ARTICLE
JOURNAL OF UNIVERSITY OF BABYLON
For Pure and Applied Sciences (JUBPAS)
Vol.33; No.3.| 2025

Assessment of Protective Lipid Against Decreased Bone Mineral Density by DEXA Scan for the Lumbar Spine and Lower Extremities.

Wafaa T. Jaafar[1*], Numan S. Dawood[2], Mahmoud M. Mohamed[3]

[1,2]Department of Physiology, College of Medicine, University of Baghdad, Baghdad, Iraq.
[3]Department of Anatomy, College of Medicine, University of Baghdad, Baghdad, Iraq.
* Corresponding author: Numan S. Dawood , Department of Physiology, College of Medicine, University of Baghdad, Baghdad, Iraq
Email: numans@comed.uobaghdad.edu.iq

Accepted: 4/8/2025 **Published:** 30 /9/2025

ABSTRACT

Background: Using dual-energy X-ray absorptiometry to assess bone mineral density in the lumbar spine and lower extremities. The percentage of lipid was conducted in the body. While it is acknowledged that lipid profile (triglycerides) can impact bone mineral density and cause protection from osteoporosis, the specifics of this relationship are still unknown.

The objective: This study aims to assess sex differences and age in the influence of lipid profiles on bone mineral density (BMD) in the lumbar spine and lower extremities.

Method: This study had 170 participants (85 men and 85 women). There were 40 males and 45 females among the patients who reported bone soreness. In addition, 85 seemingly healthy volunteers (45 males and 40 females) were evaluated and regarded to be the control group. Dual-energy X-ray absorptiometry was used to assess BMD of every participant for lumbar vertebrae and hip structure.

Results: Statistically significant differences in BMD-induced protection from osteoporosis were noted between the control group and patients with certain conditions, and between diagnostic lipid profiles. Conclusions: Our findings reveal that patients with hyper lipid exhibited high BMD in both sexes. The research findings indicated that females exhibited a higher prevalence of lipid profile abnormalities compared to males.

Keywords: BMD, Lipid profile, dual-energy X-ray absorptiometry scan, lumbar spine & lower limbs.

مجلة جامعة بابل للعلوم الصرفة والتطبيقية مجلة جامعة بابل للعلوم الصرفة والتطبيقية
info@journalofbabylon.com | jub@itnet.uobabylon.edu.iq | www.journalofbabylon.com ISSN: 2312-8135 | Print ISSN: 1992-0652

info@journalofbabylon.com | jub@itnet.uobabylon.edu.iq | www.journalofbabylon.com ISSN: 2312-8135 | Print ISSN: 1992-0652

INTRODUCTION

Osteoporosis, a disease characterized by a lack of bone mass, or amount, and alterations in quality of bone microarchitecture, which increases the risk of Fractures and fragility fractures are linked to an increase in Co-morbidities, mortality, and a decline in quality of life [1,2].

Density of bone minerals the most useful indicator of bone quality for clinical therapy is bone mineral density (BMD) where BMDs that are higher or lower than what is considered to be the normal range are strongly indicative of bone health problems [3].

Dual Energy X-Ray Absorptiometry (DEXA) is the most effective X-ray method for assessing and determining bone mineral density (BMD). It is distinguished by its superior spatial resolution, directional precision, and rapid execution while ensuring minimal patient exposure to X-rays. A gamma camera can identify existing bone abnormalities; a gamma camera is capable of detecting any actual bone issues [4,5].

Certain studies have established a correlation between lipid profiles and disorders associated with bone mineral density (BMD). The mechanism of this association may be directly related to the cholesterol biosynthetic pathway, which regulates cholesterol levels and influences osteoclast activity.

DXA scans can produce images of the entire body, hip, posterior-anterior (PA), which is lumbar spine (LS), and/or forearm. Decrease in bone mass and the associated modification of bone structure lead to heightened bone fragility and an elevated risk of fracture [6]. Hypertriglyceridemia has a protective effect on bone mineral density [7].

