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Original Article

The influence of age and gender on mandibular indices in sample of Libyan population

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ABSTRACT

Radiographic Mandibular Indices serve as easy and relatively cheap tools for evaluating bone mineralization.

Objectives: To examine the effect of age and gender on three mandibular indices: the panoramic mandibular index (PMI), the mandibular ratio (MR) and the mandibular cortical index (MCI), among Libyan population.

Methods: the three indices were measured on 317 digital (OPGs) of adult humans (155 males, 162 females). The sample was divided into six age groups (from 18-25 years. through 56-65 years). The measurements were analyzed for interactions with age and sex, using SPSS (Statistical Package for Social Studies) software version no. 22. The tests employed were two way ANOVA, the unpaired T-test and chi-square test.

Results: The mean PMI fluctuated between 0.37 s.d. 0.012 and 0.38 s.d. 0.012.among the sixth age groups. One-way ANOVA statistical test revealed no significant of age on PMI. On the other hand gender variation has effect on PMI, since independent sample t-test disclosed that the difference between the male and female PMI means statistically significant. ANOVA test showed that the means of MR among age groups showed a negative correlation i.e. MR mean declined from 3.01 in 18-25 age group to 2.7 in 55-65 age group. In contrary, the gender showed no effect on MR according two sample t-test at $p > 0.05$. In regards with MCI, statistical analysis showed that it affected by age that is C1 was decreasing by age while C2 and C3 were increased by age. Using chi square test the result indicated that there is a significant difference among the different age group and the two genders in MCI readings.

Conclusion: PMI was influenced significantly by age but minimally by the gender. MR is not affected by gender but has a negative correlation with age. MCI is affected by both age and gender.

Key Words: radiographic indices, Panoramic mandibular index, mandibular ratio, Mandibular cortical index.

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INTRODUCTION

Throughout life, sections of bone are constantly destroyed and rebuilt, allowing the skeleton to be rejuvenated, and fulfill mineral demands [(1)]. This turnover ensures also the continuous replacement of old bone tissue, which, in turn, affects bone adaptation to various mechanical forces exerted on the skeleton [(2)]. In dental treatment Healthy bone with a normal regenerative capacity is essential for a successful outcome. It is important to know the quantity and quality of bone in the jaws when planning prosthetic and pre-prosthetic surgical treatment [(3)]. Bone density and mineralization is a crucial issue that must be evaluated prior to placement of implant material such as for prosthodontic purposes, or for orthodontic-anchorage purposes; for this reasons any deterioration in bone

metabolism, such as osteoporosis, much be detected in advance before any dental treatment that needs bone-surgical intervention. Osteoporosis is the most common metabolic abnormality affecting bones [4]. Osteoporosis is defined as a "skeletal disorder characterized by low bone mass and micro-architectural deterioration of bone tissue leading to enhanced bone fragility, with consequent increase in fracture risk" [3]. It is characterized by compromised bone strength, is frequently not detected until a fracture occurs [5], known as "the silent epidemic" because of its high frequency and indiscernible symptomology [4]. Mandible can be affected by osteoporosis [6]. Bone mass is primarily determined by genetic factors, gender being the most important. The peak bone mass is observed around 30 years of age in both genders but is greater in males than in females. Bone loss occurring with age is a commonly observed phenomenon in humans. It affects both sexes but is increased in postmenopausal females [7].

Dentistry of bone and detection defects in bone mineralization, such as osteoporosis, are usually diagnosed by bone mineral densities (BMD) by using dual energy x-ray absorptiometry (DXA) [8-10]. Panoramic mandibular index (PMI) and mandibular cortical index (MCI) are indices used by oral radiologist and several studies concluding that; these indices are positively correlated to (BMD) (T-score) and might be used as indicators for osteoporosis [11, 12] and they are better than antigonial index (AI) [5]. Using such indices, several studies has been put forward to evaluate the effect of age and gender on the bone mineralization in different ethnic populations, since it has been found that bone density seems to be effects by the two independent variables. On the other hand none of such investigations has been done on the Libyan society. Hence, the aim of this study was to evaluate the (PMI) and (MCI) in sample of Libyan population and correlating them to age and gender.

