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Identification of Facial Shape by Applying Golden Ratio amongst the Meitei Students of RIMS, Imphal

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Abstract

INTRODUCTION: All human faces are unique and contribute to individual identity. Facial features differ among different races and ethnic groups. The shape of the face is defined as normal, short and long according to the golden ratio. The scientific applications of golden proportion have been done in various fields like prosthodontics, surgery, orthodontic, facial attractiveness study, and in the development of facial mask and dental grid system.

MATERIALS AND METHODS: 150 Meitei students (70 males; 80 females) of RIMS, Imphal within the age group 18-35 years, were selected randomly after taking signed witnessed consent and anthropometric measurements of the face were taken using spreading calliper. Physiognomical facial height, Morphological facial height, facial width, Morphological facial index and Golden face ratio were measured and the shapes of the faces were classified based on Golden ratio. Statistical analysis was done using SPSS (version 21.0). Independent t test was done. $P < 0.05$ was considered as significant.

RESULTS: Based on the Golden ratio, our results showed that out of 70 male students, 54 (77.14%) had short face, 13(18.57%) had normal face and 3(4.29%) had long face. Out of 80 female students, 74 (92.50%) had short face, 6(7.50%) had normal face and none of the female had long face. Morphological facial height and Golden face ratio showed significant sexual difference in the two groups. The prevalence of golden face ratio in the whole sample is 12.7%.

CONCLUSION: Golden ratio or divine ratio is a mathematical ratio believed to be the most aesthetically pleasing and harmonious means of design. The facial shape data is valuable for identifying individuals with long, short or normal face. Individuals with long and short face are at risk of developing various disorders. Hence knowledge of the facial shape is important for early diagnostic and treatment procedures.

Keywords: golden ratio, facial height, facial width

Introduction

All human faces are unique and contribute to individual identity. The face is one of the most fundamental parts of the body for self recognition.[1] The concept of golden ratio dates back to Ancient Greece. It was named as Phi by sculptor Parthenon Phidias and is an irrational number approximately equal to 1.618. It is also called as "Divine proportions" or "Fibonacci ratio".[2] Golden ratio is a mathematical ratio believed to be the most aesthetically pleasing and harmonious means of design[3]. Facial type and morphology is indispensable for planning and recognition of anthropometric measurements of the face.[1] Facial features differ among different races and ethnic groups.[4] Facial forms are classified according to facial index.[5]

The shape of the face was defined as normal, short and long according to golden ratio. The scientific applications of golden proportion have been done in various fields like prosthodontics, surgery, orthodontic, facial attractiveness study, and in the development of facial mask and dental grid system.[3] Facial measurements have been used by numerous researchers particularly anatomists, forensic scientists, plastic surgeons, physical anthropologists to establish standardized mean values for skeletal, dental and soft tissue structures as well as for classification of facial morphology of different populations.[6] The craniofacial area of the body is subject to changes more particularly during growth and development period.[7] Facial development occurs mainly between the fourth and eight weeks of gestation, five facial primordia appear early in the fourth week around the large primordial stomodeum, the single frontonasal prominence, the paired maxillary prominences and the paired mandibular prominences, the five facial prominences are active centres of growth in the underlying mesenchyme.[8] The average width of the face has been found to increase slightly during adulthood.[9] Genetics and environmental factors are responsible for the variations in craniofacial dimensions. [10] The type of face depends on many factors such as ethnicity, genetic influence, traditions, nutrition, certain pathology conditions, environment and climate.[11]

Segher's et al. was the first to introduce "golden proportion" as planning tool in facial surgery.[12] Deviations from the standard golden ratio can result in health problems and such individuals could result in facial abnormalities, and could be at risk of developing various respiratory , jaw and maxillofacial disorders. The various statistical analyses indicate that people giving involuntary preference to the populations that approximates the divine ratio.[3]

Rickets observed the presence of golden proportion in cephalogram and photograph of beautiful faces.[13] Levin suggested that divine population can be used as a guideline for the ideal size of teeth, and he developed a dental grid system to evaluate the dental aesthetics.[14] In the last decade, face detection has become one of the most active research topics in computer vision and pattern recognition for its interesting applications, such as face recognition, face tracking, facial expression analysis, human computer interface, and video surveillance. Recently, a number of promising face detection approaches have been developed.[15] In the present study, we applied the golden ratio to the obtain quantitative data and classify the result in the form of different facial shapes and also to identify the individuals with long , normal and short face and to determine if there is any significant differences in the measurements and index among the Meitei students of RIMS.

