

## EVALUATION OF PHYSICAL ACTIVITY IN MOROCCAN POSTMENOPAUSAL WOMEN WITH OSTEOPOROTIC VERTEBRAL FRACTURES

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### ABSTRACT

**Introduction:** The purpose of our study is to compare between physical activity (PA) in postmenopausal women with osteoporotic vertebral fractures and healthy women and to evaluate the relationship between PA and clinical and para-clinical parameters related to osteoporotic fracture. **Methods:** A case-control cross-sectional study, which included 128 postmenopausal women with densitometric osteoporosis as defined by World Health Organization, with at least one radiological vertebral fracture. Physical activity was assessed by the International Physical Activity Questionnaire (IPAQ) short version with three items: vigorous, moderate activity and walking. Bone mineral density (BMD) and X-rays were performed in all patients. The controls were healthy women included in a randomized order in the general population, they were matched for age. **Results:** 128 patients with a mean age of  $61.01 \pm 8.40$  years were included. 100 controls were included with a mean age of  $60.61 \pm 8.25$  years. The patients had a median age of menopause of 48.90 years [48-50], were osteoporotic in 49.2% and had osteopenia in 34.9%. 84 patients had a current back pain, and an average of three vertebral fracture with a median Genant score of 3.02[1-23]. There was no significant difference between the subjects of our study for total PA. However, vigorous-intensity activity and walking were significantly different between the two groups ( $p < 0.05$ ). Three independent factors were associated with a reduction of total physical activity: age, Genant score and physical function (for all  $p < 0.05$ ). In multivariate analysis, a significant association between total physical activity and age ( $p = 0.003$ ), trochanter BMD ( $p = 0.01$ ), Genant score ( $p = 0.02$ ) and physical function (2nd domain QUALEFFO) ( $p = 0.01$ ) persisted. **Conclusion:** In postmenopausal women with osteoporotic vertebral fractures, PA is decreased with the severity of vertebral fractures and with the increasing age.

**Keywords:** Morocco; Osteoporosis; Physical activity, Postmenopausal; Vertebral fractures,

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### INTRODUCTION

Osteoporosis is a prevalent metabolic bone disease characterized by low bone mass and microarchitectural deterioration of bone tissue leading to an increased fracture risk in a range of skeletal sites, affecting function and quality of life [1–3]. Osteoporosis is a considerable public health problem because of its potentially severe consequences for both the patient and

the health care system if a fracture occurs [4]. In Morocco, the prevalence of osteoporosis ranges between 30.1% and 37.9% [5,6]. Osteoporotic vertebral fractures (VFs) are common, have a major health impact and incur high societal costs, morbidity and even mortality [3]. An osteoporotic vertebral fracture can cause severe pain and disability [7]. Its presence increases the risk of future vertebral and non-vertebral fracture [8]. Exercise is recommended for people with

osteoporosis to prevent bone loss, falls and fractures [7]. It increases flexibility and posture allowing women with osteoporosis to easily perform everyday task and improve their quality of life [9]. However, patients with vertebral fractures often avoid physical activity (PA). A literature review showed that women with vertebral fracture have reduced everyday activities [10].

The aim of this study was to compare physical activity in Moroccan postmenopausal women with osteoporotic vertebral fractures and healthy subjects and to evaluate the relationship between physical activity and clinical and paraclinical parameters related to osteoporotic fractures. To our knowledge, such this study in Morocco has not been undertaken to date.

## METHODS

### A- Study population

A case-control cross sectional study was conducted in postmenopausal women with osteoporotic VFs, recruited at "El Ayachi University Hospital. 128 patients were included. The diagnosis of osteoporosis was made on the basis of a reduction in bone mineral density (BMD) at spine and hip scan according to the WHO criteria [11], with at least one radiological vertebral fracture according to Genant [12]. All the fractures were due to bone fragility and not to major trauma. We excluded from the study other causes of bone loss.

A control group of 100 healthy women was included in a randomized order in the general population and was also involved and filled out the questionnaire. They were matched for age.

Informed consent was obtained from all subjects and the study was approved by the ethics committee of our university.

### B- Methods

Data collection and measurements: the socio demographic, clinical and paraclinical parameters related to patients were collected. We also recorded age of menopause, educational level, personal history of peripheral fracture, back pain, and comorbidities.

Anthropometric data: Weight and height were measured and the Body mass index (BMI) was calculated as body weight / height<sup>2</sup> (kg/m<sup>2</sup>).

