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Differences in Mean Cephalic Index Based on Pubertal and Post Pubertal Age Groups in the Timorese in Kupang City

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ABSTRACT: Identification of victims of death due to disasters and accidents is important to fulfill the rights of victims. The identification process is carried out by anthropometric measurements, one of which is the measurement of the cephalic index. Age is one of the factors of the cephalic index value and head shape based on the time of the start of the fusion process in each bone as well as the role of hormones during growth or pubertal. The cephalic index can also serve to monitor indications of the development and growth of a varied population and its distribution and find out if there are abnormalities in the head. This study aims to determine the difference in the mean cephalic index based on the age of pubertal and post-pubertal in the Timorese in Kupang City. This research is comparative analytic with a cross-sectional approach design. The sample selection technique in this study used a concecutive sampling technique with a total sample of 100 people. The research begins with an explanation of the general description of the study, informed consent, and measuring the width and length of the head using spreading caliper. The data analysis used is an independent t-test. From the results of using the independent t-test, there was no significant difference in the mean cephalic index based on the age of pubertal and post-pubertal in the Timorese in Kupang City with a p value = 0.12. There is no significant difference in the mean cephalic index based on the age of pubertal and post-pubertal in the Timorese in Kupang City.

KEYWORDS: Cephalic Index, Pubertal Age, Post-pubertal Age, Kupang City

INTRODUCTION

Data from the Indonesian Declaration of Independence reports that in the ten-year period (2010-2019) there have been 23,953 disaster events. In that period, the highest number of disaster events occurred in 2019, namely 3,885 disaster events and the lowest number of disaster events occurred in 2013 with 1,784 disaster events [1]. Every disaster event can cause injuries to death. Generally, the condition of victims who died due to disasters is difficult to recognize due to various causative factors such as injuries that cause limbs to separate, not intact and experience decay. Victim identification is carried out to determine the clarity of the identity or identity of the victim so that the victim can be returned to the family and buried in accordance with the religion, custom or belief of the victim.[2]

Victims who died as a result of disasters in Indonesia will be identified by the Indonesian Disaster Victim Identification (DVI) team [3]. A preliminary examination that is often used to identify the dead is anthropometric measurements. The identification process is carried out by looking at human differences more thoroughly using head, face and nose indices. With this index measurement, it will be easier to group humans into the same characteristics, one of which is using the cephalic index [4].

The cephalic index was first discovered by a Swedish anatomist named Andrez Retzius (1796-1860) and was first used to classify human bodies found in Europe [5]. By obtaining information about the shape of the head, it can help the identification process and classify a population based on race, gender, nutritional status, geographical location, and the environment of an individual [6]. Age is a factor in the value of the cephalic index and the shape of the head is based on the timing of the start of the fusion process in each bone and the role of hormones during growth or pubertal[7]. In addition to being useful in the field of forensic anthropology, and planning plastic surgery on the head, the cephalic index can serve to monitor indications of development and growth of a population that varies along with its distribution and determine whether there are abnormalities in the head [8].

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METHOD

This type of research is comparative analytic with a cross-sectional approach design. This study was conducted in Kupang City in 5 sub-districts in Kupang City in October 2022 - January 2023. Measurement of head length and width using spreading caliper and the results will be calculated cephalic index. The total sample in this study was 100 people who belonged to the Timorese Tribe. The independent variables in this study are pubertal age (11-19 years) and post-pubertal age (≥20 years) and the dependent variable is the cephalic index (head width divided by head length and multiplied by 100). Data were analyzed using independent t-test.

RESULT

The characteristics of 100 respondents can be seen in the figure below

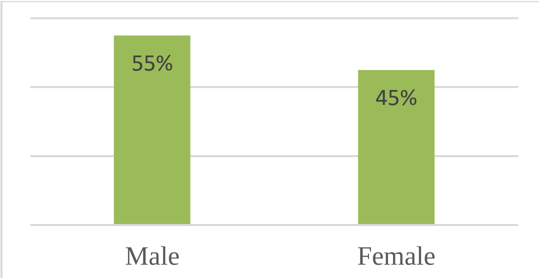

Figure 1. Characteristics of Respondents Based on Gender

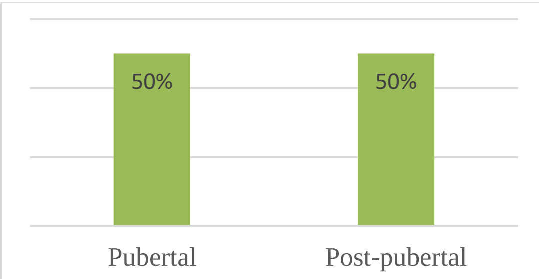

Figure 2. Characteristics of Respondents Based on Pubertal and Post-pubertal Age

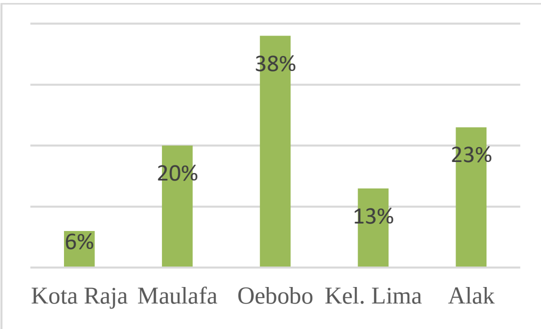

Figure 3. Characteristics of Respondents Based on Adress

Based on gender, it shows that the respondents who took part in this study had 55 male respondents and 45 female respondents. Based on age, the age division of respondents consists of the pubertal age group and the post-pubertal age group, each of which has a total of 50 respondents. Based on address (sub-district), it shows that the respondents who took part in this study were mostly from Oebobo sub-district with 38 respondents and the least respondents came from Kota Raja sub-district with 6 respondents.