Materials And Methods

After getting approval from the Research Ethics Board, Regional Institute of Medical Sciences (A/206/REB/Prof (FP)/164/139/14/2022), a cross-sectional study was carried out in the Department of Anatomy, RIMS. 150 Meitei students (70 males; 80 females) within the age group 18-35 years were selected. After explaining the measurement process to each subjects and taking signed witnessed consent, anthropometric measurements of the face was taken using spreading caliper. Subjects with mixed ethnic groups, history of facial trauma and facial surgery and craniofacial deformity were excluded from the study. Each measurements was repeated three times by the same investigators and the mean value of the measurements were taken. The landmark points used in measuring the parameters were : nasion - the midpoint of the nasofrontal suture; trichion - point where the anterior border of the hair on the forehead is cut by the mid-sagittal plane; zygion - most laterally placed point on the zygomatic arch ; gnathion - lowest point on the lower margin of the lower jaw intersected by the mid-sagittal plane [Fig 1]. The parameters used are :

Morphological facial height : the vertical distance between nasion and gnathion [fig 2]

Physiognomical facial height : the vertical distance between trichion and gnathion [fig 3]

Facial width : the vertical distance between gyzgion of the right to the zygion of the left [fig 4]

From the above measurements, Morphological facial index and Face golden ratio were calculated using the formula

Morphological facial index = (morphological facial height/ facial width) x 100.[5]

Face golden ratio = physiognomical facial height/ facial width.[16]

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Based on this ratio, faces were classified into 3 groups:

< 1.6 - short face

= 1.60 - 1.69 - normal face

≥ 1.7 - long face

Statistical analysis was done using SPSS (version 21.0). Independent t test was done. P < 0.05 were considered as significant.

Fig-1 : anthropometrical landmarks of the face

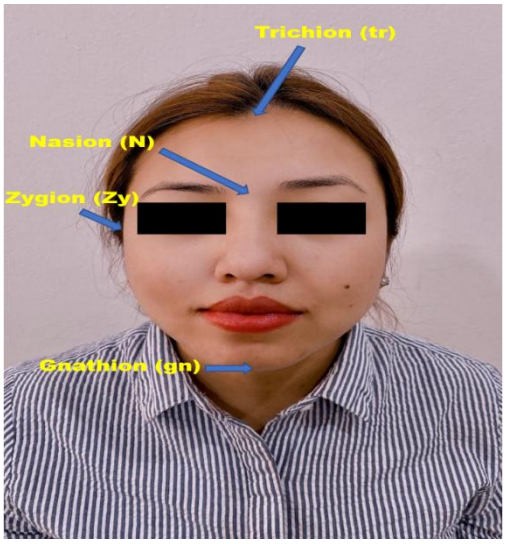

Fig-2: morphological facial height **Fig-3: physiognomical facial height**

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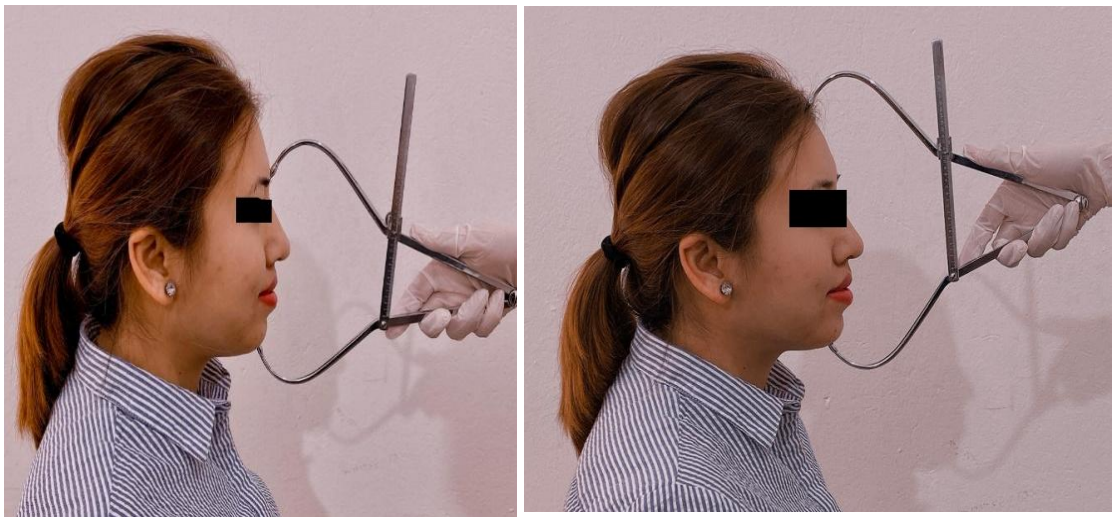

