

## Geographic Variation in low BMD Incidence Relying on the Predictive Indicator T-score

**Received:** 19 October 2022, **Revised:** 26 November 2022, **Accepted:** 24 December 2022

### Eiman Shahrour 1\*

1Department of Biochemistry and Microbiology, Faculty of Pharmacy, Tishreen University, Ministry of High Education, Lattakia, Syria; eimanm.shahrour@gmail.com

### Bassel AL-Halabi 2,

2Department of Molecular Biology and Biotechnology, Human Genetics Division, Atomic Energy Commission, Damascus, Syria.; mbalhalabi@aec.org.sy

### Amir N Dabboul<sup>3</sup>

3Department of Molecular Biology and Biotechnology, Human Genetics Division, Atomic Energy Commission, Damascus, Syria.; Adabboul@aec.org.sy

### Walid Al-Achkar<sup>4</sup>,

4Department of Molecular Biology and Biotechnology, Human Genetics Division, Atomic Energy Commission, Damascus, Syria.; walashkar@aec.org.sy

### Abd Alrazak Hassan<sup>5</sup>,

5Department of Internal medicine, Faculty of Medicine, Tishreen University, Ministry of High Education, Lattakia, Syria ; dr.abd.hassan@gmail.com

### Atieh Khamis<sup>6</sup>,

6Department of Biochemistry and Microbiology, Faculty of Pharmacy, Tishreen University, Ministry of High Education, Lattakia, Syria

### Haissam Yazigi<sup>7</sup>

7 Department of Laboratory Diagnosis, Faculty of Medicine, Tishreen University, Ministry of High Education, Lattakia, Syria ; dr.h.yazigi@gmail.com

### \*Corresponding Author: Eiman Shahrour

EMIAL: eimanm.shahrour@gmail.com; Tel.: +963945638291

### Key Words:

Femur BMD, lumbar BMD, urbanization, rural region

### Abstract:

Background and aims: Many factors affect bone mineral density BMD, such as genetic, nutritional, environmental, physical activity and health status. The goal is to study the effect of urbanization on the BMD of the Syrian society and to know the prevalence rates of BMD cases as a diffusion study. Methods: The study included 150 participants who visited the clinic of rheumatology at Tishreen University Hospital, Lattakia, Syria. All participants were women with pre-menopause or post-menopause. A questionnaire was filled with various clinical and personal information, including place of residence. BMD was measured using DEXA. Descriptive statistical frequently test was used to calculate the ratios of the distribution of BMD values among different geographical regions. Results: According to geographical regions (outskirts, city, northern countryside, eastern countryside, western countryside, southern countryside), the highest percentages of BMD status for femur and lumbar BMD, respectively are (41.4% normal, 41.4% osteopenia) (55.4% normal, 46.4% osteopenia) (55.6% normal, 55.6% osteopenia) (61.1% normal, 50% osteopenia) (40% normal, 40% osteoporosis) (42.9% osteopenia, 42.9% osteoporosis), respectively. In the Syrian coast and Syria in general, the prevalence rates of the three BMD statuses (normal, osteopenia, osteoporosis) are 49.3%, 32%, 18.7%, respectively for femur BMD, 32.7%, 43.3%, 24%, respectively for Lumbar BMD. Discussion: It is the first study of its kind in Syria. In all geographic regions except for the southern countryside, the highest rates are for normal BMD in the femur

# Journal of Coastal Life Medicine

region and for low BMD(osteopenia) in the lumbar region. Approximately equal proportions between the countryside and the city show the slight impact of urbanization on Syrian society. As for the southern countryside, the highest percentages are for low BMD(osteopenia) in the femur region and low BMD(osteoporosis) in the lumbar region . Conclusions: The southern countryside suffers from low BMD at the highest rate among the studied geographical areas. The negative impact of urbanization on BMD appears slightly. And there are no obvious effects of the economic war in Syria on BMD.

