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Peak Bone Mineral Density Levels in Normal Omanis, a Pilot Study

S. Al. Hadhrami[1], J. Al. Sulaimi[1], D. Al. Kindi[1], O. Elshafie[1], S. Hussien[2*], A. Al. Zakwani[3] and N. Woodhouse[1]

[1]Internal Medicine Department in Sultan Qaboos University Hospital, Muscat, Oman.
[2]Radiology Department in Sultan Qaboos University Hospital, Muscat, Oman.
[3]Industrial and Innovation Centre, Muscat, Oman.

Authors' contributions

This work was carried out in collaboration between all authors. Authors NW, SH and OE designed the study. Authors SAH, JAS and DAK recruited the normal volunteers and arranged for their blood samples to be collected, analyzed and documented. Author SH supervised the DXA measurements and together with authors NW, OE, SAH, JAS and DAK carried out the literature search. Author AAZ performed the statistical analyses. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To determine normal peak bone mineral density (PBMD) values in a cohort of healthy Omanis.
Study Design: Cross-sectional study.
Place and Duration of the study: in the Departments of Nuclear Medicine and Medicine at Sultan Qaboos University Hospital in Oman between 2012 and 2013.
Methodology: Omani employees aged between 25 to 34 years at Sultan Qaboos University Hospital (SQUH) were randomly chosen and invited to participate. Fifty normal males and 50 females were studied. Their fully informed consent was obtained to establish PBMD values using dual energy X-ray absorptiometry (DXA). Blood was also taken to determine their serum calcium,

**Corresponding author: Email: samirhus@gmail.com;*

phosphate, alkaline phosphatase and parathyroid hormone (PTH) levels as well as a complete blood count (CBC), serum sodium, potassium and creatinine levels. Statistical analysis was done based on Hologic Delphi Reference Values on a reference curve generation using z-scores and the fitting a polynomial curve of third order. This data was interpolated, sampled and tested to verify the initial results.

Results: Our results show that normal Omani PBMD values of L1-L4 in women were 0.94 ± 0.11 and in men 0.99 ± 0.12 g/cm^2. These are significantly lower than those of a normal Caucasian population by 26.5% in women P-value (<.001) and by 23.8% in men P-value (<.001). Only three subjects had values on or slightly above the mean Caucasian level but sixteen had values on or below -2SD. The blood tests were within the normal range in all subjects.

Conclusion: Omani mean PBMD values obtained in this study are substantially lower than Caucasian values. To avoid the use of inappropriate anti-resorptive therapy we should consider revising our reference range. We recommend using normal Asian reference values as they are almost identical to those obtained in this study until a normal reference range is established for this country.

Keywords: Peak bone mineral density; osteoporosis; dual energy X-ray absorptiometry; Oman.

1. INTRODUCTION

Osteoporosis is a major public concern and is characterized by low bone mass with microarchitectural deterioration resulting in increased susceptibility to fractures [1,2]. It is estimated that 1 in 2 women and 1 in 5 men over 50 years of age will experience a fracture during their lifetime [3]. The World Health Organization (WHO) definition of osteoporosis relates it to the peak bone mass between the age of 20 to 39 years (commonly referred as a T-score), and the WHO define osteoporosis as a T-score equal to or below-2.5 standard deviation (SD) of the mean value obtained from the local population, while T-score values between -1.0 to -2.5 SD below the mean signify a diagnosis of osteopenia [1-2]. In fact there is considerable variation in BMD between races correlated with the muscle mass as well as genetic factors: Blacks have the highest and Asian the lowest values with Caucasian measurements falling in between [4-8].

In Oman progressively more patients are being diagnosed and treated for osteoporosis by orthopedicians, rheumatologists, endocrinologists and obstetricians.

However, the diagnosis of osteopenia or osteoporosis is made using normal Caucasian values as a reference. We began to question this approach as we observed that Omanis have a body frame which is more slender than their Caucasian counterparts and lower serum creatinine levels, which reflect muscle mass [9,10]. As muscle mass is linearly correlated with BMD [11] we suspected that Omani PBMD levels might be lower than those of Caucasians. As a result we carried out a pilot study of normal Omani PBMD values to determine whether Caucasian reference values are suitable for use in Omanis.

2. METHODOLOGY

This study was approved by the Sultan Qaboos University ethics committee. Omani employees from the Sultan Qaboos University Hospital (SQUH) were randomly chosen by inviting every other person attending the university vaccination center to participate. Fifty males and 50 females aged between 25 and 34 were studied. All gave fully informed consent and completed a detailed questionnaire concerning any family history of bone disease or fractures, medications, alcohol, cigarette smoking and diet. Blood was also taken to determine their serum calcium, phosphate, alkaline phosphatase and parathyroid hormone (PTH) levels as well as a complete blood count (CBC), serum sodium, potassium and creatinine levels. Those with a family history of bone disease or fractures or abnormality in their blood results were excluded.

