ORIGINAL ARTICLE

Screening of Bone Mineral Density (BMD) among Elderly Population in Jordan

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ABSTRACT

Introduction: : The health of the skeletal system is a vital issue in elderlies, hence, screening studies that investigate elders' bone health and identify associated factors affecting bone density are of prime importance. This study purposed to evaluate bone mineral density levels and examine its relationship with socio-demographic and clinical data, and body measurements among Jordanian elderlies aged 60 years and over. **Methods:** A cross-sectional, descriptive correlational study was used using a systematic random sampling technique to recruit 155 participants in Amman governorate. A questionnaire consists of socio-demographic and clinical data, and a form measures bone mineral density and body mass index were used. Bone mineral density was measured using a CM200 light device, where the T-score used to assess the bone mineral density. The T -scores equal -1 < -2.5 indicate osteopenia, while < -2.5 reflect osteoporosis. **Results:** Of the 151 subjects with completed data, 34.5% osteopenia, and 9.2% osteoporosis. The lowest bone mineral density was observed among older participants, divorced, illiterate, experiencing arthritis disease, and had a family history of osteoporosis and fractures. Sex, marital status, number of cola glasses, and number of cigarettes had a negative correlation with T-score, conversely, arthritis and family history of fracture had a positive correlation. The number of cola glasses was the main predictor. **Conclusion:** Jordanian elderlies experienced low bone mineral density. Developing appropriate health promotion programs for changing unhealthy behaviors and screening purposes are needed to enhance the knowledge of bones health and reduce the risks of developing osteopenia or osteoporosis.

Keywords: Bone mineral density; Clinical history; Elderly; Lifestyle; Socio-demographic

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INTRODUCTION

It is widely acknowledged that the percentage of aged people is rising worldwide. This trend would be the most vital transformation in relation to the social fabric in contemporary societies (1). As people age, a wide range of physiological changes in all organs take place as a natural part of the aging process and they occur at different levels. Although these changes cannot be a sign of an underlying disease, they can impose high levels of distress on people and complexities in their health status. Keep in mind that, some of these health conditions become more prominent with age, such as but not limited to osteoporosis which is a progressive bone disease. Hence, the public should be aware of such problem and adopting a healthy lifestyle to prevent the deterioration of overall bone health (2).

Low bone mineral density is one of the most common physiological changes among elderlies that increases the risk of osteoporosis which in turn results in high levels of disabilities among this cohort. The World Health Organization (WHO) (3) defined osteoporosis as "low bone mass and micro-architectural deterioration of bone tissue leading to bone fragility and consequent increase in fracture". Osteoporosis reduces bone's strength which in turn would prompt bone fractures; subsequently impacts on the quality of life among older people (4).

Therefore, bone mineral density (BMD) measurement needs to be considered using a noninvasive method such as bone densitometry. It is a reliable measure for predicting the occurrence of a fracture, however, it falls in short in respect to predicting bone size (5). A convenient protocol to calculate bone densitometry was developed by the WHO (6) -is the T-score. It compares the BMD of persons over age 50 with the average BMD of a 30-years old healthy white women (7). An

osteoporosis T-score of -1 and above is indicative of normal BMD, and the range of -1 and less signifies low BMD (6).

The existence of osteoporosis in the Middle Eastern region is widely acknowledged in various studies, a literature review study has reported that osteoporosis is a serious health threat in particular in the Middle Eastern countries and low bone density is highly prevalent (8). Osteoporosis is a progressive health problem and does not manifest itself until a fracture incident takes place. Keep in mind that osteoporosis-related fractures are a result of an accident that is inadequate to cause fracture for normal healthy bone (9).

Certain risk factors are associated with the development of low bone mineral density: non-modifiable variables such as age and sex, and modifiable factors such as excessive coffee and cola consumption, smoking, sedentary lifestyle, and low socioeconomic status (10, 11). Previous evidence around the world showed that factors such as sex (being female), low educational level, a diet low in calcium (11) and inadequate sunlight exposure (12) are positively correlated with low BMD. However, in Jordan, this issue was not investigated thoroughly.