## 1. Introduction

Morbidity and mortality associated with hip fracture is a major public health concern [1-5]. Suboptimal bone mineral density (BMD) Can contribute to osteoporotic hip fracture [1,5]. A previous systematic review showed moderate evidence for lower fracture rates in rural areas compared to urban areas [6] There is therefore a need to examine the effect of urbanicity on bone mass accrual and loss[5]. An adverse effect of urbanization on bone health is thought to be responsible. Urbanization is associated with several lifestyle factors which are potentially deleterious for bone including reduced weight bearing physical activity, smoking and alcohol intake, availability of sugary and fatty foods, and less outdoor activities leading to reduced vitamin D stores.[7,8] There have been very few studies examining relationships between urbanization and bone mass per se. In a study comparing bone mineral density (BMD) between rural and urban populations in Thailand, femoral neck BMD was found to be higher in males and females living in rural areas compared with urban dwellers from Bangkok, while little difference was observed at the lumbar spine [9]. The observed difference at the hip but not the lumbar spine is consistent with the hypothesis that reduced weight bearing physical activity makes at least some contribution to the apparent increase in risk of hip fracture following urbanization[10]. Although the underlying reason for this trend is largely unknown. Measurement of bone mineral density (BMD) is considered the primary predictor of fracture risk .Therefore, it could be hypothesized that the urban-rural difference in fracture incidence is partly explained by the urban-rural difference in BMD[11]. Bone densitometry tools like dual-energy x-ray absorptiometry (DXA) have been used for the assessment of bone mass and density. These data enable assessment of association between urbanicity and BMD[12] Some previous studies reported that rural subjects had higher BMD or bone mineral content (BMC) than those urban subjects [13,14], but another study found no such difference [15]. The pace of urbanization in

developing countries is more pronounced than in developed countries. Therefore, developing countries are ideal settings for studying the urban-rural difference in BMD. So, Syria is a good example for studying, especially as it is a country that suffered from war that affected the economic level of the people.

## 2. Methodology

The study included 150 participants who visited rheumatology clinic at Tishreen University Hospital, Lattakia, Syria, throughout the period between March 2019 and September 2021, which was interspersed with interruptions due to the Corona pandemic. The work was approved by the Ethics Committee in Syrian Ministry of High Education, and prior written consents were obtained from all the participants.

All of the participants were interviewed using a structured questionnaire. The questionnaire included socio-demographic characteristics, work habits, physical activity, medication history, age, age of beginning and end of menstrual, pregnancy and number of children, history of family orthopedic complaint, clinical history of bone pain , measurements of height and weight, body mass index BMI (kg/m<sup>2</sup>), data of fractures, lumbar and femur Z-score, lumbar and femur T-score. All participants were women with pre-menopause or post-menopause. They were from different families. Blood phosphorous and calcium values were collected from patients' files. The controls had high or normal T-score for both femur and lumbar T-score. All patients with hypertension, diabetes, osteomalacia, surgical menopause and cancer were excluded. Participants were divided into 5 groups according to geographical distribution.

### Bone densitometry

The bone mineral density (BMD; g/cm<sup>2</sup>) of the lumbar spine (L1-L4) and left femur as measured by dual energy X-ray absorptiometry (DXA) (Medix DR, France). All DXA scans were conducted by a

# Journal of Coastal Life Medicine

specially trained specialist. BMD Results were converted to age- and gender-specific Z-score that matched normal Caucasians. The samples were classified into 3 groups (normal, osteopenia, and osteoporosis) according to the World Health Organization classification of T-score values.

### Statistical study:

Statistical analysis was performed using SPSS computer software version 20 (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp; 2011). Descriptive statistical frequently test was used to get the frequency of BMD cases in the femur and lumbar region after dividing the participants according to the geographical areas (Outskirts, city, southern countryside, northern countryside, western countryside, eastern countryside).

### 3. Result:

All data about age, age of beginning and end of menstrual, pregnancy and number of children, history of family orthopedic complaint, bone complaint, measurements of height and weight, body mass index BMI (kg/m<sup>2</sup>), data of fractures, classification of cases according to WHO\*, are contained in the table below table,1. All participants had normal blood concentrations of calcium and phosphorous.

#### Variable Case

Total number	150
Age	60(40, 80)
Age of beginning of menstrual	14(11, 17)
Age of end of menstrual	50.5(46, 55)
Weight	69.5(40,99)
Height	165(150,180)
BMI	29.69(17.99, 41.4)
Data on fractures(YES/NO)	85/65
History of family orthopedic complaint(YES/NO)	56/94
Clinical history of bone complaint(YES/NO)	139/11

L2-L4(lumbar) Z-score (-4.1, 3.1)

L2-L4 (lumbar)T-score (-5.6, 1.2)

Femur Z-score (-1.9, 1.1)

Femur T-score (-2.2, 1.1)

Normal(T-score ≥1) \*

Osteopenia (-2.5) < T-score <(-1)

Osteoporosis T-score ≤ (-2.5)

Total 74

48

28

150

\* World Health Organization Definition of Osteoporosis by T-score values

**Table.1:** Clinical, laboratory, demographic and radiological information for participants

The number of participants according to the geographical areas are (29/Outskirts, 56/city,14/southern countryside,18/northern countryside, 15/western countryside, 18/eastern countryside). Results of descriptive statistical frequently test with & without division according geographical areas and the percentage of bone statuses are shown in table2.