MATERIALS AND METHODS

This is descriptive cross sectional study conducted in Faculty of Dentistry, Benghazi University from October 2017 to March 2018, in Oral Medicine, Pathology, Radiology and Diagnosis department. Ethical approval was obtained from the committee of higher studies and research in the faculty.

Sample size and selection: From the department data base, 368 OPG where initially examined 51 OPGs where excluded, and 317 OPGs (162 Females, 155 Males)where the size of the sample of this studies following the criteria (Table 1).

Table 1: Inclusion and exclusion criteria of the sample of the study

Inclusion criteria	Exclusion criteria
Adult (> 18yrs) Male or Female Libyan person.	Chronic metabolic, endocrine or bone disease.
Willingness to cooperate	Hormonal treatment
	Pregnancy or lactation
	Contraceptive usage
	Calcium and/or Vit. D supplements usage
	Error, artifact or distortion in the OPG

Data where traveled from PC of Oral Radiology department to lap top. Age of each patient was recorded at exposure time. Using Digora® for Windows 1.51, measuring indices is done by one examiner in a blind fashion as follow:

Lower panoramic mandibular index (PMI) was measured according to Benson et al. [13]. PMI is the ratio of ***CI*** to ***h***, where CI is the height of the mandible cortex(cortical index) (CI) in line perpendicular to the tangent pass along lower border of mandible at the mental area; and ***h*** is the distance from the lower border of lower cortex of mandible to the inferior border of mental foramen **(Figure 1, A).**

Panoramic mandibular index (PMI) = CI/h

Mandibular ratio (MR) according to Ortman et al [14], it equals the mandibular height (H) which is the distance from upper border to the lower border of mandible at mental area divided by the height of the mandible from the lower border to the lower border of mental foramen (h) (Figure 1, B).

Mandibular ratio (MR) = H/h

Mandibular cortical index (MCI) was measured according to Klemetti et al. [15]; *It is three graded scale, which shows the demarcation between cortical plate and spongiose:* C1: a straight and clear cortical edge (Figure 2, A). C2: cortical edge is fragmented with semilunar defects (Figure 2, B). C3: porosity of the cortical bone, the end of the cortical bone cannot be detected (Figure 2, C).

All measurements were recorded as the average of both right and left side of the mandible where it was possible; otherwise only one side was considered.

RESULTS

Statistical analysis:

The mean values of the Panoramic Mandibular Index (PMI) and the Mandibular Ratio MR among the two genders and the six groups were compared for sake of significance using statistical analysis. SPSS (Statistical Package for Social Studies) software Version No. 22 was used. Mann-Whitney test were used for comparison MR means among the two genders, as this test is the recommended test as an alternative to un-paired t-test when there is a lack of normality in the data distribution. ANOVA test was substituted by kruskal-Wallis test for inter- and intra-age group comparisons. The effect of age on the two indices was studied using the correlation relation between the age variable and each index. Regarding the third index, Mandibular Cortical Index (MCI), chi-square test was applied to figure out the significance of effects of age and gender on the index.

This study showed that the mean of the panoramic mandibular index (PMI) among females was 0.385 ± 0.078 and the range value was 0.354 (min. = 0.208, max. = 0.562) while males PMI-mean value was 0.363 ± 0.082, and it ranged from 0.208 to 0.600.(rage = 0.391) (Table 2). The mean of the Mandibular Ratio (MR) for females was 2.92 ± 0.522 and the rage value was 4.25 (min.= 1.993, max.= 4.25). For males, the mean of MR was 2.83 ± 0.441and the rage was 2.21 (min. = 2.00, max.= 4.21) (Table 3).

In regard with the mandibular cortical index (MCI), out of 162 females member of the sample 72 showed C1, 51 showed C2 and 37 showed C3, whereas in case of the males who were 155 members, 44 showed C1, 67 showed C2 and 44 showed C3 (Table 4).

Effect of gender:

Mann-Whitney test indicated that there no effect of gender on Mandibular Ratio MR (***p***> 0.05), on the other hand the test revealed that Panoramic Mandibular Index PMI is significantly affected by gender (P< 0.05) (Figure 3).

Influence of gender on Mandibular Cortical Index (MCI): Chi-square test resulted in a significant difference in the index among females and males members of the sample ($p < 0.01$) (Table 5).