Jordan is ranked among the least ten countries in terms of caring for elderlies, in particular in health service that is provided to elderlies such as screening, health promotion, and disease prevention programs (13). Only two studies related to BMD were conducted in Jordan and both investigated Jordanian menopause women. The first one conducted among women aged between 50 years and 60 years revealed that the prevalence of low BMD was 26.0% (38.5% osteopenia and 13.5 % osteoporosis) (14). Another study was held by Hyassat and his colleague in 2017 (15) reported that 37.5% of menopause Jordanian females had osteopenia and 44.6% had osteoporosis. Although the mentioned studies reported important results, it only recruited females and did not investigate the levels of BMI among males. So, this study will screen BMD among both elderly males and females.

Therefore, screening studies that investigate elderlies' bones health status and identify associated factors affecting BMD is of prime importance in relation to Jordanian elderlies because there is a dearth of data in this regards. Thus, this study sought to screen the levels of BMD and to examine its relationship with socio-demographic characteristics, anthropometric measurement (BMI), clinical history, and lifestyle practices among Jordanians aged 60 years and above.

MATERIALS AND METHODS

Design, setting, and sampling

A cross-sectional design study recruited Jordanian elderlies residing at Amman (the capital of Jordan). A systematic random sampling technique was used in which Amman Governorate divided into four parts (west, east, north, and south). We also requested a list of residential units from the municipality at Amman. They provided us with all the information they have in relation to the number of residential units and the number of residents in addition to their phone numbers. Afterwards, residential units were selected at a fixed interval (every third residential unit) from each part. The residential unit that had older and who full fill the inclusion criteria in the selected residential units were invited to take part in the study. A power analysis was used to calculate the sample size using G* power 3.1 software (16). A sample size of 140 older participants was needed to attend to the study research questions, however, the authors distributed 155 questionnaires in order to allow for missing data or incomplete questionnaire. Subjects were eligible to take part in this study if they met the following criteria: Jordanians, aged 60 years and over, not cognitively impaired, not having a terminal disease, able to communicate, and willing to participate in the study.

Measurements

The study used the following tools: a questionnaire that contains socio-demographic data and clinical data and a form measuring BMD and BMI. The brief description of the above-mentioned tools is provided hereafter.

Socio-demographic and Clinical Data Questionnaire

This questionnaire was developed by the first author. The socio-demographic data included the following items: age, sex, marital status, educational level, and monthly income (1 Jordanian Dinar equals 1.41$). Also, clinical data divided into two parts; a self-reporting instrument that involves questions about chronic health problems, family history of osteoporosis and fracture, and lifestyle practices such as dietary habits. To illustrate, dietary behaviors entail; consumption of milk and dairy products, smoking, coffee consumption, cola beverages, physical activity, and sunlight exposure. In relation to the smoking status we asked the participants if they smoke cigarettes on a daily or occasional basis (current smokers); if they smoked in the past on daily or occasional basis but they are now no longer using tobacco and/or if they never smoked or they smoked very little (nonsmokers). Concerning sun exposure, it was determined by asking the participants "how often you expose your face, arms, and feet to sun exposure. After that, we categorized their responses to regular exposure (if the participants reported sun exposure around 10-30 minutes daily; intermittent exposure (if they reported sun exposure 10-30 minutes on an occasional basis; no exposure (if they reported less than 10-30 minutes on an occasional basis.

BMD and BMI

These variables were directly measured by two of the

researchers at the recruitment site. To illustrate, BMD was measured using a CM200 light device (Ultrasound Bone Densitometer). This device is a portable compact design with a heal temperature sensor and it is a practical method to be used at the site of the data collection. It measures human bone density on Calcaneus (heel bone) by using ultrasound technology with non-invasive nature of ultrasound and easy-to-use interface operation with only 3-10 seconds for the measurement. It is a valid and reliable measure of screening individuals at risk of developing osteoporosis (17). Its measurement precision = % CV 0.5% or better (in test cases measurement). The T-score, Z score, and SOS (speed of sound; in m/sec) are generated automatically by the machine. The interpretation of ultrasound bone densitometer is guided by the WHO diagnostic criteria according to T-score relative to BMD value within SD (18). The T -scores results are categorized as: a) normal BMD (T-score no more than -1 standard deviation), b) osteopenia (T-score between -1.0 and < -2.5; a condition of less than normally mineralized bone), c) osteoporosis (T-score equal to or less than -2.5), and severe osteoporosis (T-score below -2.5 for patients with a fragility fracture) (6).

