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Article ID: WMC001447

Article Type: Original Articles

Submitted on:04-Jan-2011, 12:46:00 PM GMT **Published on:** 05-Jan-2011, 08:46:16 PM GMT

Article URL: http://www.webmedcentral.com/article_view/1447

Subject Categories:RADIOLOGY

Keywords:Bone mass, Panoramic Mandibular Index, Mandible, Panoramic radiography

How to cite the article:Rao G S, Chatra L , Shenai P . Evaluation Of Adult Cortical Bone Mass As Measured By Panoramic Mandibular Index - A Radiological Study . WebmedCentral RADIOLOGY 2011;2(1):WMC001447

Evaluation Of Adult Cortical Bone Mass As Measured By Panoramic Mandibular Index - A Radiological Study

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Abstract

Background: In human beings the loss of bone mass with increasing age is a universally observed phenomenon. Human bones decrease in density & increase in porosity beginning at about the third decade of life. Various techniques have been used to assess the bone mass. Panoramic mandibular index is one of the radiomorphometric indexes which are based on the linear measurements of cortical bone. Therefore a study was undertaken to evaluate the adult cortical bone mass using Panoramic Mandibular Index (PMI) and to identify the normal ranges and to investigate their relationship with age, and gender.

Methods: A radiological study was conducted on 100 healthy individuals aged 30 - 60 years, with each of 50 males and females. Panoramic radiographs of 100 individuals was obtained and the bone mass was measured using panoramic mandibular index (PMI).

Results: The mean PMI of the selected population was 0.275 (range 0.185 - 0.476). The mean PMI of males and females was 0.276 & 0.274 respectively. Males of age group 30 - 40 years, 40 - 50 years and 50 - 60 years showed mean PMI of 0.285, 0.277 and 0.267 respectively. Similarly in females of age group 30 - 40 years, 40 - 50 years and 50 - 60 years, the mean PMI was 0.271, 0.286, and 0.265 respectively.

Conclusion: This study revealed that with the advancing age the bone mass decreased. The bone mass of both the genders was almost equal and the bone mass after menopause decreased.

Introduction

In human being, the loss of bone mass with increasing age is a universally observed phenomenon. Human bones decrease in density & increase in porosity beginning at about the third decade of life. Both men and women are affected with the loss of bone mass, but women lose bone mass at a rate 3 times that of men especially after menopause. The variation in the rate of loss of bone mass varies depending on race,

gender, geographical location and age. Like the black women rarely have any severe loss of bone mass than White or Asian ethnics. 1

This loss of bone mass / bone density has been demonstrated at several sites in the skeleton like metacarpal, metatarsal, radius, humerus, hip, femur including mandible. Various techniques have been used for assessing bone density including single photon absorptiometry (SPA), dual photon absorptiometry (DPA), dual energy x- ray absorptiometry (DXA), quantitative computed tomography (QCT), radiographic absorptiometry (RA), intraoral radiographs and panoramic radiographs. 2

The loss of the bone mass may be detected in mandible using radiographic techniques. The mandibular bone mass measured correlates with that of other skeletal sites like hip, lumbar spine. Mostly these techniques focus on the panoramic indices. Such indices are mandibular cortical index (MCI), mandibular cortical thickness (MCT), Gonial index (GI), Antegonial index (AI), mental index (MI) , the ratio of alveolar bone height to basal bone height of the mandible. 3

Panoramic mandibular index is one such index used to measure the mandibular bone mass using panoramic radiographs. This method is an easy, inexpensive and noninvasive technique reported for screening individuals with low bone mass 4. Hence using these measurements as a reference the individual may be further categorized as a high risk for developing osteoporosis and refer them to do further higher investigative modality.

Panoramic mandibular index (PMI) is the ratio of the thickness of the inferior mandibular cortex in the mental region over the distance between the lower border of the mandible and either the inferior or the superior border of the mental foramen 4.

Present study is an attempt to evaluate the adult cortical bone mass using PMI and also evaluate the bone mass between the gender and different age groups.

Materials and Methods

The study consisted of 100 healthy patients who

visited the dental OPD of Yenepoya Dental College, Mangalore, Karnataka, India with 50 each of males and females. Most of the individuals belonged to the Dakshina Kannada district and north Kerala.