Some studies have demonstrated that individuals with a high lipid profile are more protected against fractures. Nevertheless, prior research has also demonstrated that the application of mechanical force, either body weight on the extremities or during exercise (in a suitable and regular way), will lead to an increase in BMD [8]. above disparity in body fat The between men and women arises due to the fact that women, at certain stages of their lives, may provide substance to a developing fetus and, subsequently, a newborn, through their own bodily resources [9,10]. Historically, studies have indicated that obesity and osteoporosis were independent conditions; however, current research has revealed a significant overlap in genetic and environmental factors between these two disorders [11]. Various studies have revealed that lipid profile may potentially have positive impacts on bone health [12]. Nevertheless, there are conflicting findings, indicating that an increased lipid will not necessarily provide a protective effect against osteoporosis or fracture [13]. Numerous studies have demonstrated a higher prevalence of osteoporosis in women compared to men, a difference that can be attributed to the anatomical, occupational, and hormonal differences between the two sexes [14]. The purpose of this work is to assess the relationship between high lipid profile and BMD in the lumber spine and lower extremities, in both healthy and patient individuals of both sexes.

info@journalofbabylon.com | jub@itnet.uobabylon.edu.iq | www.journalofbabylon.com ISSN: 2312-8135 | Print ISSN: 1992-0652

METHODS

Study design and setting

The study was conducted from December 2023 to May 2024. The patients were chosen from the Rheumatology Outpatient Clinic at Baghdad Teaching Hospital, located in Medical City, Baghdad, Iraq. The study sample consisted of 170 volunteers of diverse genders and ages spanning from 20 to 45 years. The participants were classified into control and patient groups based on their gender, as outlined in Table 1.

Table 1. Classification of research subjects into two categories

Total Participants.		Controls		patients	
170		85		85	
male	female	male	female	male	female
85	85	45	40	40	45

Ethical considerations

The research obtained approval for ethics from the University of Baghdad's College of Medicine, in partnership with the Ministry of Health, namely the outpatient facility at the Medical City Teaching Hospital. Furthermore, explicit consent was obtained from each participant.

Sample selection and inclusion criteria

All individuals in the study had no prior complaints of hypertension or diabetes mellitus, were nonsmokers, and had not undergone any long-term treatment in the four months before the trial. In summary, aside from patients who visited the rheumatology outpatient clinic and reported significant bone pain, the participants had no prior complaints of any ailments, whereas the control group were otherwise healthy and did not report any musculoskeletal issues.

Outcome measurements

All participants' weights and heights were recorded, as well as their DEXA scans. For all control and patient groups, the DEXA device was utilized to assess the bone mineral density (BMD) with special focus paid to evaluating the back vertebra and lower extremities on both sides of the body, and lipid profile analysis of all participants.

ISSN: 2312-8135 | Print ISSN: 1992-0652 | jub@itnet.uobabylon.edu.iq | www.journalofbabylon.com | info@journalofbabylon.com

STATISTICAL ANALYSIS.

Statistical analyses were carried out utilizing edition 22 of the Statistical Software for Social Sciences (SPSS). Depending on the quantity of specimens, paired and unpaired statistical tests were performed to compare the baseline (normal) and osteoarthritis groups. Means and standard errors were calculated, and statistical significance was attributed to p-values less than 0.05.

RESULTS

The anthropometric measurements of male and female subjects of varying ages (20 to 45 years) were collected: the mean age was 40.85±1.75 for males and 41.55±1.75 for females; the mean height was 169.75±1.25 cm for males and167.55±1.35 cm for females; and the mean weight was 82.65±4.75 kg for males and 81.67±3.85 kg for females, as shown in Table 2.

Table 2: The anthropometric measurements of the male and female subjects considered in this study

Female	Female	Male
Age (20-45 years)	41.55±1.75	40.85±1.75
Height (cm)	167.55±1.35	169.75±1.25
Weight (kg)	81.67±3.85	82.65±4.75

Values were expressed as mean±SEM.

