7.47)	*	-	-	-	-	-	-	-	-	-	-	-
Kuk et al.[110]	2005	251	37.6 (8.6)	66.7 (8)	*	-	*	-	*	-	-	-	-	-	-	-
Laitinen et al.[111]	1991	257	36.7 (9)	59.6 (6.4)	-	*	-	-	-	-	-	-	-	-	-	-
Lejskova et al.[112]	2012	480	48.6 (2.4)	52.2 (2)	*	-	*	*	-	*	-	-	-	-	-	-
Leon-Guerrero et al.[113]	2017	275	43.94 (6.63)	58.44 (8.69)	*	*	*	-	-	-	-	-	-	-	-	-
Ley et al.[114]	1992	131	32 (6)	53 (5)	*	*	-	-	-	-	-	-	-	-	-	-
Lin et al.[115]	2006	594	46 (3.6)	53.1 (4.4)	*	*	*	-	-	-	-	-	-	-	-	-
Lindquist et al.[116]	1980	326	50 (NA)	50 (NA)	-	*	-	-	-	-	-	-	-	-	-	-
Lindsay et al.[117]	1992	150	39.65 (9.98)	59.34 (8.37)	*	*	-	-	*	-	-	-	-	-	-	-
Lovejoy et al.[118]	2008	85	50.2 (0.3)	52.1 (0.3)	-	*	-	-	*	-	*	*	-	-	-	-
Lyu et al.[119]	2001	203	45.1 (3.4)	53.4 (5)	*	*	*	*	-	*	-	-	-	-	-	-
Maharlouei et al.[120]	2013	924	46.5 (5)	58.6 (6.7)	*	-	*	*	-	-	-	-	-	-	-	-
Malacara et al.[121]	2002	901	46.8 (3.1)	50.9 (4.4)	*	*	-	-	-	-	-	-	-	-	-	-

Malacara et al.[121]	2002	1180	45.2 (2.9)	49.8 (3.28)	*	*	-	-	-	-	-	-	-	-	-	-
Malacara et al.[121]	2002	546	44.8 (3.6)	49.9 (4.2)	*	*	-	-	-	-	-	-	-	-	-	-
Malacara et al.[121]	2002	2000	45.1 (3.4)	50.8 (3.4)	*	*	-	-	-	-	-	-	-	-	-	-
Malacara et al.[121]	2002	1008	44.3 (2.4)	50.6 (2.6)	*	*	-	-	-	-	-	-	-	-	-	-
Malacara et al.[121]	2002	2000	45.4 (2.6)	51 (2.4)	*	*	-	-	-	-	-	-	-	-	-	-
Manabe et al.[122]	1999	254	45.7 (4.2)	60.3 (5.5)	*	*	*	*	-	*	-	-	-	-	-	-
Manjer et al.[123]	2001	9738	42.8 (7.9)	54.1 (3)	*	*	-	-	-	-	-	-	-	-	-	-
Mannisto et al.[124]	1996	417	43.3 (6)	59.8 (7.7)	*	*	-	*	*	-	-	-	-	-	-	-
Martini et al.[125]	1997	757	43.2 (6.7)	59.9 (8.1)	*	*	-	-	*	-	-	-	-	-	-	-
Marwaha et al.[126]	2013	1423	31 (8.6)	64.5 (7.4)	*	*	-	-	-	-	-	-	-	-	-	-
Matsushita et al.[127]	2003	281	43 (6.3)	62.4 (7.9)	*	*	-	-	-	-	-	-	-	-	-	-
Matsuzaki et al.[128]	2017	1760	29.3 (9.9)	46.8 (6.9)	*	*	-	-	-	-	-	-	-	-	-	-
Matthews et al.[129]	1989	138	47.3 (1.5)	47.8 (1.6)	*	*	-	-	-	-	-	-	-	-	-	-
Mesch et al.[130]	2006	60	33 (5.6)	55 (5.6)	*	-	*	*	-	-	-	-	-	-	-	-

Meza-Munoz et al.[131]	2006	113	40.03 (7.16)	53.75 (4.28)	*	-	-	-	-	-	-	-	-	-	-	-
Minatoya et al.[132]	2014	66	NA (NA)	NA (NA)	*	-	-	-	-	-	-	-	-	-	-	-
Mo et al.[133]	2017	200	41.7 (6.3)	59.7 (6.8)	*	*	-	*	*	-	-	-	-	-	-	-
Mo et al.[133]	2017	200	42 (5.4)	59.8 (7)	*	*	-	*	*	-	-	-	-	-	-	-
Mo et al.[133]	2017	216	42.1 (6.4)	60.8 (8.1)	*	*	-	*	*	-	-	-	-	-	-	-
Mo et al.[133]	2017	244	43.2 (7)	60.8 (7.6)	*	*	-	*	*	-	-	-	-	-	-	-
Muchanga et al.[134]	2014	200	44 (3)	53 (4)	*	-	*	-	-	-	-	-	-	-	-	-
Muti et al.[135]	2000	576	44.5 (4.8)	57.7 (5.1)	*	-	-	*	-	-	-	-	-	-	-	-
Nitta et al.[136]	2016	38610	45.5 (3.8)	62.4 (7.8)	-	*	-	-	-	-	-	-	-	-	-	-
Noh et al.[137]	2013	540	46.92 (4.7)	59.34 (5.82)	*	-	-	-	-	-	-	-	-	-	-	-
Nordin et al.[138]	1992	259	43.1 (7.5)	59.9 (8.5)	-	*	-	-	-	-	-	-	-	-	-	-
Ohta et al.[139]	2010	373	14.8 (1.7)	71.9 (4.5)	*	*	-	-	-	-	-	-	-	-	-	-
Oldroyd et al.[140]	1998	211	37.2 (8.8)	61.6 (7.9)	-	*	-	-	-	-	-	-	-	-	-	-

Pacholczak et al.[141]	2016	294	41.8 (6.1)	63.4 (10.2)	*	*	*	*	-	*	-	-	*	-	-	-
Park et al.[142]	2012	1020	37 (7.25)	58.5 (7.7)	-	*	-	-	*	-	-	-	-	-	-	*
Park et al.[143]	2017	43599	45.6 (5)	59.6 (6.8)	*	*	*	*	-	*	-	-	-	-	-	-
Pavicic et al.[144]	2010	535	45.6 (6)	58.79 (8.2)	*	*	-	-	-	-	-	-	-	-	-	-
Pavlica et al.[145]	2013	160	38.87 (9.81)	58.42 (1.01)	*	*	-	-	-	-	-	-	-	-	-	-
Phillips et al.[146]	2008	78	32.9 (9.14)	(10.73 61.4)	*	*	*	*	-	-	-	-	-	-	-	-
Polesel et al.[147]	2015	311	34.83 (8.4)	52.63 (5.72)	*	-	*	-	-	-	-	-	-	-	-	-
Pollan et al.[148]	2012	3574	49 (2.9)	58 (4.5)	*	*	*	*	-	*	-	-	-	-	-	-
Portaluppi et al.[149]	1997	1376	48 (3.1)	53.3 (4.2)	*	-	-	-	-	-	-	-	-	-	-	-
Priya et al.[150]	2013	65	38.65 (6.21)	55.32 (6.32)	*	*	*	*	-	*	-	-	-	-	-	-
Rantalainen et al.[151]	2010	303	23 (4.7)	57.7 (4.2)	*	*	-	-	-	-	-	-	-	-	-	-
Reina et al.[152]	2015	192	33 (11)	58.9 (8.9)	-	*	-	-	-	-	-	-	-	-	-	-
Revilla et al.[153]	1997	151	37.4 (7.2)	59.9 (9.7)	*	*	-	-	-	-	-	-	-	-	-	-

Revilla et al.[154]	1997	144	36.1 (6.9)	60.6 (10.5)	*	*	-	-	-	-	-	-	-	-	-	-
Rice et al.[155]	2015	1607	43.3 (4.1)	53.4 (5.3)	*	-	-	-	-	-	-	-	-	-	-	-
Rico et al.[156]	2001	270	35.1 (7.7)	59.5 (9.8)	*	*	-	-	-	-	-	-	-	-	-	-
Rico et al.[157]	2002	297	34 (7)	59 (9)	*	*	-	-	-	-	-	-	-	-	-	-
Roelfsema et al.[158]	2016	91	35.83 (6.84)	59.08 (6.81)	*	-	-	-	-	-	-	-	-	-	-	-
Rosenbaum et al.[159]	1996	41	27 (8.94)	66 (9.17)	*	*	-	-	*	-	-	-	-	-	-	-
Salomaa et al.[160]	1995	778	47.4 (2.4)	57.9 (4.9)	*	-	-	-	-	-	-	-	-	-	-	-
Sarrafzadegan et al.[161]	2013	4143	32.15 (9.22)	(10.39 59.8)	*	*	*	*	-	-	-	-	-	-	-	-
Schaberg-Lorei et al.[162]	1990	109	42.3 (4.8)	58.4 (5.1)	-	*	*	-	*	-	-	-	*	-	*	-
Schwarz et al.[163]	2007	1119	45.6 (4.2)	64.6 (8)	*	-	-	-	-	-	-	-	-	-	-	-
Shakir et al.[164]	2004	4092	53.2 (1.6)	56.9 (2.9)	-	-	-	*	-	-	-	-	-	-	-	-
Sherk et al.[165]	2011	73	22.8 (2.74)	64 (3.93)	-	*	-	-	*	-	-	-	-	-	-	-

Shibata et al.[166]	1979	448	46.9 (1.4)	47.4 (1.4)	*	-	-	-	-	-	-	-	-	-	-	-
Sieminska et al.[167]	2006	131	28.2 (4.1)	53.9 (3.2)	*	-	-	*	-	-	-	-	-	-	-	-
Skrzypczak et al.[168]	2005	1647	43.66 (4.07)	56.01 (7.08)	*	-	-	-	-	-	-	-	-	-	-	-
Skrzypczak et al.[169]	2007	10216	43.43 (4.93)	62.87 (8.53)	*	-	-	-	-	-	-	-	-	-	-	-
Soderberg et al.[170]	2002	75	37.9 (7.9)	60.7 (6.1)	*	-	*	*	-	*	-	-	*	-	-	-
Son et al.[171]	2015	1470	46.8 (2.5)	52.2 (3.1)	*	-	*	-	-	-	-	-	-	-	-	-
Soriguer et al.[172]	2009	409	36.9 (7.5)	64.1 (5.2)	*	-	*	*	-	-	-	-	*	-	-	-
Staessen et al.[173]	1989	462	42.6 (5.1)	53 (5)	*	*	-	-	*	-	-	-	-	-	-	-
Suarez-Ortegon et al.[174]	2012	123	42.2 (5.6)	51.8 (6.8)	*	-	*	-	*	-	-	-	-	-	-	-
Suliga et al.[175]	2016	3636	49.7 (3.1)	55.2 (3)	*	-	*	-	*	-	-	-	-	-	-	-
Sumner et al.[176]	1998	65	32.6 (3.7)	57.8 (5.9)	*	*	-	-	*	-	-	-	-	-	-	-
Tanaka et al.[177]	2015	464	41.4 (6.5)	62.8 (6.8)	*	*	-	-	*	-	-	-	-	*	-	-
Thomas et al.[178]	2000	302	35 (8.6)	69.8 (13.1)	*	*	-	-	-	-	-	-	-	-	-	-

Torng et al.[179]	2000	1543	42.7 (5.8)	61.2 (9.5)	*	*	-	-	-	-	-	-	-	-	-	-
Toth et al.[180]	2000	81	47 (3)	51 (4)	*	*	-	-	*	-	*	*	-	-	-	-
Tremollieres et al.[181]	1996	168	49.3 (3.2)	53.8 (3.1)	*	*	-	-	-	-	-	-	-	-	-	-
Trikudanathan et al.[182]	2013	170	49.3 (3)	49.4 (3)	*	-	*	-	-	-	*	*	-	-	-	-
Van-Pelt et al.[183]	1998	31	29 (4.12)	61 (4.36)	*	*	*	-	*	-	-	-	*	-	*	-
Van-Pelt et al.[183]	1998	58	30 (5.48)	56 (5.57)	*	*	*	-	*	-	-	-	*	-	*	-
Veldhuis et al.[184]	2016	120	34 (9.3)	64 (8.52)	*	-	-	-	-	-	*	*	-	-	-	-
Wang et al.[185]	2012	1526	44.2 (6.6)	56.3 (4.6)	-	-	-	-	*	-	-	-	-	-	-	-
Wang et al.[186]	2006	346	33.36 (9.2)	(10.75 66.75)	*	-	-	-	-	-	-	-	-	-	-	-
Wang et al.[187]	2012	1143	49.13 (2.72)	64.72 (7.61)	*	-	*	*	-	*	-	-	-	-	-	-
Wee et al.[188]	2013	283	45.81 (1.12)	56.8 (1.84)	*	-	-	-	-	-	-	-	-	-	-	-

Williams et al.[189]	1997	115	32.7 (10.9)	63.9 (11.6)	*	-	-	-	-	-	-	-	-	-	-	-
Wing et al.[190]	1991	340	NA (NA)	NA (NA)	*	*	-	-	-	-	-	-	*	-	-	-
Xu et al.[191]	2010	252	44.7 (4.1)	70.7 (6.3)	*	*	-	-	-	-	-	-	-	-	-	-
Yamatani et al.[192]	2013	40	42.6 (7.35)	60.6 (7.5)	*	*	-	-	-	-	*	*	-	-	-	-
Yannakoulia et al.[193]	2007	114	38.6 (7.7)	57.5 (6.2)	*	*	*	*	*	-	-	-	-	-	-	-
Yoldemir et al.[194]	2012	190	45.27 (2.93)	57.02 (6.15)	*	*	-	*	-	-	-	-	-	-	-	-
Yoo et al.[195]	2012	358	34.2 (9.7)	61.1 (7.7)	*	*	*	*	*	-	*	*	-	-	-	-
Yoo et al.[196]	1998	306	NA (NA)	NA (NA)	*	*	-	-	-	-	-	-	-	-	-	-
Yoshimoto et al.[197]	2011	278	41.8 (6.2)	62.1 (8.2)	*	*	-	-	-	-	-	-	-	-	-	-
Zhong et al.[198]	2005	676	NA (NA)	NA (NA)	*	*	-	-	-	-	-	-	-	-	-	-
Zhou et al.[199]	2010	729	42.2 (3.8)	53.8 (2.8)	*	-	-	-	-	-	-	-	-	-	-	-
Zhou et al.[200]	2015	6324	44.1 (4.8)	60 (7.8)	*	*	*	*	-	-	-	-	-	-	-	-
Zivkovic et al.[201]	2011	271	37 (5.3)	54 (4.5)	*	-	*	-	-	-	-	-	-	-	-	-

Abbreviations: PreM, Premenopausal; PostM, Postmenopausal; BMI, Body Mass Index; BW, Body Weight; WC, Waist Circumference; WTHR, Waist to Hip Ratio; BF %, Total Body Fat Percentage; HC, Hip Circumference; AF, Subcutaneous Abdominal Fat; VF, Visceral Fat; SSIF, Suprailliac Skinfold Thickness; TF %, Trunk Fat Percentage; AF, Abdominal Skinfold Thickness; LF %, Total Leg Fat Percentage; SD, Standard Deviation.
Note: * indicates inclusion of measure.

References

1. ABATE M, SCHIAVONE C, DI CARLO L, SALINI V. Prevalence of and risk factors for asymptomatic rotator cuff tears in postmenopausal women Menopause (New York, NY) 2014;21:275-80.
2. ABDULNOUR J, DOUCET E, BROCHU M, et al. The effect of the menopausal transition on body composition and cardiometabolic risk factors: a Montreal-Ottawa New Emerging Team group study. Menopause (New York, NY) 2012;19:760-7.
3. ABILDGAARD J, PEDERSEN AT, GREEN CJ, et al. Menopause is associated with decreased whole body fat oxidation during exercise. American journal of physiology Endocrinology and metabolism 2013;304:E1227-36.
4. ADAMS-CAMPBELL LL, KIM KS, DUNSTON G, LAING AE, BONNEY G, DEMENAIS F. The relationship of body mass index to reproductive factors in pre- and postmenopausal African-American women with and without breast cancer. Obesity research 1996;4:451-6.
5. AGRINIER N, COURNOT M, DALLONGEVILLE J, et al. Menopause and modifiable coronary heart disease risk factors: a population based study. Maturitas 2010;65:237-43.
6. AGUADO F, REVILLA M, HERNANDEZ ER, VILLA LF, RICO H. Behavior of bone mass measurements. Dual energy x-ray absorptiometry total body bone mineral content, ultrasound bone velocity, and computed metacarpal radiogrammetry, with age, gonadal status, and weight in healthy women. Investigative radiology 1996;31:218-22.
7. ALBANESE CV, CEPOLLARO C, DE TERLIZZI F, BRANDI ML, PASSARIELLO R. Performance of five phalangeal QUS parameters in the evaluation of gonadal-status, age and vertebral fracture risk compared with DXA. Ultrasound in medicine & biology 2009;35:537-44.

8. ALLALI F, EL MANSOURI L, ABOURAZZAK F, et al. The effect of past use of oral contraceptive on bone mineral density, bone biochemical markers and muscle strength in healthy pre and post menopausal women. BMC women's health 2009;9:31.

9. ALOIA JF, VASWANI A, MA R, FLASTER E. To what extent is bone mass determined by fat-free or fat mass? Am J Clin Nutr 1995;61:1110-4.

10. AMANKWAH EK, FRIEDENREICH CM, MAGLIOCCO AM, et al. Anthropometric measures and the risk of endometrial cancer, overall and by tumor microsatellite status and histological subtype. American journal of epidemiology 2013;177:1378-87.

11. AMARANTE F, VILODRE LC, MATURANA MA, SPRITZER PM. Women with primary ovarian insufficiency have lower bone mineral density. Brazilian journal of medical and biological research = Revista brasileira de pesquisas medicas e biologicas 2011;44:78-83.

