Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 10, Issue, 03, pp.66409-66416, March, 2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

FACTORS, AGE AND SEX RELATED VALUES OF DXA ASSESSED SPINE AND HIP BONE MINERAL CONTENT AND BONE MINERAL DENSITY IN URBAN CONGOLESE POPULATION

***,[1]Joseph Médard Kabeya Kabenkama and [2]Jean–Marie Mbuyi Muamba**

[1]Department of Radiology, Kinshasa University School of Medicine and Hospital, Kinshasa, Democratic Republic of the Congo
[2] Departments of Internal Medicine, Rheumatology, Kinshasa University School of Medicine and Hospital, Kinshasa, Democratic Republic of Congo

ARTICLE INFO

Article History:
Received 29th December, 2017
Received in revised form
04th January, 2018
Accepted 19th February, 2018
Published online 28th March, 2018

Key words:
Normative Values,
Bone Mass, DXA,
Bone Mineral Density,
Bone Mineral Content,
Congolese,
Bone mass factors,
Calcium, BMI,
OH vitamine D,

ABSTRACT

Introduction: WHO criteria for the diagnosis of osteoporosis and the associated risks of fractures are based on bone parameters assessed by dual x absorptiometry wich will be compared with normative T-score or Z-score values of the same ethnical origine. Thus the necessity to establish normative data for each population according to habit and ethnicity. Normative Data including male and female and studies about factors of bone mass for Congolese populations were lacking. This study aims to establish these normative values and to determine factors influencing bone mass in Congilese population.

Materials and Methods: 660 people: 56 men and 604 women were recruited after public media advertising and undergoes DXA of spine and hip from June 2016 to June 2017.

All the subjects undergoes also clinical examination by a physician, DXA, and biological tests from blood and urines samples. To be included in the study, one must agreed and fulfill the conditions of absence of factor affecting bone metabolism.

Results: Bone mass parameters shows a growth up to the peak that is reached in the fourth decade followed by a slow decay that causes a loss of nearly 14.2% to 20 % in BMC and BMD.

The BMD and BMC values are higher in male and the decay were present in both sex but more pronounced in female. Age, BMI, serum calcium, OH Vitamine D, serum iron, and cholesterol are significative bone mass factors in single regression models but in multiple regression models only Age and Calcium remains significative factors on all sites while BMI and cholesterol are selectively significant for sites and parameters.

Citation: Joseph Médard Kabeya Kabenkama and Jean–Marie Mbuyi Muamba, 2018. "Factors, age and sex related values of dxa assessed spine and hip bone mineral content and bone mineral density in urban congolese population", *International Journal of Current Research*, 10, (03), 66409-66416.

INTRODUCTION

Osteoporosis is a public health problem with an attempted heavy burden for incoming year caracterised namely by higher life esperancy, endemic obesity, growing sedentarism and changes in life style specially for southern countries who are progressively undergoing an epidemiological transition despite limited access to equivalent care and equipment (Cooper and Davkinson, 1992; World Health Organization, 2010). The main impact of osteoporosis on bone system is the decrease with ageing in bone strength and the in creased risk of fracture And the operational definition of osteoporosis is provided by dual-energy X-ray absorptiometry (DXA), which is the WHO-validated reference method, isrelated to etnicity (Cooper and Davkinson, 1992; World Health Organization, 2010; WHO, 2007; Kelly *et al.,* 2009). Bone mass is a major determinant of bone strength and, after reaching peak values in the third or fourth decade of life, bone mineral content and density begins to decline until sixth or seventh decade of life wich results in low bone mass and decline of bone strenght wich is a risk factor for fragility fractures that occures with ageing and osteoporosis (WHO, 2010; Sangmo *et al.,* 2011). Several studies wich investigated bio-anthropometrics (age, gender, heigh, weight) and ethnic group-specific differences in whole body and regional bone mineral density (BMD) in Europeans and overseas Caucasians, in Aseans, in South African Black and White populations in Middle-Eastern and Arab populations showed that there are racial/ethnic differences in BMD and BMC values of populations of different ethnic origines altought living in the same environmental location (Maghraoui *et al.,* 2006; Conradie *et al*., 2015; Muhammad *et al.,* 201; Wulan *et al.,* 2010; Cvijetić Avdagić *et al.,* 2012;

******Corresponding author:* **Joseph Médard Kabeya Kabenkama,**
Department of Radiology, Kinshasa University School of Medicine and Hospital, Kinshasa, Democratic Republic of the Congo.

Krall and Dawson-Hughes, 1993; Kabeya Kabenkama *et al.,* 2017; WHO, 1995; Adami *et al.,* 2010). To Heredity is attribu table 46-62% of variance of bone density but an individual's life-style accounts for a potentially large part (Albala *et al.,* 1996). Heredity is known to be more important for peak bone density and also weaker in the cortical than in the trabecular parts of the skeleton. While the environmental factors are known to be important for bone health (Behzad *et al.,* 2017). Necessity to establish reference data for bone mass measurements for each population according to habit and ethnicity is then obvious. Apart from ethnicity, dietary habits and the environment, it is important to consider the other factors of bone mass and the degree of connection between bone mass and these factors. To the best of our knowledge, normative values for DXA of Congolese women have been published (Cooper and Davkinson, 1992) but there are no studies reporting values in both sexes as well as reporting anthropo-biometric and / or biological factors influencing bone mass. Thus, this study aims to describe the profile of spine and hip DXA parameters this population and establish anthropo-demographics and biological factors and determinants of spine and total hip BMC and BMD in Congolese populations.

