

## **Relation of Reproductive Factors and Heel Quantitative Ultrasound Parameters in Normal Women of Tehran**

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### **Abstract**

Quantitative Ultrasound (QUS) is a noninvasive, inexpensive and portable method for bone densitometry. It may measure some other parameters in addition to BMD, like elasticity and micro architecture. This study designed to determine the relation between reproductive factors and calcaneus QUS parameters in normal women of Tehran. BMD of heel in 151 normal women, 20-72Y/O (participator of Iranian Multi center Osteoporosis Study) was assessed using Achilles+ (GE, Lunar Corporation, USA). After assessment of normal values, Stiffness Index percentiles acquired. With consideration of correlation between variables, multiple regression analysis was used. Mean±SD values of Speed of Sound (SOS), Broad Band Ultrasound Attenuation (BUA) and Stiffness Index (SI), was 36/75±1527/25, 121/42±15/1, 94/46±17/92, respectively. Parameters decreased with age ( $P<0/01$ ). Years of menopause significantly related with QUS parameters and age of menopause significant related with SOS and SI. Results show effectiveness of some reproductive factors on QUS parameters.

**Keywords:** *BMD, QUS, Reproductive factors, Menopause*

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### **Introduction**

Osteoporosis is a systemic disease of bone that is determined by reduced bone density and changes of bone micro architecture (1). It causes general bone fragility and pathologic fractures in different parts of body. Osteoporotic fractures are an important cause of excess morbidity and mortality among elderly individuals (2) and pathologic fracture of femoral neck is the most important kind of such fractures.

Osteoporosis is defined by reduction of BMD to 2.5 SD below bone mineral density of young normal population and DXA (Dual X-ray Absorptiometry) is the gold standard method for diagnosis of it (1). However it seems that other factors (other than bone mineral density) like

elasticity and biomechanical characteristics of bone are also important in bone fragility. DXA is not a good method for assessment of such characteristics, so methods like QUS (quantitative ultrasound of bone) with their ability in assessing of such characteristics are now appreciated as novel methods for assessing the bone (3,4). DXA, also, is not readily available everywhere and its cost is relatively high. The use of cheaper technologies such as QUS, potentially easily available in most first-level medical centers, might provide a convenient alternative to DXA (2).

Little is know regarding the relationship of QUS to risk factors that have been found to predict DXA-BMD values (2). There is not a

good correlation between QUS and DXA in diagnosis of osteoporosis. An Iranian study showed it 0.29-0.35 and other studies showed it 0.2-0.8 (5-7), but some studies showed QUS can differentiate between women with fragility fracture and women without it (8) and predict the pathologic fractures (9,10).

QUS measures SOS (speed of sound) and BUA (broad band ultrasound attenuation) in bone (4, 5). And after that calculates SI ( $SOS - 420 \times BUA + 0 / 28 \times \text{Stiffness Index} = 0 / 67$ ) as an index for fracture Prediction. Some studies showed that SOS is influenced by the elasticity of bone as well as by its density and BUA is determined by mechanisms of diffraction, scattering and absorption in the bone, marrow and soft tissue (11).

As the above matters, QUS may be able to be used for assessing the effects of factors that affect the calcium metabolism in body, but their effects can't be seen using Dual X-ray Absorptiometry. Some of these factors are pregnancy, abortion and breast feeding (12, 13) or years since menopause in women (2). Different studies showed different effects of above factors on QUS parameters (14-19) that are some opposite to each other. On the other hand there are differences in quality and quantity of bone in different countries and different races and ethnic, So we planned this study to assess the effects of reproductive factors on QUS parameters in normal Iranian women.

## Methods and materials

**Subjects** 151 normal women, 20-72Y/O, participants of IMOS study (Iranian Multi-center Osteoporosis Study) entered our study. IMOS was a study with randomize cluster sampling of Tehran women without known osteoporosis risk factors,. All subjects gave informed consent and completed a questionnaire about the demographic and reproductive factors, and all were evaluated by QUS at the heel.

**QUS evaluation** The QUS measurements were carried out with an Achilles apparatus (Lunar Corporation, Madison, Wisconsin, 53713.USA). Operators were trained and skillful.

**Statistical procedures** At the first, all of reproductive variables were evaluated for the correlation between each couple of them with use of correlation matrix. According the multiple regression method, all of independent reproductive variables that had correlation coefficient  $> 0.8$  were excluded. The excluded variables consisted of: number of pregnancy, duration of breast feeding, reproductive period (difference of age menarche and menopause) and the time of reproductive period that spend with pregnancy in any woman. The included variables consist of: number of delivery, age of menarche, age of menopause and years since menopause.

Then multiple linear regression with backward method was used. The relation between the variables and QUS parameters analyzed by two ways; univariate and multivariate (with control of the role of the other variables) and then reported in these cases: unadjusted correlation coefficient (first state) and adjusted correlation coefficient (second state).

## Results

Characteristics of participators are demonstrated in table 1. Mean values of SOS, BUA and SI, in according, was  $1527/25 \pm 36/75$ ,  $121/42 \pm 15/1$  and  $94/46 \pm 17/92$ . SI percentiles (2.5, 50 and 97.5) (Fig. 1). QUS parameters showed a significant decrease with age ( $P < 0.01$ ). After adjustment, Relation of age of menopause and years since menopause was significant with SOS and SI ( $P < 0.01$ ) and only years since menopause had a relation with BUA. Relation of number of deliveries and age of menarche was not significant with QUS parameters (Table 2).