12. AMIRI P, DEIHIM T, NAKHODA K, HASHEMINIA M, MONTAZERI A, AZIZI F. Metabolic syndrome and health-related quality of life in reproductive age and post-menopausal women: Tehran Lipid and Glucose Study. Archives of Iranian medicine 2014;17:423-8.

13. ANGSUWATHANA S, LEERASIRI P, RATTANACHAIYANONT M, et al. Health check-up program for pre/postmenopausal women at Siriraj Menopause Clinic. Journal of the Medical Association of Thailand = Chotmaihet thangphaet 2007;90:1-8.

14. ARMELLINI F, ZAMBONI M, PERDICHIZZI G, et al. Computed tomography visceral adipose tissue volume measurements of Italians. Predictive equations. European journal of clinical nutrition 1996;50:290-4.

15. ARTHUR FK, ADU-FRIMPONG M, OSEI-YEBOAH J, MENSAH FO, OWUSU L. The prevalence of metabolic syndrome and its predominant components among pre-and postmenopausal Ghanaian women. BMC research notes 2013;6:446.

16. AYDIN ZD. Determinants of age at natural menopause in the Isparta Menopause and Health Study: premenopausal body mass index gain rate and episodic weight loss. Menopause (New York, NY) 2010;17:494-505.

17. AYUB N, KHAN SR, SYED F. Leptin levels in pre and post menopausal Pakistani women. JPMA The Journal of the Pakistan Medical Association 2006;56:3-5.

18. BANCROFT J, CAWOOD EH. Androgens and the menopause; a study of 40-60-year-old women. Clinical endocrinology 1996;45:577-87.

19. BEDNAREK-TUPIKOWSKA G, FILUS A, KULICZKOWSKA-PLAKSEJ J, TUPIKOWSKI K, BOHDANOWICZ-PAWLAK A, MILEWICZ A. Serum leptin concentrations in pre- and postmenopausal women on sex hormone therapy. Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology 2006;22:207-12.

20. BELL RJ, DAVISON SL, PAPALIA MA, MCKENZIE DP, DAVIS SR. Endogenous androgen levels and cardiovascular risk profile in women across the adult life span. Menopause (New York, NY) 2007;14:630-8.

21. BEN ALI S, BELFKI-BENALI H, AHMED DB, et al. Postmenopausal hypertension, abdominal obesity, apolipoprotein and insulin resistance. Clinical and experimental hypertension (New York, NY : 1993) 2016;38:370-4.

22. BEN ALI S, BELFKI-BENALI H, AOUNALLAH-SKHIRI H, et al. Menopause and metabolic syndrome in tunisian women. BioMed research international 2014;2014:457131.

23. BEN ALI S, JEMAA R, FTOUHI B, et al. Relationship of plasma leptin and adiponectin concentrations with menopausal status in Tunisian women. Cytokine 2011;56:338-42.

24. BERG G, MESCH V, BOERO L, et al. Lipid and lipoprotein profile in menopausal transition. Effects of hormones, age and fat distribution. Hormone and metabolic

research = Hormon- und Stoffwechselforschung = Hormones et metabolisme 2004;36:215-20.

25. BERGE LN, BONAA KH, NORDOY A. Serum ferritin, sex hormones, and cardiovascular risk factors in healthy women. Arteriosclerosis and thrombosis : a journal of vascular biology 1994;14:857-61.

26. BERGER GM, NAIDOO J, GOUNDEN N, GOUWS E. Marked hyperinsulinaemia in postmenopausal, healthy Indian (Asian) women. Diabetic medicine : a journal of the British Diabetic Association 1995;12:788-95.

27. BERSTAD P, COATES RJ, BERNSTEIN L, et al. A case-control study of body mass index and breast cancer risk in white and African-American women. Cancer epidemiology, biomarkers & prevention : a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology 2010;19:1532-44.

28. BHAGAT M, MUKHERJEE S, DE P, et al. Clustering of cardiometabolic risk factors in Asian Indian women: Santiniketan women study. Menopause (New York, NY) 2010;17:359-64.

29. BHUROSY T, JEEWON R. Food habits, socioeconomic status and body mass index among premenopausal and post-menopausal women in Mauritius. Journal of human nutrition and dietetics : the official journal of the British Dietetic Association 2013;26 Suppl 1:114-22.

30. BLUMENTHAL JA, FREDRIKSON M, MATTHEWS KA, et al. Stress reactivity and exercise training in premenopausal and postmenopausal women. Health psychology : official journal of the Division of Health Psychology, American Psychological Association 1991;10:384-91.

31. BONITHON-KOPP C, SCARABIN PY, DARNE B, MALMEJAC A, GUIZE L. Menopause-related changes in lipoproteins and some other cardiovascular risk factors. International journal of epidemiology 1990;19:42-8.

32. CAIRE-JUVERA G, ARENDELL LA, MASKARINEC G, THOMSON CA, CHEN Z. Associations between mammographic density and body composition in Hispanic and non-Hispanic white women by menopause status. Menopause (New York, NY) 2008;15:319-25.

33. CAMPESI I, OCCHIONI S, TONOLO G, et al. Ageing/Menopausal Status in Healthy Women and Ageing in Healthy Men Differently Affect Cardiometabolic Parameters. International journal of medical sciences 2016;13:124-32.

34. CARR MC, KIM KH, ZAMBON A, et al. Changes in LDL density across the menopausal transition. Journal of investigative medicine : the official publication of the American Federation for Clinical Research 2000;48:245-50.

35. CASTRACANE VD, KRAEMER RR, FRANKEN MA, KRAEMER GR, GIMPEL T. Serum leptin concentration in women: effect of age, obesity, and estrogen administration. Fertility and sterility 1998;70:472-7.

36. CATSBURG C, KIRSH VA, SOSKOLNE CL, et al. Associations between anthropometric characteristics, physical activity, and breast cancer risk in a Canadian cohort. Breast cancer research and treatment 2014;145:545-52.

37. CECCHINI RS, COSTANTINO JP, CAULEY JA, et al. Body mass index and the risk for developing invasive breast cancer among high-risk women in NSABP P-1 and STAR breast cancer prevention trials. Cancer prevention research (Philadelphia, Pa) 2012;5:583-92.

38. CERVELLATI C, PANSINI FS, BONACCORSI G, et al. Body mass index is a major determinant of abdominal fat accumulation in pre-, peri- and post-menopausal

women. Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology 2009;25:413-7.

39. CHAIN A, CRIVELLI M, FAERSTEIN E, BEZERRA FF. Association between fat mass and bone mineral density among Brazilian women differs by menopausal status: The Pro-Saude Study. Nutrition (Burbank, Los Angeles County, Calif) 2017;33:14-19.

40. CHANG CJ, WU CH, YAO WJ, YANG YC, WU JS, LU FH. Relationships of age, menopause and central obesity on cardiovascular disease risk factors in Chinese women. International journal of obesity and related metabolic disorders : journal of the International Association for the Study of Obesity 2000;24:1699-704.

41. CHO GJ, LEE JH, PARK HT, et al. Postmenopausal status according to years since menopause as an independent risk factor for the metabolic syndrome. Menopause (New York, NY) 2008;15:524-9.

42. CIFKOVA R, PITHA J, LEJSKOVA M, LANSKA V, ZECOVA S. Blood pressure around the menopause: a population study. Journal of hypertension 2008;26:1976-82.

43. COPELAND AL, MARTIN PD, GEISELMAN PJ, RASH CJ, KENDZOR DE. Predictors of pretreatment attrition from smoking cessation among pre- and postmenopausal, weight-concerned women. Eating behaviors 2006;7:243-51.

44. CREMONINI E, BONACCORSI G, BERGAMINI CM, et al. Metabolic transitions at menopause: in post-menopausal women the increase in serum uric acid correlates with abdominal adiposity as assessed by DXA. Maturitas 2013;75:62-6.

45. CUI LH, SHIN MH, KWEON SS, et al. Relative contribution of body composition to bone mineral density at different sites in men and women of South Korea. Journal of bone and mineral metabolism 2007;25:165-71.

46. D'HAESELEER E, DEPYPERE H, CLAEYS S, VAN LIERDE KM. The relation between body mass index and speaking fundamental frequency in premenopausal and postmenopausal women. Menopause (New York, NY) 2011;18:754-8.

47. DA CAMARA SM, ZUNZUNEGUI MV, PIRKLE C, MOREIRA MA, MACIEL AC. Menopausal status and physical performance in middle aged women: a cross-sectional community-based study in Northeast Brazil. PLoS One 2015;10:e0119480.

48. DALLONGEVILLE J, MARECAUX N, ISOREZ D, ZYLBERGBERG G, FRUCHART JC, AMOUYEL P. Multiple coronary heart disease risk factors are associated with menopause and influenced by substitutive hormonal therapy in a cohort of French women. Atherosclerosis 1995;118:123-33.

49. DANCEY DR, HANLY PJ, SOONG C, LEE B, HOFFSTEIN V. Impact of menopause on the prevalence and severity of sleep apnea. Chest 2001;120:151-5.

50. DAVIS CE, PAJAK A, RYWIK S, et al. Natural menopause and cardiovascular disease risk factors. The Poland and US Collaborative Study on Cardiovascular Disease Epidemiology. Annals of epidemiology 1994;4:445-8.

51. DE KAT AC, DAM V, ONLAND-MORET NC, EIJKEMANS MJ, BROEKMANS FJ, VAN DER SCHOUW YT. Unraveling the associations of age and menopause with cardiovascular risk factors in a large population-based study. BMC medicine 2017;15:2.

52. DEN TONKELAAR I, SEIDELL JC, VAN NOORD PA, BAANDERS-VAN HALEWIJN EA, OUWEHAND IJ. Fat distribution in relation to age, degree of obesity, smoking habits, parity and estrogen use: a cross-sectional study in 11,825 Dutch women participating in the DOM-project. Int J Obes 1990;14:753-61.

53. DMITRUK A, CZECZELEWSKI J, CZECZELEWSKA E, GOLACH J, PARNICKA U. Body composition and fatty tissue distribution in women with various menstrual status. Roczniki Panstwowego Zakladu Higieny 2018;69:95-101.

54. DONATO GB, FUCHS SC, OPPERMANN K, BASTOS C, SPRITZER PM. Association between menopause status and central adiposity measured at different cutoffs of waist circumference and waist-to-hip ratio. Menopause (New York, NY) 2006;13:280-5.

55. DOUCHI T, OKI T, NAKAMURA S, IJUIN H, YAMAMOTO S, NAGATA Y. The effect of body composition on bone density in pre- and postmenopausal women. Maturitas 1997;27:55-60.

56. DOUCHI T, YAMAMOTO S, YOSHIMITSU N, ANDOH T, MATSUO T, NAGATA Y. Relative contribution of aging and menopause to changes in lean and fat mass in segmental regions. Maturitas 2002;42:301-6.

57. DOUCHI T, YONEHARA Y, KAWAMURA Y, KUWAHATA A, KUWAHATA T, IWAMOTO I. Difference in segmental lean and fat mass components between pre- and postmenopausal women. Menopause (New York, NY) 2007;14:875-8.

58. DUBOIS EF, VAN DEN BERGH JP, SMALS AG, VAN DE MEERENDONK CW, ZWINDERMAN AH, SCHWEITZER DH. Comparison of quantitative ultrasound parameters with dual energy X-ray absorptiometry in pre- and postmenopausal women. The Netherlands journal of medicine 2001;58:62-70.

59. ENGMANN NJ, GOLMAKANI MK, MIGLIORETTI DL, SPRAGUE BL, KERLIKOWSKE K. Population-Attributable Risk Proportion of Clinical Risk Factors for Breast Cancer. JAMA oncology 2017;3:1228-36.

60. ERTUNGEALP E, SEYISOGLU H, EREL CT, SENTURK LM, GEZER A. Changes in bone mineral density with age, menopausal status and body mass index in Turkish women. Climacteric : the journal of the International Menopause Society 1999;2:45-51.

61. FENG Y, HONG X, WILKER E, et al. Effects of age at menarche, reproductive years, and menopause on metabolic risk factors for cardiovascular diseases. Atherosclerosis 2008;196:590-7.

62. FORMICA C, LORO ML, GILSANZ V, SEEMAN E. Inhomogeneity in body fat distribution may result in inaccuracy in the measurement of vertebral bone mass. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 1995;10:1504-11.

63. FRIEDENREICH C, CUST A, LAHMANN PH, et al. Anthropometric factors and risk of endometrial cancer: the European prospective investigation into cancer and nutrition. Cancer causes & control : CCC 2007;18:399-413.

64. FRIEDENREICH CM, COURNEYA KS, BRYANT HE. Case-control study of anthropometric measures and breast cancer risk. International journal of cancer 2002;99:445-52.

65. FU X, MA X, LU H, HE W, WANG Z, ZHU S. Associations of fat mass and fat distribution with bone mineral density in pre- and postmenopausal Chinese women. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2011;22:113-9.

66. FUH JL, WANG SJ, LEE SJ, LU SR, JUANG KD. Quality of life and menopausal transition for middle-aged women on Kinmen island. Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation 2003;12:53-61.

67. GAMBACCIANI M, CIAPONI M, CAPPAGLI B, BENUSSI C, DE SIMONE L, GENAZZANI AR. Climacteric modifications in body weight and fat tissue distribution. Climacteric 1999;2:37-44.

68. GENAZZANI AR, GAMBACCIANI M. Effect of climacteric transition and hormone replacement therapy on body weight and body fat distribution. Gynecological

endocrinology : the official journal of the International Society of Gynecological Endocrinology 2006;22:145-50.

69. GHOSH A. Comparison of risk variables associated with the metabolic syndrome in pre- and postmenopausal Bengalee women. Cardiovascular journal of Africa 2008;19:183-7.

70. GHOSH A, BHAGAT M. Anthropometric and body composition characteristics in pre- and postmenopausal Asian Indian women: Santiniketan women study. Anthropologischer Anzeiger; Bericht uber die biologisch-anthropologische Literatur 2010;68:1-10.

71. GRAM IT, FUNKHOUSER E, TABAR L. Anthropometric indices in relation to mammographic patterns among peri-menopausal women. International journal of cancer 1997;73:323-6.

72. GUO W, BRADBURY KE, REEVES GK, KEY TJ. Physical activity in relation to body size and composition in women in UK Biobank. Annals of epidemiology 2015;25:406-13.e6.

73. GURKA MJ, VISHNU A, SANTEN RJ, DEBOER MD. Progression of Metabolic Syndrome Severity During the Menopausal Transition. Journal of the American Heart Association 2016;5.

74. HADJI P, HARS O, BOCK K, et al. The influence of menopause and body mass index on serum leptin concentrations. European journal of endocrinology 2000;143:55-60.

75. HAGNER W, HAGNER-DERENGOWSKA M, WIACEK M, ZUBRZYCKI IZ. Changes in level of VO2max, blood lipids, and waist circumference in the response to moderate endurance training as a function of ovarian aging. Menopause (New York, NY) 2009;16:1009-13.

76. HAN D, NIE J, BONNER MR, et al. Lifetime adult weight gain, central adiposity, and the risk of pre- and postmenopausal breast cancer in the Western New York exposures and breast cancer study. International journal of cancer 2006;119:2931-7.

77. HARTING GH, MOORE CE, MITCHELL R, KAPPUS CM. Relationship of menopausal status and exercise level to HDL-cholesterol in women. Experimental aging research 1984;10:13-8.

78. HE L, TANG X, LI N, et al. Menopause with cardiovascular disease and its risk factors among rural Chinese women in Beijing: a population-based study. Maturitas 2012;72:132-8.

79. HIROSE K, TAJIMA K, HAMAJIMA N, et al. Impact of established risk factors for breast cancer in nulligravid Japanese women. Breast cancer (Tokyo, Japan) 2003;10:45-53.

80. HJARTAKER A, ADAMI HO, LUND E, WEIDERPASS E. Body mass index and mortality in a prospectively studied cohort of Scandinavian women: the women's lifestyle and health cohort study. European journal of epidemiology 2005;20:747-54.

81. HO S, WU S, CHAN S, SHAM A. Menopausal transition and changes of body composition: a prospective study in Chinese perimenopausal women. International Journal of Obesity 2010;34:1265.

82. HSU YH, VENNERS SA, TERWEDOW HA, et al. Relation of body composition, fat mass, and serum lipids to osteoporotic fractures and bone mineral density in Chinese men and women. Am J Clin Nutr 2006;83:146-54.

83. HU X, PAN X, MA X, et al. Contribution of a first-degree family history of diabetes to increased serum adipocyte fatty acid binding protein levels independent of body fat content and distribution. International journal of obesity (2005) 2016;40:1649-54.

84. HUNTER G, KEKES-SZABO T, TREUTH M, WILLIAMS M, GORAN M, PICHON C. Intra-abdominal adipose tissue, physical activity and cardiovascular risk in pre-and post-

menopausal women. International journal of obesity and related metabolic disorders: journal of the International Association for the Study of Obesity 1996;20:860-65.

85. IIDA T, DOMOTO T, TAKIGAWA A, et al. Relationships among blood leptin and adiponectin levels, fat mass, and bone mineral density in Japanese pre-and postmenopausal women. Hiroshima J Med Sci 2011;60:71-8.

86. ILICH-ERNST J, BROWNBILL RA, LUDEMANN MA, FU R. Critical factors for bone health in women across the age span: how important is muscle mass? Medscape women's health 2002;7:2.

87. ITO M, HAYASHI K, UETANI M, YAMADA M, OHKI M, NAKAMURA T. Association between anthropometric measures and spinal bone mineral density. Investigative radiology 1994;29:812-6.

88. JAFF NG, NORRIS SA, SNYMAN T, TOMAN M, CROWTHER NJ. 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. Metabolism: clinical and experimental 2015;64:1031-41.

89. JASIENSKA G, ZIOMKIEWICZ A, GORKIEWICZ M, PAJAK A. Body mass, depressive symptoms and menopausal status: an examination of the "Jolly Fat" hypothesis. Women's health issues : official publication of the Jacobs Institute of Women's Health 2005;15:145-51.

