Research Article

Multiparity as a Potential Cause of the Articular Cartilage Degradation in the Knee Joint; Sonographic Evaluation in the Postmenopausal Women

Lubna Javed[1], Raham Bacha[2], Syeda Khadija[3], Syed Amir Gilani[4], Mehboob Hassan[5]

[1-5]*The University of Lahore, Pakistan*

Abstract:

Background: Pain in knee joint is prime cause of disability particularly among postmenopausal women. Ultrasound is a non-invasive and safe imaging modality for the evaluation of knee joint pathologies.

Objective: To prove multiparity as a potential cause of femoral cartilage thinning inside knee joint causing pain in postmenopausal women.

Methodology: Two hundred knee of 100 postmenopausal women of various parity were conveniently selected. Patients with all other risk factors of the knee joint pain which acts as effect modifying factors were excluded. Femoral articular cartilage was measured at the lateral, central and medial aspect of the knee joint and their average was calculated.

Results: 51.12 ±4.46 years was the mean age of patients (ranging from 46 to 60 years). A strong negative relation was found between the parity of the patient and the femoral articular cartilage thickness at the lateral, central and medial aspect of the knee joint of all the patients with a p-value less than 0.1. Significant variation was observed in the femoral articular cartilage thickness in various parties.

Conclusion: The femoral articular cartilage decreases in size significantly with an increase in the number of deliveries (parity). So, multiparity is one of the potential causes of femoral cartilage degradation in knees joint.

Corresponding Author | Lubna Javed, The University of the Lahore **Email:** lubnajaved83@gmail.com

Key words: Femoral articular cartilage; Parity; Postmenopausal women; Knee joint, Ultrasound

Introduction:

Knee joint pain is one of the leading causes of disability particularly in postmenopausal women[1]. Occurrence of pain in knee joint is increasing by rise the usual living life of common person, however, weight, age any trauma to the joint because of repeated moves, p, bending & kneeling are commonplace chance elements of the knee-joint[2]. Knee injuries and disorders can cause pain, swelling and stiffness and can be affected by a number of diseases just as osteoarthritis, tendinitis, bursitis, chondromalacia patella, Baker's cyst, rheumatoid arthritis, dislocation and meniscus tear[3]. Along with the causes mentioned above, it is routinely observed that multiparous women in their postmenopausal age are complaining of knee pain more than uniparous and nulliparous women[4,5]. The majority of the multiparous postmenopausal women visiting the orthopedic clinics are complaining of knee pain and low back pain and. The body part which may be injured easily is knee because of its complicated large size., and more vulnerable joint in the body[6]. The knees are used almost for every type of moment starting from sitting to standing, walking and running etc. This weight bearing joint of body helps during straightening, bending, twisting as well as during rotating. These movements need the knee joint to be satisfactorily perfect[7]. The incidence of knee pain in japan is very high which is 27.3%, While it is relatively low in America 12–13%[8,9].

It's routinely observed that pregnancy can cause knee pain, however, more or less cause of the pain in knees

are well known. In case a woman carry weight of additional 25 pounds for sometime late in pregnancy, she may suffer from severe pain in knees because of this extra burden on weight bearing joints[10]. Changes in hormones level during pregnancy may cause defects in the knee joint, which leads to pain[11]. For third trimester, hormones further to loosen up the pelvic ligaments and tendons in preparation for childbirth. May losing the ligaments and tendons, including those around the knees, this can make things a little unstable[12]. This may lead to knee pain because of kneecap which may not track as desired. Parity is associated with knee cartilage defects in younger women. Such association seems added apparent with an increased number of live births, proposing a probable adverse effect (AE) of parity on knee cartilage. The prevalence of cartilage defects in multiparous lady aged 31 to 41 years was 13%[11,13]. (11,13,14) A large prospective study conducted in England while including Thirteen-lack women explained that both (i.e. parity and hormone replacement therapy) were found associated with joint pain and eventually changing. Important thing was that risk of knee replacement increase up to 8% by each birth. Parity is also associated with radiographic osteoarthritis which is the prime threat knee replacement. To check an intensification of threat for knee replacement with parity in the U.S., they assessed the association of the births to the occurrence of knee replacement in the participants who are in the study of multicenter osteoarthritis[13,14]. They evaluated either parity was associated with an increase incidence of osteoarthritis more than thirty months [13].

