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ORIGINAL ARTICLE

Association Between 2d:4d Ratio and Cardiovascular Risk Factors among Medical Students: A Study from Eastern India

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ABSTRACT

Background: Several risk factors raise the chance of heart disease. A sexually dimorphic biometric marker is the ratio of the second and fourth digits. There have been multiple findings of a relationship between 2D:4D and cardiac disease. The aim of this study was to examine the relationship between cardiovascular risk factors and the 2d:4d ratio among medical students.

Methods: A total of 200 people participated in this cross-sectional study. Medical students had assessments using anthropometric measures, including waist circumference, body weight, hip circumference, height, neck circumference, body fat percentage, and body mass index and the 2d:4d ratio was examined.

Results: The study shows significant demographic differences among participants, with gender, height, weight, BMI, and digit lengths all showing statistical significance ($p < 0.05$). However, correlations between digit lengths and anthropometric measures such as BMI, waist-to-hip ratio, neck circumference, and triceps skin fold thickness were weak and statistically insignificant. Additionally, no significant correlations were found between 2d:4d lengths and family history of health conditions.

Conclusion: The study found a correlation between demographic and family history indicating that 2d:4d lengths may not be strongly associated with other physical or hereditary factors.

KEYWORDS

• Body mass index • Body fat distribution • Digit ratio • 2D:4D ratio • Skin fold thickness

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INTRODUCTION

Cardiovascular disorders (CVD) are the main cause of death on a global scale.[1] Cardiovascular diseases such as heart attack and stroke are caused by the development of atherosclerotic plaques caused by long-term dysfunction of the endothelium. This impairment leads to inflammation of the arterial wall.[2] Furthermore, it has been noted that the varying rates of BP and cardiovascular disease between males and females may be ascribed to sex hormones including progesterone and testosterone, as well as the sex chromosomal complement.[3] Hand grip strength (HGS) has a high degree of heritability and displays clear sexual dimorphism. Anthropometric factors that influence muscle strength and may be used to predict hand grip strength include height, skin fold thickness, weight, waist-to-hip ratio, body mass index (BMI), and the 2D:4D ratio. The features of body fat distribution include the measures of the arm, neck, waist, and hip circumferences; the skin fold thickness (SFT) of the triceps, biceps, belly, and chest area. BMI is defined as the ratio of body weight to height squared. It is well recognized that fetal hormones and genetics may cause sexual dimorphism in some anthropometric measurements.[4]

The 2D:4D ratio has received a lot of focus from researchers lately, and they have discovered a link between the ratio and characteristics like coronary heart disease. The 2D:4D ratio is more prevalent in men due to its sexual dimorphism. Men's 2D:4D ratios are lower than those of women.[5] HOX genes regulate the human appendicular skeleton and urogenital system. Given the shared regulation of gonad and digit development, it is plausible that spermatogenesis and hormone concentration have an impact on digit formation. Testosterone influences the 2D and 4D ratio, finger growth, and dermatoglyphics. Therefore, there is a correlation between the degree of testicular activity in adults and the 2D and 4D ratio. [6] Manning et al. used the 2D and 4D ratio as a measure to evaluate the levels of testosterone and progesterone throughout the first three months of pregnancy.[5] Those with a lower digit ratio had a propensity to have their first myocardial infarction (MI) at a more advanced age in comparison to those with a higher digit ratio (2D:4D). There is an adverse association between the two variables, the age at which the first MI occurs and the 2D:4D ratio. However, Xing Li Wu et al. found a strong positive correlation between men's 2D:4Dand coronary heart disease.[7] This study investigated the potential correlations between cardiovascular risk factors and medical students' 2d:4d ratio.

AIMS AND OBJECTIVES

1. To find out the association between 2d:4d ratio and cardiovascular risk factors among medical students

METHODOLOGY

Research design:

The research was performed as a cross-sectional study.

Research Area:

The research was conducted at the Anatomy Department of a tertiary care Teaching Hospital in Eastern part of India.

Inclusion and exclusion criteria:

After obtaining their informed consent, all medical students were recruited to participate in the research. The students with digit malformations and those who were unable to participate in the research was not allowed to continue.

Sample collection:

Samples were collected over a period of 30 days. A total of 200 medical students took part in this study. Among the students, there were 121 males and 79 females, whose ages varied from 18 to 22. The sample distribution was determined in a random manner.