90. JEENDUANG N, TRONGSAKUL R, INHONGSA P, CHAIDACH P. The prevalence of metabolic syndrome in premenopausal and postmenopausal women in Southern Thailand. Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology 2014;30:573-6.

91. JEON YK, LEE JG, KIM SS, et al. Association between bone mineral density and metabolic syndrome in pre- and postmenopausal women. Endocrine journal 2011;58:87-93.

92. JURIMAE J, JURIMAE T. Plasma adiponectin concentration in healthy pre- and postmenopausal women: relationship with body composition, bone mineral, and metabolic variables. American journal of physiology Endocrinology and metabolism 2007;293:E42-7.

93. KADAM N, CHIPLONKAR S, KHADILKAR A, DIVATE U, KHADILKAR V. Low bone mass in urban Indian women above 40 years of age: prevalence and risk factors. Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology 2010;26:909-17.

94. KANG EK, PARK HW, BAEK S, LIM JY. The Association between Trunk Body Composition and Spinal Bone Mineral Density in Korean Males versus Females: a Farmers' Cohort for Agricultural Work-Related Musculoskeletal Disorders (FARM) Study. Journal of Korean medical science 2016;31:1595-603.

95. KAUFER-HORWITZ M, PELAEZ-ROBLES K, LAZZERI-ARTEAGA P, GOTI-RODRIGUEZ LM, AVILA-ROSAS H. Hypertension, overweight and abdominal adiposity in women. An analytical perspective. Archives of medical research 2005;36:404-11.

96. KIM HM, PARK J, RYU SY, KIM J. The effect of menopause on the metabolic syndrome among Korean women: the Korean National Health and Nutrition Examination Survey, 2001. Diabetes care 2007;30:701-6.

97. KIM JH, CHOI HJ, KIM MJ, SHIN CS, CHO NH. Fat mass is negatively associated with bone mineral content in Koreans. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2012;23:2009-16.

98. KIM S, LEE JY, IM JA, et al. Association between serum osteocalcin and insulin resistance in postmenopausal, but not premenopausal, women in Korea. Menopause (New York, NY) 2013;20:1061-6.

99. KIM YM, KIM SH, KIM S, YOO JS, CHOE EY, WON YJ. Variations in fat mass contribution to bone mineral density by gender, age, and body mass index: the Korea National Health and Nutrition Examination Survey (KNHANES) 2008-2011. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2016;27:2543-54.

100. KIRCHENGAST S, GRUBER D, SATOR M, HUBER J. Impact of the age at menarche on adult body composition in healthy pre- and postmenopausal women. American journal of physical anthropology 1998;105:9-20.

101. KIRCHENGAST S, HARTMANN B, HUBER J. Serum levels of sex hormones, thyroid hormones, growth hormone, IGF I, and cortisol and their relations to body fat distribution in healthy women dependent on their menopausal status. Zeitschrift fur Morphologie und Anthropologie 1996;81:223-34.

102. KNAPP KM, BLAKE GM, SPECTOR TD, FOGELMAN I. Multisite quantitative ultrasound: precision, age- and menopause-related changes, fracture discrimination, and T-score equivalence with dual-energy X-ray absorptiometry. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2001;12:456-64.

103. KOH SJ, HYUN YJ, CHOI SY, et al. Influence of age and visceral fat area on plasma adiponectin concentrations in women with normal glucose tolerance. Clinica chimica acta; international journal of clinical chemistry 2008;389:45-50.

104. KONRAD T, BÄR F, SCHNEIDER F, et al. Factors influencing endothelial function in healthy pre-and post-menopausal women of the EU-RISC study. Diabetes and Vascular Disease Research 2011;8:229-36.

105. KONTOGIANNI MD, DAFNI UG, ROUTSIAS JG, SKOPOULI FN. Blood leptin and adiponectin as possible mediators of the relation between fat mass and BMD in perimenopausal women. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 2004;19:546-51.

106. KONUKOGLU D, SERIN O, ERCAN M. Plasma leptin levels in obese and non-obese postmenopausal women before and after hormone replacement therapy. Maturitas 2000;36:203-7.

107. KOSKOVA I, PETRASEK R, VONDRA K, et al. Weight, body composition and fat distribution of Czech women in relation with reproductive phase: a cross-sectional study. Prague medical report 2007;108:13-26.

108. KOTANI K, CHEN JT, TANIGUCHI N. The relationship between adiponectin and blood pressure in premenopausal and postmenopausal women. Clinical and investigative medicine Medecine clinique et experimentale 2011;34:E125-30.

109. KRAEMER RR, SYNOVITZ LB, GIMPEL T, KRAEMER GR, JOHNSON LG, CASTRACANE VD. Effect of estrogen on serum DHEA in younger and older women and the relationship of DHEA to adiposity and gender. Metabolism: clinical and experimental 2001;50:488-93.

110. KUK JL, LEE S, HEYMSFIELD SB, ROSS R. Waist circumference and abdominal adipose tissue distribution: influence of age and sex. Am J Clin Nutr 2005;81:1330-4.

111. LAITINEN K, VALIMAKI M, KETO P. Bone mineral density measured by dual-energy X-ray absorptiometry in healthy Finnish women. Calcified tissue international 1991;48:224-31.

112. LEJSKOVA M, ALUSIK S, VALENTA Z, ADAMKOVA S, PITHA J. Natural postmenopause is associated with an increase in combined cardiovascular risk factors. Physiological research 2012;61:587-96.

113. LEON GUERRERO RT, NOVOTNY R, WILKENS LR, et al. Risk factors for breast cancer in the breast cancer risk model study of Guam and Saipan. Cancer epidemiology 2017;50:221-33.

114. LEY CJ, LEES B, STEVENSON JC. Sex- and menopause-associated changes in body-fat distribution. The American journal of clinical nutrition 1992;55:950-4.

115. LIN WY, YANG WS, LEE LT, et al. Insulin resistance, obesity, and metabolic syndrome among non-diabetic pre- and post-menopausal women in North Taiwan. International journal of obesity (2005) 2006;30:912-7.

116. LINDQUIST O, BENGTSSON C. Serum lipids, arterial blood pressure and body weight in relation to the menopause: results from a population study of women in Goteborg, Sweden. Scandinavian journal of clinical and laboratory investigation 1980;40:629-36.

117. LINDSAY R, COSMAN F, HERRINGTON BS, HIMMELSTEIN S. Bone mass and body composition in normal women. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 1992;7:55-63.

118. LOVEJOY JC, CHAMPAGNE CM, DE JONGE L, XIE H, SMITH SR. Increased visceral fat and decreased energy expenditure during the menopausal transition. International journal of obesity (2005) 2008;32:949-58.

119. LYU LC, YEH CY, LICHTENSTEIN AH, LI Z, ORDOVAS JM, SCHAEFER EJ. Association of sex, adiposity, and diet with HDL subclasses in middle-aged Chinese. Am J Clin Nutr 2001;74:64-71.

120. MAHARLOUEI N, BELLISSIMO N, AHMADI SM, LANKARANI KB. Prevalence of metabolic syndrome in pre- and postmenopausal Iranian women. Climacteric 2013;16:561-7.

121. MALACARA JM, CANTO DE CETINA T, BASSOL S, et al. Symptoms at pre- and postmenopause in rural and urban women from three States of Mexico. Maturitas 2002;43:11-9.

122. MANABE E, AOYAGI K, TACHIBANA H, TAKEMOTO T. Relationship of intra-abdominal adiposity and peripheral fat distribution to lipid metabolism in an island population in western Japan: gender differences and effect of menopause. The Tohoku journal of experimental medicine 1999;188:189-202.

123. MANJER J, KAAKS R, RIBOLI E, BERGLUND G. Risk of breast cancer in relation to anthropometry, blood pressure, blood lipids and glucose metabolism: a prospective study within the Malmo Preventive Project. European journal of cancer prevention : the official journal of the European Cancer Prevention Organisation (ECP) 2001;10:33-42.

124. MANNISTO S, PIETINEN P, PYY M, PALMGREN J, ESKELINEN M, UUSITUPA M. Body-size indicators and risk of breast cancer according to menopause and estrogen-receptor status. International journal of cancer 1996;68:8-13.

125. MARTINI G, VALENTI R, GIOVANI S, NUTI R. Age-related changes in body composition of healthy and osteoporotic women. Maturitas 1997;27:25-33.

126. MARWAHA RK, GARG MK, TANDON N, MEHAN N, SASTRY A, BHADRA K. Relationship of body fat and its distribution with bone mineral density in Indian population. Journal of clinical densitometry : the official journal of the International Society for Clinical Densitometry 2013;16:353-9.

127. MATSUSHITA H, KURABAYASHI T, TOMITA M, KATO N, TANAKA K. Effects of uncoupling protein 1 and beta3-adrenergic receptor gene polymorphisms on body size and serum lipid concentrations in Japanese women. Maturitas 2003;45:39-45.

128. MATSUZAKI M, KULKARNI B, KUPER H, et al. Association of Hip Bone Mineral Density and Body Composition in a Rural Indian Population: The Andhra Pradesh Children and Parents Study (APCAPS). PLoS One 2017;12:e0167114.

129. MATTHEWS KA, MEILAHN E, KULLER LH, KELSEY SF, CAGGIULA AW, WING RR. Menopause and risk factors for coronary heart disease. The New England journal of medicine 1989;321:641-6.

130. MESCH VR, BOERO LE, SISELES NO, et al. Metabolic syndrome throughout the menopausal transition: influence of age and menopausal status. Climacteric 2006;9:40-8.

131. MEZA-MUNOZ DE, FAJARDO ME, PEREZ-LUQUE EL, MALACARA JM. Factors associated with estrogen receptors-alpha (ER-alpha) and -beta (ER-beta) and progesterone receptor abundance in obese and non obese pre- and post-menopausal women. Steroids 2006;71:498-503.

132. MINATOYA M, KUTOMI G, SHIMA H, et al. Relation of serum adiponectin levels and obesity with breast cancer: a Japanese case-control study. Asian Pacific journal of cancer prevention : APJCP 2014;15:8325-30.

133. MO D, HSIEH P, YU H, et al. The relationship between osteoporosis and body composition in pre- and postmenopausal women from different ethnic groups in China. Ethnicity & health 2017;22:295-310.

134. MUCHANGA SIFA MJ, LEPIRA FB, LONGO AL, et al. Prevalence and predictors of metabolic syndrome among Congolese pre- and postmenopausal women. Climacteric 2014;17:442-8.

135. MUTI P, STANULLA M, MICHELI A, et al. Markers of insulin resistance and sex steroid hormone activity in relation to breast cancer risk: a prospective analysis of abdominal adiposity, sebum production, and hirsutism (Italy). Cancer causes & control : CCC 2000;11:721-30.

136. NITTA J, NOJIMA M, OHNISHI H, et al. Weight Gain and Alcohol Drinking Associations with Breast Cancer Risk in Japanese Postmenopausal Women - Results from the Japan Collaborative Cohort (JACC) Study. Asian Pacific journal of cancer prevention : APJCP 2016;17:1437-43.

137. NOH HM, SONG YM, PARK JH, KIM BK, CHOI YH. Metabolic factors and breast cancer risk in Korean women. Cancer causes & control : CCC 2013;24:1061-8.

138. NORDIN BE, NEED AG, BRIDGES A, HOROWITZ M. Relative contributions of years since menopause, age, and weight to vertebral density in postmenopausal women. The Journal of clinical endocrinology and metabolism 1992;74:20-3.

139. OHTA H, KURODA T, ONOE Y, et al. Familial correlation of bone mineral density, birth data and lifestyle factors among adolescent daughters, mothers and grandmothers. Journal of bone and mineral metabolism 2010;28:690-5.

140. OLDROYD B, STEWART SP, TRUSCOTT JG, WESTMACOTT CF, SMITH MA. Age related changes in body composition. Applied radiation and isotopes : including data, instrumentation and methods for use in agriculture, industry and medicine 1998;49:589-90.

141. PACHOLCZAK R, KLIMEK-PIOTROWSKA W, KUSZMIERSZ P. Associations of anthropometric measures on breast cancer risk in pre- and postmenopausal women--a case-control study. Journal of physiological anthropology 2016;35:7.

142. PARK JH, SONG YM, SUNG J, et al. The association between fat and lean mass and bone mineral density: the Healthy Twin Study. Bone 2012;50:1006-11.

143. PARK YM, WHITE AJ, NICHOLS HB, O'BRIEN KM, WEINBERG CR, SANDLER DP. The association between metabolic health, obesity phenotype and the risk of breast cancer. International journal of cancer 2017;140:2657-66.

144. PAVICIC ZEZELJ S, CVIJANOVIC O, MICOVIC V, BOBINAC D, CRNCEVIC-ORLIC Z, MALATESTINIC G. Effect of menopause, anthropometry, nutrition and lifestyle on bone status of women in the northern Mediterranean. The West Indian medical journal 2010;59:494-502.

145. PAVLICA T, MIKALACKI M, MATIC R, et al. Relationship between BMI and skinfold thicknesses to risk factors in premenopausal and postmenopausal women. Collegium antropologicum 2013;37 Suppl 2:119-24.

146. PHILLIPS GB, JING T, HEYMSFIELD SB. Does insulin resistance, visceral adiposity, or a sex hormone alteration underlie the metabolic syndrome? Studies in women. Metabolism: clinical and experimental 2008;57:838-44.

147. POLESEL DN, HIROTSU C, NOZOE KT, et al. Waist circumference and postmenopause stages as the main associated factors for sleep apnea in women: a cross-sectional population-based study. Menopause (New York, NY) 2015;22:835-44.

148. POLLAN M, LOPE V, MIRANDA-GARCIA J, et al. Adult weight gain, fat distribution and mammographic density in Spanish pre- and post-menopausal women (DDM-Spain). Breast cancer research and treatment 2012;134:823-38.

149. PORTALUPPI F, PANSINI F, MANFREDINI R, MOLLICA G. Relative influence of menopausal status, age, and body mass index on blood pressure. Hypertension (Dallas, Tex : 1979) 1997;29:976-9.

150. PRIYA T, CHOWDHURY MG, VASANTH K, et al. Assessment of serum leptin and resistin levels in association with the metabolic risk factors of pre- and post-

menopausal rural women in South India. Diabetes & metabolic syndrome 2013;7:233-7.

151. RANTALAINEN T, NIKANDER R, HEINONEN A, et al. Neuromuscular performance and body mass as indices of bone loading in premenopausal and postmenopausal women. Bone 2010;46:964-9.

152. REINA P, COINTRY GR, NOCCIOLINO L, et al. Analysis of the independent power of age-related, anthropometric and mechanical factors as determinants of the structure of radius and tibia in normal adults. A pQCT study. Journal of musculoskeletal & neuronal interactions 2015;15:10-22.

153. REVILLA M, VILLA LF, HERNANDEZ ER, SANCHEZ-ATRIO A, CORTES J, RICO H. Influence of weight and gonadal status on total and regional bone mineral content and on weight-bearing and non-weight-bearing bones, measured by dual-energy X-ray absosorptiometry. Maturitas 1997;28:69-74.

154. REVILLA M, VILLA LF, SANCHEZ-ATRIO A, HERNANDEZ ER, RICO H. Influence of body mass index on the age-related slope of total and regional bone mineral content. Calcified tissue international 1997;61:134-8.

155. RICE MS, BERTRAND KA, LAJOUS M, et al. Reproductive and lifestyle risk factors and mammographic density in Mexican women. Annals of epidemiology 2015;25:868-73.

156. RICO H, AGUADO F, ARRIBAS I, et al. Behavior of phalangeal bone ultrasound in normal women with relation to gonadal status and body mass index. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2001;12:450-5.

157. RICO H, ARRIBAS I, CASANOVA FJ, DUCE AM, HERNANDEZ ER, CORTES-PRIETO J. Bone mass, bone metabolism, gonadal status and body mass index. Osteoporosis

international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2002;13:379-87.

158. ROELFSEMA F, VELDHUIS JD. Growth Hormone Dynamics in Healthy Adults Are Related to Age and Sex and Strongly Dependent on Body Mass Index. Neuroendocrinology 2016;103:335-44.

159. ROSENBAUM M, NICOLSON M, HIRSCH J, et al. Effects of gender, body composition, and menopause on plasma concentrations of leptin. The Journal of clinical endocrinology and metabolism 1996;81:3424-7.

160. SALOMAA V, RASI V, PEKKANEN J, et al. Association of hormone replacement therapy with hemostatic and other cardiovascular risk factors. The FINRISK Hemostasis Study. Arteriosclerosis, thrombosis, and vascular biology 1995;15:1549-55.

161. SARRAFZADEGAN N, KHOSRAVI-BOROUJENI H, ESMAILLZADEH A, SADEGHI M, RAFIEIAN-KOPAEI M, ASGARY S. The association between hypertriglyceridemic waist phenotype, menopause, and cardiovascular risk factors. Archives of Iranian medicine 2013;16:161-6.

162. SCHABERG-LOREI G, BALLARD JE, MCKEOWN BC, ZINKGRAF SA. Body composition alterations consequent to an exercise program for pre and postmenopausal women. The Journal of sports medicine and physical fitness 1990;30:426-33.

163. SCHWARZ S, VOLZKE H, ALTE D, et al. Menopause and determinants of quality of life in women at midlife and beyond: the study of health in pomerania (SHIP). Menopause (New York, NY) 2007;14:123-34.

164. SHAKIR YA, SAMSIOE G, NYBERG P, LIDFELDT J, NERBRAND C. Cardiovascular risk factors in middle-aged women and the association with use of hormone therapy:

results from a population-based study of Swedish women. The Women's Health in the Lund Area (WHILA) Study. Climacteric 2004;7:274-83.

165. SHERK VD, MALONE SP, BEMBEN MG, KNEHANS AW, PALMER IJ, BEMBEN DA. Leptin, fat mass, and bone mineral density in healthy pre- and postmenopausal women. Journal of clinical densitometry : the official journal of the International Society for Clinical Densitometry 2011;14:321-5.