Ultrasound is the modality of choice for the evaluation of knee joint pathologies and normal anatomic structures[15]. In comparison to arthroscopy, ultrasound has a greater correctness, sensitivity, explicitly, +ve/-ve predictive value of 98%, 88%, 97%, 98%, and 88% respectively[16]. Pregnancy causes hormonal variation which in turn causes multiple clinical conditions including, knee pathologies. Ultrasound is noninvasive, portable, readily available and easy to handle imaging modality which has been increasingly used for two decades after the introduction of high-resolution linear array transducers[17]. Pregnancy has profound effect on thickness of articular cartilage, especially of the weight bearing joints. Similarly, increase in the number of pregnancies during child bearing age has a negative relation with the cartilage thickness. It is caused either mechanically by weight gain or by hormonal change occur during pregnancy. Irrespective of the case, ultrasound is the modality of choice for the evaluation of articular cartilage. However, the aim of this study is to prove the result of multiparity on thickness of femoral articular cartilage in postmenopausal women with knee joint pain.

Methods:

This cross-sectional-observational study was conducted in one year from 5th July 2019 to 5th July 2020. A total of 200 knees of 100 individuals were conveniently included by explaining them the process as well as the purpose of research after taking their written informed consent. The study aimed to search for any pathological change in the knee joint with the help of ultrasound in multiparous and nulliparous women in their postmenopausal age. As knee joint pain could be caused by multiple disease conditions which were acting as effect modifying factor in this study i.e., diabetes, hypertension, obesity, etc. therefore patients with these effect-modifying factors were excluded in this study. Post-menopausal women having acute or chronic pain in the knee joint and without mentioned comorbidities and willing to participate in the study were included. Study started after getting proper formal approval from the institutional review board (IRB) and the Ethical Committee. Toshiba Xario Prime Ultrasound unit with linear transducer frequency ranging from 7-14MHz was used in this study. The American Institute of Ultrasound in Medicine (AIUM) Musculoskeletal ultrasound guidelines were followed in this study, which is routinely observed in this department[18]. The confidentiality of the patient was being prioritized during the exposure and examination of the patient's knee. The patient was laid down on the examination table with a properly exposed knee and turned to the right and left lateral decubitus and prone position. Bothe the knee joints of all the patients were evaluated. All the tendons, ligaments, bursae, cortical part of the bone, articular cartilage, & both the menisci of both the knee joints were evaluated for shape, echogenicity and consistency. The thickness of the articular cartilage was measured on the medial, lateral and central region of the femoral articular cartilage while knee joint in hyperflexion (Figure 1), and

their average was calculated with the help of mathematical formula in the Microsoft excel. Statistical Package for the Social Sciences (SPSS) (SPSS 24, IBM, Armonk, NY, United States of America) software was used to evaluate data and graphs formation[19]. The results are summarized in the form of Pearson's correlation between cartilage thickness at lateral, central and medial femoral condyle and its average with the number of times the female got pregnant (parity) (Table # 1). Similarly, range, mean and standard deviation of the cartilage thickness at lateral, central and medial femoral condyle and its average (calculated in millimeter) is tabulated in various parties (Table 2).

Results:

Femoral articular cartilage thickness was measured in nulliparous and multiparous women in their post-menopausal age to establish that an important potential risk factor for pain in knee joints is parity. For this purpose, 100 postmenopausal women with 200 knees were selected having a mean age of 51.12±4.46 (46 to 60) years. A strong negative relation was found between the parity of the patient and the femoral articular cartilage thickness at the lateral, central and medial aspect of the knee joint of all the patients as shown in the Table 1.