MATERIALS AND METHODS

Subjects

After advertising in the public media for a low cost check up, a total of 802 subjects were respondents from june 2016 to june 2017 whom 713 women and 89 men.
Considering results of the check up and inclusion criteria, subjects were eligibles for the study if they:

Were black Congolese bantu from origine, living Kinshasa for, at least, 5 years.

- Had no previous high or low energy vertebral fractures.
- Had No diseases nor medications known to affect bone metabolism (cancer, diabetes, ss, prolonged diseases of the liver, kidney, thyroid gland, etc. or treatment using corticosteroids greater than or equal to 3 months, anticonvulsants, thyroid hormones, etc.)
- Havea non perturbed menstrual and reproductive histories. (Amenorrhea, anorexia nervosa, premature ovarian failure). Also excluded were women who had experienced an early menopause (before 40 years of age).
- Subjects from the postmenopausal group who had taken estrogens earlier (at least during the 2 years after menopause) or who still were taking estrogens were excluded, as well as those who had taken oral corticosteroids for more than 6 months
- Women using medications affecting calcium metabolism and those with medical conditions known to affect bone metabolism were excluded.

We excluded subjects with gastrectomy, intestinal resection, recent hyperthyroidism or hyperparathyroidism, treatment with corticosteroids, or recent severe immobilization. We did not exclude individuals using inhalation steroids, smoking, sedentary, nor athletic which are examples of voluntary factors that may have some impact on bone metabolism. Our study group consists of 660 people: 56 men and 604 women (220 premenopausal (36.42%) and 384 postmenopausal (63.57%) women) who met the inclusion criteria and who agreed to participate in the study.

Measurements

- Anthropometric parameters (age, height, and weight) were collected according to standardized procedures. Weight was measured in kg and height in cm.
- Body mass index (BMI) in Kg/m² were calculated as follows: = w (Kg)/T² (m)
- It was quoted in 6 steps according to the system proposed by WHO (Cipriani *et al.,* 2017)

1= under weight	BMI < 18.5
2= NORMALweight	BMI > 18.5
3 =over weight	BMI > 25)
4 =Obésity class I	BMI >30
5 =Obésity classe II	BMI >35
6 =Obésity classe III	BMI >40

- The DXA examinations of the lumbar spine (L1 to L4) and proximal femurs were conducted with a QDR Discovery densitometer (Hologic, Inc., Bedford, MA, USA), in accordance with the procedures recommended by the manufacturer and using Hologic Discovery software in its default configuration.

All measurements were carried out by 2 trained technicians.
The DXA instruments used in survey were calibrated according to the manufacturer requisites and phantom measurements showed stable results.

Statistical Analysis

The statistical analysis was performed using commercially available software (SPSS version 21). The results were expressed as mean, standard deviation (mean ± SD), range (minimum and maximum values) and absolute (n) and relative (%) frequencies. The differences in bmd and bmc values between subgroups were analyzed using the Student's *t*-test. The search for associated factors was done using simple linear regression. , allowing us to rule out the insignificant factors. The significant factors in simple linear regression were tested in multiple linear regressions with calculation of the coefficients of determination and the odds ratio in order to estimate the degree of association. The estimated probability for each multivariate variable was calculated. The threshold of significance was set at 0.05

Ethics statement

The study design was approved by the local ethics committee and the study was conducted in accordance with the declaration of Helsinki for human studies.

RESULTS

Age and Sex trends of Biometry and biological parameters

The values of the anthropometric and biological data obtained in both sex and theirs age-related variations are shown in Table 1A for women and 1B for men. The sample of men is quantitatively smaller than that of women, and include few subjects in the age group above 59 years. The weight is higher, at any age, in the male sex, the difference were non significative from 30 to 59 years of age ($p = 0.63$). The subject's size were significantly higher in the male at any age

(p = 0.02) and a significant decrease in size up to 4% were noted from 59 and 70 years in females. BMI values were suggestive of overweight at least at all ages, slighty increasing obesity step with age. Serum Vitamin D and calcium levels are comparatively higher in males at any age (p<0.02). Other biological parameters did not show any particular trends with age and sex.

Table 1A : Age related variation in biological and biometrical parameters in women

	AGE (years)					
Parameters	18 - 29	30 - 39	40 – 49	50 -59	60-69	70 and more
Weight(kg)	69,2±16,2	75,3±13,1	81,7±17,0	83,4±16,8	81,4±17,34	73,6±13,9
Size (m)	1,65±0,7	1,65±0,6	1,66±0,06	1,65±0,1	1,64±0,07	1,61±0,06
BMI	25,4±5,5	27,7±4,6	29,6±5,74	30,5 ±5,9	29,9±5,8	28,5±5,1
OH-Vit D	29,2±7,9	28,01±8,8	29,06±7,9	30,4±10,1	31,7±9,2	24,8±9,6
Calcium	9,44±0,28	9,23±0,3	9,27±0,3	9,50±0,3	9,4±0,49	9,16±0,64
Serum iron	68,1±24,9	75,6±37,1	79,8±34,4	88,3±29,0	85,7±25,2	87,1±43,9
TSH	1,77±1,32	1,69±0,8	2,13±3,14	2,47±7,23	2,6±3,62	2,4±0,83
Cholesterol	181,4±44,9	181,2±38,4	200,3±42,9	219,6±41,4	211,1±33,5	197,00±43,5