Table 3 lists the questionnaire responses, broken down by sex, for those who took part in the study. In spite of the fact that the DEXA scan was performed on the entire body, including the spine and left and right legs, the current investigation demonstrated a high in the lipid profile for the lower limbs.

These findings included the effects of lipid profile (80 subjects), which were compared to the normal lipid of the 80 controls (healthy subjects) for these limbs.

Table 3: Summary of the responses to the questionnaire completed by the study participants

	male	female
Normal	40	40
Lipid profile	45	35
Dominance of leg (routine and hard work)	Left side= 45	Right side =60

مجلة جامعة بابل للعلوم الصرفة والتطبيقية مجلة جامعة بابل للعلوم الصرفة والتطبيقية مجلة جامعة بابل للعلوم الصرفة والتطبيقية

info@journalofbabylon.com | jub@itnet.uobabylon.edu.iq | www.journalofbabylon.com ISSN: 2312-8135 | Print ISSN: 1992-0652

The means for the BMD for the lumbar spine of the female and male participants in this study are reported in Table 4. Table 4 demonstrates that the mean value of BMD in the lumbar spine of males in the patient group are less than those of females in the same group and the means for the control group for lumber spine are greater than those of female and for the same side of the body.

Table 4: The means for the BMD for the lumber spine of the participants as categorized by sex

Organ	Normal	(lipid profile)	P-value
Lumber Spine Female	1.225 ± 0.035	0.995 ± 0.055	< 0.001
Lumber Spine Male	1.328 ± 0.065	0.875 ± 0.045	< 0.001

Values are expressed as mean±SEM. p-value represents the comparisons between normal and lipid profile groups in both sexes.

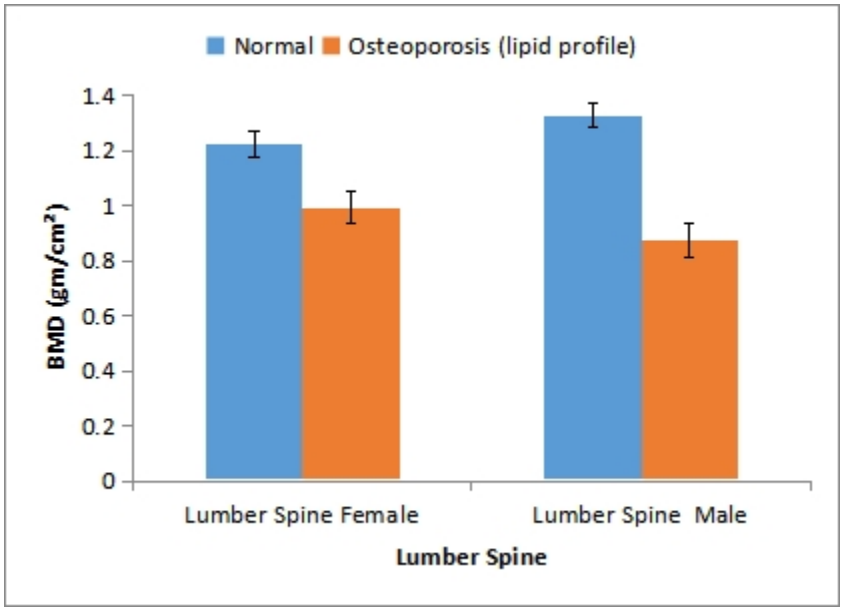

Figure 1: comparison of the mean lumbar spine of normal with patient groups for female and male

Figure 1 illustrates that there are statistically significant differences ($p<0.001$) in the mean bone mineral density (BMD) of the lumbar spine between the control and patient groups for both females and males.

مجلة جامعة بابل للعلوم الصرفة والتطبيقية مجلة جامعة بابل للعلوم الصرفة والتطبيقية

Table 5: The mean value of BMD of the left and right legs for participants according to sex.