Procedure

The height was assessed using a handheld stadiometer with a precision of 1 mm. The volunteer's blood pressure and heart rate were assessed using the OMRON HEM-7101 device on their left arm while they were sitting, after a 10-minute period of rest. The skin fold thickness measurement at four locations were obtained using a skin fold calliper, following the conventional methodology. The skin fold measurement was used to calculate body density, percentage of body fat, and total body fat. Each participant's hands were photographed using a digital camera. The camera was securely fastened to a tripod at a predetermined elevation of 32 cm for every patient. With the use of a Jamar hydraulic hand dynamometer, the participants' left and right hands' hand grip strengths were assessed. Participants were performed resistance training using dumbbells weighing 2.5 kg for female and 3.5 kg for males. Afterwards, the strength of the hand grasp was evaluated again. The values of hand grip strength before and after the activity were recorded as HGS-1 and HGS-2, respectively.

STATISTICAL ANALYSIS

The statistical analysis was performed using version 27 of SPSS software. The student's t-test was used to compare the average values between the two groups for data that follows a parametric distribution. The p-value less than (0.05) indicates the result was statistically significant.

RESULTS

The demographic profile of the research participants is shown in Table 1. Majority of the subjects in the index study were male. Participants had an average height of 164.50 ± 7.88 cm and weight of 62.23 ± 12.44 kg, both showing statistically significant values with p-values of 0.01 and 0.00 individually. The mean Body Mass Index (BMI) was 23.02 ± 4.60 kg/m², also significant with a p-value of 0.01. The measurements of the 2D and 4D digits on the right (R) and left (L) hands were 0.96 ± 0.12 and 0.99 ± 0.07 respectively, with p-values indicating significance (0.01 for the right and 0.02 for the left). These results show statistically significant differences in all measured demographic parameters.

Table 1: Demographic parameters

Variables		Mean (S.D.) / N(%)	P-Values
Gender	Male	121 (60.5)	
	Female	79 (39.5)	
Height		164.50 ± 7.88	0.01
Weight		62.23 ± 12.44	0.00
BMI		23.02 ± 4.60	0.01
Length of 2D and 4D digit (R)		0.96 ± 0.12	0.01
Length of 2D and 4D digit (L)		0.99 ± 0.07	0.02

p value <0.05 have been considered statistically significant.

The table 2 shows the statistically insignificant relationships between neck circumference, waist-to-hip ratio, BMI, and triceps skin fold thickness and 2D (index) and 4D (ring) digit lengths on both hands. The right hand had weak positive relationships with BMI (r = 0.111, p = 0.116) and triceps skin fold thickness (r = 0.129, p = 0.068). On the left hand, neck circumference, waist-to-hip ratio and BMI, had modest and negligible relationships (r = 0.057, p = 0.425, 0.055, p = 0.440, and -0.134, p = 0.058). The 2D and 4D digit lengths had minor relationships with anthropometric parameters, with the right-hand having positive correlation with BMI and triceps skin fold thickness and the left hand with a negative correlation with neck circumference.

Table 2: Correlation between the Length of 2D and 4D digit of right and left with waist-hip ratio, BMI, skin fold thickness and neck-circumference

		BMI	Waist to hip ratio	Neck circumference (cm)	Skin fold thickness Triceps (mm)
Length of 2D and 4D digit (R)	Pearson Correlation	0.111	-0.014	-0.017	0.129
	Sig. (2-tailed)	0.116	0.841	0.816	0.068
Length of 2D and 4D digit (L)	Pearson Correlation	0.057	0.055	-0.134	0.045
	Sig. (2-tailed)	0.425	0.440	0.058	0.528

Table 3 showed the link between right and left 2D and 4D digit lengths and family history problems such hypertension, T2DM, stroke, MI, and thyroid disorders. All conditions on the right hand have weak Pearson correlation coefficients, from -0.036 for MI to 0.089 for thyroid diseases. The left-hand correlations with thyroid diseases at 0.096 and T2DM at

-0.100. Both right- and left-hand data reveal weak correlations across all situations, with no significant variations in strength or direction.

