

Original article

## Physiological Effects of Age and Body Mass Index on Some Liver Function Tests in Postmenopausal Women

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### ABSTRACT

#### Keywords.

Menopause, PMW, Liver Function Tests, BMI, LDH, AST, ALT, ALP, De Ritis Ratio.

Menopause is an ordinary physiologic period in aged females. It is a usual situation that occurs at the long-lasting termination of the menstrual period because of the termination of the synthesis of fertility hormones from the ovary. Menopause is an order of aging usually associated with many events in her life, and as a part of aging, many processes stop permanently or change to accommodate this situation in life. The current study was analyzed the liver function tests represented as (Lactate dehydrogenase LDH, Aspartate aminotransferase AST, Alanine aminotransferase ALT, Alkaline phosphatase ALP, and estimated the De Ritis Ratio) in sera of 74 apparently well healthy volunteers females, including 33 apparently healthy premenopausal women age around (19-41) years old as a group of control and 41 apparently healthy postmenopausal female (the menopause occur ordinarily), aged old around (55-74) years old which divided into subcategories classified according to the age and body mass index (BMI) in order to identify the effect of age progressing and BMI on liver function tests according the elderly women. Regarding the results found in this work, there is the highest elevation in serum LDH, ALT, AST, and ALP enzyme in postmenopausal women when compared with a group of controls, and an important influence of BMI and age advances on these enzyme activities in postmenopausal women but no significant variations were found in the mean activity of ALT with increasing age in postmenopausal women. Lastly, the present results of the De Ritis Ratio recognized that there was no significant change in each contrast measured in this study. Liver enzyme elevation over a period is an important indicator of metabolic variations associated with the end of ovarian function and physical changes related to age and Body Mass Index. Furthermore, BMI appeared as a worthy predictor of elevated liver enzymes. The importance of this study is to express that changes happen in postmenopausal women related to normal physiological changes with progress age, not related to pathological conditions.

### Introduction

Menopause is a typical biological form concerning the ending of the menstrual period due to the termination of the manufacturing of fertility hormones from ovary for at least one year and permanent loss of productivity [1,2]. Menopause is a natural phase of aging in the reproductive system [3,4]. The reproductive cycle of females is categorized into three general categories: reproductive, menopause transition, and post menopause [5]. The post menopause refers to the stages of a woman's life after the cycle of menstruation is stopped for at least one year, which is divided into two stages: early and late [6]. Non-pathologic deficiency of estrogen may lead to Menopause occurs in all menstruating women [7]. The termed of Amenorrhea mean time for at least one year, a sign of stop reproductively of female and the childbearing period [8]. Amenorrhea happens around the ages of forty- five and fifty-six years in most females. The average age of usual menopause is fifty-one years [9].

In the post menopause period, the ovarian function and creation of the hormones progesterone, estrogen, and testosterone can greatly change, associated with wide changes in signs, affecting different systems [10]. There have been a large number of assumptions about the signs and symptoms that appear earlier, throughout, and later in the beginning of menopause [11]. Symptoms associated with post menopause usually due to the lowering of circulating estrogen. The health of menopausal women is mostly linked to vasomotor symptoms, atrophy of the urogenital system, cardiovascular disorder, osteoporosis, tumors, psychosis symptoms, lower cognition, and sexual difficulties [4]. The most common symptom of menopause is vasomotor symptom occur during the year of transition. About 75%-80% of female involvement vasomotor symptoms, fluctuating in severity. Usually, symptoms of menopause include palpitations, night sweats, migraines, and hot flashes [5]. The works of hepatic are responsible for many functions, including major detoxification of various metabolic compounds, protein synthesis, and production of digestive enzymes [12, 13]. The liver detoxification is an important part of the metabolic rate, erythrocyte regulation, and synthesis of glucose and storage [14,15]. The term liver function tests give an idea of the source of damage rather than on hepatic function [16].

Liver Function Tests (LFTs) include many blood tests that provide an idea about the general health of a person and hepatic function, in addition responsibility for numerous important roles in the human body [17]. Liver function tests (LFT), including

liver enzymes such as alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), and lactate dehydrogenase (LDH) [18,19], are commonly associated with liver dysfunction [20]. These tests are important biomarkers used to assess the function of the liver, diagnose, and treat hepatic diseases [21]. The estimation of these enzymes reflects the integrity of hepatocytes and can give an idea about the severity and incidence of hepatic conditions [22,23].