Fig-4: facial width

Results

Based on the Golden ratio, our results showed that out of 70 male students, 54 (77.14%) had short face, 13(18.57%) had normal face and 3(4.29%) had long face. Out of 80 female students, 74 (92.50%) had short face, 6(7.50%) had normal face and none of the female had long face as shown in Table 1. The different facial types between the two genders are shown in Figure 5. The mean facial parameters i.e morphological facial height (11.2 in females; 11.5 in males); facial width (12.3 in female; 12.5 in male); morphological facial index (12.3 in female; 12.5 in male) and the golden face ratio(1.46 in female; 1.51) are shown in Figure 6. The comparision of facial measurements between the two genders are shown in Table 2 where it was found that the Morphological facial height with p value 0.024 and Golden face ratio with p value 0.00 (both less than 0.05) showed significant sexual differences in the two groups. The prevalence of golden face ratio in the whole sample is 12.7% . 128 (85.3%) of the study population have short face, 19 (12.7%) of them have normal face and 3 (2%) of them have long face as shown in table 3.

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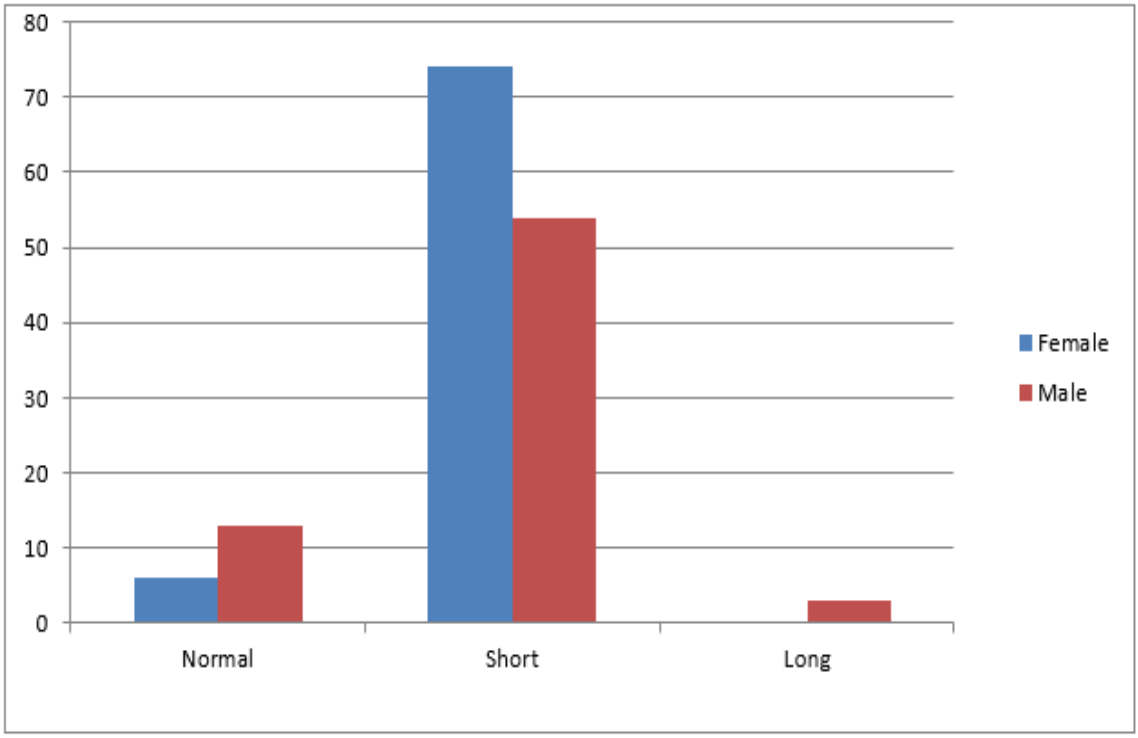