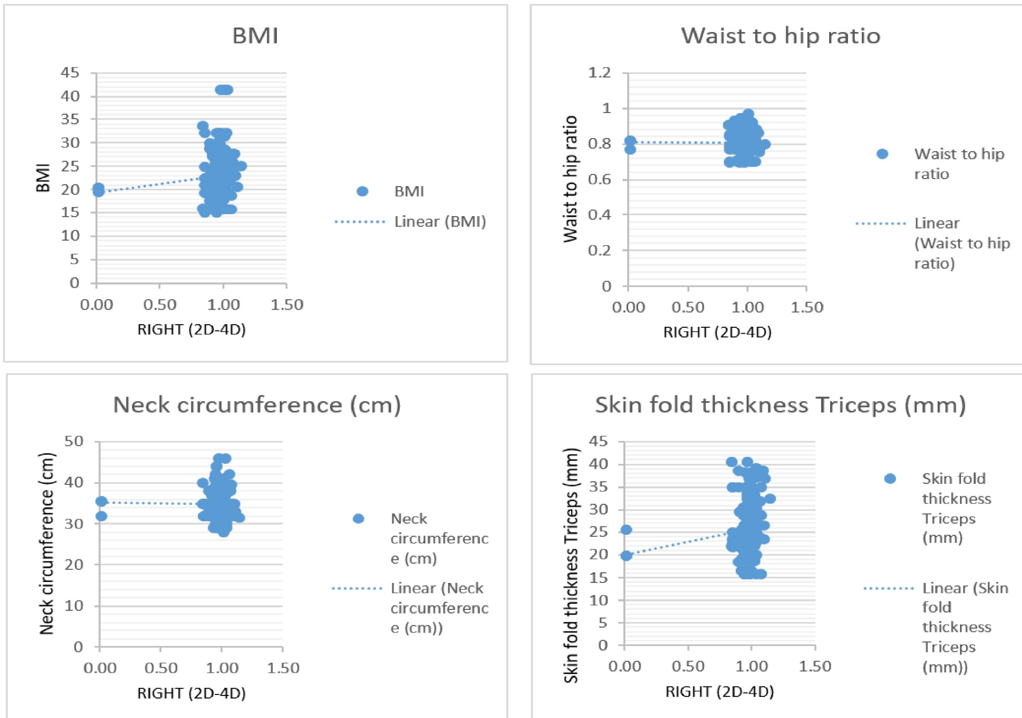

Figure 1: Correlation between the Length of 2D and 4D digit of right with waist-hip ratio, BMI, skin fold thickness and neck-circumference