Table 1B : Age related variation in biological and biometrical parameters in men

	AGE (years)					
Paramètres	18 - 29	30 - 39	40 – 49	50 -59	60-69	70 and more
Weight kg)	72,3±6,9	76,5±6,8	79,8±15,0	84,2±12,8	98,5±13,4	74,4±7,6
Size (m)	1,67±0,09	1,73±0,1	1,73±0,08	1,71±0,06	1,79±0,01	1,79±0,02
BMI	26,21±3,7	25,65±3,8	27,00±5,5	28,80±4,2	30,89±3,95	23,3±1,78
OH vit D	38,2±4,6	39,9±7,0	39,8±6,3	40,1±7,0	39,5±7,0	37,8±6,3
Calcium	10,8±0,44	10,6±0,46	10,4±0,60	10,2±0,46	10,1±0,44	10,2±0,51
Serum iron	52,8±2,04	52,3±3,54	53,2±2,83	56.1±2,53	52,1±3,55	54,2±1,83
TSH	1,6±27,12	1,4±2.32	1,44±0,07	1,55±1,17	1,3±1,35	1,42±1,17
Cholesterol	200,2±8,46	207,6±11,7	211,2±12,4	220	200,2±8,46	205,6±13,7

Age and Sex –related variations of BMC and BMD

Age and Sex related variations of spine and total hip BMC and BMD are presented on Table 2.

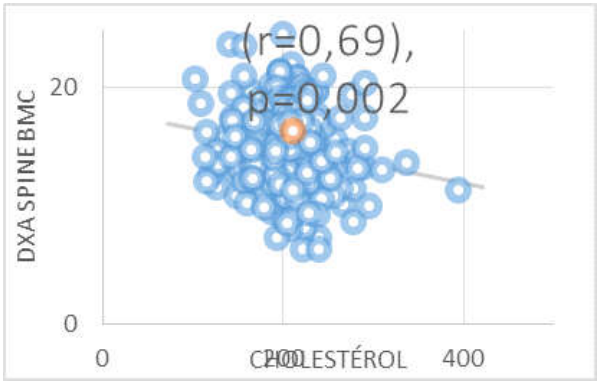
Table 2: Age and Sex related variation of BMC and BMD

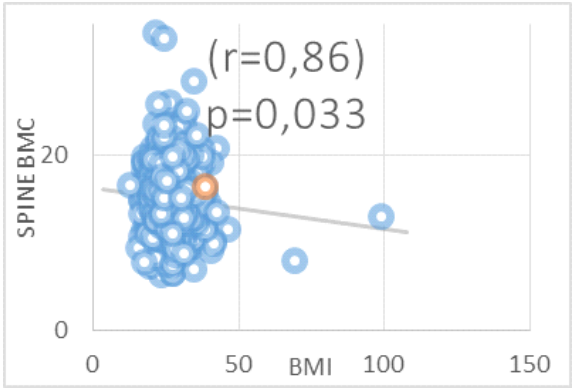
	AGE (years)					
indices	18 - 29	30 - 39	40 – 49	50 -59	60-69	70 and more
1W	15,65±4,8	17,76±2,5	17,44±3,0	14,14±3,0	14,15±3,9	12,41±3,7
1M	18,89±1,3	18,32±2,8	18,21±2,2	17,35±3,7	16,96±1,2	16,57±7,5
2W	1,07±0,17	1,11±0,1	1,19±0,1	0,99±0,1	0,98±0,21	0,89±0,20
2M	1,42±0,23	1,31±0,3	1,22±0,2	1,10±0,2	1,08±0,06	1,01±0,29
3W	0,94±0,14	0,94±0,14	1,05±0,15	0,87±0,13	0,79±0,16	0,70±0,14
3M	1,14±0,42	1,10±0,40	1,04±0,32	0,94±0,33	0,91±0,07	0,89±0,19
4W	4,31±0,73	4,31±0,71	4,58±2,61	4,08±0,67	3,78±0,87	3,19±0,71
4M	4,70±0,84	4,58±0,89	4,65±0,92	4,52±1,01	4,48±0,54	4,43±1,80

Legend table 2 W= women M=men
1 : Spine BMC L1 to L4 2 : spine BMD L1 to L4 3 Total hip BMC 4 Total hip BMD
Men values was s higher at all ages (p <0.042) except hip BMC at 40-49years (p=0.64).

Relationship between biometrical and bone mass indices in single linear regression

The search for factors influencing bone mass was investigated by analysing relationships between parameters in single linear regression. The coefficients of regression and their probabilities are presented in figure 1 :A to H.