Further, the BMI was measured by dividing weight in kilogram by the height in meter. It was categorized as follows: < 22 kg/m^2 = malnutrition, 22-27 kg/m^2 = healthy weight, and > 27 kg/m^2 = overweight (19).

Data collection method

Data were collected using a structured questionnaire and face-to-face interview methods, in addition to measuring BMD and BMI. The researchers approached the potential participants and explained to them the study purposes, those who agreed to participate and met the eligibility for the study were asked to sign a written consent. Afterward, we discussed with them the setting of the data collection procedure as well as the turnaround time for the questionnaire. Those who agreed to be visited at their residential units were handed a predetermined schedule that showed the date and the time of the visit. In addition to that, potential participants were provided with the first researcher phone number for any new arrangement or cancelation purposes.

Two of the researchers received training of one week on how to use CM-200 light device (Ultrasound Bone Densitometer) for measuring BMD. Weight and height for each participant were measured by two of the researchers to calculate a standardized anthropometric measurement (BMI). To illustrate, participants were required to stand on the weighing machine with their shoes off and with light clothes. In addition to that, weight (wt) was measured and rounded up to the nearest 0.5 kg, while height (ht) was measured and rounded to nearest 0.5 cm. Then, the BMI was calculated.

After that, each eligible participant was provided with the questionnaire that was put in a sealed envelope with the date of the turnaround time is mentioned (one-week turnaround time was given). Regarding, those who were illiterate, the researchers assisted them through reading the questionnaire for them. Approvals for this study were obtained from the Institutional Review Board (IRB) reference number (10/130/2017-2018) of the university where the authors work. Data processing issues were conducted in accordance with the Jordanian standards of data protection.

Statistical analysis

All data were entered and analyzed using the SPSS program, version 23.0. The study variables were presented using descriptive statistics including frequency, percentage, mean, and standard deviation. Pearson's and Point-biserial correlation tests held to examine the magnitude of the relationship between the independent variables (socio-demographic, medical history, anthropometric variables, and lifestyle practices) and the dependent variables (BMD using T-score). Pearson's correlation coefficient was computed to assess the strength and the direction of the relationship between BMD values (T-score) and age, monthly income, BMI, number of milk and dairy products servings, number of cigarettes, number of coffee cups, and number of cola glasses. However, Point-biserial correlation was performed to examine the relationship between BMD (T-score) and sex, marital status, educational level, chronic diseases, family history of osteoporosis and fracture, physical activity levels, and sunlight exposure. Multiple linear regression was used to detect the main predictors of low BMD. The findings were significant at $p < 0.05$.

RESULTS

Out of 155 participants, 151 participants have completed the study (91 females and 60 males), hence, this study reached a response rate of 97.4%. The mean and (S.D) of the age of the study subjects was 65.7 (6.26) years. The majority of the participants were women 60.3%, married 62.3%, with average monthly household income of 174 ± (29) Jordanian Dinars (245.21$), and more than one-third of the study subjects had completed pre-high school education. The mean and (SD) of BMI was 28.9 (6.61) and 74.8% of the participants had BMI > 27 kg/m2. Additionally, the mean and (SD) of T-score for BMD was -0.88 (0.96). Further details are depicted in Table I.