Effect of the age:

Statistical analysis found that age has a negative correlation with MR of the whole sample members, females and males members, r = -0.221, ($p < 0.05$), nevertheless, it has showed that there is a negative correlation between age and MR in females and males, r = - 0.161 and r = - 0.290 $p < 0.05$, respectively (Table 6, 7). On the other hand, statistical analysis showed that there is no correlation between age and PMI in the whole sample members r = 0.06 ($p > 0.05$), and also age has no correlation with age in females and males members of the sample separately; r = 0.088 (p>0.05), and r =0.034 ($p > 0.05$) for females and males members of the sample, respectively (Table 8, 9).

In case of MCI, the sample is segregated into six age-groups (18 years, – 25 years, 26 – 35 years, 36 – 45 years, 46 – 55 years, 56 – 65 years, 66 and more). Chi-square test resulted in a statistical significance difference values levels of MCI (C1, C2 and C3) among the six age-groups. It is clear that the level of C1 is more predominant in younger age groups and is less or not found in older members of the sample. In contrary, C3 is clearly higher in older members and less in younger aged members (Table 10 and Figure 4).

DISCUSSION

Panoramic radiograph is a simple diagnostic tool that frequently used by dentists for patients management, and radiomophometric indices applied on panoramic radiograph are useful means for evaluation of bone mineralization and bone mass. Although several studies on different ethnic groups evaluating age and gender effects of those indices are readily available in the literature, there has been none of such investigation that done on the Libyans; therefore the aim of the present study to investigate the effect of age and gender variables on the three indices: PMI, MR and MCI.

The ethnic differences in PMI [13, 15, 16] explain the difference in PMI values among several studies that conducted on different population belonging to different ethnic groups. It has been reported that ≥ 0.3 of the Brazilians [17] and 0.275 of Indians [18] showed a significant decrease of PMI with age. No trend could be detected by Mostafa et al. [19] among Egyptian people; nevertheless, they could find that there was significant difference between age groups 50-95 and 60-70 only. In other north Indian study comparing the upper PMI in different age groups and gender, it found Significant negative correlation ($p<0.05$) between age and mean panoramic mandibular index were recorded for both males and females [7].

This study has showed that there was no correlation between age and PMI, which is consistence with Mostafa et al. [19]. In contrary, gender has influenced PMI values, where females showed significant higher