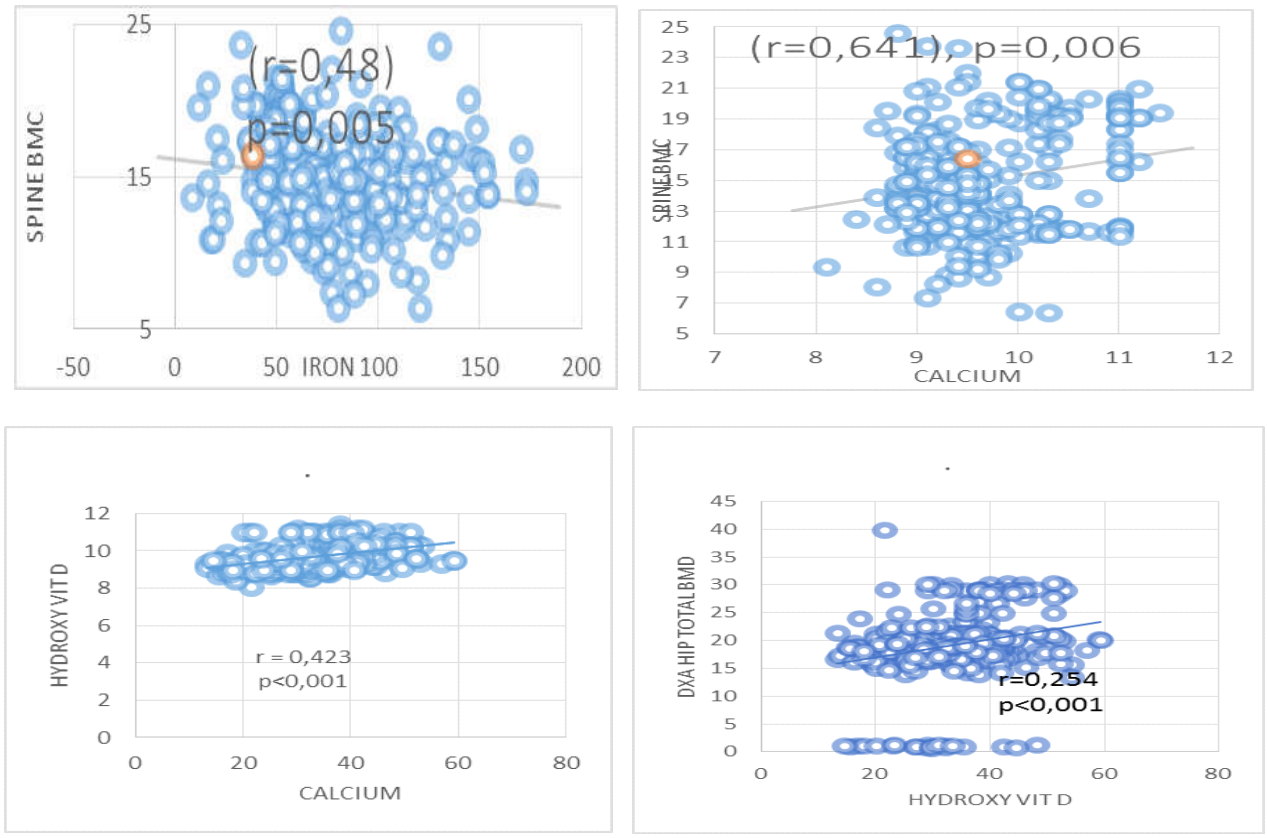


Figure 1 (A to H) presents orientation, probabilities and coefficient of regression of differents relationship parameters

Legend : 1A : Spine BMC by Age ; 1B : Spine BMC by Cholesterol
1C :Spine BMC by BMI ; 1D :Spine BMC by Iron
1E :Spine BMC by Ca++ ; 1F : Oh Vit D by Ca++
1G :Hip BMD by OH vit D ; 1 H Spine BMC by Iron
Factors whose relationship were positive and significative were:
Serum calcium by spine BMC (p = 0.006; r=0.64)
Vitamin D by hip BMD (p = 0.001; r = 0.254)
Serum calcium by vitamin D (p = 0.001; r = 0.42)
Vitamin D by serum calcium (p = 0.001; r = 0.883)

Factors whose relationship were negative and significative were:
Spine BMC by AGE (p <0.001; r = 0.94)
Spine BMC by BMI (p = 0.033; r = 0.86)
Spine BMC by serum Iron (p = 0.005; r = 0.48).
Spine BMC by Cholesterol (p = 0.002; r = 0.69).

Relationship between biometrical and bone mass indices in multiple linear regression

Significative factors in simple linear regression were analyzed in multiple regression and the results are presented below
3.4.1. Lumbar spine

*BMC of L1 to L4 vertebrae analysis in multiple regression by Age ,BMI, serum calcium, serum iron and cholesterol is presented in table 3.

Table 3. Multiple linear regression relationship of spine BMC L1 to L4 by BMI, Age, serum calcium, serum iron and cholesterol

Variables	β	ES	t	Probability (%)	ORa (IC95%)	p
(Constante)	14,278	3,297	4,282	-	2,27	0,000
Age (year)	-0,031	0,015	-2,091	72,5	0,38(0,14-1,04)	0,037
BMI	-0,050	0,026	-1,901	63,3	0,54(0,25-1,19)	0,058
Calcium	0,749	0,302	2,478	76,6	3,28(1,60-5,72)	0,014
Iron	-0,007	0,006	-1,050	63,3	0,58(0,74-1,34)	0,295
Cholesterol	-0,017	0,005	-3,280	74,6	0,34(0,15-0,79)	0,001
$R^2 = 0,359$						

Multiple regression analysis revealed that significant parameters influencing bone mineral density (Y) were AGE(X1), serum calcium (X2), and cholesterol (X3). The relation is globally negative with a polynomial curve whose function is:

SPINE BMC = -0,031 Age + 0, 749 serum Calcium -0,017 cholesterol + 14,278 with R²= 0.359

**BMD of L1 to L4 vertebrae analysis in multiple regression by Age, BMI, serum calcium, serum iron and cholesterol is presented in table 4.