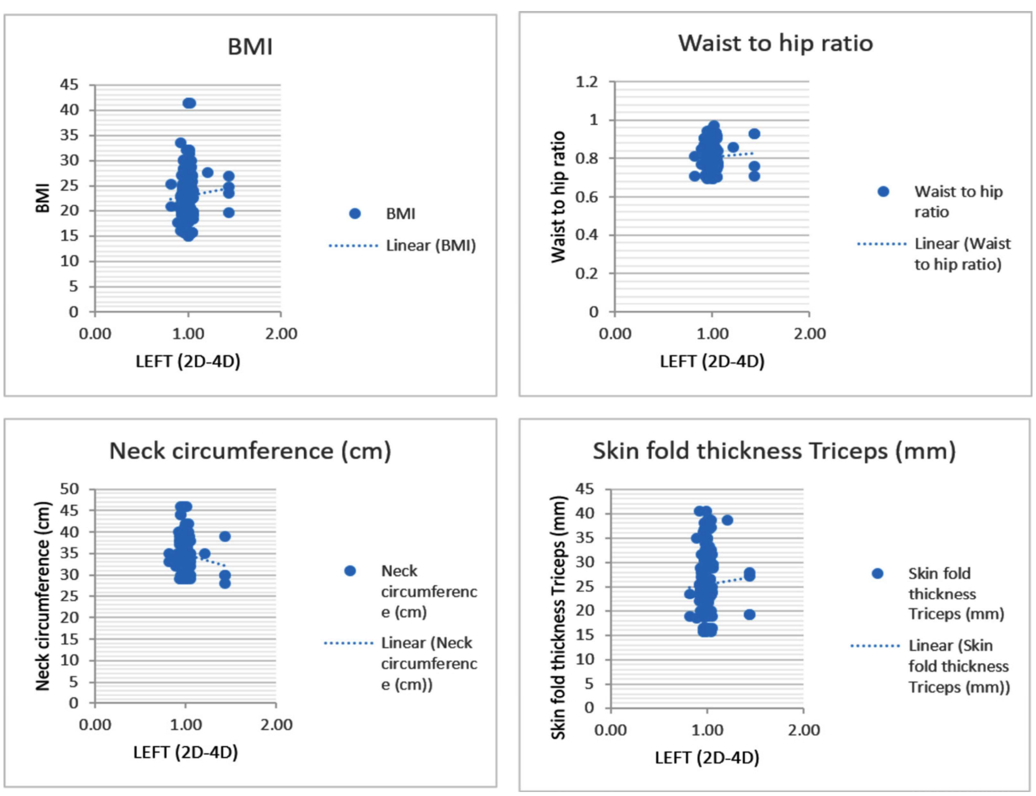

Figure 2: Correlation between the Length of 2D and 4D digit of left with waist-hip ratio, BMI, skin fold thickness and neck-circumference

Table 3: Correlation between the Length of 2D and 4D digit of right and left with family history

		Family history				
		Hypertension	T2DM	Stroke	MI	Thyroid
Length of 2D and 4D digit (R)	Pearson Correlation	-0.032	0.040	0.003	-0.036	0.089
	Sig. (2-tailed)	0.656	0.569	0.970	0.613	0.213
Length of 2D and 4D digit (L)	Pearson Correlation	-0.043	-0.100	0.059	0.004	0.096
	Sig. (2-tailed)	0.547	0.158	0.408	0.956	0.175

The table 4 present the comparison between the lengths of the 2D (index) and 4D (ring) digits of the right and left hands among students. Levene's Test indicates that the variances are equal (F = 2.92, Sig. = 0.08). The t-test shows the significant difference in the digit lengths (t = -3.20, df = 398, Sig. (2-tailed) = 0.001), with a mean difference of -0.03 and a standard error difference of 0.010. The results show significant (t = -3.20, df = 322.63, Sig. (2-tailed) = 0.002) with the same mean difference and confidence interval. These results indicate statistically significant shorter length for one of the digit pairs.