166. SHIBATA H, MATSUZAKI T, HATANO S. Relationship of relevant factors of atherosclerosis to menopause in Japanese women. American journal of epidemiology 1979;109:420-4.

167. SIEMINSKA L, WOJCIECHOWSKA C, FOLTYN W, et al. The relation of serum adiponectin and leptin levels to metabolic syndrome in women before and after the menopause. Endokrynologia Polska 2006;57:15-22.

168. SKRZYPCZAK M, SZWED A. Assessment of the body mass index and selected physiological parameters in pre- and post-menopausal women. Homo : internationale Zeitschrift fur die vergleichende Forschung am Menschen 2005;56:141-52.

169. SKRZYPCZAK M, SZWED A, PAWLIŃSKA-CHMARA R, SKRZYPULEC V. Assessment of the BMI, WHR and W/Ht in pre-and postmenopausal women. Anthropological Review 2007;70:3-13.

170. SODERBERG S, AHREN B, ELIASSON M, DINESEN B, OLSSON T. The association between leptin and proinsulin is lost with central obesity. Journal of internal medicine 2002;252:140-8.

171. SON MK, LIM NK, LIM JY, et al. Difference in blood pressure between early and late menopausal transition was significant in healthy Korean women. BMC women's health 2015;15:64.

172. SORIGUER F, MORCILLO S, HERNANDO V, et al. Type 2 diabetes mellitus and other cardiovascular risk factors are no more common during menopause: longitudinal study. Menopause (New York, NY) 2009;16:817-21.

173. STAESSEN J, BULPITT CJ, FAGARD R, LIJNEN P, AMERY A. The influence of menopause on blood pressure. Journal of human hypertension 1989;3:427-33.

174. SUAREZ-ORTEGON MF, ARBELAEZ A, MOSQUERA M, MENDEZ F, AGUILAR-DE PLATA C. C-reactive protein, waist circumference, and family history of heart attack are independent predictors of body iron stores in apparently healthy premenopausal women. Biological trace element research 2012;148:135-8.

175. SULIGA E, KOZIEL D, CIESLA E, REBAK D, GLUSZEK S. Factors Associated with Adiposity, Lipid Profile Disorders and the Metabolic Syndrome Occurrence in Premenopausal and Postmenopausal Women. PLoS One 2016;11:e0154511.

176. SUMNER AE, FALKNER B, KUSHNER H, CONSIDINE RV. Relationship of leptin concentration to gender, menopause, age, diabetes, and fat mass in African Americans. Obesity research 1998;6:128-33.

177. TANAKA NI, HANAWA S, MURAKAMI H, et al. Accuracy of segmental bioelectrical impedance analysis for predicting body composition in pre- and postmenopausal women. Journal of clinical densitometry : the official journal of the International Society for Clinical Densitometry 2015;18:252-9.

178. THOMAS T, BURGUERA B, MELTON LJ, 3RD, et al. Relationship of serum leptin levels with body composition and sex steroid and insulin levels in men and women. Metabolism: clinical and experimental 2000;49:1278-84.

179. TORNG PL, SU TC, SUNG FC, et al. Effects of menopause and obesity on lipid profiles in middle-aged Taiwanese women: the Chin-Shan Community Cardiovascular Cohort Study. Atherosclerosis 2000;153:413-21.

180. TOTH MJ, TCHERNOF A, SITES CK, POEHLMAN ET. Effect of menopausal status on body composition and abdominal fat distribution. International journal of obesity and related metabolic disorders : journal of the International Association for the Study of Obesity 2000;24:226-31.

181. TREMOLLIERES FA, POUILLES JM, RIBOT CA. Relative influence of age and menopause on total and regional body composition changes in postmenopausal women. American journal of obstetrics and gynecology 1996;175:1594-600.

182. TRIKUDANATHAN S, PEDLEY A, MASSARO JM, et al. Association of female reproductive factors with body composition: the Framingham Heart Study. The Journal of clinical endocrinology and metabolism 2013;98:236-44.

183. VAN PELT RE, DAVY KP, STEVENSON ET, et al. Smaller differences in total and regional adiposity with age in women who regularly perform endurance exercise. The American journal of physiology 1998;275:E626-34.

184. VELDHUIS JD, DYER RB, TRUSHIN SA, BONDAR OP, SINGH RJ, KLEE GG. Interleukins 6 and 8 and abdominal fat depots are distinct correlates of lipid moieties in healthy pre- and postmenopausal women. Endocrine 2016;54:671-80.

185. WANG F, MA X, HAO Y, et al. Serum glycated albumin is inversely influenced by fat mass and visceral adipose tissue in Chinese with normal glucose tolerance. PLoS One 2012;7:e51098.

186. WANG W, ZHAO LJ, LIU YZ, RECKER RR, DENG HW. Genetic and environmental correlations between obesity phenotypes and age at menarche. International journal of obesity (2005) 2006;30:1595-600.

187. WANG WS, WAHLQVIST ML, HSU CC, CHANG HY, CHANG WC, CHEN CC. Age- and gender-specific population attributable risks of metabolic disorders on all-cause and cardiovascular mortality in Taiwan. BMC public health 2012;12:111.

188. WEE J, SNG BY, SHEN L, LIM CT, SINGH G, DAS DE S. The relationship between body mass index and physical activity levels in relation to bone mineral density in premenopausal and postmenopausal women. Archives of osteoporosis 2013;8:162.

189. WILLIAMS PT, KRAUSS RM. Associations of age, adiposity, menopause, and alcohol intake with low-density lipoprotein subclasses. Arteriosclerosis, thrombosis, and vascular biology 1997;17:1082-90.

190. WING RR, MATTHEWS KA, KULLER LH, MEILAHN EN, PLANTINGA PL. Weight gain at the time of menopause. Archives of internal medicine 1991;151:97-102.

191. XU L, NICHOLSON P, WANG QJ, WANG Q, ALEN M, CHENG S. Fat mass accumulation compromises bone adaptation to load in Finnish women: a cross-sectional study spanning three generations. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 2010;25:2341-9.

192. YAMATANI H, TAKAHASHI K, YOSHIDA T, TAKATA K, KURACHI H. Association of estrogen with glucocorticoid levels in visceral fat in postmenopausal women. Menopause (New York, NY) 2013;20:437-42.

193. YANNAKOULIA M, MELISTAS L, SOLOMOU E, YIANNAKOURIS N. Association of eating frequency with body fatness in pre- and postmenopausal women. Obesity (Silver Spring, Md) 2007;15:100-6.

194. YOLDEMIR T, ERENUS M. The prevalence of metabolic syndrome in pre- and post-menopausal women attending a tertiary clinic in Turkey. European journal of obstetrics, gynecology, and reproductive biology 2012;164:172-5.

195. YOO HJ, PARK MS, YANG SJ, et al. The differential relationship between fat mass and bone mineral density by gender and menopausal status. Journal of bone and mineral metabolism 2012;30:47-53.

196. YOO KY, KIM H, SHIN HR, et al. Female sex hormones and body mass in adolescent and postmenopausal Korean women. Journal of Korean medical science 1998;13:241-6.

197. YOSHIMOTO N, NISHIYAMA T, TOYAMA T, et al. Genetic and environmental predictors, endogenous hormones and growth factors, and risk of estrogen receptor-positive breast cancer in Japanese women. Cancer science 2011;102:2065-72.

198. ZHONG N, WU XP, XU ZR, et al. Relationship of serum leptin with age, body weight, body mass index, and bone mineral density in healthy mainland Chinese women. Clinica chimica acta; international journal of clinical chemistry 2005;351:161-8.

199. ZHOU JL, LIN SQ, SHEN Y, CHEN Y, ZHANG Y, CHEN FL. Serum lipid profile changes during the menopausal transition in Chinese women: a community-based cohort study. Menopause (New York, NY) 2010;17:997-1003.

200. ZHOU Y, ZHOU X, GUO X, et al. Prevalence and risk factors of hypertension among pre- and post-menopausal women: a cross-sectional study in a rural area of northeast China. Maturitas 2015;80:282-7.

201. ZIVKOVIC TB, VUKSANOVIC M, JELIC MA, et al. Obesity and metabolic syndrome during the menopause transition in Serbian women. Climacteric 2011;14:643-8.

ST2 Table of study characteristics for longitudinal studies

Study	Year	Sample Size	PreM mean age (SD)	PostM mean age (SD)	BMI	BW	WC	BF%	AF	VF
Abdulnour et al.[1]	2012	13	50.65 (2.26)	52.76 (2.16)	-	-	-	-	*	*
Akahoshi et al.[2]	2001	48	39.40 (1.60)	45.30 (1.50)	*	-	-	-	-	-
Akahoshi et al.[2]	2001	388	44.20 (1.60)	50.10 (1.50)	*	-	-	-	-	-
Akahoshi et al.[2]	2001	565	48.30 (1.70)	54.20 (1.70)	*	-	-	-	-	-
Ford et al.[3]	2005	74	40.07 (4.43)	45.77 (4.62)	*	-	-	-	-	-
Franklin et al.[4]	2009	8	49.30 (1.70)	57.00 (2.26)	*	*	*	*	-	-
Janssen et al.[5]	2008	859	46.81 (2.52)	52.29 (2.86)	*	-	*	-	-	-
Lee et al.[6]	2009	69	50.60 (2.60)	54.70 (2.60)	*	*	-	*	*	*
Liu-Ambrose et al.[7]	2006	53	40.50 (4.70)	53.20 (4.70)	-	*	-	-	-	-
Lovejoy et al.[8]	2008	51	48.10 (0.30)	52.10 (0.30)	-	*	-	*	*	*
Macdonald et al.[9]	2005	248	47.72 (1.40)	54.13 (1.52)	*	*	-	-	-	-
Razmjou et al.[10]	2018	48	49.77 (1.80)	59.97 (1.78)	*	*	*	*	-	-

Soreca et al.[11]	2009	48	47.98 (1.32)	67.98 (1.32)	*	*	-	-	-	-

Abbreviations: PreM, Premenopausal; PostM, Postmenopausal; BMI, Body Mass Index; BW, Body Weight; WC, Waist Circumference; BF %, Total Body Fat Percentage; AF, Subcutaneous Abdominal Fat; VF, Visceral Fat; SD, Standard Deviation.
Note: * indicates inclusion of measure.

References

1. ABDULNOUR J, DOUCET E, BROCHU M, et al. The effect of the menopausal transition on body composition and cardiometabolic risk factors: a Montreal-Ottawa New Emerging Team group study. Menopause (New York, NY) 2012;19:760-7.
2. AKAHOSHI M, SODA M, NAKASHIMA E, et al. Effects of age at menopause on serum cholesterol, body mass index, and blood pressure. Atherosclerosis 2001;156:157-63.
3. FORD K, SOWERS M, CRUTCHFIELD M, WILSON A, JANNAUSCH M. A longitudinal study of the predictors of prevalence and severity of symptoms commonly associated with menopause. Menopause (New York, NY) 2005;12:308-17.
4. FRANKLIN RM, PLOUTZ-SNYDER L, KANALEY JA. Longitudinal changes in abdominal fat distribution with menopause. Metabolism: clinical and experimental 2009;58:311-5.
5. JANSSEN I, POWELL LH, CRAWFORD S, LASLEY B, SUTTON-TYRRELL K. Menopause and the metabolic syndrome: the Study of Women's Health Across the Nation. Archives of internal medicine 2008;168:1568-75.
6. LEE CG, CARR MC, MURDOCH SJ, et al. Adipokines, inflammation, and visceral adiposity across the menopausal transition: a prospective study. The Journal of clinical endocrinology and metabolism 2009;94:1104-10.
7. LIU-AMBROSE T, KRAVETSKY L, BAILEY D, et al. Change in lean body mass is a major determinant of change in areal bone mineral density of the proximal femur: a 12-year observational study. Calcified tissue international 2006;79:145-51.
8. LOVEJOY JC, CHAMPAGNE CM, DE JONGE L, XIE H, SMITH SR. Increased visceral fat and decreased energy expenditure during the menopausal transition. International journal of obesity (2005) 2008;32:949-58.
9. MACDONALD HM, NEW SA, CAMPBELL MK, REID DM. Influence of weight and weight change on bone loss in perimenopausal and early postmenopausal Scottish women.

Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2005;16:163-71.

10. RAZMJOU S, ABDULNOUR J, BASTARD J-P, et al. Body composition, cardiometabolic risk factors, physical activity, and inflammatory markers in premenopausal women after a 10-year follow-up: a MONET study. Menopause 2018;25:89-97.

11. SORECA I, ROSANO C, JENNINGS JR, et al. Gain in adiposity across 15 years is associated with reduced gray matter volume in healthy women. Psychosomatic medicine 2009;71:485-90.

ST3 Quality assessment of individual cross-sectional studies.

			Newcastle-Ottawa quality assessment scale (Adapted)									
			Selection			Comparability				Outcome		Total Score
#	Study	Year	Q1	Q2	Q3	Q4a	Q4b	Q5	Q6	Q7	Q8	(out of 9)
1	Abate et al.[1]	2014	-	*	-	*	*	*	*	*	*	7
2	Abdulnour et al.[2]	2012	*	*	-	*	*	*	*	*	*	8
3	Abildgaard et al.[3]	2013	*	*	-	*	*	*	*	*	*	8
4	Adams-Campbell et al.[4]	1996	*	*	*	*	-	-	-	-	*	5
5	Agrinier et al.[5]	2010	*	*	*	*	-	*	*	*	*	8
6	Aguado et al.[6]	1996	-	*	-	*	-	-	-	*	*	4
7	Albanese et al.[7]	2009	*	*	-	*	*	*	*	*	*	8
8	Allali et al.[8]	2009	*	*	-	*	-	-	-	-	-	3
9	Aloia et al.[9]	1995	*	*	-	*	-	-	-	-	-	3
10	Amankwah et al.[10]	2013	*	*	*	*	-	*	*	*	*	8
11	Amarante et al.[11]	2011	-	-	-	*	*	-	*	-	*	4
12	Amiri et al.[12]	2014	*	*	*	*	-	-	*	*	*	7

13	Angsuwanthana et al.[13]	2007	*	*	*	*	*	*	*	*	*	9
14	Armellini et al.[14]	1996	*	*	-	-	-	-	-	*	*	4
15	Arthur et al.[15]	2013	*	*	-	*	-	*	*	*	*	7
16	Aydin et al.[16]	2010	*	*	*	*	*	*	*	*	*	9
17	Ayub et al.[17]	2006	-	-	-	*	*	-	-	*	*	4
18	Bancroft et al.[18]	1996	*	*	*	*	*	*	*	*	*	9
19	Bednarek-Tupikowska et al.[19]	2006	-	-	-	*	*	-	-	*	*	4
20	Bell et al.[20]	2007	*	*	-	*	-	*	*	*	*	7
21	Ben-Ali et al.[21]	2016	*	*	-	*	-	-	*	*	*	6
22	Ben-Ali et al.[22]	2014	*	*	-	*	-	-	*	*	*	6
23	Ben-Ali et al.[23]	2011	*	*	-	*	-	*	*	*	*	7
24	Berg et al.[24]	2004	-	-	-	*	-	*	*	*	*	5
25	Berge et al.[25]	1994	*	*	*	*	-	*	*	-	-	6
26	Berger et al.[26]	1995	-	*	-	*	*	*	*	*	*	7

27	Berstad et al.[27]	2010	*	*	*	*	-	*	*	-	*	7
28	Bhagat et al.[28]	2010	*	*	-	*	-	*	*	*	*	7
29	Bhurosy et al.[29]	2013	*	*	-	*	-	*	*	*	*	7
30	Blumenthal et al.[30]	1991	*	*	*	*	*	*	*	-	-	7
31	Bonithon-Kopp et al.[31]	1990	*	*	-	*	*	*	*	-	-	6
32	Caire-Juvera et al.[32]	2008	*	*	-	*	-	*	*	*	*	7
33	Campesi et al.[33]	2016	-	-	-	*	-	*	*	-	-	3
34	Carr et al.[34]	2000	*	*	-	*	-	*	*	-	-	5
35	Castracane et al.[35]	1998	-	-	-	*	-	*	-	-	-	2
36	Catsburg et al.[36]	2014	*	*	-	*	-	-	-	-	*	4
37	Cecchini et al.[37]	2012	*	*	-	-	-	*	*	*	*	6
38	Cervellati et al.[38]	2009	-	-	-	*	-	*	*	*	*	5
39	Chain et al.[39]	2017	*	*	-	*	*	-	*	*	*	7
40	Chang et al.[40]	2000	*	*	-	*	-	*	*	*	*	7

41	Cho et al.[41]	2008	*	*	-	*	-	-	*	*	*	6
42	Cifkova et al.[42]	2008	*	*	-	*	*	*	*	*	*	8
43	Copeland et al.[43]	2006	*	*	-	*	-	*	*	*	*	7
44	Cremonini et al.[44]	2013	*	*	-	*	-	*	*	*	*	7
45	Cui et al.[45]	2007	*	*	-	*	-	*	*	*	*	7
46	D'haeseleer et al.[46]	2011	-	-	*	*	*	*	*	-	*	6
47	Da Camara et al.[47]	2015	*	*	*	*	*	*	*	*	*	9
48	Dallongeville et al.[48]	1995	*	*	-	*	*	-	*	*	*	7
49	Dancey et al.[49]	2001	*	*	-	*	-	*	*	-	-	5
50	Davis et al.[50]	1994	*	*	-	*	*	*	*	-	-	6
51	De Kat et al.[51]	2017	*	*	-	*	-	*	*	*	*	7
52	Den Tonkelaar et al.[52]	1990	*	*	-	*	-	-	*	*	*	6
53	Dmitruk et al.[53]	2018	*	*	-	*	-	*	*	*	*	7
54	Donato et al.[54]	2006	*	*	*	*	*	*	*	*	*	9