Table 4. Multiple linear regression relationship of BMD L1 to L4 by age, BMI, calcium, serum iron and cholesterol

Variables	β	ES	t	Probability (%)	ORa (IC95%)	p
(Constante)	0,894	0,244	3,670	-	2,027	0,000
Age (years)	-0,001	0,001	-,696	61,0	0,64(0,34-1,19)	0,487
BMI	-0,004	0,002	-2,224	78,7	0,27(0,37-0,59)	0,027
Calcium	0,054	0,022	2,430	73,5	2,77(1,98-3,19)	0,016
Iron	0,000	0,000	-,736	43,4	0,77(0,17-0,61)	0,462
Cholesterol	-0,001	0,000	-2,751	74,0	0,35(0,19-0,65)	0,006
$R^2 = 0,295$						

Multiple regression analysis revealed that significant parameters influencing bone mineral density (Y) were body mass index (X1), serum Calcium (X2), and cholesterol (X3). The relation is globally negative with a polynomial curve whose function is:

SPINE BMD = - 0,004 BMI + 0,054 Serum Calcium -0,001 Cholesterol + 0,894 with R²= 0.295

3.4.2 The Total hip

*BMC of total hip analysis in multiple regression by Age, BMI, serum calcium, serum iron and cholesterol is presented in Table 5.

Table 5. Multiple linear regression relationship of HIP BMC by age, BMI, calcium, iron and cholesterol

Variables	β	ES	t	Probability (%)	ORa (IC95%)	p
(Constante)	8,016	8,904	0,900		3,87	0,369
Age (years)	-0,152	0,039	-3,861	79,3	0,26(0,14-0,65)	0,000
BMI	-0,013	0,070	-0,181	53,5	0,87(0,26-1,28)	0,856
Calcium	4,189	0,818	5,120	76,5	3,25(1,25-4,58)	0,000
Iron	-0,032	0,017	-1,925	62,8	0,59(0,34-0,64)	0,055
Cholesterol	-0,006	0,014	0,425	56,2	0,78(0,26-1,24)	0,671
$R^2 = 0,477$						

Multiple regression analysis revealed that significant parameters influencing total hip BMC (Y) were AGE(X1) and serum calcium (X2).

The relation is globally negative with a polynomial curve whose function is:

Total Hip BMC = -0,152 X_1 + 4,189 X_2 + 8,016 with R²= 0.477

**BMD of total hip analysis in multiple regression by Age, BMI, serum calcium, serum iron and cholesterol is presented in Table 6.

Table 6. Multiple linear regression relationship of HIP BMD by age, BMI, calcium, iron and cholesterol

Variables	β	ES	t	Probability (%)	ORa (IC95%)	p
(Constante)	-13,195	5,898	-2,237		1,256	0,026
Age (years)	-0,065	0,026	-2,495	93,4	0,07(0,06-0,95	0,013
BMI	-0,076	0,047	1,633	63,0	0,59(0,42-0,96)	0,104
Calcium	3,056	0,542	5,638	82,1	4,60(1,62-5,95)	0,000
Serum iron	-0,002	0,011	0,201	54,8	0,83(0,28-0,98)	0,841
Cholestérol	-0,015	0,009	1,721	56,7	0,76(0,18-0,76)	0,086
$R^2 = 0,422$						

Multiple regression analysis revealed that significant parameters influencing total hip BMC (Y) were AGE (X1) and serum calcium (X2).

(X1 = AGE, X2 = Calcium)

The relation is globally negative with a polynomial curve whose function is:

: Total Hip BMD = -0,065 X_1 + 3,056 X_2– 13 with R²=0.422

DISCUSSION

This study aims to describe the profile of spine and hip BMC and BMD and describe factors influencing bone mass in Congolese population. Numerous studies have reported BMC and BMD values, but a source for normative values including men and women for the Congolese population were lacking. Among factors influencing bone mass, heredity is known to be important, specially for peak bone density and it is also weaker in the cortical than in the trabecular parts of the skeleton and, secondly, the environmental factors are known to be important for bone health (Lasley *et al.,* 2002; Bredella *et al.,* 2010). In a study by Krall EA *et al.* (Kabeya *et al.,* 1995) 46-62% of variance in bone density was attributable to heredity. However, an individual's life-style may account for a potentially large proportion of the nonheritable variance in bone density. Up the influences of heredity on age and sex –related variation of bone mass as well the speed of growth, it is known that unbalanced nutritional balance will not allow to reach the optimal amount of bone mass on the peak (Kabeya etal., 1995). **Sex**: in our study (table 2) BMC and BMD were greather in men at all ages. The age related bone growth is present in both sex and peak bone mass is reached in fourth decade suited by a progressive decay. In subjects aged less than 40 years, BMC and BMD (Table 2) were significantly higher than those aged over 40 years and these values were significantly lower in females than in men. This sexual prevalence is reported in the literature and sex appears as a determinant of bone mass, acting by the difference in sex hormone, stature, lifestyle and activity level (International osteoporosis foundation study group The middle east and africa regional audit : epidemiology, costs and burden of osteoporosis in 2011; Cooper and Davkinson, 1992; Tozin *et al.,* 2000; Kabeya *et al.,* 2017; Leslie *et al*., 2017; Montagnani *et al.,* 2011; Rexhepi *et al.,* 2015). We havent study association between BMD and sex hormone, lifestyle, activity level nor growth factors. Some studies have shown associations between gonadal steroid levels and BMD in premenopausal women where others, in which luteal phase and follicular phase serum estradiol and testosterone was measured, also failed to show significant correlations between BMD and gonadal steroids (Bredella *et al.,* 2010; Rexhepi *et al*., 2015). sex hormone levels and growth factors are multifactorially influenced and may require longitudinal studies for best understanding that are underway in some study groups, but cross-sectional data from some of these studies are already available (Bredella *et al.,* 2010; Leslie *et al.,* 2017).