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Univariate Analysis

Table 1. Mean Head Width, Head Length, and Mean Cephalic Index by Age

Age	Mean Head Lenght	Mean Head Width	Mean Cephalic Index
Pubertal (11-19 years old)	17,69	15,04	85,15
Post-pubertal (≥20-50 years old)	18,13	15,14	83,63

Table 2. Head Shape in the Pubertal Age

Head Shape	F	Mean
Dolicocephalic	0	0
Mesocephalic	6	78,00
Brachycephalic	16	82,46
Hyperbrachycephalic	28	88,22

Table 3. Head Shape in the Post-pubertal Age

Head Shapes	F	Mean
Dolicocephalic	2	72,38
Mesocephalic	8	77,66
Brachycephalic	20	82,03
Hyperbrachycephalic	20	88,75

Based on the research results listed in table 1, respondents in the pubertal age group had a mean head length of 17.69 and a mean head width of 15.04. Meanwhile, respondents with post-pubertal age had a mean head length of 17.69 and a mean head width of 15.14

Based on table 2, out of a total of 50 respondents in the pubertal age group had the most hyperbrachycephalic head type with 28 respondents or 56% and the least was the mesocephalic head type with 6 respondents or 12%, and no respondents were found with a dolicocephalic head shape.

Based on table 3, out of a total of 50 respondents in the post-pubertal age group had the most brachycephalic and hyperbrachycephalic head types with 20 respondents each or 40% each, and the least was the dolicocephalic head type with the least number of respondents 2 respondents or 4%.

Bivariate Analysis

Table 5. Statistical Test of Mean Cephalic Index at Pubertal and Post-pubertal Age

	Age	Mean Cephalic Index	*P*-Value
1.	Pubertal	85,15	P = 0,12
2.	Post-pubertal	83,63	P = 0,12

The results of statistical tests using t-independent tests between pubertal age and post-pubertal age have the same significance value, namely the P value or sig = 0.12, where the sig value is > 0.05 it means the difference between the two data is not significant.

DISCUSSION

The results of the independent t-test found that the P value or sig > 0.05, so it can be said that the difference in the mean cephalic index between pubertal and post-pubertal age in the Timorese Tribe has insignificant results. Based on the theory of cephalic index can be influenced by several factors such as geography, environment, gender, genetics, and age.

According to the theory presented by Apurba Nandy in his book entitled "Principles Of Forensic Medicine", states that each bone starts the fusion process at different times. The sagittal and coronal sutures begin the fusion process at an average age of 24-25 years then end on average around the age of 45-50 years. At the age of 25-27 years, the lambdoid sutura begins its closure activity. At the age of 70 years and above, the parieto-temporal suture typically undergoes closure. The fusion between the base of the occipital bone and the sphenoid base generally occurs in females around 18–20 years of age, and in males around 20–22 years of age [7]. Based on this developmental progression, it can be inferred that in individuals within the post-pubertal age group (beginning at approximately 20 years), several cranial sutures are expected to have gradually fused. Consequently, this group is expected to exhibit a lower cephalic index compared to individuals in the pubertal age group, in whom many sutures remain unfused. Although the mean cephalic index in both the pubertal (hyperbrachycephalic) and post-pubertal age groups was found to be relatively high, no statistically significant difference was observed between the two groups. This phenomenon may occur due to the relatively narrow age gap between the pubertal and post-pubertal groups. As a result, individuals in the post-pubertal group may not have fully undergone suture fusion, leading to an equal distribution of brachycephalic and hyperbrachycephalic head shapes within this group. This distribution influences the statistical comparison of the mean cephalic index between the post-pubertal and pubertal groups, the latter of which is predominantly characterized by the hyperbrachycephalic head type. The influence of closely grouped age classifications aligns with findings from a study by D.E.O. Eboh et al. (2016), titled "Head Phenotypes Based on Cephalic Index Among Ukwuani People in South-South Nigeria". The study reported no statistically significant difference in the mean cephalic index between the 6–12-year age group (74.37%) and the 13–19-year age group (74.71%), both of which were categorized as dolichocephalic. However, a significant difference in the mean cephalic index was observed between these two groups and the 20 years and above group (76.19%) [9].