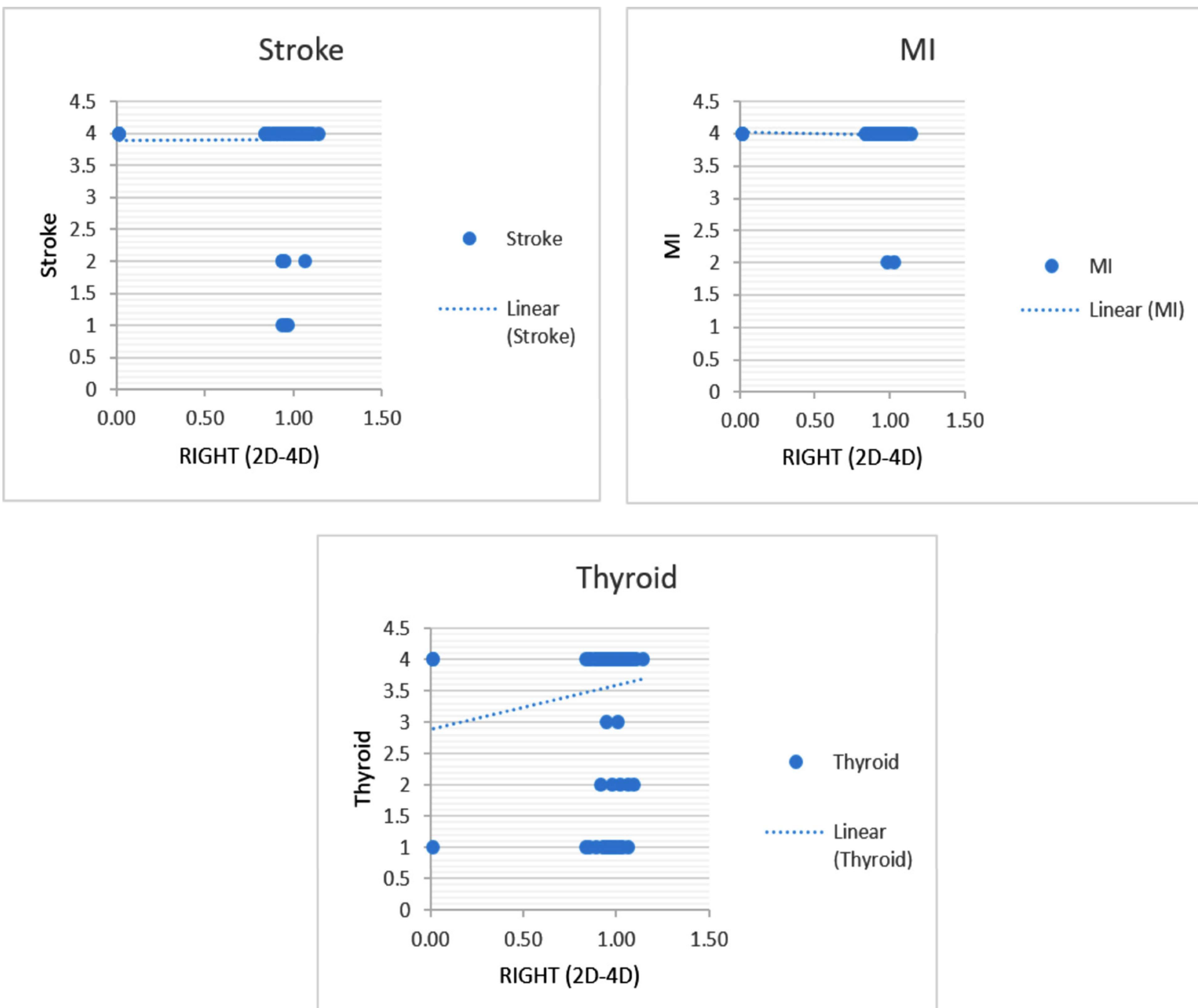

Figure 3: Correlation between the Length of 2D and 4D digit of right with Family history