The height (stature /size) of our subjects (Table 1A and B) are similar to that of other worldwide black populations (Muhammad *et al*., 2014; Wulan *et al*., 2010; Cvijetić Avdagić *et al*., 2012; Krall and Dawson-Hughes, 1993; Kabeya Kabenkama *et al*., 2017; WHO 1995; Adami *et al*., 2010) but we have not found the expected significant reduction in size which is ,in this study , limited to 4% reduction in subjects aged 70 years and over (table 1A et B). This is, in our opinion, a consequence of a comparatively lesser impact of osteoporosis on bone capital in the Congolese population as reported by Kabeya *et al.* (Yan and Li, 2013). The rarity of osteoporotic fractures in Congolese reported by Tozin *et al*. (Castro *et al.,* 2005) or more particularly, rarity of high-grade osteoporotic vertebral fractures in the Congolese population as reported by Kabeya KJM *et al.* (Felson *et al.,* 1993) but could also be justified by the reduced number of subjects in this advanced age groups or by the non-linearity of the data in this cross-sectional study. BMI of our subjects (Tables 1 A and B) seems higher than in other peoples and subjects (Wulan *et al.,* 2010; Cvijetić Avdagić *et al.,* 2012; Krall and Dawson-Hughes, 1993; Kabeya Kabenkama *et al.,* 2017; WHO, 1995; Adami *et al.,* 2010).

BMI : the BMI cotation of our subjets shows that they were at least overweighted (average BMI=29.35 kg/m²= and was found to be a factor of bone mineral density in single and multiple regression analysis in the present study (Figure 1, Table 3 and 4). Mean BMI of 29.35 kg / m² is higher than the values reported in Western, Arab and Asian Caucasian populations where the average rate is about 24 kg / m² in the most series (Muhammad*et al.,* 201; Wulan*et al.,* 2010; Cvijetić Avdagić*et al.,* 2012; Krall and Dawson-Hughes, 1993; Kabeya Kabenkama*et al.,* 2017; WHO, 1995; Adami*et al.,* 2010). These data reflect are indicators of dietary habits and lifestyle changes (Kim*et al.,* 2010) whose corollary is and will be an increase in rate of diabetes and non communicable diseases (International osteoporosis foundation study group, 2011; Kim*et al.,* 2010; Nobrega*et al.,* 2014). The results of studies regarding the relationship between BMD and many associated factors especially biological parameters, varied across various studies, attributed to characteristics of the study subjects, such as ethnicity, lifestyle, or study design. Behzad H *et al*.,2017 report The results of a systematic review of 55 studies that showed that factors such as age, low body mass index (BMI), are risk factors of low bone mass in males and females (Tozin*et al.,* 2000). Despite being a risk factor for cardiovascular disease, hypertension, and diabetes mellitus, hight BMI values and obesity has been thought to protect against osteoporosis and fat mass and has been found to be a positive predictor of BMD in same studies (Bredella*et al.,* 201; Castro et al., 2005; Montagnani et al., 2011; Yan et al., 2013; Nobrega et al., 2014; Rexhepi et al., 2015) Rexhepi *et al*., 2015found an independent association between BMI and BMD in males and females. Yan *et al*. 2013, in a cross-sectional study, shows a positive linear relationship between BMI and BMD up to 30 kg/m^2 and when BMI were greater than 30 kg/m^2, it was associated with little BMD increment. Nobrega *et al*., 2014 asserts that beneficial effect of obesity on BMD has been attributed to loading effect of weight on bone.Castro *et al*., 2005 in a cross-sectional study of White and African American females found that each unit increase of BMI significantly increased BMD in White females but decreased BMD in African American females. So he asserts: the association between BMI and BMD is ethnicity (race) dependent.In this study, conducted in black subjects in overweight, BMI was negatively correlated with BMD, which is consistent with study by Castro *et al*., 2005. However, in obese or overweight individuals, both fat mass (visceral or peripheric) and lean body mass are components of weight. Castro *et al*., 2005 reports that Visceral fat mass exerts a negative effect whereas lean mass confers a positive effect (Kim *et al*., 2010 and Nobrega *et al.* 2014 asserts that among components of metabolic syndrome, waist circumference, which is a diagnostic criteria for abdominal obesity and one major component of the metabolic syndrom had the strongest correlation with BMD and correlates with visceral fat mass. Our study dont comprise study of waist circumference.

AGE: In the present study, Age is found to be significative factor of bone mass both in simple and multiple linear models (Tables 3,5,6 and Figure 1). Age is recognised as an important cause of low BMD (WHO, 2007; ElMaghraoui *et al.,* 2006; Krall and Dawson-Hughes, 1993; Cipriani *et al.,* 2017; Lasley

et al., 2002; Bredella *et al.,* 2010). In the present study, age was negatively correlated with BMD, but the association of age with bone mass decreased non-significant level after multivariate analyses in spine BMD. Behzad *et al.* (Tozin*et al.,* 2000) think that this issue may be explained by variations in distribution of obesity, metabolic syndrom and muscle strength across various age groups. While obesity were positively distributed amongst age groups, particularly in womens and this work havent study the muscle strength what is supposed to be significantly higher in younger age groups.It may be a way which explaines age-related differences in bone mass in this study. The other parameters with statistical significance in this study were namely calcium, iron, cholesterol, and vitamin D (Figures 1). In this study, sufficient levels of serum vitamin D were observed comparable with the general population. The association between Bone mass and vitamin D in single regression (Fig 1) disapears after correction by multiple regression wich may be attributed to coexistence of one or more associated factors such as obesity and miscellaneous biological parameters in patients or inadequate sample size. These differents factors may differently affect Bone mass and confound the results.