Organ	Normal	(lipid profile)	P-value
Left Leg (Female)	0.98 ± 0.055	0.755 ± 0.055	< 0.001
Right Leg (Female)	0.985 ± 0.045	0.665 ± 0.035	< 0.001
Left Leg (Male)	0.995 ± 0.065	0.745 ± 0.065	< 0.001
Right Leg (Male)	1.25 ± 0.035	0.775 ± 0.045	< 0.001

Values are expressed as mean±SEM. p-value represents the comparisons between normal and lipid (patient) groups in both sexes.

Table 5 demonstrates that the mean value of BMD in the lower limbs of males in each group (control and lipid profile) is greater than those of females in the same groups and on the same side of the body. In females, the mean value of BMD for the right leg was greater than for the left leg in the control group by 4.3%, while in the lipid group, the left leg was greater by 12.9%. For males, the mean value of BMD in the right leg was greater than in the left leg in the control group by 10%, while in the lipid group, the left leg was greater by 16%. The mean value of BMD for the left leg in males was greater than in the left leg of females for the two groups (control and lipid) by 5.9% and 3.4%, respectively; the same was true for the right leg, with rates of 10.6% and 6.23%respectively.

Also, the mean value of BMD for the left and right legs of females in the lipid group was less than for the control group by 24.35% and 15.85%, respectively, whereas for males, these same figures were 27.34% and 20.6%, respectively.

Figure 2 demonstrates that there are no significant differences between the mean value of BMD for the left and right legs of the control and lipid profile groups in females; the same was also true for males. In addition, highly statistically significant differences ($p<0.001$) were found in the BMDs of the control and lipid groups in the left leg for females; the same was true of females' right legs. There were highly statistically significant ($p<0.001$) differences in the BMDs of the control and lipid groups for the left leg of males; the same was true for males' right legs.

info@journalofbabylon.com | jub@itnet.uobabylon.edu.iq | www.journalofbabylon.com ISSN: 2312-8135 | Print ISSN: 1992-0652

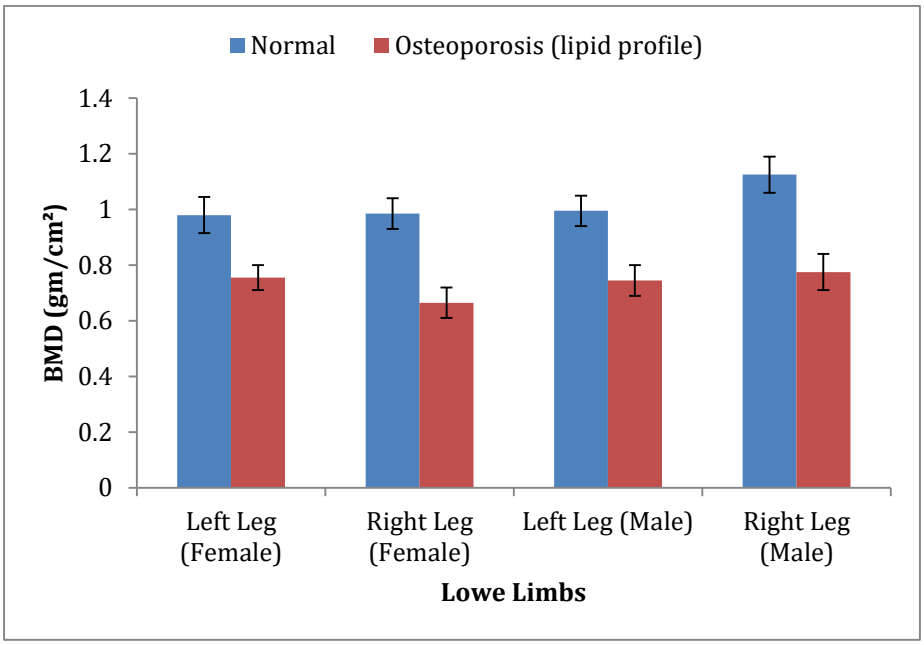

Figure 2: Comparison of the mean value of BMD for the normal and lipid groups for the lower extremities for both sexes. *significant differences compared to the normal subjects ($p<0.001$).

