RAEM
REVISTA ARGENTINA DE ENDOCRINOLOGÍA Y METABOLISMO

Trabajo Original

Prevalence of altered anthropometric indicators in population with or without alteration of bone mineral density in the Central Military Hospital

MEJIA LE[1], GÓMEZ SE[1], BASTIDAS AR2*, ARSANIOS DA[2]

[1]Central Military Hospital, Bogotá. Colombia. [2]Universidad de La Sabana. Bogotá. Colombia

INFORMACIÓN DEL ARTÍCULO

Historia del artículo:
Recibido: 2 de octubre de 2020
Revisión: 22 de noviembre de 2020
Aceptado: 24 de mayo de 2021

Palabras clave:
Osteoporosis
Densidad ósea
Enfermedades Óseas Metabólicas
Densitometría
Prevalencia

R E S U M E N

La osteoporosis se caracteriza por una disminución de la masa ósea y el deterioro de la microarquitectura ósea, objetivamente una densidad mineral ósea 2,5 SD por debajo de la población promedio de adultos jóvenes sanos. Ante la ausencia de estudios de prevalencia de indicadores antropométricos alterados en la población sudamericana, presentamos un estudio transversal de las mediciones demográficas, densitométricas y antropométricas de pacientes de Bogotá, Colombia. Se realizó un estudio descriptivo de corte transversal, en el que se tomaron mediciones demográficas, densitométricas y antropométricas de pacientes atendidos en el Hospital Central Militar de Bogotá, Colombia, desde agosto hasta noviembre de 2019. Se incluyeron 241 pacientes posmenopáusicas, que mostraron un cambio en la distancia occipucio-pared (DOP) en el 22% (IC 95% 17-27) de los pacientes y una distancia costopélvica (CPD) alterada en el 21,5% (IC 95% 17-27.4). La prevalencia de antropometría establecida por densitometría, fue de 33% y 21.6% en DOP y 31.9% y 21.6% en pacientes con CPD con osteoporosis de la columna lumbar y cuello femoral, respectivamente. La prevalencia de indicadores antropométricos alterados en nuestra población hospitalaria fue del 22% para la distancia occipucio-pared y del 21,6% para la distancia costopélvica, que varía según la edad, el peso y la densidad mineral ósea.

*Autor para correspondencia: alirio.bastidas@unisabana.edu.co

Keywords:
Osteoporosis
Bone density
Bone Diseases
Metabolic
Densitometry
Prevalence

ABSTRACT

Osteoporosis is characterized by a decrease in bone mass and deterioration of the bone microarchitecture, objectively as a bone mineral density below 2.5 SD of the average healthy young adult population. In the absence of studies of prevalence of altered anthropometric indicators in the South American population we present a cross-sectional study of the demographic, densitometric and anthropometric measurements from patients of Bogota, Colombia. This is a descriptive cross-sectional study, in which demographic, densitometric and anthropometric measurements were collected from patients attended in Central Military Hospital, in Bogota Colombia, since August to November 2019. Two hundred and forty-one postmenopausal patients were included, showing a change in the occiput-wall distance (OWD) in 22% (95% CI 17-27) of the patients and a rib-pelvic distance (RPD) altered in 21.5% (95% CI 17-27.4). The prevalence of anthropometric established by densitometry, was 33% and 21.6% in OWD and 31.9% and 21.6% in RPD patients with osteoporosis of the lumbar spine and femoral neck respectively. The prevalence of altered anthropometric indicators in our hospital population was 22% for occiput wall distance and 21.6% for rib-pelvic distance, which vary according to age, weight and bone mineral density.

INTRODUCTION

Osteoporosis is a disease which is characterized by a decrease in bone mass and deterioration of the bone microarchitecture, with a higher risk of fractures. In 1994, the WHO defined osteoporosis as a bone mineral density (BMD) below 2.5 SD of the average healthy young adult population[1, 2]. It is estimated that 10 million Americans over the age of 50 have osteoporosis, and that another 34 million are at risk for the disease[3,4].