Results %	DEXA	Geographical area		
		osteoporosis	osteopenia	normal
27.6	31	41.4	Femur left	Outskirts
24.1	41.4	34.5	Lumbar	
12.5	32.1	55.4	Femur left	City
19.6	46.4	33.9	Lumbar	
16.7	27.8	55.6	Femur left	Northern countryside
22.2	55.6	22.2	Lumbar	
28.6	42.9	28.6	Femur left	Southern

# Journal of Coastal Life Medicine

countryside				
42.9	28.6	28.6	Lumbar	
11.1	27.8	61.1	Femur left	Eastern
countryside				
11.1	50	38.9	Lumbar	
26.7	33.3	40	Femur left	Western
countryside				
40	26.7	33.3	Lumbar	
18.7	32	49.3	Femur left	Total
24	43.3	32.7	Lumbar	

**Table2:** Results of descriptive statisticaal frequently test with& without division according geographical areas

## 4. Discussion

It is the first study of its kind which is done in Syria. In all geographic regions except for the southern countryside, the highest rates is for normal BMD in the femur region and low BMD in the lumbar region (osteopenia). This is consistent with the studies that confirm that the normal BMD in countryside is higher[16-18]. As for the city, the higher percentage of the normal BMD, unlike studies that confirm the negative effect of urbanization on BMD[16-18]. The majority of the participants could be explained by city inhabitants, but from rural origins. Mean, the period of peak bone mass formation (25-30) years was in rural regions. Also, the study group is postmenopausal women only. And reference studies study both genders, this could be a reason for this suspiciousness.

As for the southern countryside, the higher percentages of low BMD in the femur region (osteopenia) and low BMD in the lumbar region (osteoporosis). These results differ with the results of studies that confirm that BMD in the countryside is higher than BMD in the city[16-18]. This may be explained by genetic, environmental, or economic reasons that require a deeper study. It is noted that the impact of the war situation in Syria on the bone mass is generally mild. The prevalence rates of the three BMD cases(normal, osteopenia, osteoporosis) on the Syrian coast in particular and Syria in general are

49.3%,32%,18,7%, respectively for femur BMD, 32.7%, 43.3%, 24%, respectively for Lumber BMD.

The limitations of this study are the number of participants is small, and of only one sex. They are only postmenopausal women.

## 5. Conclusion:

The southern countryside suffers from a low BMD at the highest rate among the geographical areas studied. The negative impact of urbanization on BMD appears slightly. And there are no obvious effects of the economic war in Syria on BMD.

**Author Contributions:** Conceptualization, E.SH and H.Y. and A.H. ; methodology, E.SH., H.Y., A.H., W.A, B.H., and A.D. ; software, E.SH; validation, H.Y , A.H. , W.A, A.D., and B.H.; formal analysis, E.SH; investigation, E.SH, A.D., and B.H.; resources, E.SH; data curation, E.SH.; writing—original draft preparation, E.SH.; writing—review and editing, E.SH, H.Y., A.H.,W.A ; visualization, H.Y.; A.H. supervision H.Y, A.H and A.KH.; project administration, W.A, A.H and H.Y. ; funding acquisition, E.SH. All authors have read and agreed to the published version of the manuscript.”

**Funding:** This research received no external funding

**Declaration:** I confirm that this work is a part of an approved PhD thesis which was approved by university board’s decision No.1698 of 05/02/2019, and this work is an original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere.

**Ethical approval statement:** The work was approved by the Ethics Committee in Syrian Ministry of Higher Education and written informed consent was obtained from all the participants according to the Declaration of Helsinki.

**Informed Consent Statement:**“Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

**Data Availability Statement:** The data that support the findings of this study are available from the corresponding author (Eiman M. Shahrour), upon

# Journal of Coastal Life Medicine

reasonable request. All relevant material is included in this publication

**Acknowledgements:** We express gratitude to our Research Team, Faculty of Pharmacy of Tishreen University and Atomic Energy Commission of SYRIA (AECS) for their support. Big thanks to Dr. **Jean-Yves Reginster** and Dr. **Didier Hans** and Dr. **Stephen Dolye** for their support. Thanks for Dr. **Nizar Mirali**. Thanks to Sir. **Ayman albloj**, Ms. **Sarah Reslan** and Pharmacist. **Mohammed Kbeili**.

## Conflict of Interests

Eiman shahrour , Bassel AL-Halabi , Amir N Dabboul, Walid Al-achkar, Abd Alrazak Hassan, Atieh Khamis, and Haissam Yazigi declare that they have no conflict of interest.