Adults aged 30 – 60 years free from any systemic diseases were included in the study. And those patients who have had previously taken or currently on any medication affecting bone metabolism or patients with fracture of mandible, with known pathology of maxillary or mandibular bone, with any developmental disturbances were excluded from the study.

The study was performed by dividing these patients into 3 age groups in both genders.

1.30 – 40 years age group

2.40 – 50 years age group

3.50 – 60 years age group.

All the patients fulfilling the above criteria were informed and only those who agreed were enrolled in the study. All the enrolled subjects were then interviewed and a detailed case history along with clinical examination was carried out on the dental chair. These patients were further subjected to orthopantomography and from the resultant radiograph panoramic mandibular index was calculated.

Panoramic mandibular index (PMI) = Thickness of the cortex (X)

(Superior / Inferior)

Distance from the superior (Y) / inferior margin

(Z) Of mental foramen to inferior border of mandible.

The values thus obtained for all the patients were tabulated and analysed using students Paired, unpaired 't' test, Analysis of variance (ANOVA) and Pearson correlation coefficient

Results

Data collected was analyzed and the results showed the following observations.

Demographic data analysis:

Among the total 100 patients, the overall mean PMI was 0.275 with minimum PMI of 0.185 to a maximum of 0.476. (Illustration 1)

Pearson correlation coefficient was used in the study and it showed a mild negative correlation between age and the PMI, however it was statistically not significant. (Illustration 2, Illustration 8)

Comparison of males and females of different age group

Males of age group 30 – 40 years, 40 – 50 years and 50 – 60 years was compared with each other, the mean PMI in these age groups was 0.285, 0.277 and 0.267 respectively. (Illustration 3, illustration 9).

Similarly females of age group 30 – 40 years, 40 – 50 years and 50 – 60 years were compared with each other, the mean PMI in these age groups was 0.271, 0.286, and 0.265 respectively. (Illustration 4) (Illustration 10)

Gender comparison:

Out of these 100 patients, 50 each were males and females. The mean PMI of males and females was 0.276 & 0.274 respectively. (Illustration 5) (Illustration 11)

Right PMI with Left PMI

The Right PMI of all 100 cases was compared with Left PMI, the mean PMI was 0.561 and 0.542 respectively. (Illustration 6) (Illustration 12)

Comparison of menstruating with the non – menstruating women

Menstruating women were compared with the non – menstruating whose mean PMI was 0.279 and 0.266 respectively. (Illustration 7) (Illustration 13)

Discussion

Analysing the results of our study, it can be noted that the mean PMI of this study population was

0.275. However this value cannot be directly compared with the figures of other studies because of the ethnic differences as reported by Benson BW et al 1991 5, Klemetti E et al 1993 6, Ledgerton D et al 1999 4. The normal value reported by Mahl CRW et al 2008 7 is ≥ 0.3 for the Brazilian ethnic group with a range of 0.31 – 0.38 obtained from studies conducted by the various authors 4, 82. The value obtained in our study is less than the reported values.

It was noticed in the study that there was a negative correlation of the PMI with the age. These findings matched with results of the study carried out by Ledgerton. D et al 1999 4

The comparison of males of different age groups suggested a gradual decline in the mean PMIs from the age group 30 – 40 years, 40 – 50 years, and 50 – 60 years as expected with the values being 0.285, 0.277 and 0.267 respectively. But these findings were in contrary with the findings reported by Benson BW et al 1991 5. Comparison of females of age 30 through 60 showed the mean PMI to be highest in the age group 40 – 50 years which was 0.28. It was seen that after the age of 50 the mean PMI declined. Similar findings were seen in the study conducted by Benson BW et al 1991 5, the highest mean PMI was seen in the age group 40 – 49 year females and after the age of 50 the mean values declined. This gradual decrease in the bone mass after 50 years is also reported by Wowern NV 1980 8, 1982 9.

When taking gender into consideration the overall mean PMI of the females was almost equal to that of the males. These findings are in agreement with Benson BW et al 1991 5 studies on adult male and female PMI where no differences in mean PMI between the genders were seen. Woweren NV et al 1978 10 in Histomorphometric analysis found that there was no sex differences in the bone mass. Bras J et al 11 also determined that no sex differentiation was present their study of the angular mandibular cortex, at least not before 60 years of age.