The measured PBMD levels in the lumbar spine were normally (Gaussian) distributed. The DXA scans were performed using a Hologic Delphi by two trained technicians and the results were reported by experienced Nuclear Medicine physician in bone densitometry. The DXA machine has < 1% variation coefficient and it is calibrated daily. Standard deviation (SD) were statistically derived for comparison with that provided by the DXA machine manufacturers (Hologic) for a reference Caucasian population.

Homogeneity of the sample population was selections of subjects taken from the sample, against the results in the remaining subjects, and the whole sample.

3. RESULTS

The subjects' complete blood counts, electrolytes, bone profiles and PTH values were all within the normal range.

The PBMD levels ± 1 SD in female and male Omanis, and female and male Caucasians are shown in Table 1. Normal female Omani values were 0.94 ± 0.11, 26.5% significantly lower than their Caucasian counterparts with values of 1.28 tested by comparing the results with random ± 0.13 g/cm^2 P-value (<.001) (Table 1 and Fig. 1a). Normal male Omani values were 0.99 ± 0.12, 23.8% lower than their Caucasian counterparts with values of 1.3 ± 0.125 g/cm^2 P-value (<.001) (Table 1 and Fig. 1b).

The Omanis full data set is compared to that of the interpolated (a) and held back data (b). There was no significant difference between the normal female and their interpolated P-value (1.00) or held back data P-value (1.00). Similarly there was no significant difference between the normal male and their interpolated P-value (.068) or held back data P-value (.28). These results confirm homogeneity of the sample [12-14] Table 1.

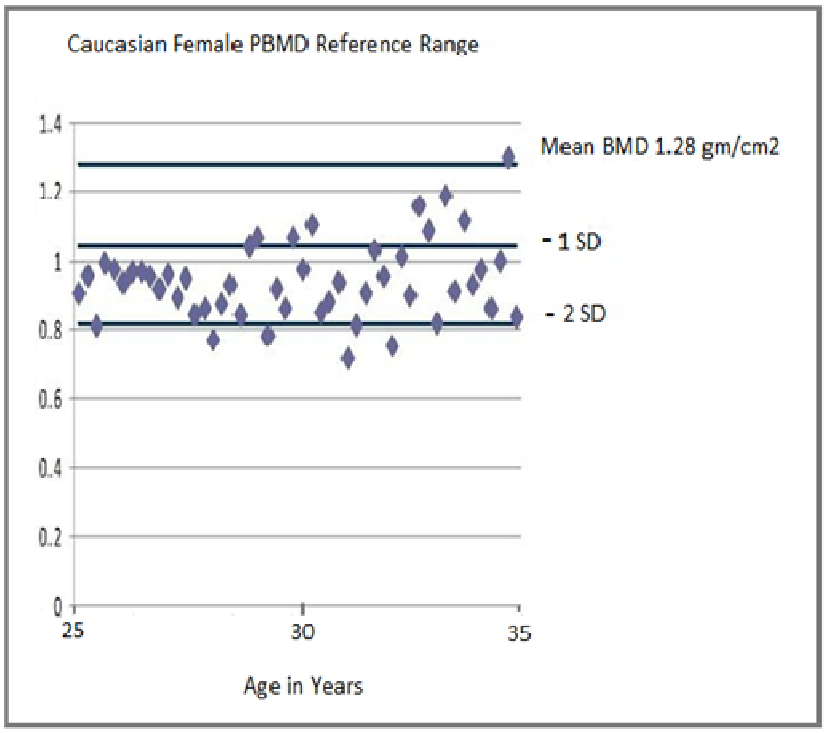

Fig. 1a. PBMD levels of 50 normal Omani females superimposed on a normal female Caucasian reference population

Table 1. Comparison of PBMD values in normal female and male Omanis and Caucasians

PBMD levels (L1-L4)		Mean	SD gm/cm2	P-value
Female	Omani	0.94	0.11	<.001
Caucasian		1.28	0.13	
Male	Omani	0.99	0.12	<.001
Caucasian		1.3	0.125	
Interpolated (a)	Male	1.00	0.12	
Female		0.94	0.13	
Held back(b)	Male	0.96	0.10	
50%	Female	0.94	0.05	

The normal Omani and Indian female mean PBMD±1 SD values are almost identical P-value (.93) Table 2.