## References

- [1] Abdul Razak, H.; Kaser, A.; (2014) Rheumatology locomotor system diseases. Tishreen university publications.
- [2] Brauer CA, Coca-Perrillon M, Cutler DM, Rosen AB. Incidence and mortality of hip fractures in the United States. *JAMA J Am Med Assoc.* 2009 Oct 14; 302(14):1573-9.
- [3] Vestergaard P, Rejnmark L, Mosekilde L. Increased mortality in patients with a hip fracture-effect of pre-morbid conditions and post-fracture complications. *Osteoporos Int J.* 2007 Dec; 18(12):1583-93.
- [4] Kanis JA, Oden A, Johnell O, De Laet C, Jonsson B, Oglesby AK. The components of excess mortality after hip fracture. *Bone.* 2003 May; 32(5):468-73. PMID: 12753862
- [5] Marks R, Allegrante JP, Ronald MacKenzie C, Lane JM. Hip fractures among the elderly: causes, consequences
- [6] Brennan SL, Pasco JA, Urquhart DM, Oldenburg B, Hanna FS, Wluka AE. The association between urban or rural locality and hip fracture in community-based adults: a systematic review. *J Epidemiol and control. Ageing Res Rev.* 2003 Jan; 2(1):57-93. PMID: 12437996
- [7] Drake MT, Murad MH, Mauck KF, Lane MA, Undavalli C, Elraiyah T, et al. Risk Factors for Low Bone Mass-Related Fractures in Men: A Systematic Review and Meta-Analysis. *J Clin Endocrinol Metab.* 2012 Mar 30; 97(6):1861-70. doi: 10.1210/jc.2011-3058 PMID: 22466344
- [8] Bachrach LK. Acquisition of optimal bone mass in childhood and adolescence. *Trends Endocrinol Metab TEM.* 2001 Feb; 12(1):22-8. *Community Health.* 2010; 64: 656-665. doi: 10.1136/jech.2008.085738 PMID: 19692712
- [9] Pongchaiyakul C, Nguyen TV, Kosulwat V, Rojroongwasinkul N, Charoenkiatkul S, Rajatanavin R. Effect of urbanization on bone mineral density: a Thai epidemiological study. *BMC Musculoskelet Disord.* 2005; 6: 5. doi: 10.1186/1471-2474-6-5 PMID: 15693996
- [10] Heli V., Yoav B., Sanjay K., Shah E., Hannah K., Radhakrishna K., Bharati K., Jon T. Urban-Rural Differences in Bone Mineral Density: A Cross Sectional Analysis Based on the Hyderabad Indian Migration Study. *PLoS ONE* 10(10): e0140787. doi:10.1371/journal.pone.0140787
- [11] Kanis JA: Diagnosis of osteoporosis and assessment of fracture risk. *Lancet* 2002, 359:1929-1936.
- [12] Mika M., Rashmi P., Bharati K., Sanjay K., Comparison of Bone Mineral Density between Urban and Rural Areas: Systematic Review and Meta-Analysis *PLoS ONE* 10(7): e0132239. doi:10.1371/journal.pone.0132239
- [13] Sundberg M, Duppe H, Gardsell P, Johnell O, Ornstein E, Sernbo I: Bone mineral density in adolescents. Higher values in a rural area – a population-based study of 246 subjects in southern Sweden. *Acta Orthop Scand* 1997, 68:456-460.
- [14] Gärdsell P, Johnell O, Nilsson BE, Sernbo I: Bone mass in an urban and a rural population: a comparative, population-based study in Southern Sweden. *J Bone Miner Res* 1991, 6:67-75.
- [15] Filip RS, Zagorski J: Bone mineral density and osteoporosis in rural and urban women. Epidemiological study of the Lublin region (Eastern Poland). *Ann Agric Environ Med* 2001, 8:221-226.
- [16] Chatlert P., Tuan N., Vongsvat K., Nipa R., Somsri Ch. and Rajata R. Effect of urbanization on bone mineral density: A Thai epidemiological study. *BMC Musculoskeletal Disord* 2005, 6:5 doi:10.1186/1471-2474-6-5
- [17] Mika M., Hannah K., Bharati K., Radhakrishna K., Heli V., Amy T., Ruth S., Liza B., Jon T.,

# Journal of Coastal Life Medicine

George P., Jonathan W, Dorairaj P., George S., Shah E., Yoav Ben-Sh., and Sanjay K. Life-course determinants of bone mass in young adults from a transitional rural community in India: the Andhra Pradesh Children and Parents Study (APCAPS). *Am J Clin Nutr* 2014; doi: 10.3945/ajcn.113.068791.

- [18] Dhanwa K., Cooper C., and Dennison E., Geographic Variation in Osteoporotic Hip Fracture Incidence: The Growing Importance of Asian Influences in Coming Decades. *J. of Osteoporosis* 2010, Article ID 757102, 5 pages doi:10.4061/2010/757102