The mean PMI s of menstruating women in comparison with that of non – menstruating women were more. Previous Studies by authors 12, 13, 14, 15, 16, 6, 17, 18 have shown that the post – menopausal women has decreased bone mass and increased cortical porosity due to loss of estrogen hormone.

Conclusion

In this study analysis of bone mass of 100 healthy adults aged 30 - 60 years using Panoramic Mandibular Index (PMI) was carried out along with comparison of the bone mass between the gender and different age groups.

The mean PMI for the selected population was 0.275. As the age advanced the values of mean PMI decreased, thus indicating that there was decrease in bone mass with age. The mean PMI in females was almost equal to that of the male mean PMI suggesting that there was no difference in the bone mass between the genders. The mean PMI of males with in each age group showed a gradual decline in the values, supporting the general consensus that bone mass decreases with advancing age. The mean PMI of females within each age group showed gradual decrease in the values after age 50. The non – menstruating women had mean PMI values less than that of the menstruating, thus displaying the fact that bone mass in post menopausal women is less when compared to perimenopausal women.

Hence this study highlights the importance of 'Panoramic mandibular index' which is the index used in this study to measure the cortical bone mass of adults, is a simple, easy and in expensive screening method of identifying individuals with low bone mass.

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Illustrations

Illustration 1

Overall PMI

	n*	Minimum	Maximum	Mean	Standard Deviation
Overall PMI	100	0.185	0.476	0.27585	0.056770

* n – no. of observations

Illustration 2

Pearson correlation coefficient

	Correlations	PMI
Age	Pearson Correlation (r)	-.107
	p-value [□]	.286
	n	100

Illustration 3

Comparison of males of different age group

PMI - male	n	Mean	Standard Deviation	Minimum	Maximum
30-40years	16	0.28592	0.067352	0.189	0.450
40-50years	18	0.27712	0.066151	0.195	0.404
50-60years	16	0.26716	0.043646	0.185	0.338
Total	50				

Illustration 4

Comparison of females of different age group

PMI – female	n	Mean	Std. Deviation	Minimum	Maximum
30-40years	16	0.27180	0.052302	0.193	0.382
40-50years	18	0.28644	0.068297	0.209	0.476
50-60years	16	0.26517	0.037193	0.210	0.333
Total	50				

Illustration: 4 Comparison of females of different age group

Illustration 5

Comparison of overall males with females

	Group	n	M e a n PMI	S t d . Deviation	M e a n Difference	p-value
PMI	Male	50	0.27675	0.059562	0.001800	0.875
	Female	50	0.27495	0.054426		

Illustration: 5 Comparison of overall males with females

Illustration 6

Comparisons of Right PMI and Left PMI

	n	Mean	S t d . Deviation	M e a n Difference	p-value
Overall right PMI	100	0.56138	0.128957	0.019360	0.093
Overall left PMI	100	0.54202	0.125226		

Illustration 7

Comparison of menstruating with the non menstruating women

	Group	n	Mean	S t d . Deviation	M e a n Difference	p-value
PMI	Menstruating	32	0.27976	0.62730	0 .013355	0.411
	Non Menstruating	18	0.26640	0.35233		