Table 1: *Pearson's correlation between Parity and femoral articular cartilage thickness at lateral, center, lateral aspect and its Average of the total 200 participants.*

Correlations		Medial in mm	central in mm	lateral in mm	Mean
Parities	Pearson Correlation	-0.227**	-0.188**	-0.229**	-.261**
	Sig. (2-tailed)	0.001	0.008	0.001	0

**. Correlation is significant at the 0.01 level (2-tailed).

Comparison of the mean and standard deviation of the lateral, central and medial aspect of the femoral cartilage in knees in various parities is given in Table 2.

Table 2: *Mean and standard deviation of the femoral articular cartilage thickness at lateral, center, lateral aspect and their Average in different parity (number of deliveries)*

		Articular cartilage thickness in (mm)			
Parities	**Parameters**	**Medial**	**Central**	**Lateral**	**Mean**
0	Mean	2.34	2.28	2.17	2.26
	Std. Deviation	0.58	0.62	0.57	0.50
1	Mean	2.72	2.83	2.68	2.74
	Std. Deviation	0.21	0.45	0.37	0.32
2	Mean	1.79	1.93	2.07	1.93
	Std. Deviation	0.32	0.45	0.43	0.24
3	Mean	2.17	2.14	1.93	2.08
	Std. Deviation	0.75	0.47	0.49	0.51
4	Mean	1.98	1.88	2.00	1.95
	Std. Deviation	0.68	0.62	0.73	0.58
5	Mean	1.81	1.72	1.96	1.83
	Std. Deviation	0.59	0.60	0.60	0.51
6	Mean	1.83	2.06	1.90	1.93
	Std. Deviation	0.38	0.62	0.45	0.37
7	Mean	1.74	2.16	1.73	1.88
	Std. Deviation	0.41	0.57	0.53	0.41
8	Mean	1.70	1.80	1.62	1.71
	Std. Deviation	0.40	0.43	0.49	0.33
9	Mean	2.01	1.82	1.86	1.90
	Std. Deviation	0.49	0.48	0.54	0.31
10	Mean	1.99	1.80	1.94	1.91
	Std. Deviation	0.40	0.45	0.62	0.43
11	Mean	2.05	1.60	1.35	1.67
	Std. Deviation	0.64	0.57	0.21	0.33
12	Mean	1.95	2.35	1.85	2.05
	Std. Deviation	0.07	0.21	0.78	0.21
13	Mean	2.05	3.00	2.15	2.40
	Std. Deviation	0.07	0.57	0.21	0.24

The mean standard deviation and range of the femoral articular cartilage in the knee joint at the lateral, central and medial aspect of all the participants are given in Table # 3. Parity of all the hundred cases is given in the form of percentage in Figure 2.

Table 3: *Mean and Standard Deviation of the femoral articular cartilage thickness at lateral, center, lateral aspect and their Average of all the 200 knees*

Variable		Minimum	Maximum	Mean	Std. Deviation
Age in Years		46	60	51.12	4.46
Femoral articular cartilage thickness (mm) in the knee joint	Medial	0.8	4.1	1.99	0.57
	Central	0.9	3.9	2.01	0.59
	Lateral	0.6	3.6	1.95	0.58
	Mean	1.00	3.60	1.98	0.48