The theory proposed by Styne (2003) explains that during puberty, a hormone with a significant role is the growth hormone (GH). During this period, GH is secreted in larger amounts and is closely associated with the growth spurt that occurs throughout puberty. This pubertal growth spurt contributes approximately 17% to the final adult height in males and 12% in females [10]. This theory highlights the strong relationship between GH and height development, indicating that the pubertal period is marked by the most rapid growth compared to any other developmental stage. It is also known that maturation is closely associated with height growth curves, thereby linking general somatic growth with craniofacial development [11]. Height growth may be impaired during the growth period due to growth hormone deficiency (GHD). Individuals with GHD experience slower growth compared to their peers. GHD may result from congenital abnormalities or acquired conditions such as tumors affecting the hypothalamic or pituitary regions. Therefore, the lack of significant findings in this study may be attributed to respondents who experienced GH deficiency during growth, subsequently affecting both their height and craniofacial development. However, further clinical examination is required to confirm this hypothesis [12].

Nutritional status is one of the factors that can influence the cephalic index. According to a study by Yu Su Min et al. (2020) titled *"Ancient to modern secular changes in the cranial/cephalic index in Korea: historical brachycephalization and recent debrachycephalization"*, cranial shape can change from one generation to the next. This generational shift—referred to as brachycephalization—may occur due to a relatively greater increase in cranial width compared to cranial length, primarily driven by improvements in nutrition. Changes in human body dimensions are influenced by socioeconomic status and nutritional conditions; current generations tend to exhibit larger and taller body dimensions than previous generations due to improved nutritional intake. Adequate nutrition supports optimal bone growth, whereas nutritional deficiencies in a generation can lead to impaired stature growth and skeletal development, including cranial bones [13]. Based on data obtained, the prevalence of stunting in Kupang City in 2013 was 36.7%, which decreased to 21.5% in 2022. This trend indicates a gradual improvement in nutritional status over the past several years [14]. Such improvement may be one of the contributing factors to the statistically non-significant difference in the mean cephalic index between the pubertal and post-pubertal age groups. The pubertal group, on average, has benefited from better nutritional conditions, which may have resulted in improved bone growth compared to the earlier post-pubertal generation. Consequently, this may explain the lack of significant difference between the two groups.

Furthermore, a study conducted by Jadav R. et al. in 2011, titled *"A Study to Correlate Cephalic Index of Various Caste/Races of Gujarat State,"* explained that genetic factors play a significant role in determining the shape and size of the human head. Variations in genetic information result in genetic diversity among offspring. Comparisons of changes in cephalic index between parents and their offspring can reflect the transmission of inherited traits and may help determine individual growth rates.

The genes inherited from one generation to the next may result in head shapes and sizes that do not differ significantly from those of previous generations [15].

The environment and geographical location of a place significantly influence human body dimensions. The physical characteristics of a population in a particular area may resemble one another due to shared lifestyle factors, such as daily activities, nutritional intake, race, ethnicity, sociocultural background, and a common genetic heritage inherited from shared ancestors within the community or population.[16] According to Rick A. Kittles and Kenneth M. Weiss (2003) in their study titled *"Race, Ancestry, and Genes: Implications for Defining Disease Risk,"* genetic differences between populations are roughly proportional to the geographical distances between them. When populations are geographically closer, genetic differences tend to be smaller, and as a result, variations in measurable outcomes such as cranial dimensions may not be statistically significant due to shared genes and cultural practices [17]. This theory is supported by a study conducted by Rona Nisrina Ananda et al. (2021), titled *"Differences in Mean Cephalic Index and Height Between Balinese and East Nusa Tenggara (NTT) Ethnic Groups in Denpasar."* The study compared the mean cephalic index between Balinese and NTT ethnic groups residing in Denpasar and found a significant difference, which was attributed to the fact that the two ethnic groups possess different racial and genetic backgrounds, with one group having migrated from NTT to Bali, thereby increasing genetic diversity among the respondents [18]. Therefore, the non-significant difference in the mean cephalic index between pubertal and post-pubertal age groups in this study may be explained by the fact that all respondents belonged to the Timorese ethnic group residing in Kupang City. They likely share similar genetic backgrounds and lifestyles, resulting in minimal variation in cranial shape and size between the pubertal and post-pubertal generations.

Based on the results of the independent t-test, a non-significant difference was found between the pubertal and post-pubertal age groups, with a p-value of 0.12. This indicates that the difference in mean cephalic index between these two age groups among the Timorese ethnic group in Kupang City is not statistically significant. Several factors may have contributed to this result, as previously discussed, including the incomplete fusion of cranial sutures in some individuals, and possible deficiencies in growth hormone (GH) secretion, which can affect cranial bone development during the growth period. Additionally, genetic factors inherited from common ancestors within the same population also play a role in influencing cephalic index variation. Nutritional status and environmental conditions further contribute to the non-significant differences observed in the mean cephalic index between the pubertal and post-pubertal age groups of the Timorese population in Kupang City.

CONCLUSION

The conclusion drawn from this study is that there is no significant difference in the cephalic index between pubertal and post-pubertal age groups among the Timorese ethnic group in Kupang City, with a p-value greater than 0.05. The mean cephalic index of the Timorese individuals in the pubertal age group falls within the hyperbrachycephalic category, whereas the mean cephalic index in the post-pubertal age group corresponds to the brachycephalic category.

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