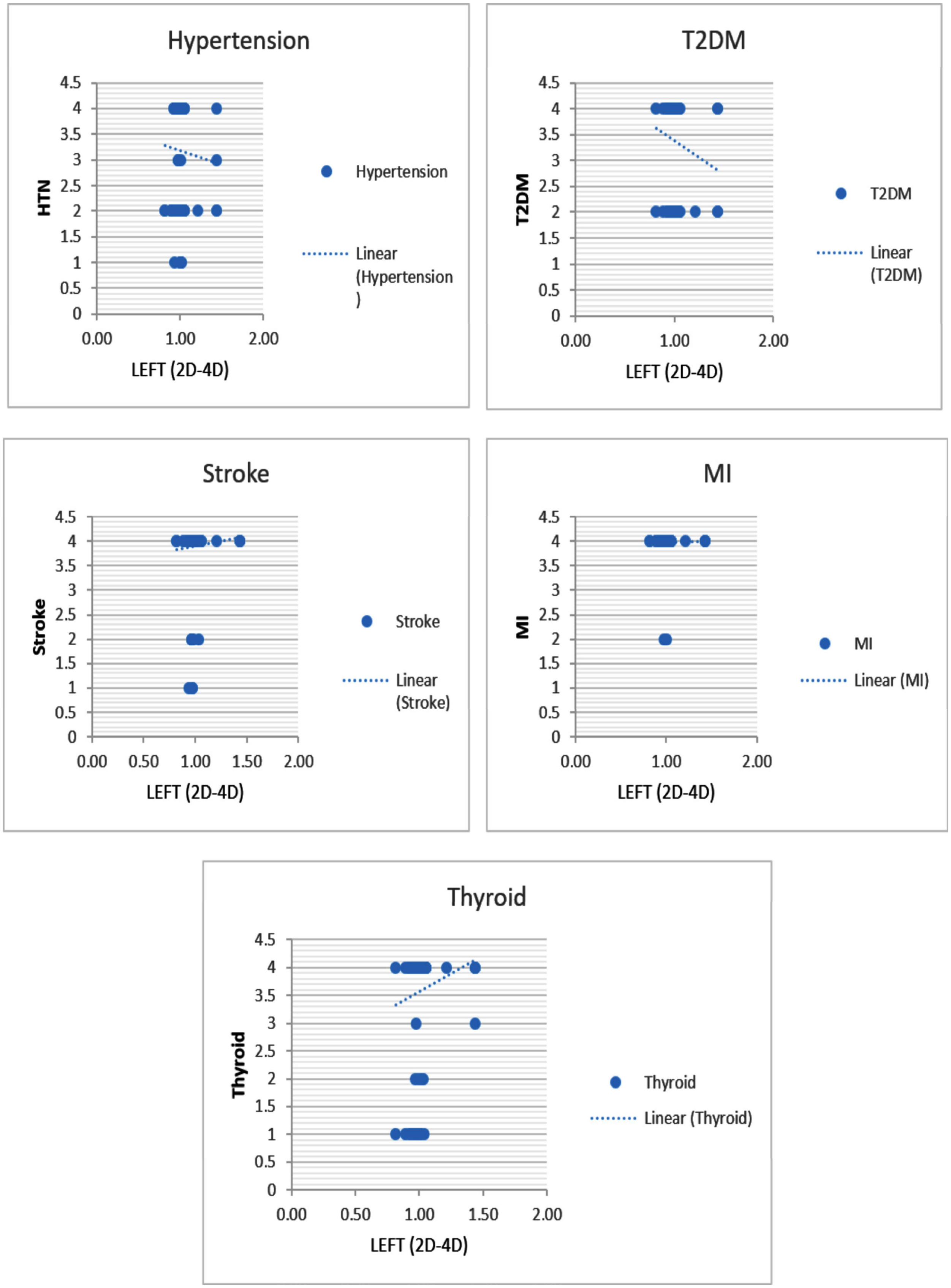

Figure 4: Correlation between the Length of 2D and 4D digit of left with Family history

Table 4: Comparing the students on the basis of Length of 2D and 4D digit of right and left

		Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Length of 2D and 4D digit of right and left	Equal variances assumed	2.92	0.08	-3.20	398	0.001	-0.03	0.010	-0.05	-0.01
	Equal variances not assumed			-3.20	322.63	0.002	-0.03	0.010	-0.05	-0.01

DISCUSSION

The study investigated the correlation between cardiovascular risk factors, including Hypertension, T2DM, Stroke, MI, and Thyroid, with the digit ratio. The digit ratio is an indicator of the level of testosterone exposure in the uterine cavity. The result found that there was a significant correlation between right hand 2d:4d and higher BMI and BP measurements. The results of this study show the correlation between 2d:4d and HTN, are consistent with other epidemiological studies that demonstrated a substantial correlation between anthropometric measurements and HTN.[8] Many previously published studies have shown right to left asymmetry not only in males but also in females.[9,10] The mean value of 2D:4D ratio in group 2was similar to another study where mean 2D:4D ratio more than 0.985 ± 0.017 was corresponding with atherosclerotic plaque in CVD.[11,12] Therefore, it was evident that high right 2D:4D is associated with CVD.

The 2D and 4D ratio were higher in both fingers with HTN family history than others. The ratio-pathological conjoining of digit relation and high BP is unclear. In the present study Cohen's effect size was found to be medium for right hand and small for the left hand. This indicates that the difference of 2D and 4D ratio for the right hand is high and is associated with a pre-disposition towards CVD in female.[13] A similar study was conducted on Chinese women found that, for each hand, the mean values of the digit ratio in patients with CVD were lower than in controls, corroborating the gender-specific results.[14] Danborno et al. connected 2d:4d to birth weight.[15] Since low birth weight predicts HTN, diabetes, and thyroid in children, 2d:4d were linked to metabolic syndrome.[16] Similar to this research, Lu et al. found that male with high digit ratios had a higher CVD risk.[17] To reduce long-term CVD risk, a regular 2d:4d test might detect at-risk populations for thyroid, diabetes, HTN, and metabolic syndrome.

Our findings showed that the hypertension group had a statistically larger 2D:4D ratio of the Rt and Lt hands. The present study's limitations, including sample selection, sample size reduction, and the tests employed for cognitive evaluation. Finger-length indicators and blood pressure and BMI could not be examined in causal associations based on a cross-sectional study. Several studies have indicated a stronger correlation between the left-hand digit ratio and certain ailments in the Chinese population. Furthermore, the influence of left-handed students on research has not been taken into consideration. More investigation on the relationship between various 2d:4d patterns and CVD risk factors would require study.

CONCLUSION

In conclusion, the study found significant demographic variations among participants, notably in height, weight, and BMI. However, the correlations between digit lengths and anthropometric measures, as well as family health histories, were weak and not statistically significant. Despite the small but significant difference in digit lengths between right and left hands, the effect size was minimal, suggesting limited practical significance. These findings highlight demographic influences while indicating that 2d:4d lengths may not be strongly associated with other physical or hereditary factors.

Conflict of Interest: Nil

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