Illustration: 7 Comparison of menstruating with the non – menstruating women

Illustration 8

Pearson correlation coefficient

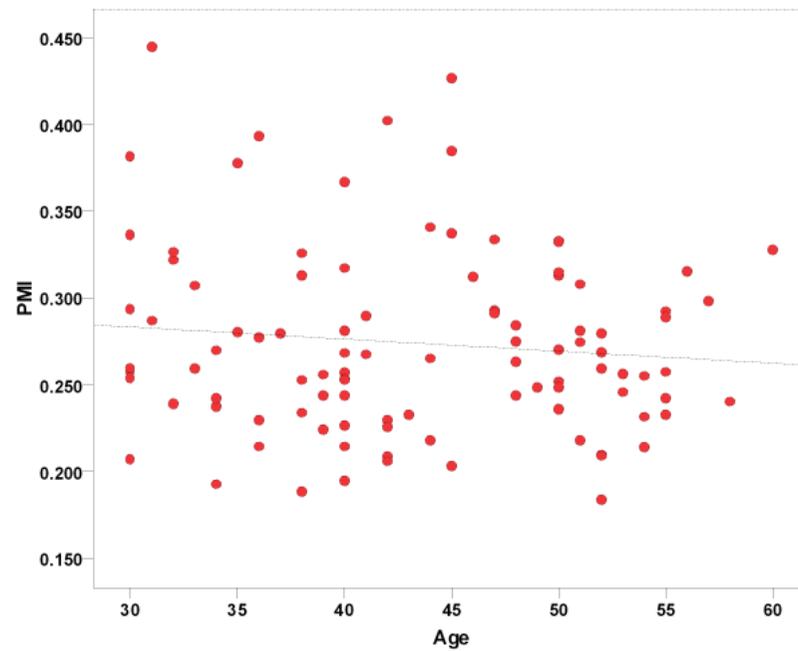


Illustration: 8 Pearson correlation coefficient

Illustration 9

Comparison of males of different age group

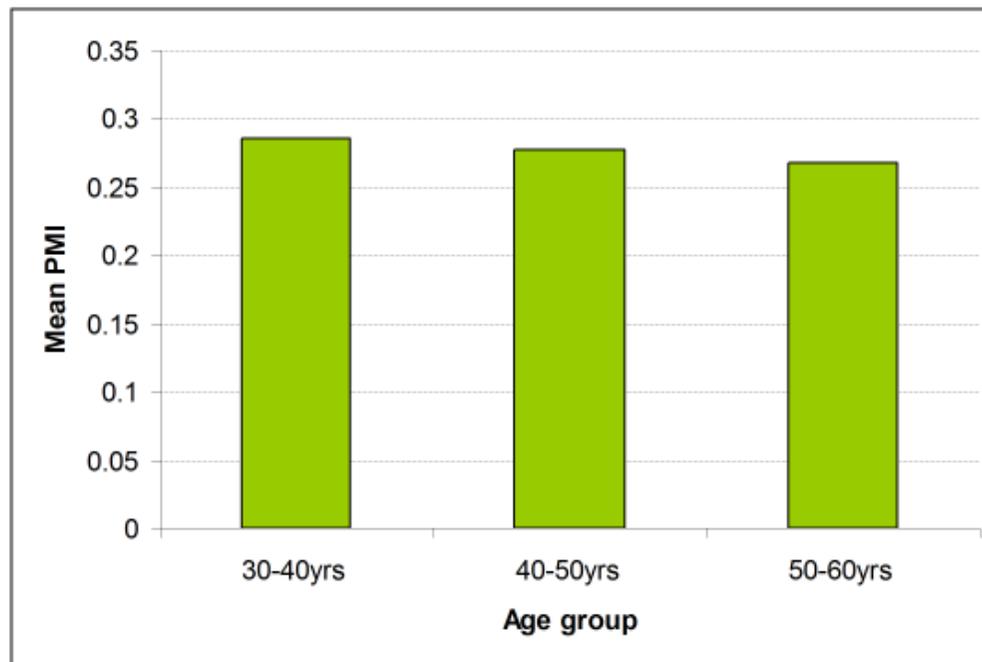


Illustration: 9 Comparison of males of different age group

