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Differences of Gonial Index value in male and female hypertension patients using panoramic radiography

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ABSTRACT

Objectives: This study aims to measure the Gonial index (GI) value in male and female hypertensive patients using panoramic radiography.

Materials and Methods: This is a comparative analytical research. The sampling technique used was the purposive sampling technique. The sample of this study was primary data from panoramic radiographs of hypertensive patients who had been X-rayed at the Radiology Installation of Ulin General Hospital, Banjarmasin.

Results: There was no significant difference in the gonial index (GI) values between men (17.83 mm) and women (19.17 mm), with the size of the right region of the female 20.33 mm and the left of the female 16.67 mm and the size of the right region of the male is 17.03 mm and the left male is 19.97 mm.

Conclusion: There was no significant difference between the gonial index (GI) values between women and men, although the decrease of bone density in women is higher than in men.

INTRODUCTION

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Hypertension can be interpreted as an abnormal increase in blood pressure in the arteries that carry blood from the heart and continues to pump it to all tissues and organs of the body.[1] The average blood pressure of a healthy adult is 120/80 mmHg.[2,3] Hpertension sufferers are said to have high blood pressure if his systolic blood pressure is > 140 mmHg and his diastolic is > 90 mmHg. The province with the highest incidence of hypertension was occupied by South Kalimantan Province with a total of 44.1%.[6] The 6,992 new cases were recorded as hypertension sufferers aged > 60 years.[6]

Hypertension is known to affect bone mineral density (BMD) by regulating blood pressure and calcium metabolism. Low calcium intake, deficiency of vitamins D and K and high sodium intake can contribute to the development of hypertension, made imbalance in calcium metabolism and calcium leakage to the bone, and leading to secondary hyperparathyroidism. This situation made increased parathyroid hormone and decreased BMD and quality the bone.

Amlodipine is the Most often drug which prescribed for hypertensive patients. These drugs can block the flow of calcium ions through the cell membranes of the heart and muscles, and prevent the mobilization of intracellular calcium. This situation can lead to direct dilatation of the coronary arteries and arterioles, which increases myocardial oxygenation and thereby lowers blood pressure by increasing peripheral vascularization.[11] Calcium channel blockers (CCB) are known to affect calcium in bone.[12]

Changes of trabecular bone density can predict throught panoramic X-rays.[10] Panoramic radiography commonly used to assess changes in density that may be affected by systemic disease. One of the systemic diseases that dentists often encounter is hypertension.[10] Bone condition analysis can be performed in several ways, one of which is panoramic radiography. Panoramic radiography can provide information such as alveolar trabecular pattern, bone mass and bone mineral density.[12] The quality and quantity of the jaws can be determined by several radiomorphometric indices, such as the mandibular cortical index, including the mandibular cortical index (MCI), panoramic mandibular index (PMI), mental index (MI), gonial index (GI), and antegonial index (AI).

The gonial index (GI) is the cortical thickness of the mandible as measured at the angle bisectrix between the tangent to the posterior border of the branch and the lower part of the mandible has a normal value> 1.2 mm.[14] The gonial index (GI) is obtained by measuring the width of the cortex on a line perpendicular to the tangent line below the lower border, passing through the gonial index (GI) or the point of intersection of the lower border of

the tangent and the line that best fits the anterior border of the ascending ramus (AI).[16] Based on this background, the researcher wanted to know the value of the Gonial Index (GI) measurement in hypertensive patients using panoramic radiography.

MATERIALS AND METHODS

This research is an comparative analytic quantitative study with a cross-sectional design that has received ethical clearance approval from the Health Research Ethics Commission FKG ULM Banjarmasin No. 063/KEPKG-FKGULM/EC/IV/2023. The population in this study were patients diagnosed with hypertension by an internist at Ulin General Hospital, Banjarmasin. Based on the calculation of the comparative analytic sample size formula, the minimum sample in this study was 18 people in each group. The sampling technique in this study was carried out by purposive sampling method. The inclusion criteria in this study were male and female hypertensive patients who were willing to be research subjects,

Respondents who met the criteria were then taken to take panoramic radiographs at the Ulin Hospital, Banjarmasin. The results of taking panoramic radiographs are collected in digital format and measured based on the gonial index (GI) method. The results that have been analyzed are recorded in the ratio of units of millimeters (mm). The data that has been obtained is then analyzed.

