

Association between Anthropometric Measurements and some Biochemical Parameters in Premenopausal and Postmenopausal Women

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Abstract:

Numerous physiological and biochemical changes are linked to menopause. The current study was intended to examine the transforms linked to anthropometric measurements and bone-related factors. In this study of 80 women which included; they comprised 40 premenopausal women and 40 postmenopausal women.

waist circumference (WC), body mass index (BMI), hip circumference (HC), moreover waist to hip ratio are among the anthropometric measurements (W-HR) recorded by standard procedures. The plasma samples were tested for the following biochemical parameters: bone-related parameters [calcium (Ca), phosphorus (P), uric acid (UA), alkaline phosphatase (ALP), and erythrocyte sedimentation rate (ESR)] and serological agglutination tests [rheumatoid factor (RF) and C-reactive protein (CRP)].

The mean of BMI, WC, and W-HR was significant ($p < 0.05$) and much higher in postmenopausal women than their values in perimenopause women, while a non-significant ($p > 0.05$) difference was found in the mean of HC between the two groups.

The findings revealed that postmenopausal women's levels of Ca were substantially ($p < 0.05$) lower than premenopausal women's levels, while postmenopausal women's levels of P were significantly ($p < 0.05$) greater than premenopausal women's levels. In comparison to premenopausal women, post-menopause women had significantly higher levels of UA, ALP, and ESR ($p < 0.05$).

The results revealed that the number and percentage of CRP positive women out of the premenopausal women are only 8 (20 %), while the number and percentage of CRP-positive women out of the postmenopausal women are only 18 (45%); the differences are significant ($p < 0.05$). Also, the results revealed that the number and percentage of RF positive women out of the premenopausal women are only 5 (12.5 %), while the number and percentage of RF-positive women out of the postmenopausal women are only 15 (37.5%). The differences are significant ($p < 0.05$).

According to the results, postmenopausal women had significant ($P < 0.05$) higher rates of all chronic illnesses than premenopausal women. On the other hand, the prevalence of bone-related disease was substantially ($P < 0.05$) greater in the premenopausal women (30%) and postmenopausal women (45%) research groups as well as the overall study population of women (37.5%). In conclusion, changes related to age in the anthropometric measurements and in the bone-related parameters, accompanied by reduced physical activity may all lead to the installation of several chronic diseases among postmenopausal women.

Keywords: Menopause, anthropometric measurements, bone-related parameters.

Introduction

Menopause, which is defined by menstrual alterations which indicate oocyte reduction and a subsequent decrease in ovarian hormone creation, is the end of menstruation permanently [1]. Menopause is linked with several biochemical and physiological changes that have consequences on bone component and their metabolism [2]. Many factors are known to influence bone mass; these factors include race, age, gender, nutrients, endocrine factors, and mechanical forces like physical activity and body weight [3]. Organ metabolic abnormalities in various organs have been linked to the drop in sex steroid hormones after menopause. Breast cancer, osteoporosis, cardiovascular disease, and impaired glucose metabolism are all more common during this stage of life [4].

The much often applied indicator of obesity in epidemiologic research studies is body BMI, which is the ratio of weight calculated in kilograms to squared height in meters (kg/m^2) due to its ease of use, low cost, and high precision and accuracy [5]. Historically, anthropometric measurements have been used to define healthy weight, overweight, and obesity at the population level [6]. The waist/hip ratio, hip/waist ratio, and waist-to-hip circumference are the most common measurements of adipose distribution (W-HR). Compared to measurements of weight or height, WC and HC measurements exhibit higher inter-observer variability [7]. The results of the case-controlled study, which included a control group of subjects of reproductive age, revealed that bone-associated issues are prevalent in adipose postmenopausal people with grand BMI and reduced estrogen levels [8].