Figure Legends

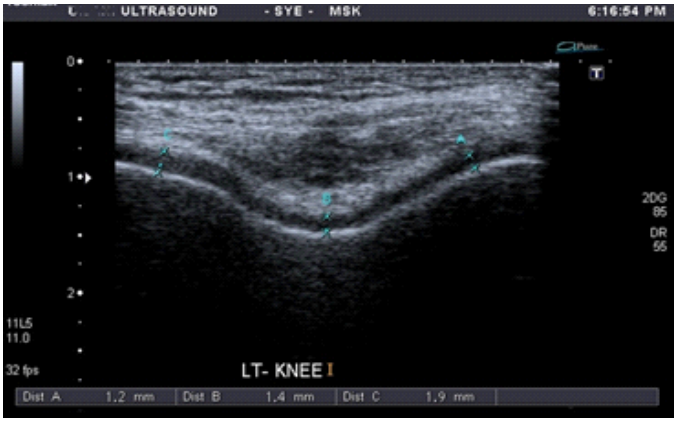
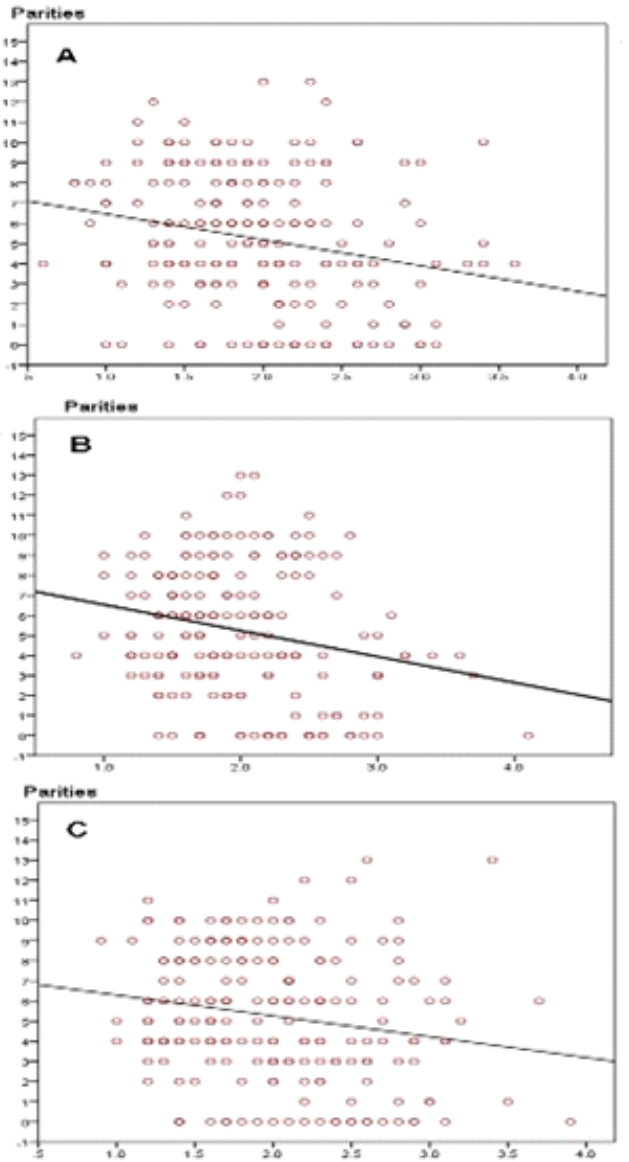


Figure 1: *The Ultrasound image shows the femoral articular cartilage of the left knee of 55-year-old women, acquired during hyperflexion of the knee joint. The vertical measurements of the cartilage are taken from lateral, central and medial facets as 1.2, 1.4 and 1.9mm respectively.*



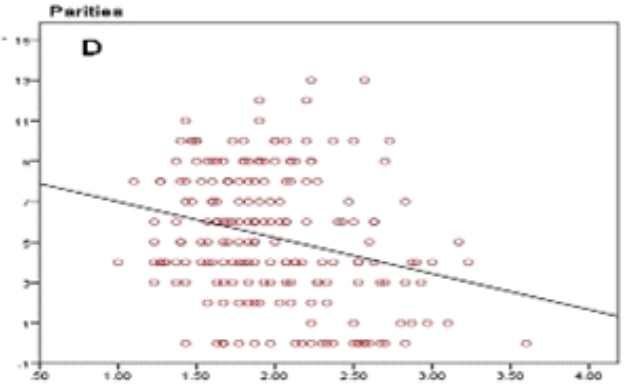


Figure 2: *The scatterplot shows the relationship between femoral articular cartilage and parity. A) The X-axis shows the lateral aspect of the femoral articular cartilage while Y-axis shows parity. B) The X-axis shows the medial aspect of the femoral articular cartilage while Y-axis shows parity. C) The X-axis shows the central part of the femoral articular cartilage while Y-axis shows parity. D) The X-axis shows the lateral aspect of the femoral articular cartilage while Y-axis shows parity. The sloop of the reference line in all the four images show us the relation between cartilage thickness and parity. Steeper the sloop stronger the relation which is seen in C and D gradual the sloop weaker the relation as shown in A and B.*