Assessment of vertebral fractures: Two Lateral radiographs (thoracic and lumbar radiographs) and antero-posterior radiographs were obtained according to

standardized procedures. A semi quantitative visual assessment of each vertebra from T4 to L4 according to Genant method [12] was performed by two rheumatologists at the same time as follows: grade 0 (no vertebral fracture); grade 1 (a decrease in the height of any vertebra of 20% to 25 %); grade 2 (a decrease of more than between 25 % to less than 40%); grade 3 (a decrease of 40% or more). The severity of vertebral fractures was assessed by Genant score.

Bone mineral density (BMD) measurements: Lumbar spine, trochanter, femoral neck and total hip BMD were measured by dual-energy X-ray absorptiometry with a lunar prodigy densitometer. Daily quality control was carried out by measurement of a lunar phantom. At the time of the study, phantom measurements showed stable results. The phantom precision expressed as the CV (%) was 0.08. Both T and Z scores were obtained. In the T-score calculations, the manufacturer's ranges for European reference population were used because of the absence of a Moroccan data base. Osteoporosis was defined as a T-score lower than -2.5, according to the World Health Organization study group definition [13].

Measurement of physical activity: In accordance with the IPAQ protocol [14], the categorical physical activity levels were coded based on total days of physical activity and metabolic equivalents of task (MET) minutes per week. Moderate physical activity was coded as five or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of at least 600 MET-minutes per week. High physical activity was coded as seven or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of at least 3 000 MET-minutes per week. Sedentary physical activity was defined as less than 150 MET minutes in one week. Those with low physical activity did not meet the moderate or high physical activity criteria. The binary physical activity category combined moderate and high levels of physical activity because both levels of activity meet the minimum criteria for health-enhancing physical exercise [14].

In this study, the short last-week Arabic version of the International Physical Activity Questionnaire (IPAQ) [15] was administered, asking about the time spent being physically active in the last 7 days. Minutes of sitting, walking, moderate-intensity (walking not included), and vigorous-intensity activities were counted for the last week.

**Quality of life assessment:** The QUALEFFO-41 [16] is a self-administered, specific questionnaire designed by the working party for quality of life of the International Foundation for osteoporosis (IOF) to be used by patients with vertebral fractures attributed to osteoporosis. It consists of 41 questions in the following five domains: pain, physical function, social function, general health perception, and mental function [16]. The QUALEFFO questionnaire was adapted and translated into classical Arabic to be used in Moroccan but also all Arabic patients in the World with vertebral fractures. Patients were asked to complete the Arabic version of QUALEFFO [17].

**Other measurements:** All the patients had evaluation of calcium, phosphate, PTH and 25-OH vitamin D serum levels. PTH was measured by second generation techniques, which are two immunoassays using antibodies directed against two distinct parts of PTH, and are generally called intact PTH assays, normal level was 10-65 pg/l. Assessment of vitamin D status was made by measurement of total 25(OH) D [both 25(OH)D<sub>2</sub> and 25(OH) D<sub>3</sub>] by isotope-dilution liquid chromatography-mass spectrometry and tandem mass spectrometry methodology and a vitamin D deficiency was defined by a level < 30 ng/ml.

**C- Statistical analysis:**

Statistical analysis was performed using the SPSS Statistical package 18.0 for Windows (SPSS 18, Chicago, IL, USA). Descriptive data are expressed as mean ± SD or as percentage.

Student's t-test for unpaired data, or the non-parametric Mann-Whitney test and the chi-square, as appropriate, were used to compare data between the two groups. The Pearson chi-square test and p-values were used to determine the strength of the association between the variables. A p value < 0.05 was considered to indicate statistical significance.

Univariate and multivariate linear regression was used to analyze continuous outcomes. The results were expressed as a β-coefficient and 95% CI.

## RESULTS

### A- Study population:

The mean age of patients was 61.01± 8.40 and the mean BMI was 28.93±4.34. Of all postmenopausal women with VFs, 60% were married and 36% were illiterate. Only 19.5% had received high school education. Overall, 48.4% reported at least one comorbidity (**Table I**).