Regarding the levels of BMD according to socio-demographics, the findings of this study showed that 43.7% of the participants had low levels of BMD (34.5% osteopenia and 9.2% osteoporosis), with higher odds among older females. However, the lowest BMD percentage was found among older participants followed by divorce and illiterate subjects. Osteopenia levels were higher in those who completed university and higher

Table 1: Socio-demographic characteristics of the participants (N=151)

Variable	n	%
Age/years		
60-64	73	48.3
> 64-69	34	22.5
> 69- 74	30	19.9
> 74- 79	8	5.3
> 79	6	4.0
Sex		
Male	60	39.7
Female	91	60.3
Marital status		
Single	6	4.0
Married	94	62.3
Divorced	17	11.3
Widowed	34	22.5
Monthly Income		
< 100 JOD (< 140.92$)	24	15.9
100-200 JOD (140.92- 281.85$)	95	62.9
> 200-300 JOD (> 281.85- 422.77$)	25	16.6
> 300 JOD (> 422.77$)	7	4.6
Educational level		
Illiterate	64	42.4
Elementary	44	29.1
Preparatory	17	11.3
High school	18	11.9
University and higher education	8	5.3
BMI (Lipschitz)		
Mean (S.D) 28.9 (6.61)		
< 22 kg/m^2	3	2.0
22-27 kg/m^2	35	23.2
> 27 kg/m^2	113	74.8

n: number; %: percentage

educational levels, however, illiterate participants had the highest percentage of osteoporosis (Table II).

Concerning the levels of BMD according to clinical history, Table III shows the percentages of low BMD according to medical history. Subjects who had normal BMI found to have a high rate of osteopenia, while those were overweight had a high level of osteoporosis. Turning to the pathological conditions, participants who were reported having rheumatoid arthritis had the lowest percentage of BMD compared to those who do not have a history of arthritis. In addition to that, participants with a family history of osteoporosis and fractures had the lowest level of BMD in comparison to their counterparts who did not report a family history of osteoporosis or fractures.

Table IV shows the levels of BMD by lifestyle practices among elderlies in Jordan, the results demonstrated that the percentage of BMD was at the low-cut levels among those who did not consume milk and dairy products. Those who smoke more than 20 cigarettes and/or consume three cups of coffee a day seemed to have very low levels of BMD. A total of 46.4% of cola consuming participants had low BMD. Osteoporosis was found highly prevalent among subjects who reported no or minimal exposure to the sunlight (14.3%), however, osteopenia found to be higher among those who reported intermittent exposure to the sunlight with a percentage of (42.5%).

Concerning correlating factors with BMD, the results

Table II: Percentages of Bone Mineral Density among elderly according to socio-demographic variables (N=151)

Variables	Normal T- score (+1- - 1) n (%)	Low bone mineral density	
		Osteopenia T- score (> -1 < - 2.5) n (%)	Osteoporosis T- score (≥2.5) n (%)
Age/years			
60-64	42 (57.5)	31 (42.5)	0 (0)
> 64-69	18 (52.9)	15 (44.1)	1 (2.9)
> 69- 74	16 (53.3)	8 (26.7)	6 (20.0)
> 74- 79	7 (87.5)	1(12.5)	0 (0)
> 79	2 (33.3)	3 (5.0)	1 (16.7)
Sex			
Male	42 (70.0)	18 (30.0)	0(0)
Female	43 (47.2)	40 (44.0)	8 (8.8)
Marital status			
Single	4 (66.7)	21 (33.3)	0 (0)
Married	58 (34)	34 (36.2)	2 (2.1)
Divorced	6 (35.3)	10 (58.8)	1 (5.9)
Widowed	16 (47.1)	13 (38.2)	5 (14.7)
Monthly Income			
> 100 JOD	13 (54.1)	7 (29.2)	4 (16.7)
100-200 JOD	48 (50.5)	44 (46.3)	3 (3.2)
> 200-300 JOD	23 (92.0)	2 (8.0)	0 (0)
> 300 JOD	1 (14.3)	5 (71.4)	1 (14.3)
Educational level			
Illiterate	38 (59.4)	21 (32.8)	5 (7.8)
Elementary	22 (50.0)	19 (43.2)	3 (6.8)
Preparatory	11 (64.7)	6 (35.3)	0 (0)
High school	10 (55.6)	8 (44.4)	0 (0)
University & higher education	4 (50.0)	4 (50.0)	0 (0)

n: number; %: percentage

Table III: Percentages of Bone Mineral Density among elderly according medical history variables (N=151)