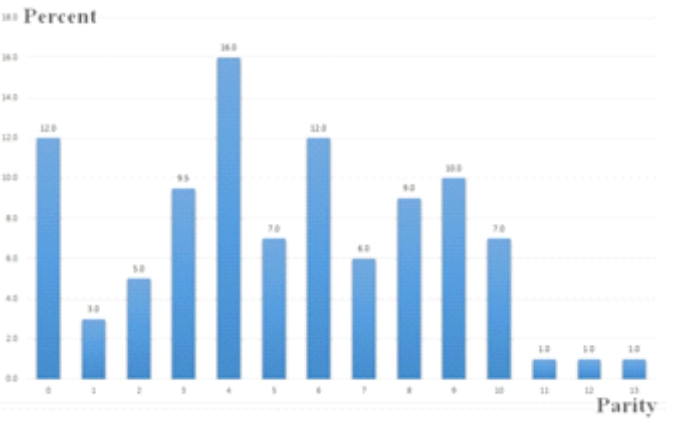


Figure 3: *In the Bar-graph, X-axis shows us parity (number of delivery) and the Y-axis shows the percentage of postmenopausal women included in this study.*

Discussions:

Femoral articular cartilage in the knee joint can very easily be evaluated with the help of ultrasound and clinically its thickness, consistency and shape are very important in the diagnosis of a myriad of knee joint pathologies. The wear and tear of the cartilage which covers the articular facet of the femur could be caused

by a variety of risk factors. There are many causes of knee joint pain, such as a ruptured ligament or torn cartilage, meniscal tear, bone degeneration, and muscular contusion to medical conditions such as arthritis, gout, infections, cyst, and masses. Diabetes, hypertension, age (46-60 years), gender (i.e. female), overweight (obesity), injury of knee(s), tedious use of joints, bone density, muscle weakness, and joint laxity all are considered risk factors for the development of knee pain. However, it was routinely observed in the multiparous women in their postmenopausal age that they were complaining of back and knee joint pain. To confirm either multiparity is a factor contributing to the development of knee joint pain or not? For this purpose, the current study was commenced by the inclusion of 100 (200 knees) postmenopausal women with knee pain. However, patients having other known risk factors and causes as mentioned above were excluded. In the current study, the mean age of the patient was 51.12 (46 to 60) years. A strong negative correlation was observed between the parity of articular cartilage thickness on the lateral, medial and central part of the articular cartilage. The correlation was significant at 0.01 level, which means a female gave birth to a smaller number of kids having thick articular cartilage while those who delivered a greater number of offspring had thin articular cartilage (Table 1). In a study, the femoral articular cartilage was measured in 40 knees (20 symptomatic and 20 asymptomatic knees) including male and female both the genders. In both the cases and control groups, the age range was similar. As in the current study, they have also measured the articular cartilage thickness at three different locations (lateral, central and medial) in each knee. The thickness at these three different facets were compared between symptomatic and asymptomatic individuals. Three musculoskeletal sonologists were assigned those ultrasound images to report for femoral cartilage clarity, grade, and presence or absence of cartilage calcifications, osteophytes, and subchondral bony irregularity. It was requested to the sonologists to grade the severity of the lesions in every three regions (lateral, central and medial) of the articular. They found a significant variation in the cartilage clarity and thickness in diseased and normal knees with a p-value of 0.02. It was concluded that femoral articular cartilage abnormalities could easily be evaluated in the knee joint, it is therefore indicated to be used in adjunct to other imaging modalities for its evaluation[20]. Another study with aimed to determine the association of parity with cartilage defects and volume. For this purpose, they include 489 postmenopausal women. It was observed that an increase in the number of child delivery was associated with decreasing cartilage volume in the knee joint[21]. It means there was a negative relation between parity and femoral articular cartilage thickness as seen in the current study (Table 1). For the determination of the association of parity with knee pain, a study was conducted on Korean women. Therefore, they included more than five thousand women of 50 years of age and concluded that parity is a risk factor of osteoarthritis[22]. In the current study it was seen that with an increase in the number births the femoral articular cartilage was decreased in size (Figure 3).