55	Douchi et al.[55]	1997	*	*	-	*	-	*	-	*	*	6
56	Douchi et al.[56]	2002	*	*	-	*	-	*	*	*	*	7
57	Douchi et al.[57]	2007	*	*	-	*	-	-	*	*	*	6
58	Dubois et al.[58]	2001	-	*	-	*	-	*	*	-	-	4
59	Engmann et al.[59]	2017	*	*	-	*	-	*	*	-	*	6
60	Ertungealp et al.[60]	1999	*	-	-	-	-	-	-	-	-	1
61	Feng et al.[61]	2008	*	*	*	*	-	*	*	*	*	8
62	Formica et al.[62]	1995	*	*	-	*	-	-	-	-	-	3
63	Friedenreich et al.[63]	2007	*	*	-	*	-	*	*	*	*	7
64	Friedenreich et al.[64]	2002	*	*	*	*	-	*	*	*	*	8
65	Fu et al.[65]	2011	*	*	-	*	-	*	*	*	*	7
66	Fuh et al.[66]	2003	*	*	-	*	*	*	*	*	*	8
67	Gambacciani et al.[67]	1999	*	*	-	*	-	*	*	*	*	7
68	Genazzani et al.[68]	2006	*	*	-	*	-	*	*	*	*	7

69	Ghosh et al.[69]	2008	*	*	-	*	-	*	*	*	*	7
70	Ghosh et al.[70]	2010	*	*	-	*	-	*	*	*	*	7
71	Gram et al.[71]	1997	*	*	-	*	*	-	*	*	*	7
72	Guo et al.[72]	2015	*	*	-	*	-	*	*	*	*	7
73	Gurka et al.[73]	2016	*	*	*	*	*	*	*	-	-	7
74	Hadji et al.[74]	2000	*	*	-	*	-	*	*	*	*	7
75	Hagner et al.[75]	2009	*	*	-	*	-	*	*	*	*	7
76	Han et al.[76]	2006	*	*	-	*	-	-	*	*	*	6
77	Harting et al.[77]	1984	*	*	-	*	-	*	-	-	-	4
78	He et al.[78]	2012	*	*	-	*	*	*	*	*	*	8
79	Hirose et al.[79]	2003	*	*	-	*	-	-	-	-	*	4
80	Hjartaker et al.[80]	2005	*	*	-	*	*	*	*	-	*	7
81	Ho et al.[81]	2010	*	*	*	-	-	*	*	*	*	7
82	Hsu et al.[82]	2006	*	*	-	*	-	-	-	*	*	5

83	Hu et al.[83]	2016	*	*	-	-	-	-	-	*	*	4
84	Hunter et al.[84]	1996	*	*	-	*	-	-	*	*	*	6
85	Iida et al.[85]	2011	*	*	-	*	-	-	-	*	*	5
86	Ilich-Ernst et al.[86]	2002	-	-	-	*	-	-	-	*	*	3
87	Ito et al.[87]	1994	-	-	-	*	-	*	*	-	-	3
88	Jaff et al.[88]	2015	*	*	-	*	*	*	*	*	*	8
89	Jasienska et al.[89]	2005	*	*	-	*	*	-	-	*	*	6
90	Jeenduang et al.[90]	2014	*	*	-	*	-	-	*	*	*	6
91	Jeon et al.[91]	2011	*	*	-	*	*	*	*	*	*	8
92	Jurimae et al.[92]	2007	-	-	-	*	-	*	*	*	*	5
93	Kadam et al.[93]	2010	*	*	-	*	*	*	*	*	*	8
94	Kang et al.[94]	2016	*	*	-	*	-	-	-	*	*	5
95	Kaufer-Horwitz et al.[95]	2005	*	*	-	*	-	*	*	*	*	7
96	Kim et al.[96]	2007	*	*	-	*	-	-	*	*	*	6

97	Kim et al.[97]	2012	*	*	-	*	-	-	-	*	*	5
98	Kim et al.[98]	2013	*	*	*	*	-	-	*	*	*	7
99	Kim et al.[99]	2016	*	*	-	*	-	-	-	*	*	5
100	Kirchengast et al.[100]	1996	*	*	*	*	-	*	*	*	*	8
101	Kirchengast et al.[101]	1998	*	*	*	*	-	*	*	*	*	8
102	Knapp et al.[102]	2001	*	-	-	*	-	-	-	-	-	2
103	Koh et al.[103]	2008	*	*	-	*	-	*	*	*	*	7
104	Konrad et al.[104]	2011	*	*	-	*	*	-	*	*	*	7
105	Kontogianni et al.[105]	2004	*	*	*	*	*	-	*	*	*	8
106	Konukoglu et al.[106]	2000	-	-	*	*	-	-	*	-	-	3
107	Koskova et al.[107]	2007	*	*	*	*	-	*	*	*	*	8
108	Kotani et al.[108]	2011	-	-	-	*	-	-	*	*	*	4
109	Kraemer et al.[109]	2001	*	*	-	*	-	-	-	-	-	3
110	Kuk et al.[110]	2005	*	*	-	*	-	-	-	*	*	5

111	Laitinen et al.[111]	1991	*	*	-	*	-	-	-	-	-	3
112	Lejskova et al.[112]	2012	*	*	-	*	*	*	*	*	*	8
113	Leon-Guerrero et al.[113]	2017	*	*	-	*	-	*	*	*	*	7
114	Ley et al.[114]	1992	*	*	-	*	-	*	*	*	*	7
115	Lin et al.[115]	2006	*	*	-	*	*	-	*	*	*	7
116	Lindquist et al.[116]	1980	*	*	*	*	*	*	*	*	*	9
117	Lindsay et al.[117]	1992	*	*	-	*	-	-	-	*	*	5
118	Lovejoy et al.[118]	2008	*	*	*	*	*	-	*	*	*	8
119	Lyu et al.[119]	2001	*	*	-	*	*	-	*	*	*	7
120	Maharlouei et al.[120]	2013	*	*	-	*	-	*	*	*	*	7
121	Malacara et al.[121]	2002	*	*	*	*	*	*	*	-	*	8
122	Manabe et al.[122]	1999	-	*	-	*	-	-	-	*	*	4
123	Manjer et al.[123]	2001	*	*	-	*	-	*	*	*	*	7
124	Mannisto et al.[124]	1996	*	*	*	*	-	-	-	*	*	6

125	Martini et al.[125]	1997	*	*	-	*	-	-	*	*	*	6
126	Marwaha et al.[126]	2013	*	*	-	*	-	*	*	*	*	7
127	Matsushita et al.[127]	2003	*	*	-	*	-	*	-	*	*	6
128	Matsuzaki et al.[128]	2017	*	*	-	*	-	-	-	*	*	5
129	Matthews et al.[129]	1989	*	*	*	*	*	*	*	-	-	7
130	Mesch et al.[130]	2006	-	-	-	*	-	*	*	*	*	5
131	Meza-Munoz et al.[131]	2006	*	*	-	*	-	*	*	*	*	7
132	Minatoya et al.[132]	2014	*	*	-	-	-	-	-	-	-	2
133	Mo et al.[133]	2017	*	*	-	*	-	-	-	*	*	5
134	Muchanga et al.[134]	2014	*	*	*	*	*	*	*	*	*	9
135	Muti et al.[135]	2000	*	*	-	*	-	-	*	*	*	6
136	Nitta et al.[136]	2016	*	*	-	*	-	-	-	-	-	3
137	Noh et al.[137]	2013	*	*	*	*	-	*	*	*	*	8
138	Nordin et al.[138]	1992	-	-	-	*	-	-	-	-	-	1

139	Ohta et al.[139]	2010	*	*	*	*	-	-	-	*	*	6
140	Oldroyd et al.[140]	1998	-	-	-	*	-	-	-	-	-	1
141	Pacholczak et al.[141]	2016	*	*	-	*	-	-	*	*	*	6
142	Park et al.[142]	2012	*	*	-	*	-	-	-	*	*	5
143	Park et al.[143]	2017	*	*	-	*	-	*	*	-	*	6
144	Pavicic et al.[144]	2010	*	*	-	*	-	*	*	*	*	7
145	Pavlica et al.[145]	2013	*	*	-	*	-	-	-	*	*	5
146	Phillips et al.[146]	2008	*	*	-	*	-	-	*	*	*	6
147	Polesel et al.[147]	2015	*	*	*	*	-	*	*	*	*	8
148	Pollan et al.[148]	2012	*	*	-	*	*	*	*	*	*	8
149	Portaluppi et al.[149]	1997	-	*	*	*	*	*	*	*	*	8
150	Priya et al.[150]	2013	*	*	-	*	-	-	*	*	*	6
151	Rantalainen et al.[151]	2010	-	-	-	*	-	*	-	*	*	4
152	Reina et al.[152]	2015	-	*	-	*	-	-	-	-	-	2

153	Revilla et al.[153]	1997	*	-	-	*	-	*	*	*	*	6
154	Revilla et al.[154]	1997	*	*	-	*	-	*	*	*	*	7
155	Rice et al.[155]	2015	*	*	-	*	-	*	*	-	*	6
156	Rico et al.[156]	2001	*	-	*	*	-	*	*	*	*	7
157	Rico et al.[157]	2002	*	-	*	*	-	*	*	*	*	7
158	Roelfsema et al.[158]	2016	*	-	-	*	-	*	*	*	*	6
159	Rosenbaum et al.[159]	1996	-	-	-	*	-	*	*	*	*	5
160	Salomaa et al.[160]	1995	*	*	-	*	-	*	*	*	*	7
161	Sarrafzadegan et al.[161]	2013	*	*	-	*	-	-	-	*	*	5
162	Schaberg-Lorei et al.[162]	1990	-	-	-	*	-	-	-	*	*	3
163	Schwarz et al.[163]	2007	*	*	-	*	-	*	*	*	*	7
164	Shakir et al.[164]	2004	*	*	*	*	*	*	*	*	*	9
165	Sherk et al.[165]	2011	-	-	-	*	-	-	-	*	*	3
166	Shibata et al.[166]	1979	-	*	-	*	*	-	-	-	-	3

167	Sieminska et al.[167]	2006	-	-	-	*	-	*	*	-	-	3
168	Skrzypczak et al.[168]	2005	*	*	-	*	-	*	*	*	*	7
169	Skrzypczak et al.[169]	2007	*	*	-	*	-	*	*	*	*	7
170	Soderberg et al.[170]	2002	*	*	-	*	-	*	*	*	*	7
171	Son et al.[171]	2015	*	*	-	*	*	*	*	*	*	8
172	Soriguer et al.[172]	2009	*	*	-	*	-	-	*	*	*	6
173	Staessen et al.[173]	1989	-	-	-	*	-	-	*	*	*	4
174	Suarez-Ortegon et al.[174]	2012	-	-	-	*	*	-	-	*	*	4
175	Suliga et al.[175]	2016	*	*	-	*	*	-	*	*	*	7
176	Sumner et al.[176]	1998	-	-	-	*	-	-	*	*	*	4
177	Tanaka et al.[177]	2015	-	-	-	*	-	*	*	*	*	5
178	Thomas et al.[178]	2000	*	*	-	*	-	-	*	*	*	6
179	Torng et al.[179]	2000	*	*	-	*	-	-	*	*	*	6
180	Toth et al.[180]	2000	-	*	*	*	*	*	*	*	*	8

181	Tremollieres et al.[181]	1996	*	*	*	*	*	-	*	*	*	8
182	Trikudanathan et al.[182]	2013	*	*	*	*	*	-	*	*	*	8
183	Van-Pelt et al.[183]	1998	-	-	*	*	-	*	*	*	*	6
184	Veldhuis et al.[184]	2016	*	*	*	*	-	-	*	*	*	7
185	Wang et al.[185]	2012	*	*	-	*	-	-	-	*	*	5
186	Wang et al.[186]	2006	*	*	-	*	-	-	*	*	*	6
187	Wang et al.[187]	2012	*	*	-	*	-	*	*	-	*	6
188	Wee et al.[188]	2013	-	*	-	*	-	*	*	*	*	6
189	Williams et al.[189]	1997	*	*	-	*	-	*	*	*	*	7
190	Wing et al.[190]	1991	*	*	-	-	-	*	*	*	*	6
191	Xu et al.[191]	2010	*	*	*	*	-	*	*	*	*	8
192	Yamatani et al.[192]	2013	*	*	*	*	-	-	*	*	*	7
193	Yannakoulia et al.[193]	2007	*	*	*	*	-	*	*	*	*	8
194	Yoldemir et al.[194]	2012	*	*	*	*	-	*	*	*	*	8

195	Yoo et al.[195]	2012	*	*	*	*	-	-	*	*	*	7
196	Yoo et al.[196]	1998	*	*	*	-	-	*	*	*	*	7
197	Yoshimoto et al.[197]	2011	*	*	-	*	-	-	-	-	-	3
198	Zhong et al.[198]	2005	*	*	-	-	-	-	-	*	*	4
199	Zhou et al.[199]	2010	*	*	*	*	-	*	*	*	*	8
200	Zhou et al.[200]	2015	*	*	-	*	-	-	*	*	*	6
201	Zivkovic et al.[201]	2011	*	*	-	*	-	-	*	*	*	6

Note: * indicates the study met the criterion for the question.

References

1. ABATE M, SCHIAVONE C, DI CARLO L, SALINI V. Prevalence of and risk factors for asymptomatic rotator cuff tears in postmenopausal women Menopause (New York, NY) 2014;21:275-80.
2. ABDULNOUR J, DOUCET E, BROCHU M, et al. The effect of the menopausal transition on body composition and cardiometabolic risk factors: a Montreal-Ottawa New Emerging Team group study. Menopause (New York, NY) 2012;19:760-7.
3. ABILDGAARD J, PEDERSEN AT, GREEN CJ, et al. Menopause is associated with decreased whole body fat oxidation during exercise. American journal of physiology Endocrinology and metabolism 2013;304:E1227-36.
4. ADAMS-CAMPBELL LL, KIM KS, DUNSTON G, LAING AE, BONNEY G, DEMENAIS F. The relationship of body mass index to reproductive factors in pre- and postmenopausal African-American women with and without breast cancer. Obesity research 1996;4:451-6.
5. AGRINIER N, COURNOT M, DALLONGEVILLE J, et al. Menopause and modifiable coronary heart disease risk factors: a population based study. Maturitas 2010;65:237-43.
6. AGUADO F, REVILLA M, HERNANDEZ ER, VILLA LF, RICO H. Behavior of bone mass measurements. Dual energy x-ray absorptiometry total body bone mineral content, ultrasound bone velocity, and computed metacarpal radiogrammetry, with age, gonadal status, and weight in healthy women. Investigative radiology 1996;31:218-22.
7. ALBANESE CV, CEPOLLARO C, DE TERLIZZI F, BRANDI ML, PASSARIELLO R. Performance of five phalangeal QUS parameters in the evaluation of gonadal-status,

age and vertebral fracture risk compared with DXA. Ultrasound in medicine & biology 2009;35:537-44.

8. ALLALI F, EL MANSOURI L, ABOURAZZAK F, et al. The effect of past use of oral contraceptive on bone mineral density, bone biochemical markers and muscle strength in healthy pre and post menopausal women. BMC women's health 2009;9:31.

9. ALOIA JF, VASWANI A, MA R, FLASTER E. To what extent is bone mass determined by fat-free or fat mass? The American journal of clinical nutrition 1995;61:1110-4.

10. AMANKWAH EK, FRIEDENREICH CM, MAGLIOCCO AM, et al. Anthropometric measures and the risk of endometrial cancer, overall and by tumor microsatellite status and histological subtype. American journal of epidemiology 2013;177:1378-87.

11. AMARANTE F, VILODRE LC, MATURANA MA, SPRITZER PM. Women with primary ovarian insufficiency have lower bone mineral density. Brazilian journal of medical and biological research = Revista brasileira de pesquisas medicas e biologicas 2011;44:78-83.

12. AMIRI P, DEIHIM T, NAKHODA K, HASHEMINIA M, MONTAZERI A, AZIZI F. Metabolic syndrome and health-related quality of life in reproductive age and post-menopausal women: Tehran Lipid and Glucose Study. Archives of Iranian medicine 2014;17:423-8.

13. ANGSUWATHANA S, LEERASIRI P, RATTANACHAIYANONT M, et al. Health check-up program for pre/postmenopausal women at Siriraj Menopause Clinic. Journal of the Medical Association of Thailand = Chotmaihet thangphaet 2007;90:1-8.

14. ARMELLINI F, ZAMBONI M, PERDICHIZZI G, et al. Computed tomography visceral adipose tissue volume measurements of Italians. Predictive equations. European journal of clinical nutrition 1996;50:290-4.

15. ARTHUR FK, ADU-FRIMPONG M, OSEI-YEBOAH J, MENSAH FO, OWUSU L. The prevalence of metabolic syndrome and its predominant components among pre-and postmenopausal Ghanaian women. BMC research notes 2013;6:446.

16. AYDIN ZD. Determinants of age at natural menopause in the Isparta Menopause and Health Study: premenopausal body mass index gain rate and episodic weight loss. Menopause (New York, NY) 2010;17:494-505.

17. AYUB N, KHAN SR, SYED F. Leptin levels in pre and post menopausal Pakistani women. JPMA The Journal of the Pakistan Medical Association 2006;56:3-5.

18. BANCROFT J, CAWOOD EH. Androgens and the menopause; a study of 40-60-year-old women. Clinical endocrinology 1996;45:577-87.

19. BEDNAREK-TUPIKOWSKA G, FILUS A, KULICZKOWSKA-PLAKSEJ J, TUPIKOWSKI K, BOHDANOWICZ-PAWLAK A, MILEWICZ A. Serum leptin concentrations in pre- and postmenopausal women on sex hormone therapy. Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology 2006;22:207-12.

20. BELL RJ, DAVISON SL, PAPALIA MA, MCKENZIE DP, DAVIS SR. Endogenous androgen levels and cardiovascular risk profile in women across the adult life span. Menopause (New York, NY) 2007;14:630-8.