the fifth most common component in the human body is calcium. Calcium has two key functions in bone: it strengthens the skeleton and acts as a dynamic storage to keep the intracellular and extracellular calcium pooling full [9]. In addition to serving as a crucial intracellular buffer, phosphorus is also essential for several cellular metabolic processes, including glycolysis and oxidative phosphorylation [10]. The main antioxidant in human plasma is uric acid, which functions as an antioxidant to prevent osteoporosis and bone loss in the normal physiological range [11]. Alkaline phosphatase (ALP) is a family of enzymes that is found in a variety of tissues. It is mostly produced in the liver and bones; however, some are also produced in the intestines and kidneys [12]. Rapid bone growth, bone illnesses, a condition that a lack of vitamin D alters the calcium amount in the blood (hyperparathyroidism), or damaged liver cells are among the factors that result in high levels of ALP in the blood [13]. The powerful effect of estrogen in the control of calcium and phosphorus is explained by a variety of research. The ovaries produce less estrogen after menopause, and this has a direct impact on the bone health of that population. As a result, calcium supplementation helps to prevent bone loss in postmenopausal women, who are known for having an imbalanced calcium interaction mechanism and estrogen insufficiency [14].

The erythrocyte sedimentation rate (ESR) test is frequently employed to evaluate the intense stage of the inflammation response and to assist in the diagnosis of diseases linked to both acute and chronic inflammation. Inflammation is not the only condition that can affect it. ESR is generally used in conjunction with other testing due to this [15]. Elevated ESR and CRP levels are said to help distinguish between inflammatory and non-inflammatory arthritis. On the other hand, only a small percentage of

older people who have hyperuricemia go on to acquire gout [16]. However, subsequent research revealed that rheumatoid factor (RF) is present in patients with different autoimmune and infectious disorders as well as in a sizable fraction of healthy persons, especially in older people [17].

Materials and Methods

Study subjects

The study comprised 80 Iraqi women with ages ranging from (23-58), 40 of whom were premenopausal and 40 of whom were postmenopausal. women who are post-menopausal between the ages of 50 and 58 and pre-menopausal between the ages 23 and 45. The subjects of the study have varying levels of education (basic, secondary, graduate, and postgraduate), as well as varying jobs (students, employed, free work, and housewives).

Collection of data

Through the use of a questionnaire (Table 1), The information was collected. The questionnaire consists of socioeconomic characteristics which included five items: age, menstrual status, marital status, education, and occupation. In addition to the main chronic diseases, that may be women suffer from such as diabetes mellitus, hypertension, cardiovascular disease, and bone-related disease.

Table 1: Sample of Questionnaire

No:	Date:		Age:	
Menopausal status:	Premenopausal		Postmenopausal	
Marital status:	Single	Married	Divorced	Widowed
Education:	Primary	Secondary	Graduate	Postgraduate
Occupation:	Student	Employed	Free work	Housewife
Chronic diseases:	Hypertension	Diabetes mellitus	Cardiovascular disease	Bone-related disease

Determination of anthropometric measurements

Anthropometric measurements were performed by standard procedures as the following: -

1. Weight

Body weight was measured in all studied women with an electronic medical scale and taken to the closest 0.1 kg.

2. Height

Barefoot stand and head upright; every woman was measured her height. The measurement was nearest to 0.1cm using a mechanical scale.

3. Body mass index (BMI)

The following formula was used to compute the BMI: weight (kg) divided by the square of height (m²).

Four categories were used to categorize the BMI status, as illustrated in (Table 2).

Table 2:

The categories of the weight status according to the value of BMI

BMI(kg/m ²)	Weight status
≤ 18.5	Underweight
18.5-24.9	Normal
25-29.9	Overweight
≥ 30	Obese

4. Waist circumference (WC)

By using an elastic non stretchable tape, the WC of the studied women was measured to the nearest 0.5 cm in a standing position. Measure midway was recorded between the iliac crest and the lower rib margin.

5. Hip circumference (HC)

Hip circumference was measured by a flexible no stretchable tape over the widest part of the hip region and considering a tolerance limit of 1 cm.

6. Waist-Hip ratio (W-HR)

The waist-hip ratio of the studied women was calculated according to the ensuing equation:

Waist circumference (WC) divided by Hip circumference (HC)

Assessment of bone-related parameters

Estimation of calcium, phosphorus, uric acid, and ALP quantitatively was performed using a calorimetric method by auto biochemistry analyzer (AU240, China). Determination of ESR depends on the plasma amount at the top of the test tube after 1 hour. The results will be in millimeters per hour (mm/hr). Red blood cells fix at a faster rate in women with inflammatory conditions.