Variable	Normal	Low bone mineral density	
	T- score (+1- - 1) n (%)	Osteopenia T- score (> -1 < - 2.5) n (%)	Osteoporosis T- score (≥ - 2.5) n (%)
BMI (Lipschitz)			
< 22 kg/m^2	2 (66.7)	1 (33.3)	0 (0.0)
22-27 kg/m^2	18 (51.4)	16 (45.7)	1 (2.9)
> 27 kg/m^2	65 (57.5)	41 (36.3)	7 (6.2)
Presence of health problems			
Yes	72 (56.7)	47 (37.0)	8 (6.3)
No	13 (54.2)	11 (45.8)	0 (0)
Types of health problems			
Rheumatoid arthritis	24 (45.3)	24 (45.3)	5 (9.4)
Hypertension	54 (58.7)	32 (34.8)	6 (6.5)
Renal diseases	13 (61.9)	8 (38.1)	1 (0)
Diabetes mellitus	44 (63.8)	21 (30.4)	4 (5.8)
Thyroid diseases	1 (25.0)	3 (75.0)	0 (0)
Bone fracture	17 (50.0)	14 (41.2)	3 (8.8)
G.I problems	27 (69.2)	8 (20.5)	4 (10.3)
Family history of osteoporosis			
Yes	19 (45.2)	19 (45.2)	4 (9.6)
No	66 (60.6)	39 (35.8)	4 (3.6)
Family history of fracture			
Yes	16 (44.5)	17 (47.2)	3 (8.3)
No	69 (60.0)	41 (35.7)	5 (4.3)

n: number; %: percentage

showed there was a significant negative correlation between SOS values, number of cola glasses (r = - 0.745; p < 0.01), and number of cigarettes (r = - 0. 297;

Table IV: Percentages of BMD among elderly according to lifestyle practices variables (N=151)

Variable	Normal T- score (+1- - 1) n (%)	Low bone mineral density	
		Osteopenia T- score (> -1 < - 2.5) n (%)	Osteopo- rosis T- score (≥ - 2.5) n (%)
Milk and dairy products intake			
Yes	71 (56.8)	48 (38.4)	6 (4.8)
No	14 (53.8)	10 (38.5)	2 (7.7)
If yes, Number of servings/day			
< 1 serving	25 (43.9)	28 (49.1)	4 (7.0)
1 < 2 servings	4 (66.6)	19 (31.7)	1 (1.7)
2 servings and more	7 (7.0)	2 (20.0)	1 (10.0)
Smoking			
Yes	35 (72.9)	12 (25.0)	1 (2.1)
No	50 (48.5)	46 (44.7)	7 (6.8)
If yes, Number of cigarettes/day			
< 10	2 (1.00)	0 (0)	0 (0)
10-20	26 (83.9)	5 (16.1)	0 (0)
>20-30	1 (25.0)	2 (50.0)	1 (25.0)
>30	7 (63.6)	4 (36.4)	0 (0)
Consuming coffee intake			
Yes	56 (58.3)	36 (37.5)	4 (5.2)
No	29 (52.7)	22 (40.0)	4 (7.3)
If yes, Number of cups/day			
1 cup	19 (57.6)	11 (33.3)	3 (9.1)
2 cups	12 (54.6)	9 (40.9)	1 (4.5)
3 cups	8 (57.1)	6 (42.9)	0 (0)
4 cups and more	17 (68.0)	8 (32.0)	0 (0)
Consuming Cola intake			
Yes	38 (53.6)	29 (40.8)	4 (5.6)
No	47 (58.8)	29 (36.2)	4 (5.0)
If yes, Number of glasses /day			
1 and 2 glasses	36 (100.0)	6	0 (0)
3 glasses	0 (0)	14 (87.5)	2 (12.5)
4 glasses and more	0 (0)	5 (71.4)	2 (28.6)
Exercise			
Regular	26 (65.0)	14 (35.0)	0 (0)
Sometimes	32 (55.2)	23 (39.7)	3 (5.2)
Never	27 (50.9)	21 (39.6)	5 (9.4)
Sunlight exposure			
Continuous	30 (60.0)	19 (38.0)	1 (2.0)
Intermittent	38 (53.4)	31 (42.5)	3 (4.1)
No Exposure	16 (57.1)	8 (28.6)	4 (14.3)

n: number; %: percentage

p < 0.05). Also, the results showed significant negative relationships between T-score values, sex (r = - 0.250; p < 0.01), and marital status (r = - 0.247; p < 0.01). However, there were statistically positive relationships between T-score values, arthritis disease (r = 0.175; p < 0.05), and family history of fracture (r = 0.168; p < 0.05) as shown in Table V.