	Normal	Short	Long
Female	6	74	0
Male	13	54	3

Figure 5: Showing facial types in two genders

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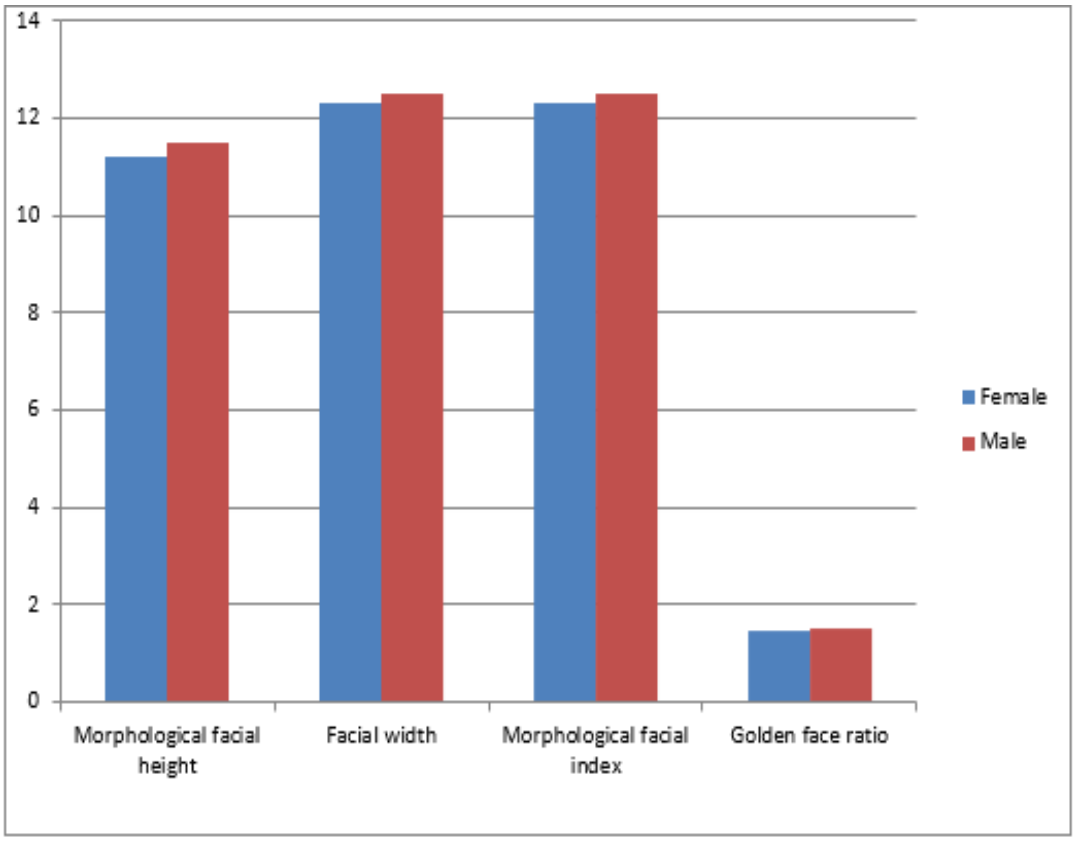

	Morphological facial height	Facial width	Morphological facial index	Golden face ratio
Female	11.2	12.3	12.3	1.46
Male	11.5	12.5	12.5	1.51

Figure 6: Showing mean facial parameters in two gender

Facial type	Female (n=80)	Male(n=70)
Normal face	6 (7.50%)	13 (18.57%)
Short face	74 (92.50%)	54 (77.14%)
Long face	0 (0.00%)	3 (4.29%)

Values are Expressed as % and total numbers

Table 1: Comparison of facial types between two genders

Parameter	Female (n=80)	Male(n=70)	P value
Morphological facial height	11.20 ± 0.72	11.57 ± 1.20	0.024*
Facial width	12.39 ± 0.78	12.56 ± 0.81	0.172
Morphological facial index	90.76 ± 7.39	92.49 ± 10.90	0.254
Golden face ratio	1.46 ± 0.091	1.5 ± 0.98	0.00*

Values are Expressed as mean, ± standard deviation, *=significant. Independent T- test is used.

Table 2: Comparison of facial measurements between two genders

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	FREQUENCY(%)
Short face	128(85.3%)
Normal face	19(12.7%)
Long face	3(2%)
Total	150(100%)

Table 3 : prevalence of golden ratio in the total sample is 12.7%

Discussion

In our present study golden ration was applied to classify the human facial form as normal, short, and long based on their variation in the growth of the craniofacial configuration in vertical and horizontal directions. From the bone structure to the internal organs, golden ratio is expressed throughout the human body in innumerable ways. As face is the most expressive part of the human body governing responsible for visual evaluation and recognition, we carried out this study to obtain a quantitative data. We also evaluated the mean values of the morphological facial height, facial width, morphological facial index according to the gender.