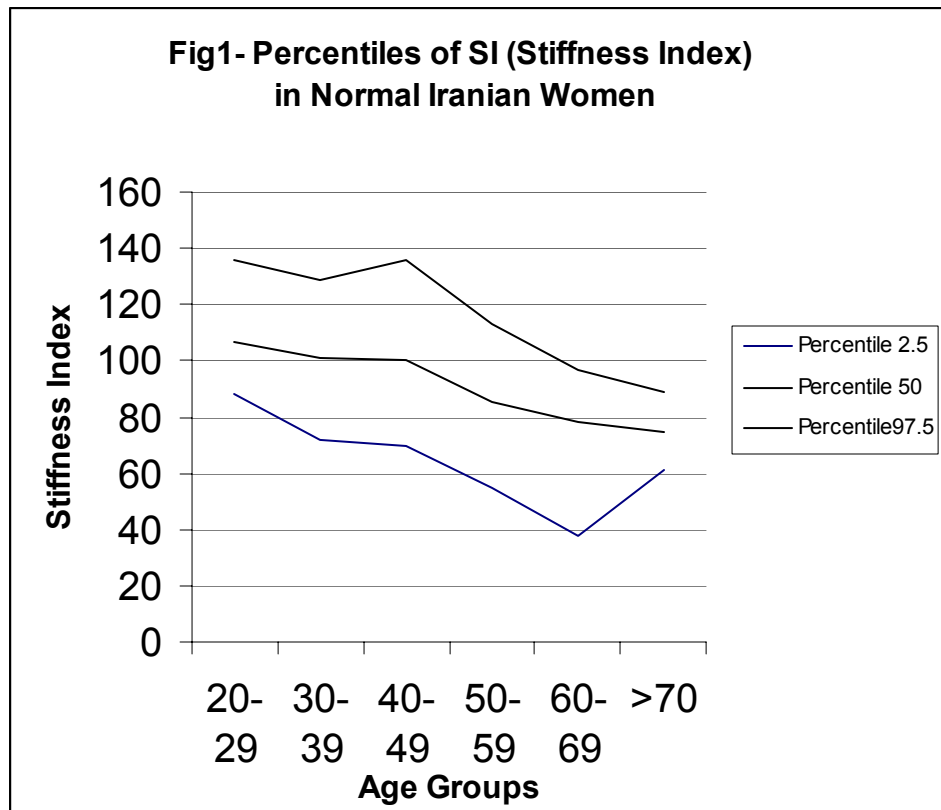
**Table 1:** Characteristics of participator

Parameters	Age	BMI	Age of menopause	Years since menopause	Gravities	Deliveries	Abortions	Months of breast feeding
Mean ±SD	42.6±12.1	27.9±5.1	47.5±5.9	9.8±7	3.8±2.6	3.1±2.2	0.7±1	54/6±56.6

**Table 2:** Correlation between Reproductive Factors and QUS Parameters

QUS parameters Reproductive factors	SDS		BUA		SI	
	u.c.c●	a.c.c●●	u.c.c	a.c.c	u.c.c	a.c.c
Age of menarche	-0.12	—	0.12	—	-0.02	—
Number of parturition	-0.34**	—	-0.18*	—	-0.31**	—
Age of menopause	0.04	0.352*	0.02	—	0.04	-0.36*
Years since menopause	-0.45**	-0.66**	-0.37*	-0.39	-0.46**	-0.68**

- Unadjusted correlation coefficient
- adjusted correlation coefficient
- \*\*  $P < 0.01$
- \*  $P < 0.05$



## Discussion

DXA method is the gold standard for osteoporosis diagnosis (1). DXA machines are non-portable, expensive devices that use X-ray for diagnosis. QUS at the heel can now be considered as an alternative technique to identify subjects with a high risk of bone fragility (11), so we planned this study to assess the effects of reproductive factors on QUS parameters in normal Iranian women.

In our study, QUS parameters (SOS, BUA, SI) had significant relationship with age, age at menopause and years passed after menopause, that is similar to before studies (14-16). Menopause is an important factor of bone loss in women, According to our results; years since menopause is the strongest predictors of decreased SoS (0.66), BUA (0.39) and SI (0.68), but effects of years after menopause was not clear on changes related to age.

Some studies considered the effect of breast feeding and pregnancy on QUS parameters (3-4, 12-14, 20-21) but we excluded these factors because strong correlation between them and other reproductive variables. About age at menarche, results are different, some studies obtained no significant relationship between it and QUS parameters (22) and some on the contrary (23).

Among the QUS parameters provided by the Achilles+ we we found that percentiles is better related to any risk factor. Acceleration of bone loss early after menopause is visible in diagram of SI percentiles (fig.1).

Conclusively, the QUS evaluation might be of interest since it detects structural or other characteristics of bone tissue, different from those measured by DXA (2,11). In our study, Stiffness Index was positively related to age of menarche and menopause, deliveries and years since menopause but after a multivariate analysis only age of menopause and years after menopause, remained significantly correlated. However we conclude that, risk factors usually associated with DXA-BMD are also associated

to calcaneal bone SI as measured by QUS. Also with invariable age of menopause with every year after menopause, SOS is decreased for 3.7 unit, BUA diminishes unitary and SI reduces a pair of units with every year passing after menopause.

It is necessary more longitudinal and multidimensional studies for Establishment of this suggestion.

## Acknowledgments

The authors would like to thank S. Shirazi, P. Athari and F.Zare for their valuable assistance.

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