Articular cartilage thickness was observed to vary with parity greater the number parity thinner the femoral articular cartilage and vice versa. Mean standard deviation and range of articular cartilage at lateral, central and medial facets is shown in Table 2. In a cross-sectional study conducted on 144 women age ranging from 31 to 41 to determine the association between parity and cartilage volume, it was concluded that Parity was linked with knee cartilage defects[23]. A case-control study of 101 patients more than fifty years of age was conducted to determine whether parity is a risk factor of knee joint pain or not. It was observed that parity was linked with knee osteoarthritis in this study p=0.001(24). It was observed that there was very little difference between the mean cartilage thickness at lateral and medial side 1.95mm and 1.99mm respectively, however, the central part of the cartilage was comparatively more thickened, measuring 2.0mm in all the participants. In a study, the mean cartilage thickness was measured with the help of magnetic resonance imaging over a predefined region in the femoral plate on lateral, medial and central regions of the femoral articular facets in 40 individuals[25]. The cartilage thickness was 2.29mm on Medial, 2.32mm on Lateral, 3.19mm in the Central part. Although the results of ultrasound and magnetic resonance imaging were significantly different from each other, however, the sidewise results of both the modalities are similar. The lateral side articular cartilage was comparatively thin

than medial and central part on ultrasound as well as on magnetic resonance imaging. While the central part was the thickest of all both on ultrasound and magnetic resonance imaging (Table #3).

Conclusion:

A significant negative relation between parity and femoral articular cartilage thickness at lateral, central and medial aspect, in the knee joint, in postmenopausal women. With an increase in the number of deliveries, the femoral articular cartilage decreases in size and vice versa. So, multiparity is a potential cause of the articular cartilage degradation in joints of knee joint.

Ethical Approval: Given
Conflict of Interest: The authors declare no conflict of interest.
Funding Source: None

References:

1. Heidari B. Knee osteoarthritis prevalence, risk factors, pathogenesis and features: Part I. Caspian journal of internal medicine. 2011; 2(2):205.
2. Boudabbous S, Neroladaki A, Bagetakos I, Hamard M, Delattre BM, Vargas MI. Feasibility of synthetic MRI in knee imaging in routine practice. Acta radiologica open. 2018;7(5):1-9.
3. Björkman A-S, Koskinen SK, Lindblom M, Persson A. Diagnostic accuracy of dualenergy CT for detection of bone marrow lesions in the subacutely injured knee with MRI as reference method. Acta Radiologica. 2020;61(6):749-59.
4. Karimzadeh H, Rafiei R, Sayedbonakdar Z, Karami M. Agreement of clinical examination and ultrasound methods for detection of joints involvements in rheumatoid arthritis. Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences. 2017;22(1):87.
5. Sudoł-Szopińska I, Jans L, Teh J. Rheumatoid arthritis: what do MRI and ultrasound show. Journal of ultrasonography. 2017;17(68):5.
6. Doria AS, Keshava SN, Mohanta A, Jarrin J, Blanchette V, Srivastava A, et al. Diagnostic accuracy of ultrasound for assessment of hemophilic arthropathy: MRI correlation. American Journal of Roentgenology. 2015;204(3):336-47.
7. Gellhorn AC, Stumph JM, Zikry HE, Creelman CA, Welbel R. Ultrasound measures of muscle thickness may be superior to strength testing in adults with knee osteoarthritis: a cross-sectional study. BMC musculoskeletal disorders. 2018;19(1):1-8.
8. Endo T, Abe T, Akai K, Kijima T, Takeda M, Yamasaki M, et al. Height loss but not body composition is related to low back pain in community-dwelling elderlies: Shimane CoHRE study. BMC musculoskeletal disorders. 2019; 20(1):1-7.
9. de Miguel E, Pecondon-Espanol A, Castaño-Sánchez M, Corrales A, Gutierrez-Polo R, Rodriguez-Gomez M, et al. A reduced 12-joint ultrasound examination predicts lack of X-ray progression better than clinical remission criteria in patients with rheumatoid arthritis. Rheumatology international. 2017;37(8):1347-56.
10. Stuchin SA. Extra-Articular Deformities and the Role of Hip Resurfacing. Bulletin of the NYU hospital for joint diseases. 2009;67(2): 135-137.
11. Hussain S, Cicuttini F, Alyousef B, Wang Y. Female hormonal factors and osteoarthritis of the knee, hip and hand: a narrative review. Climacteric. 2018; 21(2):132-9.
12. Aljary H, Czuzoj-Shulman N, Spence AR, Abenhaim HA. Pregnancy outcomes in women with rheumatoid arthritis: a retrospective population-based cohort study. The Journal of Maternal-Fetal & Neonatal Medicine. 2020;33(4):618-24.
13. Heronemus MJ, Rabe K, Tolstykh I, Gross KD, Wise BL, Nevitt MC, et al. The association of parity with greater dynamic pronation of the feet. PM&R. 2021;13(2):144-52.
14. Hassan R, Hussain S, Bacha R, Gillani SA, Malik SS. Reliability of ultrasound for the detection of rheumatoid arthritis. Journal of medical ultrasound. 2019;27(1):3.
15. Bacha R, Manzoor I, Gilani SA. Sonographic presentation of rice bodies in subacromial-subdeltoid chronic bursitis. The ultrasound journal. 2019;11(1):1-5.
16. Manzoor S. Diagnostic Accuracy of Ultrasound in Detection of Synovial Hypertrophy in Patients