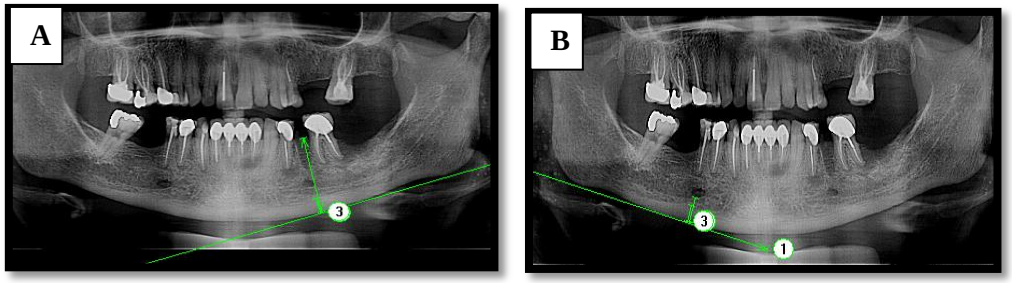

Figure 1: A) panoramic mandibular ratio PMI. B) mandibular ratio MR

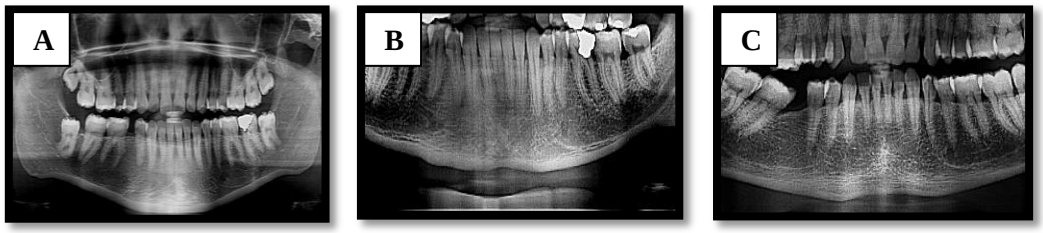

Figure 2: A) C1 clear cortical dge. B) C2 fragmented edge with Semilunar defect. C) C3 cortical edge is not well demarcated.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of MR = H/h is the same across categories of gender .	Independent-Samples Mann-Whitney U Test	.059	Retain the null hypothesis.
2	The distribution of PMI=IC/h is the same across categories of gender .	Independent-Samples Mann-Whitney U Test	.006	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 3: Gender effect on MR and PMI according to Mann-Whitney U Test.

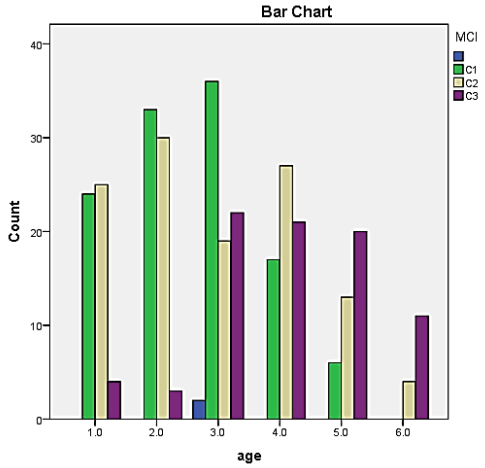

Figure 4: distribution of MCI categories among the six age groups.

Table 2: Panoramic Mandibular Index (PMI)

Group	N	Mean	s.d.	s.e.	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
18-25	55	.3670109	.08905181	.01200774	.3429369	.3910850	.25000	.60000
26-35	66	.3594170	.08480225	.01043843	.3385700	.3802640	.20833	.55000
36-45	77	.3818029	.06819532	.00772160	.3664272	.3971786	.25000	.56250
46-55	65	.3744451	.07302378	.00905748	.3563507	.3925395	.21429	.52941
56-65	54	.3873957	.09157469	.01246174	.3624006	.4123908	.20833	.56250
Total	317	.3740442	.08082143	.00453224	.3651271	.3829613	.20833	.60000

Table 3: The mandibular ratio (MR)

Group	N	Mean	s.d.	s.e.	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
18-25	55	3.0172899	.45369489	.06117621	2.8946390	3.1399408	2.22727	4.07143
26-35	66	2.9142561	.47123128	.05800456	2.7984130	3.0300992	2.00000	4.21429
36-45	77	2.9283737	.41071488	.04650430	2.8357718	3.0209756	2.20000	4.25000
46-55	65	2.8480549	.46702326	.05792711	2.7323322	2.9637776	2.00000	4.14286
56-65	54	2.7000159	.44806435	.06097384	2.5777179	2.8223139	1.93333	3.75000
Total	317	2.8856271	.45711916	.02563397	2.8351929	2.9360613	1.93333	4.25000

Table 4: Gender and Mandibular Cortex Index (MCI)

		MCI			Total
		C1	C2	C3	
gender	F	72	51	37	162
	M	44	67	44	155
Total		116	118	81	317

Table 5: Gender and MCI

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.384[a]	3	.010
Likelihood Ratio	12.226	3	.007
N of Valid Cases	317		

[a]. 2 cells (25.0%) have expected count less than 5. The minimum expected count is .98.

Table 6: Correlations of Age with MR in females members

		MR = H/h	age
MR = H/h	Pearson Correlation	1	-.161*
	Sig. (2-tailed)		.040
age	Pearson Correlation	-.161*	1
	Sig. (2-tailed)	.040	

*. Correlation is significant at the 0.05 level (2-tailed).