The decrease in BMD predicts the increased risk of fragility fractures, and multiple epidemiological studies predict that one out of every two women over 50 will suffer at least one fracture due to bone fragility during the rest of their lives[1], of which 70% will be asymptomatic. However fragility fractures have been associated with long-term negative effects, as they deteriorate the quality of life, decrease independence and increase the morbidity and mortality of patients[4,5], which is why osteoporosis and fragility fractures should be diagnosed and managed. It is necessary to perform a simple and applicable screening method in all sectors of medical care to detect asymptomatic vertebral fractures.

Clinical methods have been previously studied in Caucasian and Oriental populations[6,7,8]; finding a positive correlation of altered anthropometric indicators such as rib-pelvic distance (RPD) and occiput-wall distance (OWD) and the presence of asymptomatic vertebral fractures. In the absence of studies on the prevalence of altered anthropometric indicators in the South American population, it is necessary to carry out studies to calculate their frequency, especially in the population at risk of fracture. This information could be especially useful in clinical evaluation in elderly populations and postmenopausal women. The main objective of this study is to determine the prevalence of altered RPD and OWD in a population with and without altered BMD.

MATERIALS AND METHODS

A descriptive cross-sectional study was carried out, in which demographic, densitometric and anthropometric measurements of patients attended and followed by the consultation of Endocrinology of the Central Military Hospital, a highly complex hospital in Bogotá, Colombia, were collected during the August to November 2019 period.

Participants:

We included postmenopausal patients older than 50 years who had a bone densitometry in a period of no more than 6 months, who did not present any of the following precedents: traumatic fracture at the level of the thoracolumbar spine and/or pelvic, chronic use of glucocorticoids (prednisolone 5 mg or equivalent dose of another glucocorticoid for a time greater than or equal to 3 months), solid or hematological organ neoplasm and / or congenital deformity of the thoraco-lumbar spine.

Variables:
Among the variables evaluated, were included demographic characteristics: age, anthropometric characteristics: weight, height, BMI, OWD and RPD; and densitometric characteristics: BMD and T - score (comparison of the average bone density of the patient with that of a healthy person of 30 years of the same sex and ethnicity) of the lumbar spine and femoral neck.

Data sources:
Osteoporosis and osteopenia were defined according to the 1994 WHO classification, with a T score <-2.5 and between -2.5 and >1.0 respectively[7]. Interesting data was collected from the patient's medical history and the anthropometric measures were taken as follows: 1. Weight: it was done in underwear with a gown, with an empty bladder, taken on a mechanical scale at the endocrinologist´s office, which is being periodically calibrated 2. Size: it was performed with the patient barefoot in the height rod at the endocrinologist´s office and the height of the body was measured from the feet to the vertex of the head, in the Frankfurt plane. 3. OWP: the patient was asked to stand upright against the wall where the heels, buttocks and back would touch the wall, the manual measurement (with the fingers) was made from the occiput to the wall during the maximum effort to bring the head to the wall, but without lifting the chin beyond its horizontal position, it was interpreted as altered if the distance was greater than 0 fingers. 4. RPD: was performed with the patient standing upright, with the examiner behind the participant and manual measurement (with the fingers) of the distance between the lower edge of the eleventh rib and the upper surface of the iliac crest was made along the average axillary line, during exhalation, considering a distance less than or equal to 2 fingers being altered.

Study size:
The sample size was determined for a confidence interval with a prevalence of anthropometric alterations of 50%, and an estimated population taken to densitometry in the Military Hospital of 5000 patients, and an accuracy of 10%, convenience sampling and estimated loss of 20%, a minimum of 227 subjects is estimated.

Statistical Analysis:
The data were collected in Excel of Microsoft and were reviewed by the two main researchers to avoid errors in the transcription, after, analysis statistic in the SPSS program was realized, quantitative variables were described with averages and standard deviation if their distribution was normal or in medium and interquartile ranges if their distribution was not normal. The qualitative variables were described in frequencies and percentages, the prevalence of RPD and OWD abnormal was calculated with the number of subjects with abnormal anthropometric measurements over the total of the subjects with densitometry taken to the study, the prevalence of RPD and OWD abnormal by osteoporosis and osteopenia according WHO was independent calculated. Finally, the prevalence of RPD and OWD abnormal were estimated by BMI <25, BMI 20 to 30, BMI >25, age 50 to 60, age 60 to 70 and age >60, 95% confidence interval for a proportion was calculated for each group.