The data analysis used is comparative analytic analysis. If the data is normally distributed, a parametric test will be carried out with an independent t test, but if the data is not normally distributed, an attempt will be made to modify the data so that it remains normal, but if it is not achieved and the results are abnormal, then a non-parametric test is carried out with the Man-Whitney test.

RESULTS

This research was conducted on 36 hypertensive patients who were treated at Ulin General Hospital, Banjarmasin. This research was conducted in March 2023 – June 2023. The data obtained in the study were then analyzed using descriptive analysis. Sample characteristics are presented in Table 1. From the table it can be seen that the sample characteristics indicate that respondents aged 46-51 years were the most respondents in this study, including 15 respondents.

The results of measuring mandibular cortical width according to gender using the Gonial Index are shown in Table 2. The table shows that women have an average mandibular cortical thickness of 1.16 mm. In men, the average mandibular thickness is 1.22 mm. This table also shows that women have an average right jaw cortical width of 1.03 mm and 0.84 mm on the left jaw and men have an average

Table 1. Characteristics of Research Samples Based on Age and Gender According to Gonial Index (GI)

Variable Age	Frequency	Percentage
40-45 years	2	5%
46-51 years	15	42%
52-57 years	13	36%
58-73 years	6	17%
Gender		
Woman	18	50%
Man	18	50%
Total	36	100%

Table 2. Average Width of the Right and Left Mandibular Cortex Based on Gender According to the Gonial Index (GI)

Gender	n	Mandibular Cortex Width (Mean + SD)	
Woman	18	1.16 ± 0.13	
		Right	**Left**
		1.03 ± 0.47	0.84 ± 0.5
Man	18	1.22 ± 0.23	
		Right	**Left**
		1.11 ± 0.48	1.05 ± 0.42

right jaw cortical width of 1.11 mm and 1.05 mm on the left jaw.

The results of bone density measurements of hypertensive patients according to GI are presented in Table 3. From the table it can be seen that based on gender, there were 7 women whose values were not within normal limits and 11 subjects whose values were within normal limits. This table also shows that six male subjects experienced a decrease in bone density and 12 subjects did not experience a decrease in bone density. bone density occurs.

The results of the study of the right and left cortical index (GI) thickness values according to sex are shown in Table 4. Table 4 shows that, in relation to the jaw, women have a mandibular cortical thickness value according to GI on the right side of the jaw greater than 20.33 mm compared to 16.67 mm on the left side of the jaw. Meanwhile, the thickness of the cortical index (GI) for men based on the side of the jaw in Table 4 shows that the thickness of the cortical index (GI) for men on the left side of the jaw is higher, namely 19.97 mm, compared to the right side of the jaw, which is 17.03 mm.

The results of the study regarding differences in mandibular cortical thickness according to the gonial index (GI) on the right and left jaws according to sex were analyzed using the SPSS program. Before carrying out the different test, a normality test was carried out using the Shapiro-Wilk test. Based on the results of the normality test, a significant value of less than 0.05 was found, indicating that the measurement data was not normally distributed. The analysis was continued with a nonparametric comparative hypothesis test using the Mann-Whitney test. The results of the Mann-Whitney test for differences in cortical gonadal index (GI) thickness between the right and left jaws in women are presented in Table 4. In this table the significance value is 0.296 (> 0.05) which means the null hypothesis (Ho) is accepted, so that it can be concluded that there is no difference in the thickness of the Gonia Cortical Index (GI) for women between the right and left jaws. The results of the Mann-Whitney test for differences in cortical thickness values based on the gonial index (GI) are shown in Table 4. This table shows that in the male sex between the right and left jaws there is a significance value of 0.402 (> 0.05), which means the null hypothesis (Ho) is accepted, so this shows that there is no significant difference.