**Table I:** Sociodemographic characteristics and physical activity level of the study population

	Control (n=100)	PMW with VFs (n=128)	p*
Age (yrs) <sup>1</sup>	60.61± 8.25	61.01± 8.40	0.71
BMI(kg/m <sup>2</sup> ) <sup>1</sup>	26.77± 3.88	28.92± 4.34	<0.001
Marital status <sup>2</sup>			<0.0001
-Single	19 (19%)	2 (1.5%)	
-Married	64 (64%)	77 (60.1%)	
-Divorced	09 (09%)	11 (8.5%)	
-Widower	08 (08%)	38 (29.6%)	
Educational level <sup>2</sup>			0.0001
-No formal education	18 (18%)	46 (35.9%)	
-Elementary education	17 (17%)	15 (11.7%)	
-Secondary education	13 (13%)	42 (32.8%)	
-University education	52 (52%)	25 (19.5%)	
Number of comorbidities <sup>2</sup>			0.0001
- 0	66 (66%)	57 (44.5%)	
- 1-2	34 (34%)	62 (48.4%)	
- ≥3	0 (0%)	9 (7.1%)	
Total physical activity <sup>3</sup> (MET-minutes per week)	2009.25 [580.87 -5726.25]	1998.50 [672.70-5443.50]	0.72
-Vigorous-intensity activity <sup>3</sup>	60 [0-1440]	0 [0-480]	0.001
-Moderate-intensity activity <sup>3</sup>	40 [0-2490]	720 [0-2160]	0.60
-walking <sup>3</sup>	462 [198-1186.50]	693 [231-1386]	0.04

<sup>1</sup>mean ± standard deviation; <sup>2</sup>number and percentage; <sup>3</sup>median and quartiles; \* "p" value < 0.05 was considered to indicate statistical significance; PMW=postmenopausal women; MET: metabolic equivalents of task

The patients had a median age of menopause of 48.90 years [48-50]. Of all patients 49.2% were osteoporotic, 35% had osteopenia and 16% had a normal BMD. The BMD was lower at the trochanter. Almost 84 women reported a current back pain (65.6%). The median number of vertebral fractures was 2.85 [3-13]. The

majority was located at the dorsal level (55.5%), 4 at the lumbar level (3.1%) and 51 (39.3%) at both thoracic and lumbar spine. More than 50% had pain (1<sup>st</sup> domain QUALEFFO-41), and only four percent had a vitamin D deficiency (**Table II**).

**Table II:** Disease-related characteristics of postmenopausal women with osteoporotic VFs

<b>Characteristics</b>	
Age at menopause(yrs) <sup>1</sup>	48.90 [48-50]
Axial pain (VAS) <sup>2</sup>	44.5 ±18.4
1 <sup>st</sup> domain QUALEFFO-41(pain) <sup>2</sup>	54.7±15.4
Back pain	
History	28 (21.9%)
Current	84 (65.6%)
Absence	16 (12.5%)
T-score <sup>3</sup>	
Normal	20 (15.9%)
Osteopenia	47 (34.9%)
Osteoporosis	63 (49.2%)
BMD <sup>2</sup> (g/cm <sup>2</sup> )	
Lumbar	0.908 ± 0.16
Neck	0.818 ± 0.13
Trochanter	0.655 ± 0.119
Ward	0.639 ± 0.140
Femoral total	0.838 ± 0.132
Number of Vertebral fractures <sup>1</sup>	2.85 [3-13]
Fracture site <sup>3</sup>	
Dorsal	73 (57%)
Lumbar	04 (3.1%)
Dorsolumbar	51 (39.8%)
Genant score	3.02 [1-23]
Dietary calcium intake <sup>2</sup> (mg /day)	688.43 ± 232.
Vitamin D(D2+D3) level <sup>2</sup> (ng /ml)	17.73 ± 8.78
PTH level <sup>2</sup> (pg/l)	70.47 ± 26.15

<sup>1</sup> median and quartiles; <sup>2</sup> means ± standard deviation; <sup>3</sup> number and percentage; VAS= visual analogic scale; PTH=parathyroid hormone; QUALEFFO-41= quality of life of the International Foundation for osteoporosis

There was no significant difference in age between the two groups. In the control group, 52% of women had a university level of education and 66% had no comorbidities (**Table I**).

### **B -The evaluation of the physical activity:**

The assessment of the physical activity revealed that there was no significant difference between the postmenopausal women with VFs and controls for total physical activity (p=0.72). Regarding the level of physical activity, there was a significant difference between the 2 groups for both vigorous-intensity activity and walking (respectively p=0.001; p=0.04) (**Table I**). However, no difference was noticed for moderate-intensity activity (p=0.60) (**Table I**).

### **Total physical activity**

A univariate analysis was carried out to identify patients' characteristics that were related to the total physical activity. It shows that three independent factors were associated with a reduction of total physical activity: age, Genant score and physical function (for all p<0.05). There was a positive correlation between total physical activity and BMD at the different sites (for all p<0.05). No significant correlation was found between total physical activity and BMI, age at menopause, axial pain or number of comorbidities (**Table III**). We also analyzed the impact of number and site of fracture, and the history of peripheral fracture on total physical activity, there was no significant influences. In multivariate analysis, a significant association between

total physical activity and age, trochanter BMD, Genant score and physical function (2nd domain QUALEFFO) persisted (for all  $p < 0.05$ ) (**Table III**).