Estimation of the serological agglutination tests

The CRP test is based on the principle of latex agglutination. In many labs, the typical measurement is less than 1.0. However, conditions like infection and obesity may have an impact on this test. Based on the latex agglutination theory, a rheumatoid factor test calculates the level of RF in the blood.

Statistical analysis

The statistical program for the social sciences (SPSS), version 20, was applied to conduct the statistical analysis. Data are presented as mean minus standard error (M ±SE). Student's t-test was applied to compare the two groups of study (premenopausal and postmenopausal women). A P-value of <0.05 was considered significant statistically.

Results and Discussion

Characterization of premenopausal and postmenopausal women

Characterization of the studied groups was recorded as shown in (Table 1). The number of women was equal in each group (40 premenopausal women and 40 postmenopausal women). The range of age was

(23-28 years) in premenopausal women, while it was (52-58 years) in postmenopausal women. The age mean of postmenopausal women (55 ± 2.6 year) was significantly ($p < 0.05$) higher than that of premenopausal women (25 ± 2.4 year). Regarding marital status, no significant ($p > 0.05$) differences were between the two groups; the percentages of single were (25% and 20%) in perimenopause women and post-menopause women, respectively; while the percentages of married were (75% and 80%) in perimenopause women and post-menopause women, respectively.

Table 1: Characterization of the studied groups

Character	Group	
	Premenopausal	Postmenopausal
Number	40 ^a	40 ^a
Age (Range) year	23-28	52-58
Age (Mean \pm SE) year	25 ^b \pm 2.4	55 ^a \pm 2.6
Single (No.) (%)	10 (25 ^a)	8 (20 ^a)
Married (No.) (%)	30 (75 ^a)	32 (80 ^a)

► A non-significant difference ($p > 0.05$) is shown by means in a row having comparable little letters.

► A significant difference ($p < 0.05$) is shown by means in a row carrying different little letters.

The characters of the studied women revealed differences between perimenopause women and post-menopause women regarding age which was a logical finding. While the social status (single or married) was similar between the two groups, this is useful for matching between the two groups.

Anthropometric measurements of premenopausal women and postmenopausal women

Anthropometric measurements of the studied groups are shown in (Table 2). The mean values of BMI and WC in postmenopausal women (28.6 ± 2.7 kg/m²) and (92.3 ± 2.8 cm), respectively were significant ($p < 0.05$) higher than that in premenopausal women (23.4 ± 0.8 kg/m²) and (85.4 ± 2.5 cm), respectively. A non-significant ($p > 0.05$) difference was found in the mean HC between postmenopausal women (103.5 ± 2.4 cm) and perimenopause women (102.8 ± 2.6 cm), while the mean W-HR in postmenopausal women (0.89 ± 0.06) was significant ($p < 0.05$) higher than that in perimenopause women (0.83 ± 0.08).

Table 2: Anthropometric measurements of the studied groups

Anthropometric Measurements	Group	
	Premenopausal	Postmenopausal
BMI (kg/m ²)	23.4 ^b \pm 0.8	28.6 ^a \pm 2.7
Waist circumference (cm)	85.4 ^b \pm 2.5	92.3 ^a \pm 2.8
Hip circumference (cm)	102.8 ^a \pm 2.6	103.5 ^a \pm 2.4
Waist-Hip ratio	0.83 ^b \pm 0.08	0.89 ^a \pm 0.06

- ▶ A non-significant difference is indicated by means in a row with similar tiny letters ($p > 0.05$).
- ▶ A significant difference ($p < 0.05$) is shown by means in a row carrying different little letters.

Aside from BMI, there are several other indirect measures of adiposity that are often reported in the literature, such as WC, HC, and W-HR. The current findings which revealed that all the anthropometric measurements were more in postmenopausal women are in agreement with previous studies [18] It came to the conclusion that weight gain in menopausal women was attributable to hormonal alterations that take place during mid-life transition or during menopause. Gaining weight or having higher values for height, weight, and circumferences could also be caused by a change in lifestyle, less physical activity, food, or the individual's physiology. On the other hand, the latest findings contradict earlier research [19].

In agreement with a previous study [20], the value of BMI was significantly higher in the post menopause women than the perimenopause women. Also, in agreement with another study [21], When compared to premenopausal women, postmenopausal women's W-HR was shown to be considerably greater. It has been noted that postmenopausal women with metabolic syndrome had a noticeably high W-HR [22].