4. DISCUSSION

Our findings indicate that our normal Omani PBMD levels are substantially and significantly lower than those of the normal Caucasian reference range provided. BMD values were 26.5% lower in females and 23.8% in males. Eight female and 8 male volunteers had low BMD values either on or below -2SD, and only one female and two males had values slightly above the mean Caucasian value. (see Figs. 1a and 1b).

There was no family history of bone disease in any subject and all had normal electrolytes and CBC. Importantly their bone profiles and circulating PTH levels were also normal effectively excluding primary or secondary hyperparathyroidism as potential cause of bone mineral loss. Several studies have reported BMD levels in Qataris [15], Saudis [16] and Lebanese [17] and these are generally lower than those of Caucasians. If an Omani has a lower BMD than a Caucasian, is he more likely to fracture? We assume the answer is no as our normal Omani values are very similar to those of Asians who are no more likely to fracture than Caucasians [7] and almost identical to that of a normal Indian female population studied using the same methodology [18], Table 2.

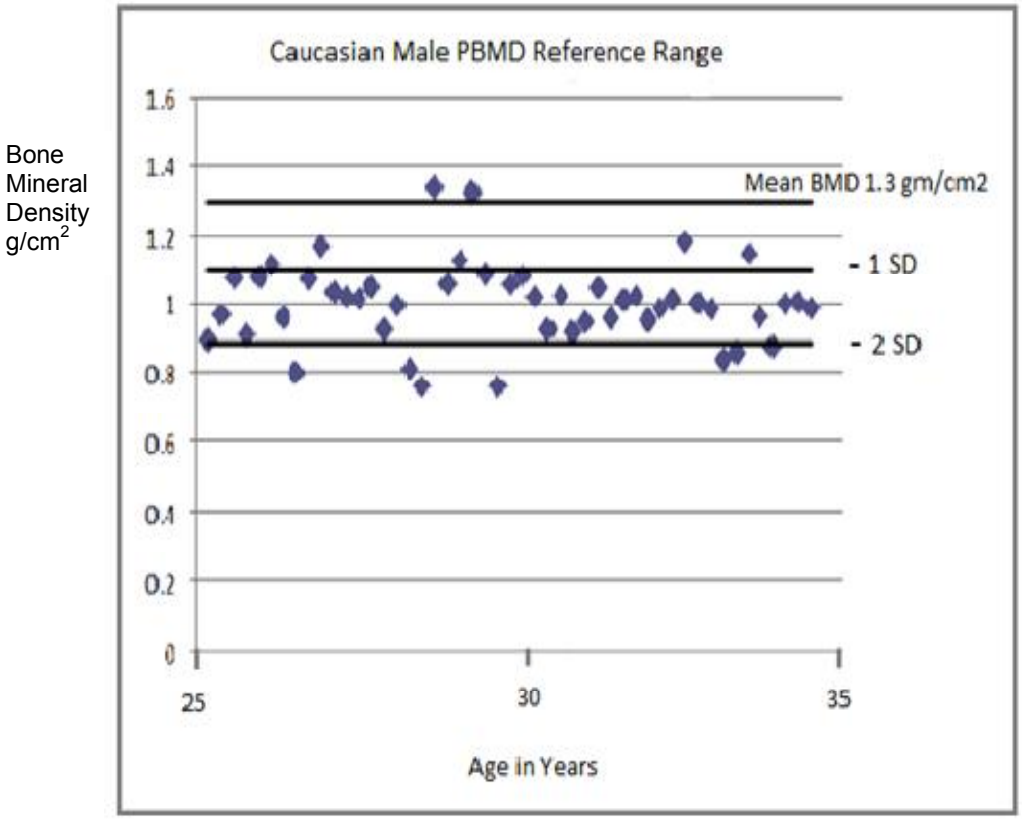

Fig. 1b. PBMD levels of 50 normal Omani males superimposed on a normal male Caucasian reference population

Table 2. Comparison of PBMD values in normal Omani and normal Indian females

Nationality	Age range	No	Mean PBMD	1 SD	P-value
Omani	25 – 34	50	0.940	±0.110	
Indian	30 - 39	50	0.942	±0.114	.93

5. CONCLUSION

In conclusion normal Omanis have a substantially lower PBMD's than their Caucasian counterparts. To avoid the use of inappropriate antiresorptive treatment we recommend using normal Asian values as they almost identical to those obtained in this study.

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CONSENT

Written and informed consent was obtained from all the volunteers.

ETHICAL APPROVAL

The study was approved by the Sultan Qaboos University ethical committee.

COMPETING INTERESTS

All authors have declared that no competing interests exist.

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