**Table III:** Clinical and paraclinical parameters influencing total physical activity in postmenopausal women with VFs in univariate and multivariate analysis

Parameters	Univariate analysis			Multivariate analysis		
	B	IC	p*	B	IC	p*
Age	-0.07	[-0.11;-0.04]	0.001	-0.05	[-0.09; -0.01]	0.003
BMI	0.06	[-0.01;0.13]	0.09	-	-	-
Age at menopause	-0.01	[-0.06;0.05]	0.95	-	-	-
Axial pain (VAS)	0.29	[-0.14;0.72]	0.18	-	-	-
Presence of comorbidities	-0.28	[-0.59;0.02]	0.06	-	-	-
History of peripheral fracture	-0.38	[-1.16;0.39]	0.32	-	-	-
Lumbar BMD	2.33	[0.45; 4.22]	0.01	0.84	[-4.23; 5.93]	0.72
Trochanter BMD	4.83	[2.32; 7.34]	0.0001	4.61	[0.93; 8.28]	0.01
Femoral total BMD	3.58	[1.31;5.86]	0.002	-1.21	[-5.50; 3.07]	0.57
25OH vit D	0.02	[-0.03;0.08]	0.46	-	-	-
Number of fractures	0.09	[-0.2;0.005]	0.06	-	-	-
Genant score	-0.11	[-0.19;-0.03]	0.004	-0.09	[-0.17; 0.013]	0.02
Pain(1 <sup>st</sup> domain QUALEFFO)	-0.08	[-0.01;0.003]	0.15	-	-	-
Physical function (2 <sup>nd</sup> domain QUALEFFO)	-0.02	[-0.03;-0.008]	0.002	-0.01	[-0.03;-0.003]	0.01

VAS = visual analogic scale ; vit D = vitamin D2+D3(ng/ml) ; QUALEFFO-41= quality of life of the International Foundation for osteoporosis ; BMD= bone mineral density; \* "p" value < 0.05 was considered to indicate statistical significance

### Vigorous-intensity activity

In univariate analysis, vigorous-intensity activity was significantly associated to age of postmenopausal women with VFs, to trochanter BMD and to vitamin D. In multivariate analysis, only age of patients appears to reduce vigorous-intensity activity (for all  $p < 0.05$ ) (**Table IV**).

### Walking

Univariate analysis showed that walking was associated to age of patients, to trochanter and femoral total BMD, to number of fractures and their severity. In multivariate analysis, walking was associated to Genant score ( $p < 0.05$ ) (**Table V**).

**Table IV:** Clinical and paraclinical parameters influencing vigorous-intensity activity in postmenopausal women with VFs in univariate and multivariate analysis

Parameters	Univariate analysis			Multivariate analysis		
	B	IC	p	B	IC	p
Age	-0.15	[-0.08; -0.18]	0.0001	-0.16	[-0.28; -0.05]	0.006
BMI	0.04	[-0.21; 0.09]	0.47	-	-	-
Age of menopause	-0.02	[-0.13; 0.08]	0.64	-	-	-
Axial pain (VAS)	0.04	[-0.76; 0.80]	0.90	-	-	-
Presence of co-morbidities	-0.11	[-1.27; 1.04]	0.84	-	-	-
History of peripheral fracture	0.02	[-1.16; 1.46]	0.97	-	-	-
Lumbar BMD	2.10	[-1.48; 5.69]	0.24	-	-	-
Trochanter BMD	7.13	[2.37; 11.89]	0.004	1.45	[-8.03; 10.95]	0.76
Femoral total BMD	4.16	[-0.18; 8.51]	0.06	-	-	-
25OH Vit D	0.11	[0.01; 0.21]	0.02	0.05	[-0.04; 0.15]	0.25
Number of fractures	-0.16	[-0.35; 0.02]	0.09	-	-	-
Genant score	-0.13	[-0.27; 0.03]	0.07	-	-	-
Pain (1 <sup>st</sup> domain QUALEFFO)	0.01	[0.01; 0.03]	0.31	-	-	-
Physical function (2 <sup>nd</sup> domain QUALEFFO)	0.04	[-0.03; 0.43]	0.80	-	-	-

VAS = visual analogic scale; vit D = vitamin D2+D3 (ng/ml) ; QUALEFFO-41= quality of life of the International Foundation for osteoporosis ; BMD=bone mineral density