21. BEN ALI S, BELFKI-BENALI H, AHMED DB, et al. Postmenopausal hypertension, abdominal obesity, apolipoprotein and insulin resistance. Clinical and experimental hypertension (New York, NY : 1993) 2016;38:370-4.

22. BEN ALI S, BELFKI-BENALI H, AOUNALLAH-SKHIRI H, et al. Menopause and metabolic syndrome in tunisian women. BioMed research international 2014;2014:457131.

23. BEN ALI S, JEMAA R, FTOUHI B, et al. Relationship of plasma leptin and adiponectin concentrations with menopausal status in Tunisian women. Cytokine 2011;56:338-42.

24. BERG G, MESCH V, BOERO L, et al. Lipid and lipoprotein profile in menopausal transition. Effects of hormones, age and fat distribution. Hormone and metabolic research = Hormon- und Stoffwechselforschung = Hormones et metabolisme 2004;36:215-20.

25. BERGE LN, BONAA KH, NORDOY A. Serum ferritin, sex hormones, and cardiovascular risk factors in healthy women. Arteriosclerosis and thrombosis : a journal of vascular biology 1994;14:857-61.

26. BERGER GM, NAIDOO J, GOUNDEN N, GOUWS E. Marked hyperinsulinaemia in postmenopausal, healthy Indian (Asian) women. Diabetic medicine : a journal of the British Diabetic Association 1995;12:788-95.

27. BERSTAD P, COATES RJ, BERNSTEIN L, et al. A case-control study of body mass index and breast cancer risk in white and African-American women. Cancer epidemiology, biomarkers & prevention : a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology 2010;19:1532-44.

28. BHAGAT M, MUKHERJEE S, DE P, et al. Clustering of cardiometabolic risk factors in Asian Indian women: Santiniketan women study. Menopause (New York, NY) 2010;17:359-64.

29. BHUROSY T, JEEWON R. Food habits, socioeconomic status and body mass index among premenopausal and post-menopausal women in Mauritius. Journal of human nutrition and dietetics : the official journal of the British Dietetic Association 2013;26 Suppl 1:114-22.

30. BLUMENTHAL JA, FREDRIKSON M, MATTHEWS KA, et al. Stress reactivity and exercise training in premenopausal and postmenopausal women. Health psychology : official journal of the Division of Health Psychology, American Psychological Association 1991;10:384-91.

31. BONITHON-KOPP C, SCARABIN PY, DARNE B, MALMEJAC A, GUIZE L. Menopause-related changes in lipoproteins and some other cardiovascular risk factors. International journal of epidemiology 1990;19:42-8.

32. CAIRE-JUVERA G, ARENDELL LA, MASKARINEC G, THOMSON CA, CHEN Z. Associations between mammographic density and body composition in Hispanic and non-Hispanic white women by menopause status. Menopause (New York, NY) 2008;15:319-25.

33. CAMPESI I, OCCHIONI S, TONOLO G, et al. Ageing/Menopausal Status in Healthy Women and Ageing in Healthy Men Differently Affect Cardiometabolic Parameters. International journal of medical sciences 2016;13:124-32.

34. CARR MC, KIM KH, ZAMBON A, et al. Changes in LDL density across the menopausal transition. Journal of investigative medicine : the official publication of the American Federation for Clinical Research 2000;48:245-50.

35. CASTRACANE VD, KRAEMER RR, FRANKEN MA, KRAEMER GR, GIMPEL T. Serum leptin concentration in women: effect of age, obesity, and estrogen administration. Fertility and sterility 1998;70:472-7.

36. CATSBURG C, KIRSH VA, SOSKOLNE CL, et al. Associations between anthropometric characteristics, physical activity, and breast cancer risk in a Canadian cohort. Breast cancer research and treatment 2014;145:545-52.

37. CECCHINI RS, COSTANTINO JP, CAULEY JA, et al. Body mass index and the risk for developing invasive breast cancer among high-risk women in NSABP P-1 and STAR breast cancer prevention trials. Cancer prevention research (Philadelphia, Pa) 2012;5:583-92.

38. CERVELLATI C, PANSINI FS, BONACCORSI G, et al. Body mass index is a major determinant of abdominal fat accumulation in pre-, peri- and post-menopausal women. Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology 2009;25:413-7.

39. CHAIN A, CRIVELLI M, FAERSTEIN E, BEZERRA FF. Association between fat mass and bone mineral density among Brazilian women differs by menopausal status: The Pro-Saude Study. Nutrition (Burbank, Los Angeles County, Calif) 2017;33:14-19.

40. CHANG CJ, WU CH, YAO WJ, YANG YC, WU JS, LU FH. Relationships of age, menopause and central obesity on cardiovascular disease risk factors in Chinese women. International journal of obesity and related metabolic disorders : journal of the International Association for the Study of Obesity 2000;24:1699-704.

41. CHO GJ, LEE JH, PARK HT, et al. Postmenopausal status according to years since menopause as an independent risk factor for the metabolic syndrome. Menopause (New York, NY) 2008;15:524-9.

42. CIFKOVA R, PITHA J, LEJSKOVA M, LANSKA V, ZECOVA S. Blood pressure around the menopause: a population study. Journal of hypertension 2008;26:1976-82.

43. COPELAND AL, MARTIN PD, GEISELMAN PJ, RASH CJ, KENDZOR DE. Predictors of pretreatment attrition from smoking cessation among pre- and postmenopausal, weight-concerned women. Eating behaviors 2006;7:243-51.

44. CREMONINI E, BONACCORSI G, BERGAMINI CM, et al. Metabolic transitions at menopause: in post-menopausal women the increase in serum uric acid correlates with abdominal adiposity as assessed by DXA. Maturitas 2013;75:62-6.

45. CUI LH, SHIN MH, KWEON SS, et al. Relative contribution of body composition to bone mineral density at different sites in men and women of South Korea. Journal of bone and mineral metabolism 2007;25:165-71.

46. D'HAESELEER E, DEPYPERE H, CLAEYS S, VAN LIERDE KM. The relation between body mass index and speaking fundamental frequency in premenopausal and postmenopausal women. Menopause (New York, NY) 2011;18:754-8.

47. DA CAMARA SM, ZUNZUNEGUI MV, PIRKLE C, MOREIRA MA, MACIEL AC. Menopausal status and physical performance in middle aged women: a cross-sectional community-based study in Northeast Brazil. PloS one 2015;10:e0119480.

48. DALLONGEVILLE J, MARECAUX N, ISOREZ D, ZYLBERGBERG G, FRUCHART JC, AMOUYEL P. Multiple coronary heart disease risk factors are associated with menopause and influenced by substitutive hormonal therapy in a cohort of French women. Atherosclerosis 1995;118:123-33.

49. DANCEY DR, HANLY PJ, SOONG C, LEE B, HOFFSTEIN V. Impact of menopause on the prevalence and severity of sleep apnea. Chest 2001;120:151-5.

50. DAVIS CE, PAJAK A, RYWIK S, et al. Natural menopause and cardiovascular disease risk factors. The Poland and US Collaborative Study on Cardiovascular Disease Epidemiology. Annals of epidemiology 1994;4:445-8.

51. DE KAT AC, DAM V, ONLAND-MORET NC, EIJKEMANS MJ, BROEKMANS FJ, VAN DER SCHOUW YT. Unraveling the associations of age and menopause with cardiovascular risk factors in a large population-based study. BMC medicine 2017;15:2.

52. DEN TONKELAAR I, SEIDELL JC, VAN NOORD PA, BAANDERS-VAN HALEWIJN EA, OUWEHAND IJ. Fat distribution in relation to age, degree of obesity, smoking habits, parity and estrogen use: a cross-sectional study in 11,825 Dutch women participating in the DOM-project. International journal of obesity 1990;14:753-61.

53. DMITRUK A, CZECZELEWSKI J, CZECZELEWSKA E, GOLACH J, PARNICKA U. Body composition and fatty tissue distribution in women with various menstrual status. Roczniki Panstwowego Zakladu Higieny 2018;69:95-101.

54. DONATO GB, FUCHS SC, OPPERMANN K, BASTOS C, SPRITZER PM. Association between menopause status and central adiposity measured at different cutoffs of waist circumference and waist-to-hip ratio. Menopause (New York, NY) 2006;13:280-5.

55. DOUCHI T, OKI T, NAKAMURA S, IJUIN H, YAMAMOTO S, NAGATA Y. The effect of body composition on bone density in pre- and postmenopausal women. Maturitas 1997;27:55-60.

56. DOUCHI T, YAMAMOTO S, YOSHIMITSU N, ANDOH T, MATSUO T, NAGATA Y. Relative contribution of aging and menopause to changes in lean and fat mass in segmental regions. Maturitas 2002;42:301-6.

57. DOUCHI T, YONEHARA Y, KAWAMURA Y, KUWAHATA A, KUWAHATA T, IWAMOTO I. Difference in segmental lean and fat mass components between pre- and postmenopausal women. Menopause (New York, NY) 2007;14:875-8.

58. DUBOIS EF, VAN DEN BERGH JP, SMALS AG, VAN DE MEERENDONK CW, ZWINDERMAN AH, SCHWEITZER DH. Comparison of quantitative ultrasound

parameters with dual energy X-ray absorptiometry in pre- and postmenopausal women. The Netherlands journal of medicine 2001;58:62-70.

59. ENGMANN NJ, GOLMAKANI MK, MIGLIORETTI DL, SPRAGUE BL, KERLIKOWSKE K. Population-Attributable Risk Proportion of Clinical Risk Factors for Breast Cancer. JAMA oncology 2017;3:1228-36.

60. ERTUNGEALP E, SEYISOGLU H, EREL CT, SENTURK LM, GEZER A. Changes in bone mineral density with age, menopausal status and body mass index in Turkish women. Climacteric : the journal of the International Menopause Society 1999;2:45-51.

61. FENG Y, HONG X, WILKER E, et al. Effects of age at menarche, reproductive years, and menopause on metabolic risk factors for cardiovascular diseases. Atherosclerosis 2008;196:590-7.

62. FORMICA C, LORO ML, GILSANZ V, SEEMAN E. Inhomogeneity in body fat distribution may result in inaccuracy in the measurement of vertebral bone mass. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 1995;10:1504-11.

63. FRIEDENREICH C, CUST A, LAHMANN PH, et al. Anthropometric factors and risk of endometrial cancer: the European prospective investigation into cancer and nutrition. Cancer causes & control : CCC 2007;18:399-413.

64. FRIEDENREICH CM, COURNEYA KS, BRYANT HE. Case-control study of anthropometric measures and breast cancer risk. International journal of cancer 2002;99:445-52.

65. FU X, MA X, LU H, HE W, WANG Z, ZHU S. Associations of fat mass and fat distribution with bone mineral density in pre- and postmenopausal Chinese women. Osteoporosis international : a journal established as result of cooperation between the

European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2011;22:113-9.

66. FUH JL, WANG SJ, LEE SJ, LU SR, JUANG KD. Quality of life and menopausal transition for middle-aged women on Kinmen island. Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation 2003;12:53-61.

67. GAMBACCIANI M, CIAPONI M, CAPPAGLI B, BENUSSI C, DE SIMONE L, GENAZZANI AR. Climacteric modifications in body weight and fat tissue distribution. Climacteric : the journal of the International Menopause Society 1999;2:37-44.

68. GENAZZANI AR, GAMBACCIANI M. Effect of climacteric transition and hormone replacement therapy on body weight and body fat distribution. Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology 2006;22:145-50.

69. GHOSH A. Comparison of risk variables associated with the metabolic syndrome in pre- and postmenopausal Bengalee women. Cardiovascular journal of Africa 2008;19:183-7.

70. GHOSH A, BHAGAT M. Anthropometric and body composition characteristics in pre- and postmenopausal Asian Indian women: Santiniketan women study. Anthropologischer Anzeiger; Bericht uber die biologisch-anthropologische Literatur 2010;68:1-10.

71. GRAM IT, FUNKHOUSER E, TABAR L. Anthropometric indices in relation to mammographic patterns among peri-menopausal women. International journal of cancer 1997;73:323-6.

72. GUO W, BRADBURY KE, REEVES GK, KEY TJ. Physical activity in relation to body size and composition in women in UK Biobank. Annals of epidemiology 2015;25:406-13.e6.

73. GURKA MJ, VISHNU A, SANTEN RJ, DEBOER MD. Progression of Metabolic Syndrome Severity During the Menopausal Transition. Journal of the American Heart Association 2016;5.

74. HADJI P, HARS O, BOCK K, et al. The influence of menopause and body mass index on serum leptin concentrations. European journal of endocrinology 2000;143:55-60.

75. HAGNER W, HAGNER-DERENGOWSKA M, WIACEK M, ZUBRZYCKI IZ. Changes in level of VO2max, blood lipids, and waist circumference in the response to moderate endurance training as a function of ovarian aging. Menopause (New York, NY) 2009;16:1009-13.

76. HAN D, NIE J, BONNER MR, et al. Lifetime adult weight gain, central adiposity, and the risk of pre- and postmenopausal breast cancer in the Western New York exposures and breast cancer study. International journal of cancer 2006;119:2931-7.

77. HARTING GH, MOORE CE, MITCHELL R, KAPPUS CM. Relationship of menopausal status and exercise level to HDL-cholesterol in women. Experimental aging research 1984;10:13-8.

78. HE L, TANG X, LI N, et al. Menopause with cardiovascular disease and its risk factors among rural Chinese women in Beijing: a population-based study. Maturitas 2012;72:132-8.

79. HIROSE K, TAJIMA K, HAMAJIMA N, et al. Impact of established risk factors for breast cancer in nulligravid Japanese women. Breast cancer (Tokyo, Japan) 2003;10:45-53.

80. HJARTAKER A, ADAMI HO, LUND E, WEIDERPASS E. Body mass index and mortality in a prospectively studied cohort of Scandinavian women: the women's lifestyle and health cohort study. European journal of epidemiology 2005;20:747-54.

81. HO S, WU S, CHAN S, SHAM A. Menopausal transition and changes of body composition: a prospective study in Chinese perimenopausal women. International Journal of Obesity 2010;34:1265.

82. HSU YH, VENNERS SA, TERWEDOW HA, et al. Relation of body composition, fat mass, and serum lipids to osteoporotic fractures and bone mineral density in Chinese men and women. The American journal of clinical nutrition 2006;83:146-54.

83. HU X, PAN X, MA X, et al. Contribution of a first-degree family history of diabetes to increased serum adipocyte fatty acid binding protein levels independent of body fat content and distribution. International journal of obesity (2005) 2016;40:1649-54.

84. HUNTER G, KEKES-SZABO T, TREUTH M, WILLIAMS M, GORAN M, PICHON C. Intra-abdominal adipose tissue, physical activity and cardiovascular risk in pre-and post-menopausal women. International journal of obesity and related metabolic disorders: journal of the International Association for the Study of Obesity 1996;20:860-65.

85. IIDA T, DOMOTO T, TAKIGAWA A, et al. Relationships among blood leptin and adiponectin levels, fat mass, and bone mineral density in Japanese pre-and postmenopausal women. Hiroshima J Med Sci 2011;60:71-8.

86. ILICH-ERNST J, BROWNBILL RA, LUDEMANN MA, FU R. Critical factors for bone health in women across the age span: how important is muscle mass? Medscape women's health 2002;7:2.

87. ITO M, HAYASHI K, UETANI M, YAMADA M, OHKI M, NAKAMURA T. Association between anthropometric measures and spinal bone mineral density. Investigative radiology 1994;29:812-6.

88. JAFF NG, NORRIS SA, SNYMAN T, TOMAN M, CROWTHER NJ. 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. Metabolism: clinical and experimental 2015;64:1031-41.

89. JASIENSKA G, ZIOMKIEWICZ A, GORKIEWICZ M, PAJAK A. Body mass, depressive symptoms and menopausal status: an examination of the "Jolly Fat" hypothesis. Women's health issues : official publication of the Jacobs Institute of Women's Health 2005;15:145-51.

90. JEENDUANG N, TRONGSAKUL R, INHONGSA P, CHAIDACH P. The prevalence of metabolic syndrome in premenopausal and postmenopausal women in Southern Thailand. Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology 2014;30:573-6.

91. JEON YK, LEE JG, KIM SS, et al. Association between bone mineral density and metabolic syndrome in pre- and postmenopausal women. Endocrine journal 2011;58:87-93.

92. JURIMAE J, JURIMAE T. Plasma adiponectin concentration in healthy pre- and postmenopausal women: relationship with body composition, bone mineral, and metabolic variables. American journal of physiology Endocrinology and metabolism 2007;293:E42-7.

93. KADAM N, CHIPLONKAR S, KHADILKAR A, DIVATE U, KHADILKAR V. Low bone mass in urban Indian women above 40 years of age: prevalence and risk factors. Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology 2010;26:909-17.

94. KANG EK, PARK HW, BAEK S, LIM JY. The Association between Trunk Body Composition and Spinal Bone Mineral Density in Korean Males versus Females: a

Farmers' Cohort for Agricultural Work-Related Musculoskeletal Disorders (FARM) Study. Journal of Korean medical science 2016;31:1595-603.

95. KAUFER-HORWITZ M, PELAEZ-ROBLES K, LAZZERI-ARTEAGA P, GOTI-RODRIGUEZ LM, AVILA-ROSAS H. Hypertension, overweight and abdominal adiposity in women. An analytical perspective. Archives of medical research 2005;36:404-11.

96. KIM HM, PARK J, RYU SY, KIM J. The effect of menopause on the metabolic syndrome among Korean women: the Korean National Health and Nutrition Examination Survey, 2001. Diabetes care 2007;30:701-6.

97. KIM JH, CHOI HJ, KIM MJ, SHIN CS, CHO NH. Fat mass is negatively associated with bone mineral content in Koreans. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2012;23:2009-16.

98. KIM S, LEE JY, IM JA, et al. Association between serum osteocalcin and insulin resistance in postmenopausal, but not premenopausal, women in Korea. Menopause (New York, NY) 2013;20:1061-6.