with Osteoarthritis. Journal of Rawalpindi Medical College. 2017;21(4):366-70.

17. Mohammad S, Bacha R, Ullah H, Manzoor I. Sonographic comparison of patellar tendon thickness with height in chronic diabetic patients and normal individuals. Orthop Res Rev. 2018; 2(2):1-6.
18. Ullah S, Bacha R, Gilani SA, Asif HM, ul Hasan Z, Sharif Z, et al. Sonographic Association of Prostate Volume with Post Micturition Residual Volume in Benign Prostate Hyperplasia. RADS Journal of Pharmacy and Pharmaceutical Sciences. 2018;6(2):107-12.
19. Abbasi TA, Gilani SA, Bacha R, Fatima W. Comparison of Doppler and Greyscale Compression Sonography in the Diagnosis of Deep Vein Thrombosis. Annals of King Edward Medical University. 2018;24(4):966-73.
20. Kazam JK, Nazarian LN, Miller TT, Sofka CM, Parker L, Adler RS. Sonographic evaluation of femoral trochlear cartilage in patients with knee pain. JUM. 2011;30(6):797-802.
21. Wei S, Venn A, Ding C, Martel-Pelletier J, Pelle-tier J-P, Abram F, et al. The associations between parity, other reproductive factors and cartilage in women aged 50–80 years. Osteoarthr Cartil. 2011;19(11): 1307-13.
22. Kim SM, Cheon J-Y, Park Y-G, Kim H-R, Shin JC, Ko HS. The associations between parity, other reproductive factors, and osteoarthritis in women aged over 50 years; data from the Korean National Health and Nutrition Examination Survey V (2010–2012). Taiwan J Obstet Gynecol. 2017; 56(2):153-8.
23. Wei S, Jones G, Venn A, Cicuttini F, March L, Otahal P, et al. The association between parity and knee cartilage in young women. Rheumatology. 2012;51(11):2039-45.
24. Triyadi A, Pramudiyo R, AR JI. Association of Obesity, Parity, and History of Knee Injury with Knee Osteoarthritis in Female. Althea Med J. 2015;2(4):492-6.
25. Favre J, Scanlan SF, Erhart-Hledik JC, Blazek K, Andriacchi TP. Patterns of femoral cartilage thickness are different in asymptomatic and osteoarthritic knees and can be used to detect disease-related differences between samples. J Biomech Eng. 2013;135(10):1-10.