**Table V:** Clinical and para clinical parameters influencing walking in postmenopausal women with VFs in univariate and multivariate analysis

Parameters	Univariate analysis			Multivariate analysis		
	B	IC	p*	B	IC	p*
Age	0.04	[-0.07;-0.008]	0.01	-0.25	[-0.06; -0.01]	0.16
BMI	0.02	[-0.04;0.08]	0.52	-	-	-
Age at menopause)	0.03	[-0.02;0.08]	0.23	-	-	-
Axial pain (VAS)	0.34	[-0.03;0.73]	0.04	-	-	-
Presence of comorbidities	0.03	[-0.24; 0.31]	0.78	-	-	-
History of peripheral fracture	-0.61	[-1.30;0.08]	0.08	-	-	-
Lumbar BMD	1.37	[-0.35; 3.10]	0.11	-	-	-
Trochanter BMD	2.68	[0.35; 5.01]	0.02	0.96	[-2.48;4.41]	0.58
Femoral total BMD	3.05	[0.98;5.11]	0.004	0.68	[-2.61; 3.98]	0.68
Number of fractures	-0.11	[-0.20;-0.02]	0.01	0.11	[-0.10;0.33]	0.31
Pain(1 <sup>st</sup> domain QUALEFFO)	-0.002	[-0.18; 0.17]	0.98	-	-	-
Physical function (2 <sup>nd</sup> domain QUALEFFO)	-0.12	[-0.34; 0.10]	0.28	-	-	-

VAS = visual analogic scale; vit D =vitamin D2+D3 (ng/ml); ; QUALEFFO-41= quality of life of the International Foundation for osteoporosis ; BMD=bone mineral density; \* "p" value < 0.05 was considered to indicate statistical significance

## DISCUSSION

We present the results of the first study in Morocco that assess the impact of osteoporotic VFs on physical activity. Our results show that vigorous-intensity activity and walking were significantly different in postmenopausal women with VFs compared with controls. The vigorous-intensity activity was associated to age. This can be explained by the fact that women may change their patterns of physical activity

throughout their lifespan. Ageing may lead to a moderate and less vigorous physical activity [18]. In addition, it was shown that people with vertebral fractures are more likely to experience falls [19], therefore the fear of falling may decrease mobilization of the patients and limit their physical activity [11]. Beyond of osteoporosis, the engagement in physical activity depends on various factors such as socioeconomic conditions [20]. The reduction of physical activity could be also related to the educational

level. In fact more than 50% of the controls, have a university education, so they are aware of the vital aspect of healthcare and the necessity of the exercise in the management of osteoporosis.

Our study shows that walking was significantly associated to the severity of VFs assessed by the Genant score. Our results agree with a prospective study in the UK that showed that moderate/severe VFs were associated with a reduced walking duration whereas mild VFs had no impact on it [21].

In our study, no association between BMI and levels of physical activity were found. Longstemo et al. [18] demonstrated that changes in physical activity lead to changes in BMI.

The association between physical activity and BMD is source of increasing interest. Several studies were conducted and have yielded conflicting results [18,22–25]. In fact, not all types of exercise have the same positive effect on bone mineral density [26]. In our work, we found an association between total physical activity and BMD. Segev et al [27] reported in a literature review that physical activity had a positive effect on BMD. However, the precise training protocol for postmenopausal women remains unclear [27].

Our results show that walking was significantly associated with both trochanter BMD and femoral total BMD, whereas three studies showed that walking was effective in preserving BMD in the hipbone in postmenopausal women but did not show significant increases [24,28,29]. In our study there was no association between vigorous-intensity activity or walking and lumbar BMD. It seems that the most effective intervention for BMD at the spine is the multicomponent training exercise program [26].

Our data must be examined bearing in mind the study limitations. It is a cross-sectional and monocentric study which potentially causes a selection bias. Another potential study limitation is the IPAQ questionnaire, which was used to assess physical activity. The potential weakness of the questionnaire is that physical activity was determined by self-report and so is subject to recall bias. The questionnaire addressed broad categories of physical activity, and we used METs to summarize the data. However; these MET assessments were designed with aerobic activity and cardiovascular risks in mind rather than the possible effects of activity on bone.

## CONCLUSION

In this study, we tried to assess the association between physical activity and clinical and para-clinical parameters related to osteoporotic VFs. Our findings

suggested that high physical activity and walking were different between postmenopausal women with VFs and controls. The reduction of the physical activity seems to be related to the age and to the severity of vertebral fractures.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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