Table VI presents the predictors of BMD among older participants. A multiple linear regression analysis was used to predict the main factors influencing BMD and leading to low BMD. The full model containing all predictors was not a statistically significant at α < 0.05 (F [8, 29] = 2.28; p = 0.062; R= 0.68; R2 =0.46; adjusted R2 = 0.26). This indicated that 26.0% of the variance was explained by the whole model. After adjusting for the other variables in the model, the number of cola glasses was the only predictor and negatively associated with BMD (β = - 0.45; p < 0.05). However, none of the other variables in the model were significantly associated with T-scores.

Table V: Correlation between BMD (SOS) and study variables

Variables	r	p-value
Age/years	- 0.045	0.587
Income	0.073	0.371
BMI	- 0.026	0.752
Number of milk and dairy products servings /day	0.168	0.059
Number of cigarettes/day	- 0.297	0.040*
Number of coffee cups/day	0.021	0.838
Number of cola glasses/day	- 0.745	0.000**
	r p.b	**p-value**
Gender	-0.250	0.002**
Marital Status	-0.247	0.002**
Educational level	0.099	0.225
Chronic diseases		
Arthritis	0.175	0.033*
Thyroid diseases	0.075	0.364
Diabetes mellitus	-0.133	0.105
Hypertension	-0.026	0.753
Kidney diseases	-0.069	0.411
Family history of osteoporosis	0.144	0.079
Family history of fracture	0.168	0.046*
Demonstrating exercise	-0.112	0.172
Sunlight exposure	-0.043	0.598

** Significant at < 0.01 level
* Significant at < 0.05

Table VI: Predictors of BMD

Predictors	B	B	t	p-value	95.0% CI
Number of cola glasses	-0.40	-0.45	-2.38	0.02	-0.79 - -0.05
Number of cigarettes	-0.18	-0.20	-1.09	0.28	-0.54 - 0.16
Family history of fracture	-0.09	-0.05	-0.33	0.73	-0.70 - 0.50
Rheumatoid arthritis disease	0.04	0.02	0.14	0.88	-0.54 - 0.62
Gender	-0.16	-0.10	-0.57	0.56	-0.72 - 0.41
Marital status	0.06	0.08	0.36	0.721	-0.28 - 0.40
R^2= 0.32 **Adjusted R^2 = 0.18**					

B: Unstandardized; B: Standardized; CI: Confidence Interval

DISCUSSION

This study is the first to assess the levels of BMD among Jordanian elderlies, Random sampling technique was used in data collection to provide representative data of the elderly population in Jordan. In relation to demographic distribution and based on the international standards of the levels of BMD, Jordanian elderlies were found to have low levels in this regards. These results lend support to the previous literature reporting that Caucasian and Asian descent have lower BMD compared to other races (20- 22). However, the levels of BMD among the participants of this study were lower than their counterparts in the western communities (10, 20). This study also demonstrated that around two-thirds of the participants were overweight. Interestingly, lower

levels of BMD and being overweight share common grounds, particularly in regard to the Jordanian life style. Namely, the Jordanian lifestyle includes low levels of physical activities and unhealthy eating habits (23). Needless to say, that this study was held among Arabs, and it was earlier found that Asian ethnicity is a risk factor that impacts on the levels of BMD (20-22).

Additionally, the findings of this study showed that women had the lowest levels of BMD in comparison with their counterparts from men. These findings are consistent with previous studies (10, 24, 25), in which, it was reported that women are more prone to have their bone brittle in comparison to their matching participants from men, and female sex was identified as a risk factor for low levels of BMD (10, 26- 28). These findings could be explained by changes in sex hormones levels such as estrogen in particular, after the menopause period that interferes with bone tissue synthesis (25). To illustrate, a significant decline of the levels of the BMD during the menopause period were documented, in particular, estrogen levels (29). These low levels of estrogen influenced the calcium balance negatively, leading to bone breakdown and decrease bone formation, subsequently, loss of bone mass and thinning of bones (30).