DISCUSSION

Osteoporosis is widely recognized as a prevalent disorder impacting bone integrity, characterized by fragile and easily fractured osteoporotic bone. The most effective and secure diagnostic instrument for predicting osteoporosis is the DEXA device. [15]. DEXA is regarded as extremely advantageous for assessing mineral density, fat mass, and lean mass in various regions of the body. Despite extensive studies on the correlation between lipid profile and bone mineral density (BMD), the specifics of this link remain unclear. This study indicated that the lipid profile was often higher in females. This is supported by the results [1,16]. The primary finding of this research indicated that lipids exhibited a positive correlation with bone mineral density (BMD) in both the lumbar region and lower extremities across both sexes, as evidenced in Tables 4 and 5. This conclusion is consistent with several other analogous research [17, 18]. The positive correlation between lipid levels and bone mineral density (BMD) is more pronounced in female than in males., [10, 19]. Regular and healthy exercise will enhance bone mineral density (BMD) [20,21]. The right lower limb had elevated lipid levels (triglycerides) and consequently a relatively high bone mineral density (BMD) in males, while a similar pattern was observed in females, indicating higher lipid levels and reduced BMD in the right compared to the left lower limbs. This may be attributed to the tendency of females to manage the family, and despite their employment, they often do not engage in what is deemed good regular exercise. This indicates that housework is detrimental to bone health; [22] presented analogous results and a rationale. Lipid levels were seen to rise in relation to osteoporosis in the lower limbs of both sexes (refer to Table 5). The little disparity between males and females can be elucidated by the significant variation in their respective levels

info@journalofbabylon.com | jub@itnet.uobabylon.edu.iq | www.journalofbabylon.com ISSN: 2312-8135 | Print ISSN: 1992-0652

of physical activity, including walking, running, and stair climbing. This aligned with the findings of Benedetti et al. [23].

STUDY LIMITATIONS

To obtain more precise and trustworthy outcomes, the total number of people taking part in the current research should be raised. Furthermore, it is better to group both controls and patients by decade of life.

CONCLUSION

Whole-body or localized dual-energy X-ray absorptiometry scans yield favorable outcomes when utilized as supplementary metrics in lieu of DXA scans that exclusively assess the spine or hip. The results of our study indicated that individuals diagnosed with hyperlipidemia (triglycerides) demonstrated a relatively high percentage of minerals in bone in the lumbar spine and lower extremities regions, which can be relative to increased BMD resulting from hyperlipidemia in tissue, applicable to both sexes. Moreover, females were diagnosed with hyperlipidemia more often than males, while the right side predominated in the lower limbs of both sexes. Moreover, inadequate exercise adversely affects bone mineral density. This study's findings indicate that inequalities in bone mineral density severity are more significant in the lower extremities compared to the lumbar vertebrae and between genders.

RECOMMENDATION

Despite the small number of patients in each instance (control and patient lipid), which was a drawback of this study in terms of further analysis, the results were promising. As a result, additional research involving a larger number of patients is required to facilitate a more comprehensive statistical analysis and, as a result, obtain more precise findings to substantiate the results of the current study and determine whether this methodology constitutes a reliable source of medical examination. Furthermore, it is crucial to compare the lipid of people with various disorders to that of healthy people and patients.

ACKNOWLEDGMENTS

The authors thank the College of Medicine, University of Baghdad, and the staff of the Outpatient Rheumatology Clinic, Bone Mineral Density Unit (DEXA Unit), Baghdad Teaching Hospital, Medical City, Baghdad, for help and guidance during the study.

info@journalofbabylon.com | jub@itnet.uobabylon.edu.iq | www.journalofbabylon.com ISSN: 2312-8135 | Print ISSN: 1992-0652

Conflict of interests.