Illustration 10

Comparison of females of different age group

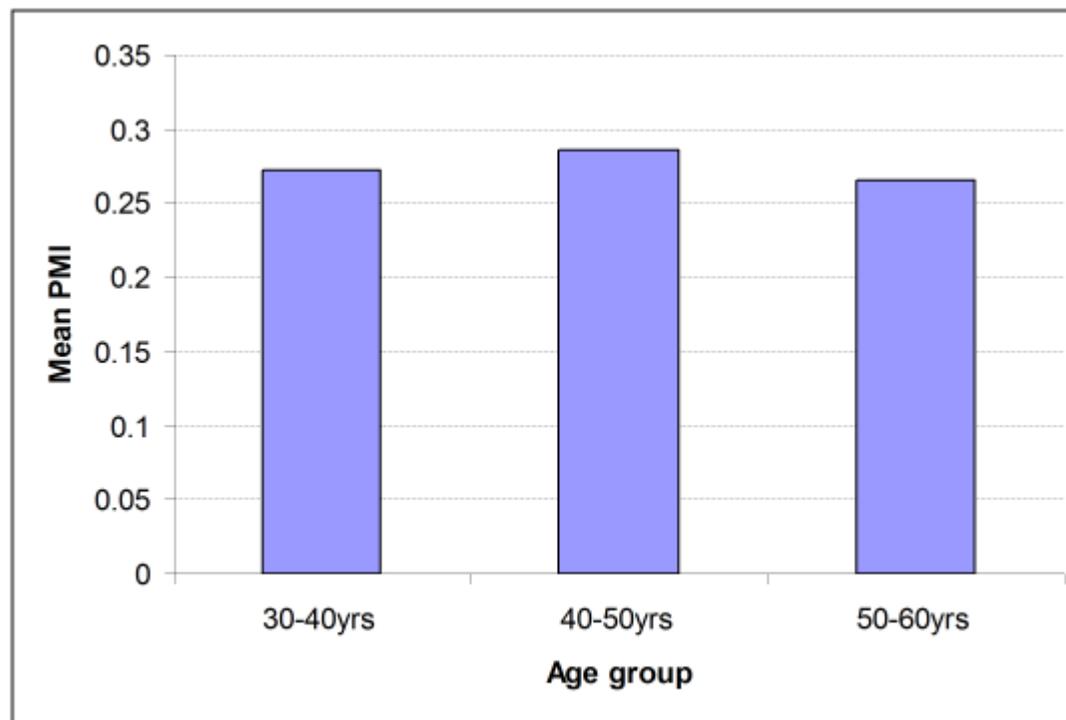


Illustration: 10 Comparison of females of different age group

Illustration 11

Comparison of overall males with overall females

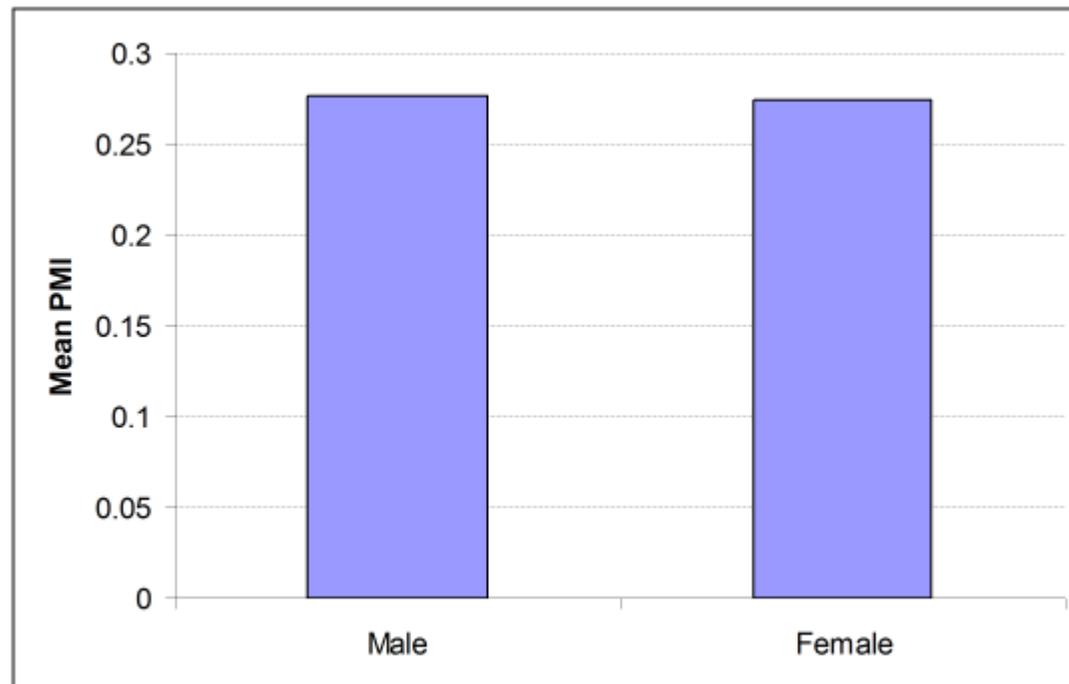


Illustration: 11 Comparison of overall males with overall females

Illustration 12