RESULTS

A total of 258 postmenopausal female patients over 50 years of age were evaluated in the outpatient clinic of Endocrinology between August 15 to October 31, 2019; 241 were included, 17 patients were excluded due to incomplete date. Was identified that the average age of the studied population was 63.5 years with a SD of 7.7, the average weight was 59.2 kilograms, height was 1.53 meters and a Body Mass Index (BMI) of 25.01 kg/m2 with a SD of 3.6. Table I shows the subjects included in terms of age, anthropometric measurements and BMI in relation to bone densitometry. In 22% (95% CI 17-27) of the postmenopausal patients evaluated, abnormal OWD was found. Regarding RPD, it was identified that 21.5% (95% CI 17-27.4) of the patients had this measure altered (Table II).

When evaluating the anthropometric data obtained and the results of densitometry in terms of T score, it was observed that in those patients with osteoporosis at the level of the lumbar spine, 33% had an altered OWD and an abnormal RPD in 32%. And in those patients with osteoporosis of the femoral neck, abnormality of the OWD was evidenced in 38.5% and in the RPD distance of 46.2%. Table 2 shows the prevalence of altered anthropometric indices in the population with osteopenia and with adequate BMD. In this sample, the frequency of altered anthropometric measurements in the population with osteoporosis was higher than the population with normal BMD (Table I). Additionally, it was found that patients with a body mass index in obesity had a lower prevalence of alteration of the anthropometric indicators with respect to those with normal BMI (Table III). It was identified that of the total of the patients, 78% (n= 190) presented alteration in the BMD, interpreting it as a T score <-1.0 SD, of which 39% (n= 94) had osteoporosis and 39.8% (n= 96) had osteopenia. Likewise, altered densitometry variables in the femoral neck were evidenced in 55% (n= 134) of the patients evaluated, of which 5.39% (n= 13) and 50% (n= 121) had osteoporosis and osteopenia respectively.

Of the reported asymptomatic fractures, 70% were in morphometric vertebrae. In patients with osteoporosis of both the lumbar spine and the femoral neck, adequate body mass indexes were observed (with an average of 23.9 and 21.4 kg/m2, respectively), unlike those with adequate BMD where the average of the BMI was in the lumbar column of 26.4 kg/m2 and in the femoral neck of 26.3 kg/m2; inferring that those patients with higher BMI, are associated with better bone mass (Table I).

The average age of patients with osteoporosis of the lumbar spine was 65.39 years and the femoral neck was 66.18 years. In contrast, patients with normal densitometry the average age was 62.1 years in both the lumbar and femoral neck. Which evidences a discrete tendency in deterioration of bone mass with age. (Table I). In addition, there was an increase in the prevalence of anthropometric measurements altered at an older age (Table IV).

Table I. Age and anthropometric characteristics of the population in relation to bone mineral densitometry.