The current investigation showed that rising BMI values correlated with rising WC and W-HR values. These results concur with other related research [23] It discovered that increased visceral and subcutaneous fat in menopause was positively connected with the menopausal women's BMI and the WC and W-HR. In the present study, the severe BMI women had the greatest level of W-HR, and W-HR increased as BMI increased. These results are consistent with a prior study [24], which noted that BMI, WC, and W-HR values were related to metabolic riskiness variables and may also predict numerous metabolic riskiness factors.

Bone-relate parameters in premenopausal women and post-menopause women

The data presented in (Table 3) shows the bone-related parameters of the studied groups. The level of calcium in postmenopausal women (7.8 ± 0.9 mg/dl) was significantly ($p < 0.05$) lower than that in perimenopause women (8.5 ± 0.8 mg/dl), while the level of phosphorus in postmenopausal women (3.7 ± 0.6 mg/dl) was significant

($p < 0.05$) higher than that in premenopausal women (2.6 ± 0.5 mg/dl). A significant ($p < 0.05$) increase was found in levels of uric acid (5.0 ± 0.5 mg/dl), ALP (80.6 ± 12.8 IU/L), and ESR (30.4 ± 3.5 mm/hr) in postmenopausal women compared with their values [2.8 ± 0.4 mg/dl), (74.2 ± 10.5 IU/L), and (16.8 ± 1.2 mm/hr)], respectively in premenopausal women.

Table 3: Bone-related parameters of the studied groups

Bone-related Parameters	Group	
	Premenopausal	Postmenopausal
Calcium (mg/dl)	$8.5^a \pm 0.8$	$7.8^b \pm 0.9$
Phosphorus (mg/dl)	$2.6^b \pm 0.5$	$3.7^a \pm 0.6$

Uric acid (mg/dl)	2.8 ^b ± 0.4	5.0 ^a ± 0.5
Alkaline phosphatase (IU/L)	74.2 ^b ± 10.5	80.6 ^a ± 12.8
ESR (mm/hr)	16.8 ^b ± 1.2	30.4 ^a ± 3.5

- ▶ A non-significant difference is indicated by means in a row with similar tiny letters ($p > 0.05$).
- ▶ A significant difference ($p < 0.05$) is shown by means in a row carrying different little letters.

Menstrual status is a serious determinant of the bone body. After menopause, there is an accelerated phase of bone loss due to estrogen insufficiency, which can cause bone resorption [25]. The decrease in levels of calcium and the increase in levels of phosphorus and ALP in postmenopausal women as stated in this work are in line with previous studies of bone-related parameters [26]. Researchers came to the conclusion that low estrogen activity at these two sites caused the menopausal decline in calcium, which is indicative of a change in the parathyroid hormone (PTH) set point and thus causes a drop in gastrointestinal intake and tubular reabsorption of calcium and phosphorus. According to reports, any disruption of the actions of calcium-regulating hormones like PTH and the active unit of vitamin D may cause changes in the levels of serum calcium and phosphorus [27]. On the other hand, the level of calcium in the bloodstream is influenced by a lot of phosphate present. The body's reactions to calcium and phosphate are diametrically opposed; when blood calcium levels increase, phosphate levels decrease [28].

This suggests that uric acid may have a preventive impact against bone loss in postmenopausal women. The current conclusion about uric acid concurs with a prior study that found a greater blood uric acid level was linked with a higher bone mineral intensity [29]. Also, a recent study [30] revealed that uric acid may have a preventive impact on bone health in people with rheumatoid arthritis, most likely due to its antioxidant effect against bone loss brought on by oxidative stress. Furthermore, epidemiological researches show that hyperuricemia might be linked to the levels of inflammatory biomarkers changes, particularly CRP [31]. ESR readings tend to be greater in females and the elderly, which may help to explain why they are higher in postmenopausal women. The sex variations in fibrinogen levels are correlated with these higher values. However, it has also been observed that obese individuals have a slightly higher ESR [32].