99. KIM YM, KIM SH, KIM S, YOO JS, CHOE EY, WON YJ. Variations in fat mass contribution to bone mineral density by gender, age, and body mass index: the Korea National Health and Nutrition Examination Survey (KNHANES) 2008-2011. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2016;27:2543-54.

100. KIRCHENGAST S, GRUBER D, SATOR M, HUBER J. Impact of the age at menarche on adult body composition in healthy pre- and postmenopausal women. American journal of physical anthropology 1998;105:9-20.

101. KIRCHENGAST S, HARTMANN B, HUBER J. Serum levels of sex hormones, thyroid hormones, growth hormone, IGF I, and cortisol and their relations to body fat distribution in healthy women dependent on their menopausal status. Zeitschrift fur Morphologie und Anthropologie 1996;81:223-34.

102. KNAPP KM, BLAKE GM, SPECTOR TD, FOGELMAN I. Multisite quantitative ultrasound: precision, age- and menopause-related changes, fracture discrimination, and T-score equivalence with dual-energy X-ray absorptiometry. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2001;12:456-64.

103. KOH SJ, HYUN YJ, CHOI SY, et al. Influence of age and visceral fat area on plasma adiponectin concentrations in women with normal glucose tolerance. Clinica chimica acta; international journal of clinical chemistry 2008;389:45-50.

104. KONRAD T, BÄR F, SCHNEIDER F, et al. Factors influencing endothelial function in healthy pre-and post-menopausal women of the EU-RISC study. Diabetes and Vascular Disease Research 2011;8:229-36.

105. KONTOGIANNI MD, DAFNI UG, ROUTSIAS JG, SKOPOULI FN. Blood leptin and adiponectin as possible mediators of the relation between fat mass and BMD in perimenopausal women. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 2004;19:546-51.

106. KONUKOGLU D, SERIN O, ERCAN M. Plasma leptin levels in obese and non-obese postmenopausal women before and after hormone replacement therapy. Maturitas 2000;36:203-7.

107. KOSKOVA I, PETRASEK R, VONDRA K, et al. Weight, body composition and fat distribution of Czech women in relation with reproductive phase: a cross-sectional study. Prague medical report 2007;108:13-26.

108. KOTANI K, CHEN JT, TANIGUCHI N. The relationship between adiponectin and blood pressure in premenopausal and postmenopausal women. Clinical and investigative medicine Medecine clinique et experimentale 2011;34:E125-30.

109. KRAEMER RR, SYNOVITZ LB, GIMPEL T, KRAEMER GR, JOHNSON LG, CASTRACANE VD. Effect of estrogen on serum DHEA in younger and older women and the relationship of DHEA to adiposity and gender. Metabolism: clinical and experimental 2001;50:488-93.

110. KUK JL, LEE S, HEYMSFIELD SB, ROSS R. Waist circumference and abdominal adipose tissue distribution: influence of age and sex. The American journal of clinical nutrition 2005;81:1330-4.

111. LAITINEN K, VALIMAKI M, KETO P. Bone mineral density measured by dual-energy X-ray absorptiometry in healthy Finnish women. Calcified tissue international 1991;48:224-31.

112. LEJSKOVA M, ALUSIK S, VALENTA Z, ADAMKOVA S, PITHA J. Natural postmenopause is associated with an increase in combined cardiovascular risk factors. Physiological research 2012;61:587-96.

113. LEON GUERRERO RT, NOVOTNY R, WILKENS LR, et al. Risk factors for breast cancer in the breast cancer risk model study of Guam and Saipan. Cancer epidemiology 2017;50:221-33.

114. LEY CJ, LEES B, STEVENSON JC. Sex- and menopause-associated changes in body-fat distribution. The American journal of clinical nutrition 1992;55:950-4.

115. LIN WY, YANG WS, LEE LT, et al. Insulin resistance, obesity, and metabolic syndrome among non-diabetic pre- and post-menopausal women in North Taiwan. International journal of obesity (2005) 2006;30:912-7.

116. LINDQUIST O, BENGTSSON C. Serum lipids, arterial blood pressure and body weight in relation to the menopause: results from a population study of women in Goteborg, Sweden. Scandinavian journal of clinical and laboratory investigation 1980;40:629-36.

117. LINDSAY R, COSMAN F, HERRINGTON BS, HIMMELSTEIN S. Bone mass and body composition in normal women. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 1992;7:55-63.

118. LOVEJOY JC, CHAMPAGNE CM, DE JONGE L, XIE H, SMITH SR. Increased visceral fat and decreased energy expenditure during the menopausal transition. International journal of obesity (2005) 2008;32:949-58.

119. LYU LC, YEH CY, LICHTENSTEIN AH, LI Z, ORDOVAS JM, SCHAEFER EJ. Association of sex, adiposity, and diet with HDL subclasses in middle-aged Chinese. The American journal of clinical nutrition 2001;74:64-71.

120. MAHARLOUEI N, BELLISSIMO N, AHMADI SM, LANKARANI KB. Prevalence of metabolic syndrome in pre- and postmenopausal Iranian women. Climacteric : the journal of the International Menopause Society 2013;16:561-7.

121. MALACARA JM, CANTO DE CETINA T, BASSOL S, et al. Symptoms at pre- and postmenopause in rural and urban women from three States of Mexico. Maturitas 2002;43:11-9.

122. MANABE E, AOYAGI K, TACHIBANA H, TAKEMOTO T. Relationship of intra-abdominal adiposity and peripheral fat distribution to lipid metabolism in an island population in

western Japan: gender differences and effect of menopause. The Tohoku journal of experimental medicine 1999;188:189-202.

123. MANJER J, KAAKS R, RIBOLI E, BERGLUND G. Risk of breast cancer in relation to anthropometry, blood pressure, blood lipids and glucose metabolism: a prospective study within the Malmo Preventive Project. European journal of cancer prevention : the official journal of the European Cancer Prevention Organisation (ECP) 2001;10:33-42.

124. MANNISTO S, PIETINEN P, PYY M, PALMGREN J, ESKELINEN M, UUSITUPA M. Body-size indicators and risk of breast cancer according to menopause and estrogen-receptor status. International journal of cancer 1996;68:8-13.

125. MARTINI G, VALENTI R, GIOVANI S, NUTI R. Age-related changes in body composition of healthy and osteoporotic women. Maturitas 1997;27:25-33.

126. MARWAHA RK, GARG MK, TANDON N, MEHAN N, SASTRY A, BHADRA K. Relationship of body fat and its distribution with bone mineral density in Indian population. Journal of clinical densitometry : the official journal of the International Society for Clinical Densitometry 2013;16:353-9.

127. MATSUSHITA H, KURABAYASHI T, TOMITA M, KATO N, TANAKA K. Effects of uncoupling protein 1 and beta3-adrenergic receptor gene polymorphisms on body size and serum lipid concentrations in Japanese women. Maturitas 2003;45:39-45.

128. MATSUZAKI M, KULKARNI B, KUPER H, et al. Association of Hip Bone Mineral Density and Body Composition in a Rural Indian Population: The Andhra Pradesh Children and Parents Study (APCAPS). PloS one 2017;12:e0167114.

129. MATTHEWS KA, MEILAHN E, KULLER LH, KELSEY SF, CAGGIULA AW, WING RR. Menopause and risk factors for coronary heart disease. The New England journal of medicine 1989;321:641-6.

130. MESCH VR, BOERO LE, SISELES NO, et al. Metabolic syndrome throughout the menopausal transition: influence of age and menopausal status. Climacteric : the journal of the International Menopause Society 2006;9:40-8.

131. MEZA-MUNOZ DE, FAJARDO ME, PEREZ-LUQUE EL, MALACARA JM. Factors associated with estrogen receptors-alpha (ER-alpha) and -beta (ER-beta) and progesterone receptor abundance in obese and non obese pre- and post-menopausal women. Steroids 2006;71:498-503.

132. MINATOYA M, KUTOMI G, SHIMA H, et al. Relation of serum adiponectin levels and obesity with breast cancer: a Japanese case-control study. Asian Pacific journal of cancer prevention : APJCP 2014;15:8325-30.

133. MO D, HSIEH P, YU H, et al. The relationship between osteoporosis and body composition in pre- and postmenopausal women from different ethnic groups in China. Ethnicity & health 2017;22:295-310.

134. MUCHANGA SIFA MJ, LEPIRA FB, LONGO AL, et al. Prevalence and predictors of metabolic syndrome among Congolese pre- and postmenopausal women. Climacteric : the journal of the International Menopause Society 2014;17:442-8.

135. MUTI P, STANULLA M, MICHELI A, et al. Markers of insulin resistance and sex steroid hormone activity in relation to breast cancer risk: a prospective analysis of abdominal adiposity, sebum production, and hirsutism (Italy). Cancer causes & control : CCC 2000;11:721-30.

136. NITTA J, NOJIMA M, OHNISHI H, et al. Weight Gain and Alcohol Drinking Associations with Breast Cancer Risk in Japanese Postmenopausal Women - Results from the Japan Collaborative Cohort (JACC) Study. Asian Pacific journal of cancer prevention : APJCP 2016;17:1437-43.

137. NOH HM, SONG YM, PARK JH, KIM BK, CHOI YH. Metabolic factors and breast cancer risk in Korean women. Cancer causes & control : CCC 2013;24:1061-8.

138. NORDIN BE, NEED AG, BRIDGES A, HOROWITZ M. Relative contributions of years since menopause, age, and weight to vertebral density in postmenopausal women. The Journal of clinical endocrinology and metabolism 1992;74:20-3.

139. OHTA H, KURODA T, ONOE Y, et al. Familial correlation of bone mineral density, birth data and lifestyle factors among adolescent daughters, mothers and grandmothers. Journal of bone and mineral metabolism 2010;28:690-5.

140. OLDROYD B, STEWART SP, TRUSCOTT JG, WESTMACOTT CF, SMITH MA. Age related changes in body composition. Applied radiation and isotopes : including data, instrumentation and methods for use in agriculture, industry and medicine 1998;49:589-90.

141. PACHOLCZAK R, KLIMEK-PIOTROWSKA W, KUSZMIERSZ P. Associations of anthropometric measures on breast cancer risk in pre- and postmenopausal women--a case-control study. Journal of physiological anthropology 2016;35:7.

142. PARK JH, SONG YM, SUNG J, et al. The association between fat and lean mass and bone mineral density: the Healthy Twin Study. Bone 2012;50:1006-11.

143. PARK YM, WHITE AJ, NICHOLS HB, O'BRIEN KM, WEINBERG CR, SANDLER DP. The association between metabolic health, obesity phenotype and the risk of breast cancer. International journal of cancer 2017;140:2657-66.

144. PAVICIC ZEZELJ S, CVIJANOVIC O, MICOVIC V, BOBINAC D, CRNCEVIC-ORLIC Z, MALATESTINIC G. Effect of menopause, anthropometry, nutrition and lifestyle on bone status of women in the northern Mediterranean. The West Indian medical journal 2010;59:494-502.

145. PAVLICA T, MIKALACKI M, MATIC R, et al. Relationship between BMI and skinfold thicknesses to risk factors in premenopausal and postmenopausal women. Collegium antropologicum 2013;37 Suppl 2:119-24.

146. PHILLIPS GB, JING T, HEYMSFIELD SB. Does insulin resistance, visceral adiposity, or a sex hormone alteration underlie the metabolic syndrome? Studies in women. Metabolism: clinical and experimental 2008;57:838-44.

147. POLESEL DN, HIROTSU C, NOZOE KT, et al. Waist circumference and postmenopause stages as the main associated factors for sleep apnea in women: a cross-sectional population-based study. Menopause (New York, NY) 2015;22:835-44.

148. POLLAN M, LOPE V, MIRANDA-GARCIA J, et al. Adult weight gain, fat distribution and mammographic density in Spanish pre- and post-menopausal women (DDM-Spain). Breast cancer research and treatment 2012;134:823-38.

149. PORTALUPPI F, PANSINI F, MANFREDINI R, MOLLICA G. Relative influence of menopausal status, age, and body mass index on blood pressure. Hypertension (Dallas, Tex : 1979) 1997;29:976-9.

150. PRIYA T, CHOWDHURY MG, VASANTH K, et al. Assessment of serum leptin and resistin levels in association with the metabolic risk factors of pre- and post-menopausal rural women in South India. Diabetes & metabolic syndrome 2013;7:233-7.

151. RANTALAINEN T, NIKANDER R, HEINONEN A, et al. Neuromuscular performance and body mass as indices of bone loading in premenopausal and postmenopausal women. Bone 2010;46:964-9.

152. REINA P, COINTRY GR, NOCCIOLINO L, et al. Analysis of the independent power of age-related, anthropometric and mechanical factors as determinants of the structure

of radius and tibia in normal adults. A pQCT study. Journal of musculoskeletal & neuronal interactions 2015;15:10-22.

153. REVILLA M, VILLA LF, HERNANDEZ ER, SANCHEZ-ATRIO A, CORTES J, RICO H. Influence of weight and gonadal status on total and regional bone mineral content and on weight-bearing and non-weight-bearing bones, measured by dual-energy X-ray absosorptiometry. Maturitas 1997;28:69-74.

154. REVILLA M, VILLA LF, SANCHEZ-ATRIO A, HERNANDEZ ER, RICO H. Influence of body mass index on the age-related slope of total and regional bone mineral content. Calcified tissue international 1997;61:134-8.

155. RICE MS, BERTRAND KA, LAJOUS M, et al. Reproductive and lifestyle risk factors and mammographic density in Mexican women. Annals of epidemiology 2015;25:868-73.

156. RICO H, AGUADO F, ARRIBAS I, et al. Behavior of phalangeal bone ultrasound in normal women with relation to gonadal status and body mass index. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2001;12:450-5.

157. RICO H, ARRIBAS I, CASANOVA FJ, DUCE AM, HERNANDEZ ER, CORTES-PRIETO J. Bone mass, bone metabolism, gonadal status and body mass index. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2002;13:379-87.

158. ROELFSEMA F, VELDHUIS JD. Growth Hormone Dynamics in Healthy Adults Are Related to Age and Sex and Strongly Dependent on Body Mass Index. Neuroendocrinology 2016;103:335-44.

159. ROSENBAUM M, NICOLSON M, HIRSCH J, et al. Effects of gender, body composition, and menopause on plasma concentrations of leptin. The Journal of clinical endocrinology and metabolism 1996;81:3424-7.

160. SALOMAA V, RASI V, PEKKANEN J, et al. Association of hormone replacement therapy with hemostatic and other cardiovascular risk factors. The FINRISK Hemostasis Study. Arteriosclerosis, thrombosis, and vascular biology 1995;15:1549-55.

161. SARRAFZADEGAN N, KHOSRAVI-BOROUJENI H, ESMAILLZADEH A, SADEGHI M, RAFIEIAN-KOPAEI M, ASGARY S. The association between hypertriglyceridemic waist phenotype, menopause, and cardiovascular risk factors. Archives of Iranian medicine 2013;16:161-6.

162. SCHABERG-LOREI G, BALLARD JE, MCKEOWN BC, ZINKGRAF SA. Body composition alterations consequent to an exercise program for pre and postmenopausal women. The Journal of sports medicine and physical fitness 1990;30:426-33.

163. SCHWARZ S, VOLZKE H, ALTE D, et al. Menopause and determinants of quality of life in women at midlife and beyond: the study of health in pomerania (SHIP). Menopause (New York, NY) 2007;14:123-34.

164. SHAKIR YA, SAMSIOE G, NYBERG P, LIDFELDT J, NERBRAND C. Cardiovascular risk factors in middle-aged women and the association with use of hormone therapy: results from a population-based study of Swedish women. The Women's Health in the Lund Area (WHILA) Study. Climacteric 2004;7:274-83.

165. SHERK VD, MALONE SP, BEMBEN MG, KNEHANS AW, PALMER IJ, BEMBEN DA. Leptin, fat mass, and bone mineral density in healthy pre- and postmenopausal women. Journal of clinical densitometry : the official journal of the International Society for Clinical Densitometry 2011;14:321-5.

166. SHIBATA H, MATSUZAKI T, HATANO S. Relationship of relevant factors of atherosclerosis to menopause in Japanese women. American journal of epidemiology 1979;109:420-4.

167. SIEMINSKA L, WOJCIECHOWSKA C, FOLTYN W, et al. The relation of serum adiponectin and leptin levels to metabolic syndrome in women before and after the menopause. Endokrynologia Polska 2006;57:15-22.

168. SKRZYPCZAK M, SZWED A. Assessment of the body mass index and selected physiological parameters in pre- and post-menopausal women. Homo : internationale Zeitschrift fur die vergleichende Forschung am Menschen 2005;56:141-52.

169. SKRZYPCZAK M, SZWED A, PAWLIŃSKA-CHMARA R, SKRZYPULEC V. Assessment of the BMI, WHR and W/Ht in pre-and postmenopausal women. Anthropological Review 2007;70:3-13.

170. SODERBERG S, AHREN B, ELIASSON M, DINESEN B, OLSSON T. The association between leptin and proinsulin is lost with central obesity. Journal of internal medicine 2002;252:140-8.

171. SON MK, LIM NK, LIM JY, et al. Difference in blood pressure between early and late menopausal transition was significant in healthy Korean women. BMC women's health 2015;15:64.

172. SORIGUER F, MORCILLO S, HERNANDO V, et al. Type 2 diabetes mellitus and other cardiovascular risk factors are no more common during menopause: longitudinal study. Menopause (New York, NY) 2009;16:817-21.

173. STAESSEN J, BULPITT CJ, FAGARD R, LIJNEN P, AMERY A. The influence of menopause on blood pressure. Journal of human hypertension 1989;3:427-33.

174. SUAREZ-ORTEGON MF, ARBELAEZ A, MOSQUERA M, MENDEZ F, AGUILAR-DE PLATA C. C-reactive protein, waist circumference, and family history of heart attack are

independent predictors of body iron stores in apparently healthy premenopausal women. Biological trace element research 2012;148:135-8.