Serum Calcium had a very significant positive relationship ($p = 0.006$ and $r = 0.641$) while the mean level was within the norms (Figure 1 and Tables 1,3-6). This place of serum calcium as a determinant of bone mass in an intertropical sunlighting environment should be studyied in depth because this positive relationship means that an improvement of dietary calcium intake or a drug supplementation will be accompanied by a higher calcemia which, in all statistical models will encrease the BMC and BMD, if Oh vitamine D boost The calcium intestinal absorption. Cholesterol shows a close relationship with spine BMC and BMD in single and multiple regression models but disapears after multiple regression in hip and there is no significant relationship demonstrated between BMI and cholesterolin this study This issue must be questionned and longitudinal studies of age-related changes in body composition, body fat and body mass distribution, and markers of dyslipidemia are needed to give answers and may explain this issue. Nonetheless, the associations of others anthropologic and biological parameters with BMD did not reach a statistical level.

Conclusion

The present study is the first large-scale report on the DXA normative values of BMD and BMC of the lumbar spine L1 to L4 and of the hip in healthy Congolese men and women From 16 to 92 years. The normative values of the BMC and BMD were established for the lumbar spine and the hip on a sample of adequate size of the urban population of Kinshasa. From 16 years of age, bone mass parameters increase until the peak reached in the fourth decade, followed by a decline, which results in a loss of almost 14.2% to 20% of BMC and BMD. The BMD and BMC values are higher in male and the decrease was present in both sex but more pronounced in female. Age, BMI, serum calcium, OH Vitamine D, serum iron, and cholesterol are significative bone mass factors in single regression models but in multiple regrssion models only Age, Calcium remains significative factors of BMC and BMD on allmost all sites while BMI and cholesterol are selectively significant for sites and parameters. Curves of regression functions present polynomial profiles with age and calcium as major factors.

BMI and cholesterol are also determinants but with lower significance. The reference values and curves of age related lumbar spine and total hip BMD and BMC are significantly different from values in others populations. However, the validation of some of these results requires longitudinal studies.

Limits

The main limitation of our study lies in the fact that it is a cross-sectional study carried out on an urban population to establish normative data for the whole country of which the rural populations are in the majority. Longitudinal data are more suited for risk factors determination.

REFERENCES

Adami, S., Zivelonghi, A., Braga, V. *et al*. 2010. Insulin-like growth factor-1 is associated with boneformation markers, PTH and bone mineral density in healthy premenopausal women. *Bone*., 46:244–247. (PubMed: 19853071)

Albala, C., Yanez, M., Devoto, E. *et al*. 1996. Obesity as a protective factor for postmenopausal osteoporosis. *Int J Obes Metab Disord,* 20:1027-1032.

Behzad, H., Muhammadi, A., Javadian, Y. *et al*. 2017. Associated Factors of Bone Mineral Density and Osteoporosis in Elderly Males *Int J Endocrinol Metab*., 15(1):e39662. doi: 10.5812/ijem.39662.

Bredella, MA., Ghomi, RH., Thomas, BJ. *et al*. 2010. Comparison of DXA and CT in the Assessment of Body Composition in Premenopausal Women With Obesity and Anorexia Nervosa. *Obesity (Silver Spring).*18:2227–33. (PubMed: 20111013)

Castro, JP., Joseph , LA., Shin, JJ., Arora, SK., Nicasio, J. and Shatzkes, J. 2005. Differential effect of obesity on bone mineral density in White, Hispanic and African American women: a cross sectional study. *Nutr Metab*., 2(9).

Cipriani, C., Pepe, J., Bertoldo, F. *et al.* 2017. The epidemiology of osteoporosis in Italian postmenopausal women according to the National Bone Health Alliance (NBHA) diagnostic criteria: a multicenter cohort study. *J Endocrinol Invest*., (09) ; 761-4

Conradie, M., Conradie, M. M., Scher, A. T., Kidd, M. and Hough, S. 2015. Vertebral fracture prevalence in black and white South African women. *Arch Osteoporos*,*10*, 203. https://doi.org/10.1007/s11657-015-0203-x

Cooper, C. and Davkinson. 1992. Secular trends in the incidence of postmenopausal vertebral fractures. Calcified tissue int. 51:100-104.

Cooper, C. and Davkinson. 1992. Secular trends in the incidence of postmenopausal vertebral fractures. Calcified tissue int. 51:100-104.

Cvijetić Avdagić, S., Colić Barić, I., Keser, I., Rumbak, I. 2012. Šatalić ZInfluence of heredity and environment on peak bone density: a review of studies in Croatia. *Arh Hig Rada Toksikol.,* 63 Suppl 1:11-6. doi: 10.2478/10004-1254-63-2012-2130

El, Maghraoui, A., Guerboub, AA., Achemlal, L., Mounach, Nouija,i A., Ghazi, M., Mohamed, AT. 2006. Bone Mineral Density of the Spine and Femur in Healthy Moroccan Women. *Journal of Clinical Densitometry*, *9*(4), 454-460. https://doi.org/10.1016/j.jocd.2006.07.001

Felson, DT., Zhang, Y., Hannan, MT. and Anderson JJ.1993. Effects of weight and body mass index on bone mineral density in men and women: the Framingham study. *J Bone*

Miner Res., 8(5):567–73.doi:10.1002/jbmr.5 650080507. (PubMed: 8511983).