Distribution of the studied groups according to serological agglutination tests

The prevalence of the groups under study in terms of serological agglutination tests is shown in (Table 4). The results showed that out of the total studied women, 26 (32.5%) are positive for CRP. The number and percentage of CRP-positive women out of the premenopausal women are only 8 (20 %), while the number and percentage of CRP-positive women out of the postmenopausal women are only 18 (45%); the differences are significant ($p < 0.05$). Also, the results revealed that out of the total studied women, 20 (25%) are positive for RF. The number and percentage of RF-positive women out of the

premenopausal women are only 5 (12.5 %), while the number and percentage of RF-positive women out of the postmenopausal women are only 15 (37.5%). The differences are significant ($p < 0.05$).

Table 4: Distribution of the studied groups according to serological agglutination tests

Groups	C-Reactive Protein (CRP)				Rheumatoid Factor (RF)			
	Positive		Negative		Positive		Negative	
	No.	%	No.	%	No.	%	No.	%
Premenopausal women (No. 40)	8	20% ^b	32	80% ^a	5	12.5% ^b	35	87.5% ^a
Postmenopausal women (No. 40)	18	45% ^a	22	55% ^b	15	37.5% ^a	25	62.5% ^b
Total women (No. 80)	26	32.5%	54	67.5%	20	25%	60	75%

► A non-significant difference is indicated by means in a row with similar tiny letters ($p > 0.05$).

► A significant difference ($p < 0.05$) is shown by means in a row carrying different little letters.

In this study, the increased number and percentage of CRP positive in postmenopausal women in comparison with perimenopause women may be due to increased levels of serum uric acid in postmenopausal women. However, this finding is in agreement with [33]; in that population-based study, the authors concluded that high serum uric acid levels were positively and independently associated with serum CRP in healthy post-menopause women. The results of earlier investigations support the idea that uric acid induces the production of proinflammatory markers like CRP by vascular smooth muscles, which play a serious role in the inflammatory cascading linked to atherosclerotic [34]. The elevated number and percentage of RH positive in post-menopause women compared with perimenopause women is closer to a local former study which stated that the levels of RF were higher in post-menopause women compared with perimenopause women in patients with rheumatoid arthritis and in control groups [35]. According to a recent study, RF titer reflected the severity of the rheumatoid arthritis condition [36].

Frequency of chronic diseases in the studied women

The frequency of chronic diseases was recorded in the studied women as has been shown in (Table 5). The results revealed that the frequency of all chronic diseases was significantly ($P < 0.05$) higher in the post menopause women compared with the perimenopause women. On the other hand, the frequency of bone-related disease was significant ($P < 0.05$) higher in the total studied women (37.5%) as well as in the two groups of the study, perimenopause women (30%) and pos menopause women (45%).

Table 5: Frequency of chronic diseases in the studied groups

Chronic diseases	Premenopausal		Postmenopausal		Total	
	No.	%	No.	%	No.	%
Hypertension	3	7.5	6	15	9	11.3

Diabetes mellitus	2	5	4	10	6	7.5
Cardiovascular disease	1	2.5	3	7.5	4	5
Bone-related disease	12	30	18	45	30	37.5
Non	22	55	9	22.5	31	38.7
Total	40	100	40	100	80	100

The current findings, which showed the prevalence of all chronic illnesses, particularly those affecting the bones, in post-menopause women, may be illustrated by the lack of estrogen in this population, which in turn caused several physiological changes in various bodily organs. Osteopenia and osteoporosis, in particular, have been linked to calcium insufficiency and malabsorption brought on by hormonal imbalance [37].

The unfavorable impact of menopause is due to a drop in estrogen levels, which changes insulin levels, lipid profiles, BMI, and lipid profiles, as well as increases the riskiness of hypertension. Additionally, it has been shown that menopause causes an increase in free radical generation because of abrupt changes in hormonal status [38]. Women experience bone loss shortly after menopause because of an increase in resorption lacunae and osteoclasts in the skeleton, that outweighs osteoblasts' ability to build new bone [39]. Additionally, body composition changes in aging-related women, hormonal and metabolic alterations, as well as an incline in physical actions, might all contribute to the emergence of a number of problems, including obesity, type II diabetes, and dyslipidemia [40].

This study's findings suggest that a number of chronic diseases may develop in postmenopausal women due to of age-related alternations in anthropometric measurements and bone-related factors, together with decreased physical activity.

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