There are non-conflicts of interest.

References

1- Zhou, P., Liu, L., Lu, K. et al. Association between triglycerides and lumbar bone mineral density in Chinese patients with osteoporotic fractures: a retrospective cross-sectional study. Sci Rep 14, 29473 (2024). https://doi.org/10.1038/s41598-024-78926-x

2- Li, Yue. "Association between obesity and bone mineral density in middle-aged adults." Journal of orthopaedic surgery and research 17.1 (2022): 268.

3- Dennison, Elaine M., et al. "Lipid profile, obesity and bone mineral density: the Hertfordshire Cohort Study." Journal of the association of physicians 100.5 (2007): 297-303.

4- Numan Salman Dawood, Zainab Sami Abdel Aziz, Haneen Maan Alkhaales. Evaluation of the relationship between osteoporosis and body fat mass of the upper and lower extremities by dual-energy X-ray absorptiometry. Al-Rafidain J Med Sci. 2024;6(1):34-38. doi:10.54133/ajms.v6i1.410.

5- Arif, M, Gaur DK, Gemini N, Iqbal ZA, Alghadir AH. Correlation of percentage body fat, waist circumference and waist-to-hip ratio with abdominal muscle strength. Healthcare. 2022;10(12):2467. doi: 10.3390/healthcare10122467.

6- Zainab S.Abdel Aziz, Numan S.Dawood, Maan H. Al-khalisy. Evaluationof the effect oftype II diabetes mellitus onBone Mineral Density of Upper and Lower Limbs by Dual-Energy X-Ray Absorptiometry. JFac Med Baghdad2023; Vol.65, No.1, 27-33. DOI: https://doi.org/10.32007/jfacmedbagdad.6511980.

7- Kim, Kyong-Chol, et al. "Relation between obesity and bone mineral density and vertebral fractures in Korean postmenopausal women." Yonsei medical journal 51.6 (2010): 857-863.8. Rania Jamal Ahmed, Numan Salman Dawood, Maan Hamad Al-Khalisy. The Relationship between Anemia and Bone Mineral Density Measured by Dual X-Ray Absorptiometry. Al-Rafidain J Med Sci. 2024;6(2):111-115. DOI: https://doi.org/10.54133/ajms.v6i2.800.

8- Scott, David, et al. "Associations of sarcopenic obesity and dynapenic obesity with bone mineral density and incident fractures over 5–10 years in community-dwelling older adults." Calcified tissue international 99.1 (2016): 30-42.10.

9- Zainab S.Abdel Aziz, Numan S.Dawood, Maan H. Al-khalisy. Study of the Effect of Diabetes Mellitus I on Bone Mineral Density of Upper and Lower Limbs by Dual-Energy X-Ray Absorptiometry. Bionatura. 2023; 8 (3), p: 10. DOI:10.21931/RB/CSS/2023.08.03.75.

10- Wen, Z.; Li, Y.; Xu, L.; Yue, C.; Wang, Q.; Chen, R.; Ding, N.; Qu, X.; Ou, Y.; Yang, Y.; et al. Triglyceride Glucose–Body Mass Index Is a Reliable Indicator of Bone Mineral Density and Risk of Osteoporotic Fracture in Middle-Aged and Elderly Nondiabetic Chinese Individuals. J. Clin. Med. 2022, 11, 5694. https://doi.org/10.3390/jcm11195694

11- Du, Dengkui, et al. "The relationship between central obesity and bone mineral density: a Mendelian randomization study." Diabetology & Metabolic Syndrome 14.1 (2022): 63.

info@journalofbabylon.com | jub@itnet.uobabylon.edu.iq | www.journalofbabylon.com ISSN: 2312-8135 | Print ISSN: 1992-0652