		Total population (n=241)	**TS LS ≤2,5** (n=94)	**TS LS -1,0 a -2,49** (n=96)	**TS LS >-1,0** (n=51)	**TS FN ≤2,5** (n=13)	**TS FN -1,0 a -2,49** (n=121)	**TS FN >-1,0** (n=107)
Age (years)	$\bar{x}$ (ds)	63,52(7,70)	65,39(7,84)	62,43(7,10)	62,14(7,99)	66,18(9,66)	64,44(7,68)	62,16(7,31)
	M(RIQ)	62,60(12)	65,35(12)	62,10(11)	61,00(12)	67,90(16)	64,10(10)	61,30(11)
Weight (Kg)	$\bar{x}$ (ds)	59,19(9,64)	55,63(7,71)	60,40(9,93)	63,47(10,15)	48,81(8,93)	57,05(8,05)	62,86(9,80)
	M(RIQ)	58,5(13)	55,55(10)	60,75(14)	62,00(15)	45,80(13)	55,60(11)	62,30(12)
Height (m)	$\bar{x}$ (ds)	1,53(0,057)	1,52(0,05)	1,54(0,05)	1,54(0,05)	1,50(0,06)	1,53(0,06)	1,54(0,05)
	M(RIQ)	1,53(0,08)	1,51(0,06)	1,54(0,09)	1,55(0,06)	1,51(10)	1,52(0,09)	1,54(0,07)
BMI (Kg/m2)	$\bar{x}$ (ds)	25(3,62)	23,96(3,15)	25,27(3,64)	26,43(3,88)	21,42(3,44)	24,23(3,16)	26,31(3,62)
	M(RIQ)	24,76(4,6)	23,62(4,0)	25,05(4,5)	25,43(5,8)	20,35(5,3)	23,88(4,0)	25,96(4,3)
Occiput-wall distance (number of fingers) n (%)								
	0	188 (78)	63 (67)	85 (88,5)	40 (78,4)	8 (61,5)	93 (76,9)	87 (81,3)
	1	11 (4,6)	4 (4,3)	5 (5,2)	2 (3,9)	1 (7,7)	5 (4,1)	5 (4,7)
	2	21 (8,7)	13 (13,8)	4 (4,2)	4 (7,8)	2 (15,4)	12 (9,9)	7 (6,5)
	3	14 (5,8)	10 (10,6)	1 (1)	3 (5,9)	0 (0)	9 (7,4)	5 (4,7)
	4	7 (2,9)	4 (4,3)	1 (1)	2 (3,9)	2 (15,4)	2 (1,7)	3 (2,8)
Rib-pelvic distance (number of fingers) n (%)								
	1	5 (2,1)	4 (4,3)	1 (1)	0 (0)	1 (7,7)	4 (3,3)	0 (0)
	2	47 (19,5)	26 (27,7)	10 (10,4)	11 (21,6)	5 (38,5)	26 (21,5)	16 (15)
	3	131 (54,4)	49 (52,1)	56 (58,3)	26 (51)	5 (38,5)	65 (53,7)	61 (57)
	4	58 (24,1)	15 (16)	29 (30,2)	14 (27,5)	2 (15,4)	26 (21,5)	30 (28)

TS = T score, LS =Lumbar spine, FN = Femoral neck

Table II. Prevalence of abnormal anthropometric measurements in the population T score.

	General population (n=241)	**Population TS LS ≤-2,5** (n=94)	**Population TS LS -1,0 to -2,49** (n=96)	**Population TS LS >-1** (n=51)	**Population TS FN ≤-2,5** (n=13)	**Population TS FN -1,0 to -2,49** (n=121)	**Population TS FN >-1** (n=107)
OWD>0	22% (IC95%: 17-27)	33% (IC95%: 23,9-43,5)	11,5% (IC95%: 5,5-18)	21,6% (IC95%: 10-33)	38,5% (IC95%: 11,1-66,7)	23,1% (IC95%: 14,9-30,9)	18,7% (IC95%: 11,4-26,7)
RPD≤2	21,6% (IC95%: 17-27,4)	31,9% (IC95%: 22,3-41,6)	11,5% (IC95%: 5,4-18,2)	21,6% (IC95%: 10,3-34)	46,2% (IC95%: 18,8-75,0)	24,8% (IC95%: 16,9-33,0)	15% (IC95%: 8,3-22,4)

TS = T score, LS = Lumbar Spine, FN = Femoral Neck, OWD = Occiput-wall distance, RPD= Rib-pelvic distance

Table III. Prevalence of abnormal anthropometric indices by BMI (Kg/m2).

Prevalence of abnormal anthropometric indices by BMI			
	<25 (n=128)	25 – 30 (n=89)	> 30 (n=24)
OWD>0	21,9% (IC95%: 15-29,7)	24,7% (IC95%: 15,8-34)	12,5% (IC95%: 0-27,3)
RPD≤2	24,2% (IC95%: 17,2-31,7)	18% (IC95%:10,4-26,8)	20,8% (IC95%: 5-39,1)

OWD =Occiput-wall distance, RPD= Rib-pelvic distance

Table IV. Prevalence of anthropometric means altered by age.

Prevalence of abnormal anthropometric indices by age (years)			
	50 - 60 (n=88)	60 - 70 (n=105)	> 70 (n=48)
OWD>0	15,9% (IC95%: 8,3-24,4)	20,0% (IC95%: 12,7-27,7)	37,5% (IC95%: 25-52,1)
RPD≤2	11,4% (IC95%: 5,2-18,4)	21,9% (IC95%:14,4-30,8)	39,6% (IC95%: 26,2-54,2)

OWD = Occiput-wall distance, RPD= Rib-pelvic distance

DISCUSSION

This is the first study in our population that evaluates the frequency of altered anthropometric semiological measurements in postmenopausal patients taken to bone densitometry. Of a total of 241 patients evaluated by the endocrinology service of the Central Military Hospital, it was found that the prevalence of altered anthropometric indicators corresponded to 22% for the occiput-wall distance and 21.6% for the rib-pelvic distance; proportions lower than those found by Kiyoko et al[8], who evaluated 116 Japanese women, where the frequency of these alterations was 40% and 45% respectively. However, this population had 58% of women older than 70 years and in our study it was 20%.