The results of the Mann-Whitney test between men and women in the study sample are shown in Table 5. The table shows that the mean cortical index (GI) thickness in women was 19.17 mm higher than in the male group with an average of 17.83 mm. The results of the Mann-Whitney test for differences in the thickness of the right GI cortex of men and women showed a significant value of 0.704 (> 0.05), meaning that the null hypothesis (Ho) was accepted. It means that there is no significant difference.

Table 3. The Average Value of Mandibular Cortical Thickness by Gender According to the Gonial Index (GI)

Variable (Gender)	Decreased bone density		Total
	Value does not fit normal limits	Value within normal limits	
Man	6	12	18
Woman	7	11	18

Table 4. Cortical thickness value of the right and left Gonial Index (GI) based on gender.

Gender	N	Gonal Index (GI)		P-Value
		Right Jaw (means)	Left Jaw (means)	
Woman	18	20,33	16,67	0.296
Man	18	17.03	19.97	0.402

Table 5. The results of the Mann-Whitney test to analyze differences in the cortical thickness Gonial Index (GI) values based on gender

Variable	Gender	n	Means	P-Value
Gonial Index	Man	18	17.83 mm	0.704
	Woman	18	19.17 mm	

DISCUSSION

The results showed that the mean value of mandibular cortical thickness of the right female jaw was obtained 20.33 mm and the female left jaw was obtained 16.67 mm. The results of this study are supported by Azhari et.al (2017) which states that there is a significant difference in thickness between the right and left mandible based on the gonial index. The difference between the right and left mandible in this condition is still classified as facial asymmetry which is considered normal.[23] This situation is triggered by genetic conditions, muscle mass, and differences in sex hormones secreted in males and females. Women are known to have high estrogen levels and low testosterone levels resulting in a rapid increase in bone mass, but not bone width. The increase in bone mass occurs because the increase in endosteal apposition is greater than the increase in periosteal apposition. In young adults, there are differences in muscle-bone relationships between males and females. Another condition that is known to influence the difference in size between the thickness of the right and left mandible is caused by the growth of the right side of the face being more dominant than the left side. This condition also occurs in larger brain dimensions on the right side.[21,22]

The results showed that the mandibular cortical thickness of the right jaw for men was 17.03 mm and for the left jaw for men was 19.97 mm. Azhari et.al 2017 in his research stated that mandibular growth is a constant remodeling process. The mandible is a bone that has many morphological variations and has the most postnatal growth compared to other facial bones.[21] Bone apposition and bone resorption that occur with increasing human age causes the shape and size of the mandible to change. The difference in the width of the mandibular cortex of the right and left jaws can be caused by many factors including ethnic, genetic, environmental factors and one-sided chewing patterns. One of the factors that play an important role in influencing growth patterns is the gender factor. Gender will affect the growth tempo, growth time, bone and tooth maturity. Differences in the timing of puberty between boys and girls affect bone maturity. The peak of growth for women is earlier than for men with the female skeletal growth pattern being faster and shorter, while the male skeletal growth pattern tends to be slower and longer.[28]

The results showed that the difference in mean mandibular cortical thickness values for men and women based on the gonial index (GI) of the female group was higher with an average value of 19.17 mm compared to the male group with an average value of 17.83 mm. Statistical results using the Mann-Whitney test obtained a p-value of 0.704 (P>0.05), so based on these results it can be concluded that there was no significant difference between the sample groups in the gonial index (GI) value between men and women. The results of this study are supported by research conducted by Bajoria et al. which shows that there is no significant difference in the results of the gonial index (GI) measurement of the study sample based on gender. This situation is known to be caused by various factors other than gender which can affect the results of the study including ethnic factors and other factors known to play a role in decreasing bone density and the small sample size. This statement is in accordance with the research of Naik A et al. which shows that the condition of a person's bone density can be influenced by many factors which include gender, age, race, lifestyle, and calcium intake. Other factors are also influenced by hormone levels. The hormone estrogen found in women can decrease in levels when women enter menopause. which shows that the condition of a person's bone density can be influenced by many factors which include gender, age, race, lifestyle, and calcium intake. Other factors are also influenced by hormone levels. The hormone estrogen found in women can decrease in levels when women enter menopause. which shows that the condition of a person's bone density can be influenced by many factors which include gender, age, race, lifestyle, and calcium intake. Other factors are also influenced by hormone levels. The hormone estrogen found in women can decrease in levels when women enter menopause.[23] Another factor that is known to cause a decrease in bone density is bone remodeling activity which is influenced by genetic conditions, muscle mass, and differences in sex hormones secreted in males and females. Genetic factors include differences in gene expression that affect the function of bone cells, such as osteoclasts and osteoblasts that play a role in the occurrence of osteoporosis and differences in peak bone mass between men and women.[7,10] The results of this study are supported by research by Azhari et al. 2019 which states that the average length of the right and left mandible in men and women is relatively small, there is a relatively small difference.[24]