12- Numan S Dawood, Ruwaidah A Mussttaf, Mayyadah Hasan Rhaif AL-Sahlanee. Model for prediction of the weight and height measurements of patients with disabilities for diagnosis and therapy. Int J Bioautomation. 2021:25(4):343-352. doi:10.7546/ijba.2021.25.4.000824.
13- Savvidis, Christos, Symeon Tournis, and Anastasia D. Dede. "Obesity and bone metabolism." Hormones 17.2 (2018): 205-217.15. Jain RK, Vokes T. Fat mass has negative effects on bone, especially in men: A cross-sectional analysis of NHANES 2011-2018. J Clin Endocrinol Metab. 2022;107(6):e2545–e2552. doi: 10.1210/clinem/dgac040.
14- Cobayashi, Fernanda, Luiz A. Lopes, and José AAC Taddei. "Bone mineral density in overweight and obese adolescents." Jornal de Pediatria 81 (2005): 337-342.17. Jassim NA. Bone mineral density status in 48 Iraqi hyperthyroid patients. J Fac Med Baghdad. 2009;51(2):136-138. doi: 10.32007/jfacmedbagdad.5121141.
15- Hammoud, Emneh, et al. "Does the severity of obesity influence bone mineral density values in premenopausal women?." Journal of Clinical Densitometry 24.2 (2021): 225-232.19. Abed E, Rasheed MK, Hussein KG. Assessment of total procollagen type 1 intact N-terminal propeptide, C-telopeptide of type 1 collagen, bone mineral density and its relationship to body mass index in men with type 2 diabetes. J Fac Med Baghdad. 2022; 64(2):81-85. doi: 10.32007/jfacmedbagdad.6421942.
16- Seo, Young-Gyun, et al. "Relationship between bone mineral density and body composition according to obesity status in children." Endocrine Practice 27.10 (2021): 983-991.21. Davey MS, Staunton P, Mohan K, Tatro E, Baker JF, Devitt A. Multiple Vertebral Compression Fractures Secondary to Pregnancy-induced Osteoporosis: A Case Report. J Orthop Case Rep. 2024; 14(6):101-107. doi: 10.13107/jocr.2024.v14.i06.4518.
17- Greco, Emanuela A., Andrea Lenzi, and Silvia Migliaccio. "The obesity of bone." Therapeutic advances in endocrinology and metabolism 6.6 (2015): 273-286.
18- Proietto, Joseph. "Obesity and bone." F1000Research 9 (2020): F1000-Faculty.
19- López-Gómez, Juan J., José L. Pérez Castrillón, and Daniel A. de Luis Román. "Impact of obesity on bone metabolism." Endocrinología y Nutrición (English Edition) 63.10 (2016): 551-559.
20- Compston, Juliet. "Obesity and bone." Current osteoporosis reports 11.1 (2013): 30-35.
21- Rosen, Clifford J., and Mary L. Bouxsein. "Mechanisms of disease: is osteoporosis the obesity of bone?." Nature clinical practice Rheumatology 2.1 (2006): 35-43.
22- Chen, Jun, et al. "The association between abdominal obesity and femoral neck bone mineral density in older adults." Journal of orthopaedic surgery and research 18.1 (2023): 171.
23- Felson, David T., et al. "Effects of weight and body mass index on bone mineral density in men and women: the Framingham study." Journal of Bone and Mineral Research 8.5 (1993): 567-573.
24- Wang, Gao-Xiang, et al. "Effect of obesity status on adolescent bone mineral density and saturation effect: a cross-sectional study." Frontiers in Endocrinology 13 (2022): 994406.

مجلة جامعة بابل للعلوم الصرفة والتطبيقية مجلة جامعة بابل للعلوم الصرفة والتطبيقية

info@journalofbabylon.com | jub@itnet.uobabylon.edu.iq | www.journalofbabylon.com ISSN: 2312-8135 | Print ISSN: 1992-0652