When evaluating the presence of anthropometric indicators altered according to age, it was evident that the prevalence of alterations of these measurements were greater according to the increase in age; data that coincide with literature[8,9]. Additionally, a lower prevalence of altered anthropometric indicators was observed in the population with a body mass index greater than or equal to 30 kg/m2, which could be due to the lower prevalence of osteoporosis in the obese population or the difficulty of performing the anthropometric measurement, especially rib-pelvic distance in this population group[6]. In the same way, Christina Ziebart et.al[10] and Balzini et.al[11] described the importance of ankylosing spondylitis, spinal extensor, ankle joint dorsiflexors and plantar flexors strength on head posture, aspects could change the OWD distance and therefore influence the results; however, those variables were not evaluated in this study. We found that in subjects with bone mineral density in the range of osteoporosis, there was a higher frequency of alteration of the anthropometric indicators evaluated, with respect to those with adequate bone mineral density. Suggesting that these alterations can be found more frequently in subjects with lower bone mineral density, which is why it is considered that these measurements could be useful in the detection of patients with a high risk of symptomatic and asymptomatic fractures[8,12], where subjects of greater age and with alterations of these measurements presented greater frequency lumbar fractures. The evaluation of these measurements and other useful measurements such as the evaluation of historical height[13] can guide the physician in requesting X-rays, vertebral morphometry[14] or computed tomography[15], which are useful tools in the diagnostic approach in these patients at present.

The prevalence in our study of osteoporosis of the lumbar spine and femoral neck was 44.4%, data superior to those reported by epidemiological studies of the global population where a 33% prevalence of osteoporosis is documented[4,6,16]; probably this difference is due to the hospital population evaluated by our study[17]. Regarding the age distribution, it was evident that osteoporosis was more prevalent in the group of patients older than 70 years, data concurring to that described in the literature that bone mass decreases with age[6]. A lower number of cases of osteoporosis of the lumbar spine and femoral neck in patients with body mass indexes in the range of overweight and obesity were observed in our study, data according to that found in different studies where a strong association of obesity is established as a protector against bone loss[6,18].

Although the results of this study are reasonable, one of the limitations was that the measurements made with the fingers may not be objective and may be inaccurate with some degree of inter-rater variability, however it is a simple maneuver to perform during the physical examination. Another limitation was that when using a hospital population, the prevalence of altered anthropometric measurements may be overestimated, however, they are present in our environment and are easily accessible; a population study could be carried out that measures these alterations and eventually use a clinical prediction rule that evaluated weight, age and semiological findings to corroborate osteoporosis and / or fragility fractures.

CONCLUSIONS

This study, which establishes that there is a higher prevalence of altered anthropometric indicators in the osteoporotic population and at an older age, serves as a basis for considering a larger sample size in order to draw conclusions of value in the subgroups evaluated; as well as serving as a platform for the realization of causality studies and establish an association of the altered anthropometric indicators and the diagnostic prediction of asymptomatic vertebral fracture in the osteoporotic population. In conclusion, the prevalence of altered anthropometric indicators in our hospital population was 22% for occiput wall distance and 21.6% for rib-pelvic distance, which vary according to age, weight and bone mineral density.

Acknowledgement: We declare we do not receive any support or collaboration from any institution.

Statement of ethics: The project was approved under all the respective indications of the ethics committee, no personal information was taken outside the indicated in the protocols of the hospital, no experiments were carried out in humans or animals.

Disclosure Statement: We don´t have any financial interests or nonfinancial relationships.

Funding Sources: We don't have any founding source.

Author Contributions:
Esperanza L Mejia: Interpretation of results, data collection.
Esperanza S Gómez: Interpretation of results, data collection.
Alirio R Bastidas: Epidemiological adviser, interpretation results.
Daniel M Arsanios: Translation, writing of results, discussion and search of information sources.