Table 7: Correlations of Age with MR in Male members

		MR = H/h	age
MR = H/h	Pearson Correlation	1	-.290**
	Sig. (2-tailed)		.000
age	Pearson Correlation	-.290**	1
	Sig. (2-tailed)	.000	

**. Correlation is significant at the 0.01 level (2-tailed)

Table 8: Correlations of Age with PMI in female members

		age	PMI=IC/h
age	Pearson Correlation	1	.088
	Sig. (2-tailed)		.264
PMI=IC/h	Pearson Correlation	.088	1
	Sig. (2-tailed)	.264	

Table 9: Correlations of Age with PMI in male members

		age	PMI=IC/h
age	Pearson Correlation	1	.034
	Sig. (2-tailed)		.674
PMI=IC/h	Pearson Correlation	.034	1
	Sig. (2-tailed)	.674	

Table 10: Age and MCI (C1, C2, and C3)

Age groups	MCI				Total
		C1	C2	C3	
18-25	0	24	25	4	53
26-35	0	33	30	3	66
36-45	2	36	19	22	79
46-55	0	17	27	21	65
56-65	0	6	13	20	39
66-	0	0	4	11	15
Total	2	116	118	81	317

value than males (0.385 and 0.363, respectively), the finding that was to be insignificant with Mostafa et al. [19]. However, Govindraju and Chandra [20] concluded that the influence of gender is significant on PMI. (PMI females mean 0.013, males mean 0.001). This common finding can be explained by the fact that the distance between the mental foramen and the inferior cortex of the mandible (h) is less in females than males due to skeletal variations between sexes [19]. On the other hand, remarkably Hastar et al. [21] studied PMI in Turkish elderlies (60-88 years) to conclude that the Panoramic Mandibular Index was significantly higher in males (PMI mean= 0.34) than females (PMI mean= 0.27).

Watson et al. [22] correlating PMI with osteoporotic changes on menopausal women, sub grouping the sample in to normal and osteoporotic and they found no significant difference between the groups. Drozdzowska et al. [23] also found no significance correlation between PMI means and bone quality on postmenopausal edentulous women aged from 48 to 71 years. A weak significant correlation between PMI and bone mass density observed by Klemetti et al. [15] who concluded that, strong positive correlation between PMI and general mineral status is difficult to be proved never there is; marked deviation of PMI values from PMI values of population can be used as indicator for bone mineral changes [23].

As it is generally believed that the bone mass decreased with age [23], this study's results showed that MR mean values were decreased significantly with age, which goes well with results observed by Kalinowski et al [24] who noted that the Mean height of the mandible decreased with age starting from the age group 30–39 years, and gender difference most prominent in elderly above 70 years with mean values 27.48 mm in males and 22.26 mm in females. Measurements of distance between the mandibular inferior margin and lower margin of the mental foramen (h) resulted in lack of correlation with age but significant difference noted between male and female in both H and h measurements. Balcikonyte et al. [25] revealed no correlation between age and H and h values. In the present study the mean values of MR in females was significantly higher (2.92) than males (2.83), mean value of H in female was (5.282) and males was (5.802). Again the mean value of h in males was (2.085) higher than females mean value (1.831), that reflect the effect of gender on the MR ratio.

In term of mandibular cortical index MCI statistical significant values of MCI in different age groups C1 was highest in middle age group 36 – 45 years (36), while C3 recorded more in group 36 – 45 years, group 46 – 55 years and group 56 – 65 years with numbers of sample members 22, 21, and 20, respectively. C2 observed more in 26 – 35 years with 30 members. It is believed that MCI might be an indicator for decrease in bone mineral density BMD [21, 26-28]; Hastar et al. [21] found a significant effect of gender on MCI as they found that 68.5% and 2.8% of women had eroded mandibular cortex (C2 and C3), respectively, whereas only 21.8% and 0% of men had eroded mandibular cortex (C2 and C3),respectively, in study correlating the MCI with age ,gender and patients with or without osteoporosis. On the other hand, Knezovic-Zlataric et al. [29] found no gender effect on MCI and MCI C3 tend to be frequent with age and significantly higher in women than man in old age patients.

In 2017, Omar et al. [30],were conducted a cross sectional study among patients attended poly clinic in Benghazi city for vitamin D level screening Out of 184 subjects; 90.8% were females, and 9.2% were males, they found 76.1% of patients were suffering of vitamin D deficiency, while 15.2% insufficient level and smallest group presented with 8.7% sufficient vitamin D level. This may indirectly explain the observations regarding MCI C3 that found in more than age group and both genders in current study, more investigations are require to find out the correlation between vitamin D serum level and MCI reading as it is may use as indicator for vitamin D deficiency.

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