International osteoporosis foundation study group The middle east and africa regional audit : epidemiology, costs and burden of osteoporosis in 2011. 2011 International Osteoporosis Foundation report 102011-5000

Kabeya Kabenkama, JM., Tozin, RR., Jean Jacques Malemba, Jean–Marie Mbuyi Muamba. 2017. Normative Values of Bone Mineral Content and Bone Mineral Density Assessed by Double X-ray Absorptiometry in Congolese Urban Women. *Applied Science and Innovative Research*, Vol. 1, No. 2, 142-155

Kabeya, JM., Mbuyi Muamba, JM., Tozin, R., Dequeker, J. 1995. Bone mass in Zaireans: Radiogrammetric determination *Clinical Rheumatology,* January, Volume 14, Issue 1 : 87–92

Kabeya, KJM., Banza, IL., Lelo, TM. *et al.* 2017. Multidetector CT in Quantitative Morphometric Assessment of Post-Menopausal Vertebral Fractures in Black Women of Central Africa *Research in Health Science,* Vol. 2, No. 4, 2017 :335-349.

Kelly, TL., Wilson, KE. and Heymsfield S B. 2009. Dual energy X-Ray absorptiometry body composition reference values from NHANES. *PLoS One*, *4*, 7038. https://doi.org/ 10.1371/journal.pone.0007038

Kim, HY., Choe, JW., Kim, HK., Bae, SJ., Kim, BJ., Lee, SH. *et al.* 2010. Negative association between metabolic syndrome and bone mineral density in Koreans, especially in men. *Calcif Tissue Int.,* 86(5):350–8. doi: 10.1007/s00223-010-9347-2. (PubMed: 20354685).

Krall, EA., and Dawson-Hughes B. 1993. Heritable and life-style determinants of bone mineral density. *J Bone Miner Res.* Jan;8(1):1-9.

Lasley, BJ., Santoro, N., Randolf, JF. *et al.* 2002. The relationship of circulating dehydroepiandrosterone, testosterone and estradiol to stages of the menopausal transition and ethnicity. *J Clin Endocrinol Metab*.87 :3760-67.

Leslie, WD., Morin, SN., Majumdar, SR. *et al.* 2017. Effects of obesity and diabetes on rate of bone density loss. *Osteoporos Int.,* (9) : 4223-9

Montagnani, A., Gonnelli, S., Alessandri, M., and Nuti, R. 2011. Osteoporosis and risk of fracture in patients with diabetes: an update. *Aging Clin Exp Res.,* 23(2):84–90. doi: 10.1007/BF03351073. (PubMed: 21743287).

Muhammad, M. A., Muhammad, W., Hussain, S., and Gohar, J. 2014. Lumbar Morphometry: A Study of Lumbar Vertebrae from a Pakistani Population Using Computed Tomography Scans. *Asian Spine J.*, *8*(4), 421-426. https://doi.org/10.4184/asj.2014.8.4.421

Nobrega da Silva, V., Goldberg, TB., Mosca, LN., Bisi Rizzo Ada, C., Teixeira Ados, S., Corrente JE. 2014. Metabolic syndrome reduces bone mineral density in overweight adolescents. *Bone,* 2014;66:1–7. doi:10.1016/j.bone.2014 .05.011. (PubMed: 24875293).

Rexhepi ,S., Bahtiri, E., Rexhepi, M., Sahatciu-Meka, V. and Rexhepi, B. 2015. Association of Body Weight and Body Mass Index with Bone Mineral Density in Women and Men from Kosovo. *Mater Sociomed*., 27(4):259–62. doi: 10.5455/msm.2015.27.259-262. (PubMed: 26543419

Sangmo, H, Han, JO., Hoon, C., Jung, GK., Sung, KL., Eun, KK., and Woong. HC. 2011. Characteristics of Body Fat, Body Fat Percentage and Other Body Composition for Koreans from KNHANES IV. *J Korean Med Sci.*, *26*(12), 1599-1605. https://doi.org/10.3346/jkms.2011.26.12.1599

Tozin, R.R., Ngeleka, M., Ingwen, M., Mbuyi Muamba, JM. And Mputu, LA. 2000. Les aspects cliniques de la femme congolaise menopausée. *Annales de l'IRSS*, 1, 3, 19-22

WHO scientific group on the assessment of osteoporosis at primary health care level 2007 (Summary Meeting Report Brussels, Belgium, 5-7 May 2004 who publications 2007.

WHO. 1995 Physical status: 1995 the use and interpretation of anthropometry. Report of a WHO Expert Committee. *World Health Organ Tech Rep Ser.* 854:1–452.

World Health Organization (WHO). 2010 Global Status : Report on Non-Communicable Diseases .2010

Wulan, S N., Westerterp, K. R., and Plasqui, G. 2010. Ethnic differences in body composition and the associated metabolic profile: A comparative study between Asians and Caucasians. *Maturitas*, *65*, 315-319. https://doi.org/10. 1016/j.maturitas.2009.12.012

Yan,W. and Li, X. 2013. Impact of diabetes and its treatments on skeletal diseases. *Front Med.,*7(1):81–90. doi:10.1007 /s11684-013-0243-9. (PubMed: 23377889).

****