## Methods

This study was performed on 74 apparently healthy women. The range of age between (19-74) years old. The group of control includes 33 apparently healthy premenopausal women (non-pregnant typical weight women), aged between (19- 41) years, with a mean of (27) years, their BMI ranged between (19.7- 24.5) with a mean of (21.7). The 2nd group in this study included 41 apparently healthy postmenopausal women (PMW) (the menopause occurred normally) aged between (55-74) years, with a mean age of (61) years. The postmenopausal women set were separated into subcategories according to their BMI and age. The PMW cluster was subdivided into 2 subcategories according to their age. The first is the early PMW group aged between (55-64) years with a mean of 59 years, the 2nd is the late PMW group aged between (65-74) years with a mean of 68 years. Similarly, the PMW group was subdivided into two subgroups according to their BMI. One subgroup is obese PMW their BMI >30. The second subgroup is the non-obese PMW group their BMI between (19.2- 24.3) with a mean of (22.8). All data was reserved for each woman of both groups, including forename, age, weight, height, job, smoking habit, alcohol consumption, family history, and any medication consumption. Women with past hepatic diseases or some additional illnesses, smoking habits, and spirits consumption were avoided from the study. The BMI was calculated using the following equation:

$$\text{BMI} = \text{weight ( Kg )} / (\text{height m})^2. [24]$$

About five mL of venous blood samples were obtained by antecubital venipuncture. The blood samples were moved directly into non-heparinized plain tubes and incubated for 10 minutes in an incubator at 37 °C and centrifuged for fifteen minutes at three thousand revolutions per minute to completely separate the blood sera. The sera divided were used for the measurement of hepatic enzymes (LDH, ALP, ALT & AST). Lactate dehydrogenase was measured spectrophotometrically according to the UV kinetic method [25]; using a kit provided by Biolabo. The aminotransferases (ALT& AST) were calorimetrically measured according to the process of (Reitman and Frankel, 1957) [26]; using a kit supplied by (Randox/UK). Estimation of serum ALP activity was based on the colorimetric method [27]; by a kit (biolabo / France). Lastly, De Ritis Ratio found the ratio equation of AST/ ALT [28].

The unpaired t-test is used in the analysis of data. The outcomes are spoken as the mean ± standard deviation (SD) to discover the significant changes between the study groups, and the likelihood level  $p \leq 0.05$  is statistically significant [29].

## Results

The contrast among the results of sera LDH, Aminotranferases, ALP activity as well as De Ritis ratio in PMW and control group as appear in (Table 1), a significant raise of sera LDH, AST, ALT, and ALP sera activity in PMW (307.5±11.4), (13.15±3.13), (12.10±3.28) and (61.71±8.08) respectively in comparison with premenopausal women (268.7±14.6), (10.18±3.0), (8.97±2.40) and (50.2±10.8) respectively. Regarding the influence of BMI on the sera activity of LDH, ALP, ALT and AST in postmenopausal women groups as appear in (Table 2), the current results show a significant influence of BMI on the sera activity of these enzymes in obese female PMW group (312.11±9.87), (14.56±2.28), (13.89±2.45), and (68.44±6.59) respectively in comparison with non-obese PMW group (303.9±11.4), (12.04±3.31), (10.70±3.21) and (56.43±4.37) respectively.

The contrast between the outcomes of serum activity LDH, transaminases, and ALP in obese PMW and control groups, as appears in (Table 3), a significant elevation of these enzyme activities in obese PMW in comparison with the control group. Likewise, the present study expresses the changes of serum LDH, AST, ALT, and ALP between early and late postmenopausal age of the PMW group as presented in (Table 4), little raises in the mean of serum activities of ALT with progression of postmenopausal age, but it's not statistically significant; while the results show a significant raise of sera activity of LDH, AST, and ALP by means of advanced age of PMW. The outcomes of serum activity LDH, Aminotransferases, and ALP in early and late age of PMW group with control group as exposed in (Tables 5 and 6), there was a significant rise in serum LDH, AST, ALT and ALP in early and late age of PMW in comparison with premenopausal women. Lastly, the present results of the De Ritis Ratio recognized that there was no significant change in each contrast measured in this study.

**Table 1. Liver function tests in postmenopausal women and control group**

Parameters	Mean±SD	T-value	P-value
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	Control group (No.=33)	PMW group (No.=41)		
Sera LDH (U/L)	268.7±14.6	307.5±11.4	-12.85	0.0000
Sera AST (U/L)	10.18±3.0	13.15±3.13	-4.12	0.0001
Sera ALT (U/L)	8.97±2.40	12.10±3.28	-4.57	0.0000
Sera ALP (U/L)	50.2±10.8	61.71±8.08	-5.25	0.0000
De Ritis Ratio	1.294±0.711	1.168±0.395	0.96	0.34

**Table 2. Liver function tests in postmenopausal women according to BMI**

Parameters	Mean±SD		T-value	P-value
	Non obese PMW group (No.=23)	Obese PMW group (No.=18)		
Sera LDH (U/L)	303.9±11.4	312.11±9.87	-2.44	0.019
Sera AST (U/L)	12.04±3.31	14.56±2.28	-2.75	0.0091
Sera ALT (U/L)	10.70±3.21	13.89±2.45	-3.50	0.0012
SeraALP (U/L)	56.43±4.37	68.44±6.59	-7.00	0.0000
De Ritis Ratio	1.207±0.447	1.078±0.252	1.09	0.28

**Table 3. Liver function tests in obese PMW and control groups.**

Parameters	Mean±SD		T-value	P-value
	Control group (No.=33)	Obese PMW group (No.=18)		
Sera LDH (U/L)	268.7±14.6	312.11±9.87	-11.28	0.0000
Sera AST (U/L)	10.18±3.00	14.56±2.28	-5.38	0.0000
Sera ALT (U/L)	8.97±2.40	13.89±2.45	-6.94	0.0000
Sera ALP (U/L)	50.2±10.8	68.44±6.59	-6.53	0.0000
De Ritis Ratio	1.294±0.711	1.078±0.252	1.24	0.22