175. SULIGA E, KOZIEL D, CIESLA E, REBAK D, GLUSZEK S. Factors Associated with Adiposity, Lipid Profile Disorders and the Metabolic Syndrome Occurrence in Premenopausal and Postmenopausal Women. PloS one 2016;11:e0154511.

176. SUMNER AE, FALKNER B, KUSHNER H, CONSIDINE RV. Relationship of leptin concentration to gender, menopause, age, diabetes, and fat mass in African Americans. Obesity research 1998;6:128-33.

177. TANAKA NI, HANAWA S, MURAKAMI H, et al. Accuracy of segmental bioelectrical impedance analysis for predicting body composition in pre- and postmenopausal women. Journal of clinical densitometry : the official journal of the International Society for Clinical Densitometry 2015;18:252-9.

178. THOMAS T, BURGUERA B, MELTON LJ, 3RD, et al. Relationship of serum leptin levels with body composition and sex steroid and insulin levels in men and women. Metabolism: clinical and experimental 2000;49:1278-84.

179. TORNG PL, SU TC, SUNG FC, et al. Effects of menopause and obesity on lipid profiles in middle-aged Taiwanese women: the Chin-Shan Community Cardiovascular Cohort Study. Atherosclerosis 2000;153:413-21.

180. TOTH MJ, TCHERNOF A, SITES CK, POEHLMAN ET. Effect of menopausal status on body composition and abdominal fat distribution. International journal of obesity and related metabolic disorders : journal of the International Association for the Study of Obesity 2000;24:226-31.

181. TREMOLLIERES FA, POUILLES JM, RIBOT CA. Relative influence of age and menopause on total and regional body composition changes in postmenopausal women. American journal of obstetrics and gynecology 1996;175:1594-600.

182. TRIKUDANATHAN S, PEDLEY A, MASSARO JM, et al. Association of female reproductive factors with body composition: the Framingham Heart Study. The Journal of clinical endocrinology and metabolism 2013;98:236-44.

183. VAN PELT RE, DAVY KP, STEVENSON ET, et al. Smaller differences in total and regional adiposity with age in women who regularly perform endurance exercise. The American journal of physiology 1998;275:E626-34.

184. VELDHUIS JD, DYER RB, TRUSHIN SA, BONDAR OP, SINGH RJ, KLEE GG. Interleukins 6 and 8 and abdominal fat depots are distinct correlates of lipid moieties in healthy pre- and postmenopausal women. Endocrine 2016;54:671-80.

185. WANG F, MA X, HAO Y, et al. Serum glycated albumin is inversely influenced by fat mass and visceral adipose tissue in Chinese with normal glucose tolerance. PloS one 2012;7:e51098.

186. WANG W, ZHAO LJ, LIU YZ, RECKER RR, DENG HW. Genetic and environmental correlations between obesity phenotypes and age at menarche. International journal of obesity (2005) 2006;30:1595-600.

187. WANG WS, WAHLQVIST ML, HSU CC, CHANG HY, CHANG WC, CHEN CC. Age- and gender-specific population attributable risks of metabolic disorders on all-cause and cardiovascular mortality in Taiwan. BMC public health 2012;12:111.

188. WEE J, SNG BY, SHEN L, LIM CT, SINGH G, DAS DE S. The relationship between body mass index and physical activity levels in relation to bone mineral density in premenopausal and postmenopausal women. Archives of osteoporosis 2013;8:162.

189. WILLIAMS PT, KRAUSS RM. Associations of age, adiposity, menopause, and alcohol intake with low-density lipoprotein subclasses. Arteriosclerosis, thrombosis, and vascular biology 1997;17:1082-90.

190. WING RR, MATTHEWS KA, KULLER LH, MEILAHN EN, PLANTINGA PL. Weight gain at the time of menopause. Archives of internal medicine 1991;151:97-102.

191. XU L, NICHOLSON P, WANG QJ, WANG Q, ALEN M, CHENG S. Fat mass accumulation compromises bone adaptation to load in Finnish women: a cross-sectional study spanning three generations. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 2010;25:2341-9.

192. YAMATANI H, TAKAHASHI K, YOSHIDA T, TAKATA K, KURACHI H. Association of estrogen with glucocorticoid levels in visceral fat in postmenopausal women. Menopause (New York, NY) 2013;20:437-42.

193. YANNAKOULIA M, MELISTAS L, SOLOMOU E, YIANNAKOURIS N. Association of eating frequency with body fatness in pre- and postmenopausal women. Obesity (Silver Spring, Md) 2007;15:100-6.

194. YOLDEMIR T, ERENUS M. The prevalence of metabolic syndrome in pre- and post-menopausal women attending a tertiary clinic in Turkey. European journal of obstetrics, gynecology, and reproductive biology 2012;164:172-5.

195. YOO HJ, PARK MS, YANG SJ, et al. The differential relationship between fat mass and bone mineral density by gender and menopausal status. Journal of bone and mineral metabolism 2012;30:47-53.

196. YOO KY, KIM H, SHIN HR, et al. Female sex hormones and body mass in adolescent and postmenopausal Korean women. Journal of Korean medical science 1998;13:241-6.

197. YOSHIMOTO N, NISHIYAMA T, TOYAMA T, et al. Genetic and environmental predictors, endogenous hormones and growth factors, and risk of estrogen receptor-positive breast cancer in Japanese women. Cancer science 2011;102:2065-72.

198. ZHONG N, WU XP, XU ZR, et al. Relationship of serum leptin with age, body weight, body mass index, and bone mineral density in healthy mainland Chinese women. Clinica chimica acta; international journal of clinical chemistry 2005;351:161-8.

199. ZHOU JL, LIN SQ, SHEN Y, CHEN Y, ZHANG Y, CHEN FL. Serum lipid profile changes during the menopausal transition in Chinese women: a community-based cohort study. Menopause (New York, NY) 2010;17:997-1003.

200. ZHOU Y, ZHOU X, GUO X, et al. Prevalence and risk factors of hypertension among pre- and post-menopausal women: a cross-sectional study in a rural area of northeast China. Maturitas 2015;80:282-7.

201. ZIVKOVIC TB, VUKSANOVIC M, JELIC MA, et al. Obesity and metabolic syndrome during the menopause transition in Serbian women. Climacteric : the journal of the International Menopause Society 2011;14:643-8.

ST4 Quality assessment of individual longitudinal studies.

			Newcastle-Ottawa quality assessment scale (Adapted)									
			Selection			**Comparability**				**Outcome**		**Total Score**
#	**Study**	**Year**	**Q1**	**Q2**	**Q3**	**Q4a**	**Q4b**	**Q5**	**Q6**	**Q7**	**Q8**	**(out of 9)**
1	Abdulnour et al.[1]	2012	*	*	-	*	*	*	*	*	*	8
2	Akahoshi et al.[2]	2001	*	*	*	*	*	*	*	*	*	9
3	Ford et al.[3]	2005	*	-	*	*	*	*	*	*	*	8
4	Franklin et al.[4]	2009	-	-	-	*	*	-	*	*	-	4
5	Janssen et al.[5]	2008	*	*	-	*	*	*	*	*	*	8
6	Lee et al.[6]	2009	*	*	-	*	*	*	*	*	*	8
7	Liu-Ambrose et al.[7]	2006	*	*	-	*	*	*	*	*	*	8
8	Lovejoy et al.[8]	2008	*	*	*	*	*	-	*	*	*	8
9	Macdonald et al.[9]	2005	*	*	-	*	*	*	*	*	*	8
10	Razmjou et al.[10]	2018	*	*	-	*	*	*	*	*	*	8
11	Soreca et al.[11]	2009	*	*	-	*	*	*	-	*	*	7

Note: * indicates the study met the criterion for the question.

References

1. ABDULNOUR J, DOUCET E, BROCHU M, et al. The effect of the menopausal transition on body composition and cardiometabolic risk factors: a Montreal-Ottawa New Emerging Team group study. Menopause (New York, NY) 2012;19:760-7.
2. AKAHOSHI M, SODA M, NAKASHIMA E, et al. Effects of age at menopause on serum cholesterol, body mass index, and blood pressure. Atherosclerosis 2001;156:157-63.
3. FORD K, SOWERS M, CRUTCHFIELD M, WILSON A, JANNAUSCH M. A longitudinal study of the predictors of prevalence and severity of symptoms commonly associated with menopause. Menopause (New York, NY) 2005;12:308-17.
4. FRANKLIN RM, PLOUTZ-SNYDER L, KANALEY JA. Longitudinal changes in abdominal fat distribution with menopause. Metabolism: clinical and experimental 2009;58:311-5.
5. JANSSEN I, POWELL LH, CRAWFORD S, LASLEY B, SUTTON-TYRRELL K. Menopause and the metabolic syndrome: the Study of Women's Health Across the Nation. Archives of internal medicine 2008;168:1568-75.
6. LEE CG, CARR MC, MURDOCH SJ, et al. Adipokines, inflammation, and visceral adiposity across the menopausal transition: a prospective study. The Journal of clinical endocrinology and metabolism 2009;94:1104-10.
7. LIU-AMBROSE T, KRAVETSKY L, BAILEY D, et al. Change in lean body mass is a major determinant of change in areal bone mineral density of the proximal femur: a 12-year observational study. Calcified tissue international 2006;79:145-51.
8. LOVEJOY JC, CHAMPAGNE CM, DE JONGE L, XIE H, SMITH SR. Increased visceral fat and decreased energy expenditure during the menopausal transition. International journal of obesity (2005) 2008;32:949-58.
9. MACDONALD HM, NEW SA, CAMPBELL MK, REID DM. Influence of weight and weight change on bone loss in perimenopausal and early postmenopausal Scottish women.

Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2005;16:163-71.

10. RAZMJOU S, ABDULNOUR J, BASTARD J-P, et al. Body composition, cardiometabolic risk factors, physical activity, and inflammatory markers in premenopausal women after a 10-year follow-up: a MONET study. Menopause 2018;25:89-97.

11. SORECA I, ROSANO C, JENNINGS JR, et al. Gain in adiposity across 15 years is associated with reduced gray matter volume in healthy women. Psychosomatic medicine 2009;71:485-90.

ST5 Definition of data elements

Data Element Name	Abbreviation	Unit of Measurement	Type/Method of Measurement
Body Mass Index	BMI	Weight in kilograms, divided by height in meters squared (kg/m^2)	Measured directly, or using self-reported weight and height
Body Weight	BW	Weight in kilograms (kg)	Measured directly, or using self-report weight
Waist Circumference	WC	Centimeters (cm)	According to the World Health Organisation, measured at the midpoint between the lower margin of the least palpable rib and the top of the iliac crest.
Hip Circumference	HC	Centimeters (cm)	According to the World Health Organisation, measured around the widest portion of the buttocks.
Waist to Hip Ratio	WTHR	A ratio of waist circumference to hip circumference	Divide waist circumference by hip circumference
Body Fat Percentage	BF %	Percentage (%)	Dual Energy X-ray Absorptiometry (DEXA) or Bioelectrical Impedance Analysis (BIA) or hydrodensiometry or near infrared interactance or skinfold estimates
Trunk Fat Percentage	TF %	Percentage (%)	Dual Energy X-ray Absorptiometry (DEXA) or Bioelectrical Impedance Analysis (BIA)
Total Leg Fat Percentage	LF %	Percentage (%)	Dual Energy X-ray Absorptiometry (DEXA) or Bioelectrical Impedance Analysis (BIA)
Subcutaneous Abdominal Fat	AF	Centimeters cubed (cm^3)	Computed Tomography (CT) scan
Visceral Fat	VF	Centimeters cubed (cm^3)	Computed Tomography (CT) scan
Suprailliac Skinfold Thickness	SISF	Millimeters (mm)	Measure the thickness of skin at the suprailliac, using calipers
Abdominal Skinfold Thickness	ASF	Millimeters (mm)	Measure the thickness of skin at the suprailliac, using calipers

ST6 Output for cross-sectional studies

Fat Mass Measure	k (Samples)	Total PreM Sample Size	Total PostM Sample Size	PreM Mean Age (SD)	PostM Mean Age (SD)	PreM Mean Fat Mass (SD)	PostM Mean Fat Mass (SD)	Unstandardised Estimate (95 % CI)	p-value	Standardised Estimate (95 % CI)	p-value
BMI	171 (181)	453 036	523 796	41.96 (3.69)	59.42 (3.06)	24.75 (1.60)	26.64 (1.25)	**1.14 (0.95, 1.32)**	<0.0001	**0.28 (0.23, 0.33)**	<0.0001
BW	109 (122)	113 603	204 845	43.36 (4.71)	59.55 (3.27)	64.82 (7.91)	66.12 (9.17)	**1.00 (0.44, 1.57)**	0.0005	**0.08 (0.03, 0.14)**	0.0040
WC	70 (72)	214 712	326 639	42.28 (3.65)	59.07 (1.91)	78.58 (4.24)	83.61 (3.19)	**4.63 (3.90, 5.35)**	<0.0001	**0.45 (0.37, 0.52)**	<0.0001
WTHR	47 (50)	199 140	309 797	42.39 (3.44)	59.09 (1.42)	0.78 (0.03)	0.81 (0.03)	**0.04 (0.03, 0.05)**	<0.0001	**0.65 (0.52, 0.77)**	<0.0001
BF %	46 (52)	58 605	113 226	43.81 (4.67)	59.55 (3.81)	32.44 (3.47)	35.69 (3.84)	**2.88 (2.13, 3.63)**	<0.0001	**0.90 (0.09, 1.71)**	0.0292
HC	25 (25)	185 885	297 189	42.48 (3.08)	59.15 (0.95)	100.30 (2.66)	102.73 (2.25)	**2.01 (1.36, 2.65)**	<0.0001	**0.20 (0.13, 0.27)**	<0.0001
AF	10 (10)	696	833	41.01 (6.96)	57.48 (5.36)	194.05 (23.65)	221.21 (32.09)	**28.73 (8.56, 48.91)**	0.0053	0.85 (-0.50, 2.21)	0.2176
VF	10 (10)	696	833	41.01 (6.96)	57.48 (5.36)	69.22 (15.75)	104.36 (13.92)	**26.90 (13.12, 40.68)**	0.0001	**0.59 (0.20, 0.98)**	0.0028
SISF	9 (10)	1103	745	39.76 (4.41)	61.89 (4.77)	22.16 (7.04)	24.55 (9.90)	**2.65 (0.45, 4.85)**	0.0181	**0.28 (0.05, 0.50)**	0.0149
TF %	7 (7)	39 335	95 756	45.28 (6.61)	59.68 (3.41)	31.27 (4.78)	33.74 (5.36)	**5.49 (3.91, 7.06)**	<0.0001	**0.68 (0.52, 0.83)**	<0.0001
ASF	4 (5)	199	359	40.64 (6.32)	62.99 (5.16)	26.65 (8.14)	29.43 (9.82)	**6.46 (0.51, 12.42)**	0.0335	**0.61 (0.05, 1.18)**	0.0338
LF %	3(3)	991	524	36.96 (1.13)	55.18 (5.17)	36.33 (5.47)	36.00 (2.62)	**-3.19 (-5.98, -0.41)**	0.0246	**-0.51 (-0.95, -0.07)**	0.0227

Abbreviations: PreM, Premenopausal; PostM, Postmenopausal; BMI, Body Mass Index; BW, Body Weight; WC, Waist Circumference; WTHR, Waist to Hip Ratio; BF %, Total Body Fat Percentage; HC, Hip Circumference; AF, Subcutaneous Abdominal Fat; VF, Visceral Fat; SSIF, Suprailliac Skinfold Thickness; TF %, Trunk Fat Percentage; AF, Abdominal Skinfold Thickness; LF %, Total Leg Fat Percentage; k = number of studies; SD, Standard Deviation; CI, Confidence Interval.
Note: Bolded estimates indicate significance at the p <0.05 level. Means and standard deviations are computed as weighted means and weighted standard deviations, taking into account sample size.

ST7 Output for longitudinal studies

Fat Mass Measure	k (Samples)	Total Sample Size	PreM Mean Age (SD)	PostM Mean Age (SD)	PreM Mean Fat Mass (SD)	PostM Mean Fat Mass (SD)	Unstandardised Estimate (95% CI)	p-value	Standardised Estimate (95% CI)	p-value
BMI	8 (10)	2 355	46.67 (2.53)	52.80 (3.71)	24.30 (1.97)	25.03 (2.37)	**0.93 (0.26, 1.59)**	0.0061	**0.21 (0.07, 0.35)**	0.0036
BW	7 (7)	525	47.64 (3.06)	55.76 (5.08)	66.11 (3.89)	69.19 (3.71)	**2.99 (1.36, 4.63)**	0.0003	**0.39 (0.12, 0.66)**	0.0049
BF%	4 (4)	176	49.59 (1.24)	55.49 (3.65)	36.29 (4.88)	37.84 (3.33)	**2.18 (0.21, 4.16)**	0.0299	**0.28 (0.13, 0.42)**	0.0001
WC	3 (3)	915	46.99 (2.04)	52.73 (5.17)	80.79 (3.62)	84.06 (2.61)	**3.82 (0.87, 6.77)**	0.0111	0.38 (-0.07, 0.84)	0.1004
AF	3 (3)	133	49.65 (1.61)	53.51 (1.64)	215.14 (66.15)	242.28 (77.34)	18.53 (-3.64, 40.69)	0.1014	0.52 (-0.31, 1.35)	0.2168
VF	3 (3)	133	49.65 (1.61)	53.51 (1.64)	78.63 (14.45)	92.23 (12.77)	**12.95 (8.65, 17.25)**	<0.0001	0.49 (-0.03, 1.01)	0.0629

Abbreviations: PreM, Premenopausal; PostM, Postmenopausal; BMI, Body Mass Index; BW, Body Weight; BF %, Total Body Fat Percentage; WC, Waist Circumference; AF, Subcutaneous Abdominal Fat; VF, Visceral Fat; k = number of studies; SD, Standard Deviation; CI, Confidence Interval.

Note: Bolded estimates indicate significance at the $p < 0.05$ level. Means and standard deviations are computed as weighted means and weighted standard deviations, taking into account sample size.