Another study conducted by Ye et al. 2017 states that decreased bone density is not only influenced by gender, but there are several factors that can influence it including age, smoking habits, coffee drinking habits, diabetes, and heart disorders. This statement is supported by research conducted by Weng et al. 2022 which shows a decrease in bone density in samples with smoking habits compared to non-smokers. The presence of nicotine in cigarettes is known to cause disturbances in bone metabolism through inhibition of osteoblasts through nicotine receptors in osteoblasts. Nicotine is also known to have a role in increasing osteoclast release by increasing the activation of aryl hydrocarbon receptors in osteoclasts.[24,26]

The difference in the gonial index (GI) measurement values for men and women that have been obtained is in accordance with the research by Gunawan et al. which shows that the decrease in bone density in women with hypertension is higher than in men.[23] This condition can be influenced by various factors including one-sided mastication patterns. Other factors that play a role in

decreasing bone density in women include growth and bone density in women which are heavily influenced by the hormone estrogen. The hormone estrogen is needed for bone formation and maintaining bone mass in women. After the age of 40, women experience a faster and more rapid decrease in bone mass due to reduced levels of estrogen in the body.[7]

One of the factors that plays a role in the difference of bone density between men and women is the accelerated growth they experience. Boys have an additional two years of growth compared to girls so boys have more bone mass than girls.[22,20] This research is also supported by research from Pamadya et al. 2014 which states that there is a difference in the average value of the mandibular cortex thickness of postmenopausal women using the gonial index (GI) on panoramic radiographs.[25] The results of this study explained that measurements of the mandibular cortex as measured using the gonial index (GI) were proven to be able to identify the patient's mandibular bone mineral density.[10]

The role of the calcium rate in patients with hypertension is also important in influencing the decrease in bone density. This statement is supported by research conducted by Gwen et al. (2020) which shows that there are differences in bone density between normal patients without hypertension and patients who have hypertension. This condition is known to be triggered by various factors, one of which is a diet that is low in calcium and potassium. Dietary intake that is low in calcium and potassium is known to cause a decrease in bone density in these individuals. Another factor that plays a role in this regard is the role of abnormalities of calcium metabolism in patients with hypertension. Abnormalities of calcium metabolism in patients with hypertension are known to cause increased release of parathyroid hormone (PTH) which in turn will trigger an increase in intracellular calcium levels to exceed normal limits. The high production of parathyroid hormone (PTH) and intracellular calcium levels will trigger the release of angiotensin II which is a factor triggering the contraction of blood vessels. In addition to triggering the release of angiotensin II, this situation will cause an increase in calcitonin secretion. Which causes the re-absorption of calcium by the kidneys and the performance of the digestive system will decrease. This condition will result in increased excretion of calcium through the urine, causing bone density to become more brittle.[23]

CONCLUSION

The results of the research that has been carried out show that the measurement value using the gonial index (GI) in women has the highest average mandibular cortical density with an average mandibular cortex value of 1.16 mm with an average width of the right cortex of 20.33 mm and a width of the left cortex of 16.67 mm. 1.22

mm with an average right cortex width of 17.03 mm and a left cortex width of 19.97 mm and the average gonial index (GI) value of the female group was higher with an average value of 19.17 mm compared to the male group with an average value of 17.83 mm. The result of this study also showed that there is no significant difference between the gonial index (GI) values between women and men (P> 0,05).

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FOOTNOTES

All authors have no potential conflict of interest to declare for this article. All procedures conducted were in accordance with the ethical standards.

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