**Table 4. Liver function tests in postmenopausal women according to age.**

Parameters	Mean±SD		T-value	P-value
	Early PMW group (No.=22)	Late PMW group (No.=19)		
Sera LDH (U/L)	302.18±8.86	313.6±11.1	-3.68	0.0007
Sera AST (U/L)	12.14±3.40	14.32±2.38	-2.34	0.024
Sera ALT (U/L)	11.55±2.94	12.74±3.62	-1.16	0.25
Sera ALP (U/L)	57.59±5.58	66.47±8.02	-4.16	0.0002
De Ritis Ratio	1.139±0.514	1.203±0.362	-0.45	0.65

**Table 5. Liver function tests in the early PMW group and the control group.**

Parameters	Mean±SD		T-value	P-value
	Control group (No.=33)	Early PMW group (No.=22)		
Sera LDH (U/L)	268.7±14.6	302.18±8.86	-9.63	0.0000
Sera AST (U/L)	10.18±3.00	12.14±3.40	-2.24	0.029
Sera ALT (U/L)	8.97±2.40	11.55±2.94	-3.56	0.0008
Sera ALP (U/L)	50.2±10.8	57.59±5.58	-2.96	0.0045
De Ritis Ratio	1.294±0.711	1.139±0.514	0.88	0.38

**Table 6. Liver function tests in the late PMW group and the control group.**

Parameters	Mean±SD	T-value	P-value
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	Control group (No.=33)	Late PMW group (No.=19)		
Sera LDH (U/L)	268.7±14.6	313.6±11.1	-11.63	0.0000
Sera AST (U/L)	10.18±3.00	14.32±2.38	-5.13	0.0000
Sera ALT (U/L)	8.97±2.40	12.74±3.62	-4.51	0.0000
Sera ALP (U/L)	50.2±10.8	66.47±8.02	-5.73	0.0000
De Ritis Ratio	1.294±0.711	1.203±0.362	0.52	0.61

*p*-value ≤ 0.05 was considered statistically significant.

## Discussion

Regarding the results of the present study, an obviously significant rise of sera lactate dehydrogenase, aminotransferases & alkaline phosphatase in postmenopausal women, in contrast to premenopausal women, was noted. Furthermore, according to the influence of age and BMI on sera hepatic enzymes, a significant elevation in the sera LDH, ALP, AST and ALT in postmenopausal women compared to premenopausal, likewise, a significant effect of BMI and age progresses on all enzymes within postmenopausal women group nevertheless there is no significant differences were found in sera ALT activity as well as the deities ratio with increasing age in postmenopausal women because the liver's natural age-related decline in enzyme production balances out the liver stress caused by post-menopausal metabolic changes. These outcomes of the recent work are in line with Mohammed (30), Gill *et al.*, [31], Abdkarem and Zainulabdeen (32). The elevation of the aminotransferases enzymes in postmenopausal women is commonly due to a reduction of estrogen level after menopause, which stimulates many metabolic dysfunction systems that lead to metabolic dysfunction-associated steatotic liver disease (MASLD; previously termed nonalcoholic fatty liver disease, NAFLD) [33,34], reflecting the rising prevalence of obesity, inflammation, and insulin resistance [35,36]. Lower levels of vitamin D and estrogen hormone in PMW may be associated with oxidative stress [37].

Accelerated bone turnover because of menopause related osteoporosis may cause increased ALP in postmenopausal women. Most of the ALP isoenzymes are derived from the bones and liver [38]. Additionally, the elevation of LDH in aging women may contribute to the reduction of vitamin D, which promotes oxidative stress and tissue injury, besides metabolic changes that are accelerated by the menopause-related drop in estrogen [32,33]. The postmenopausal period leads to a decline in estrogen, which is known as an antioxidant, leading to oxidants that contribute to metabolic shifts and increased tissue injury [39]. As well as the accumulative effect of toxic metals and substances, again responsible for the occurrence of oxidative stress and liver function disturbances. Oxidative stress is associated with numerous human pathologies and female reproductive diseases [40,41].

## Conclusion

In summary, this study demonstrates that postmenopausal women experience significant elevations in liver enzymes — LDH, AST, ALT, and ALP — compared with premenopausal controls. Both age progression and BMI exert a notable influence on these enzyme activities, with obesity amplifying the changes. However, ALT activity and the De Ritis ratio did not show significant variation with age. These findings suggest that liver enzyme elevation in postmenopausal women reflects normal physiological changes linked to aging and metabolic shifts rather than pathological conditions, and BMI serves as a strong predictor of enzyme elevation.

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## Conflict of Interest

The researcher ensures there is no conflict of interest.

## Adherence to Ethical Standards

The approval number and date Reference code : PREC-26-1-49 Date Monday ,June 6-2026 **please ensure that contact the committee via [pharmacy.ethics@uomosul.edu.iq](mailto:pharmacy.ethics@uomosul.edu.iq)**

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