REFERENCES

1. **Sambrook P, Cooper C. Osteoporosis.** Lancet. 2006; 367:2010-8.
2. **Camacho PM, Petak SM, Binkley N, Diab DL, Eldeiry LS, Farooki A, et al.** American association of clinical endocrinologists/american college of endocrinology clinical practice guidelines for the diagnosis and treatment of postmenopausal osteoporosis-2020 update. Endocr Pract. 2020; 26(Suppl 1):1-46.
3. **González LA, Vásquez GM, Molina JF.** Epidemiología de la osteoporosis. Revista Colombiana de Reumatología. 2009; 16:61-75.
4. **Rachner TD, Khosla S, Hofbauer LC.** Osteoporosis: now and the future. Lancet. 2011; 377:1276-87.
5. **Cooper C.** Epidemiology of osteoporosis. Osteoporos Int. 1999; 9 (Suppl 2):S2-8.
6. **Green AD, Colón-Emeric CS, Bastian L, Drake MT, Lyles KW.** Does this woman have osteoporosis? JAMA. 2004; 293:2890-900.
7. **Siminoski K, Warshawski RS, Jen H, Lee KC.** The accuracy of clinical kyphosis examination for detection of thoracic vertebral fractures: comparison of direct and indirect kyphosis measures. J Musculoskelet Neuronal Interact. 2011; 11:249-56.
8. **Abe K, Tamaki J, Kadowaki E, Sato Y, Morita A, Komatsu M, et al.** Use of anthropometric indicators in screening for undiagnosed vertebral fractures: a cross-sectional analysis of the Fukui Osteoporosis Cohort (FOC) study. BMC Musculoskelet Disord. 2008; 9:157.
9. **Jiang Y, Zhang Y, Jin M, Gu Z, Pei Y, Meng P.** Aged-Related Changes in Body Composition and Association between Body Composition with Bone Mass Density by Body Mass Index in Chinese Han Men over 50-year-old. PLoS One. 2015; 10:e0130400.
10. **Ziebart C, Adachi JD, Ashe MC, Bleakney RR, Cheung AM, Gibbs JC, et al.** Exploring the association between number, severity, location of fracture, and occiput-to-wall distance. Arch Osteoporos. 2019; 14:27.
11. **Balzini L, Vannucchi L, Benvenuti F, Benucci M, Monni M, Cappozzo A, et al.** Clinical characteristics of flexed posture in elderly women. J Am Geriatr Soc. 2003; 51:1419-26.
12. **Xuan R, Song Y, Baker JS, Gu Y.** The Evaluation of Bone Mineral Density based on Age and Anthropometric Parameters in Southeast Chinese Adults: A Cross-Sectional Study. Med Sci Monit. 2020; 26:e923603.
13. **Nakano M, Nakamura Y, Suzuki T, Kobayashi T, Takahashi J, Shiraki M.** Implications of historical height loss for prevalent vertebral fracture, spinal osteoarthritis, and gastroesophageal reflux disease. Sci Rep. 2020; 10:19036.
14. **Chou SH, Vokes T.** Vertebral Morphometry. J Clin Densitom. 2016; 19:48-53.
15. **Imai K.** Vertebral fracture risk and alendronate effects on osteoporosis assessed by a computed tomography-based nonlinear finite element method. J Bone Miner Metab. 2011; 29:645-51.
16. **Baccaro LF, Conde DM, Costa-Paiva L, Pinto-Neto AM.** The epidemiology and management of postmenopausal osteoporosis: a viewpoint from Brazil. Clin Interv Aging. 2015; 10:583-91.
17. **Spechbach H, Fabreguet I, Saule E, Hars M, Stirnemann J, Ferrari S, et al.** Higher rates of osteoporosis treatment initiation and persistence in patients with newly diagnosed vertebral fracture when introduced in inpatients than later in outpatients. Osteoporos Int. 2019; 30:1353-62.
18. **Xiang BY, Huang W, Zhou GQ, Hu N, Chen H, Chen C.** Body mass index and the risk of low bone mass-related fractures in women compared with men: A PRISMA-compliant meta-analysis of prospective cohort studies. Medicine (Baltimore). 2017; 96:e5290.