Comparison of right PMI with left PMI

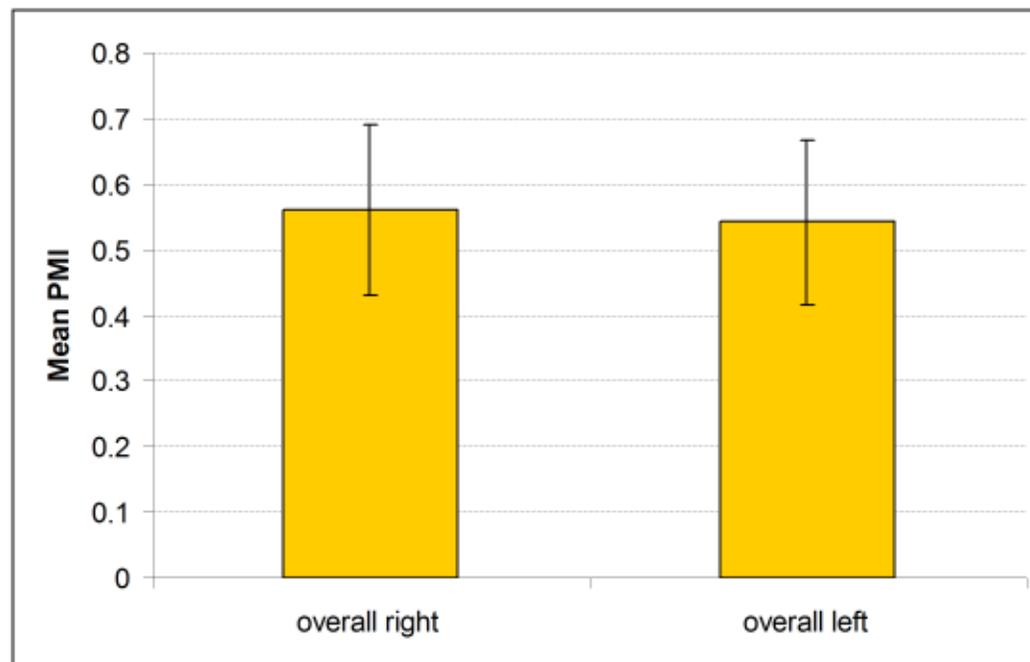


Illustration: 12 Comparison of right PMI with left PMI

Illustration 13

Comparison of menstruating with non

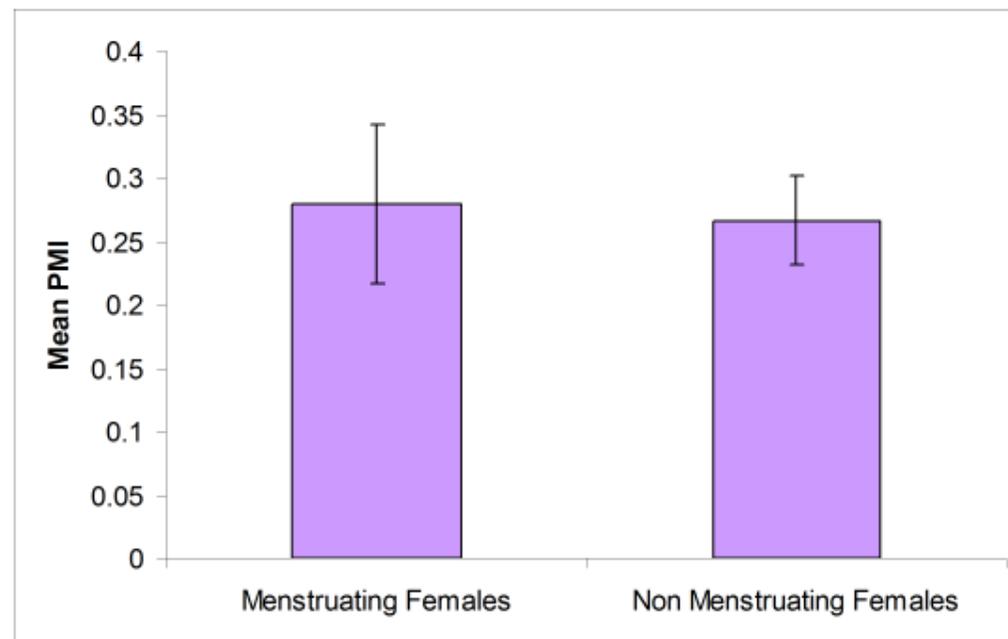


Illustration: 13 Comparison of menstruating with non – menstruating women

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