Sinus cavities tend to be narrow in long faces compared to normal face resulting in turbulent airflow, sleep apnoea and snoring. People with short faces have abnormal jaw development causing excessive pressure on the temporomandibular joint and their jaw is positioned in such a manner that interferes brain blood flow resulting in frequent headache.[3]

In our study, we found that both genders have more short faces and males have more normal faces than females, and none of the females had long face. Morphological facial height and face golden ratio showed significant sexual difference in the two groups. Saraswathin reported sexual dimorphism of face and found that males significantly deviate from the golden ratio whereas in our study females deviate more from the golden ratio.[17] Packiriswamy et al. showed variations of facial morphology according to gender and race and suggested that facial morphology can be important tool to find out various types of faces for early preventive and corrective measures.[12] There was increase in the mean value of the morphological facial index in males as compared to a study done by Devi B et al. in 100 males of Bishnupur district of Manipur.[6] This change in facial index may possibly because of better nutrition, improved socio-economic conditions, better health care and changing living conditions of the present Meitei population. Our study also had similar findings with that of Sema P et al.[16] in healthy Turkish population where maximum of them have short faces in both the genders.

Zhuang et al.[18] in their study of facial morphology among gender, ethnicity and age groups, reported statistically significant differences in facial anthropometric dimensions and suggested that respiratory equipment manufacturers can design various respiratory devices for supplying respiratory protective equipment to their employees.Mohammad et al.[19] in their study of multifactorial facial golden ratio and evaluation of facial appearance, reported that no significant association was found between golden ratios.Liu et al.[20] studied " three- dimensional analysis of facial morphology" and reported sexual dimorphism for facial features in both the Chinese and African American population . Basrei R et al.[1], in their study reveal highly significant desparities among genders. The male participant have close resemblance with the facial golden ratio in comparision to female which was similar to our study.

Kumar S et al.[21], in a study of the North Maharastrian population evaluated the relationship between facial aesthetic and the FGR reveal the measurement of the anterior facial height showed proportionality with the total facial height in comparision with the golden proportion. Jefferson[22] in their study stated that deviation from the golden ratio can result in

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development of facial abnormalities and disorders. In short faces people, jaw is positioned in such a manner that interferes brain blood flow that results in frequent headaches and it further deteriorates on clenching and grinding teeths.[3]

The facial width of the males in our study is more than the females which was in contrast with the study done by Packiriswamy et al.[12], where the width of the face in females were wider in females than in males of Malaysian population. The number of subjects with long face were lesser in all the 3 the racial groups; it was interesting to note that none of the Malay female had long face. This finding was in agreement to our study where none of the female had long face. Saraswathi [17], in a study on 75 subjects, reported that 14 individuals had normal shape of the face, 61 individuals had long (11) and short face (50). A similar study conducted by Farkas et al.[23] where the face was wider in females more than in males.

The facial dimensions were studied using direct (spreading or sliding caliper) and indirect anthropometric techniques (camera and computer analysis). In our study, direct measuring techniques which is considered to be accurate was used in the measurement. To minimize the errors, the calipers with instrumental error zero were used by one observer for taking the measurement on all the subjects. Every measurements were taken three times. This is a baseline study done on the Metei students of RIMS, Imphal ; results may not represent the whole Meitei students due to a relatively small sample size .

Conclusion

The comparative anthropometric measurement of the face reveals the evidence of significant variation in the facial morphology according to gender amongst the Meitei students. The golden ratio was used to identify subjects with short and long face in the given population at risk of developing maxillofacial, respiratory, and sleep disorders. Knowledge of the facial dimensions is of practical importance in evaluation of age, sex, and racial differences from the point of view of micro-evolutionary dynamics as well as in clinical and forensic application. Measurement methods, genetic variables, nutritional status, socioeconomic status and demographic variables including age, weight and height are some of the factors that could responsible for the differences in these facial measurements. With such a simple method, individual can be identified with various types of faces so that early preventive measures can be taken to avoid respiratory, sleep and maxillofacial disorders so that population can lead a normal life. An advanced study on the facial subunits can be done in the Meitei population to confirm quantitatively that the regular population (normal face) is healthier than the irregular ones (short and long face). It is hoped that this study will be a stepping stone for further facial analysis on this population using other classical formulas and standards.

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