This study reported that marital status had a relationship with BMD, whereas, divorced or widowed participants had the lowest levels of BMD In line with the mentioned results, Miller-Martinez et al. (26) reported that the married older clients had better BMD in comparison to their counterparts who did not have a partner. The married older had spousal support, which was correlated with better BMD (26).

The findings of this study also showed that more than half of the participants who experienced rheumatoid arthritis had low BMD levels. These results are consistent with a previous study that showed that rheumatoid arthritis was a risk factor for low BMD (31). Rheumatoid arthritis is a disease that affects the biomechanical characteristics of bones and causes changes in bone ingredients and bone mass (32) (Coulson et al., 2009).

Furthermore, this study suggested that family history of fracture was negatively correlated with the levels of BMD, and those who had a family history of fracture had the lowest BMD levels when compared to those who do not. Corresponding with our study, the published literature reported increased odds of low BMD with increasing of the older family members who experienced fractures (10, 11, 33, 34). Thus, this study added to the body of literature and confirmed that family history in relation to fracture is an important risk factor that could be overlooked at the primary care levels.

In respect to lifestyle practices, the present study indicated that low BMD increased with an increased number of cigarettes among smokers, in which the number of cigarettes negatively correlated with BMD. These findings supported previous evidence relating to bone loss to nicotine doses (34). Smoking has adverse effects on bone health, and this could be attributable to low body mass index among smokers (10, 11, 33-37). Subsequently, we believe that bone loss could be reduced or prevented by smoking cessation.

Of note, the current study confirmed that consuming Cola more than three glasses a day impose a negative effect on the levels of BMD. Similarly, a previous study suggested a negative relationship between low BMD and cola among older women (38). It was also correlated with decreased consumption of milk, calcium, and other nutrient substances (38). A possible explanation for that is that Cola contains caffeinated substances and phosphoric acid, which negatively influences bone health (39).

The results of this study showed that the number of cola glasses consumed daily was a major factor in predicting BMD among older participants. These results are not like past research findings. Kumar et al. (11) found that age, BMI, and physical activity were the main predictors for BMD. However, another study indicated that BMI, albumin in females and protein intake in males were the major factors predicting BMD among the older population (10).

Like other studies, this research has few limitations, such as, the participants were recruited from Amman Governorate, which limits the generalizability of the study. Using of heel density to estimate total bone density rather than using DEXA which is the gold standard; however, heel density method was validated by a wide range of literature and it's more convenient to be used in a primary care settings. Additionally, this study used cross-sectional design to collect the data, like any study that used this data collection design, the causal inferences could not be inferred in particular, the effect of independent variables on dependent variables. Moreover, some part of the data were collected using self-report methods, hence, subjected to recall bias. Although, this study has the above-mentioned limitations we believe that it yielded important empirical evidence that is important for future research as well as health planning in the region.

This study illuminated the need to assess the BMD and identified that people at the age of 60 and above are at risk of having low BMD levels. These data would inform the health policymakers, health programs planners and evaluation specialists, healthcare providers and the elderlies' caregivers, in particular nurses, and social workers at age residential units. Subsequently, enhancing health-related strategies to improve bones health among this cohort, such as establishing programs including screening of BMD and correlated factor. Furthermore, it

would form a base for developing health promotion and health education programs that target lifestyle practices including nutrition, recommended dietary allowances, adequate calcium intake and calcium supplements, replacement of cola and reducing cola consumption, smoking quitting, and physical activities and exercise.

CONCLUSION

Jordanian elderlies experienced significant low levels of BMD in comparison to their counterparts from other ethnicities. Sex, marital status, rheumatoid arthritis disease, family history of fracture, number of cigarettes/days, consuming cola, and number of cola glasses daily were the main risk factors for low BMD among older Jordanians. Of concerns, the public health policy response that have overlooked these problems. Hence, a national health plan that involves the mentioned issue and its implications should be in place and the plan that was released has to be re-evaluated in this regards.

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