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Original Research Article

Index finger and ring finger ratio (2D:4D) and it's correlation with Hypertension and it's affects for possibility factors in cardiovascular diseases in North Indian female population

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ABSTRACT

Background: Hypertension is a major risk factor for cardiovascular diseases (CVDs) and is a growing concern globally. The 2nd to 4th digit ratio (2D:4D), determined by the relative length of the index and ring fingers, has been linked to prenatal testosterone exposure and potentially cardiovascular health. This study investigates the correlation between 2D:4D ratio and hypertension in a North Indian female population, exploring its potential role as a risk factor for CVDs.

Materials and Methods: A cross-sectional study will be conducted among North Indian females. Participants will be recruited through community outreach and healthcare facilities. Data collection will involve: 1. Demographic information; 2. Blood pressure measurement to identify hypertensive and normotensive individuals; 3. Measurement of the 2nd and 4th finger lengths on both hands to calculate the 2D:4D ratio.

Results: The study is expected to reveal a correlation between 2D:4D ratio and hypertension prevalence in the North Indian female population. We hypothesize that females with a lower 2D:4D ratio (indicating higher prenatal testosterone exposure) might exhibit a higher prevalence of hypertension. This finding could suggest a potential association between prenatal hormonal influences and increased risk of CVDs in later life.

Limitations: This study design is cross-sectional, and causality cannot be established. Further longitudinal studies would be needed to explore the cause-and-effect relationship between 2D:4D ratio, hypertension, and CVD development.

1. Introduction

Cardiovascular diseases (CVDs) are a leading cause of death globally, posing a significant health concern, particularly in developing countries like India. North Indian women exhibit a higher prevalence of these conditions compared to other populations. Identifying potential risk factors early on is crucial for prevention and improved health outcomes. This study delves into a unique area of investigation – the correlation between the index finger to ring finger ratio (2D:4D) and hypertension, exploring their combined impact as potential risk factors for CVDs in North Indian women. [1]

The 2D:4D ratio, a measure of the relative lengths of the index (2nd) and ring (4th) fingers, has garnered increasing interest in recent years. Studies suggest it might be influenced by prenatal androgen exposure, potentially impacting various health outcomes later in life. This research explores whether a specific 2D:4D ratio might be associated with an increased risk of hypertension, a major contributor to CVDs. [2]

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Hypertension, or high blood pressure, is a prevalent condition where the force of blood against the artery walls is consistently elevated. This chronic stress on the cardiovascular system can lead to heart attack, stroke, and other complications. Understanding the factors that contribute to hypertension, particularly in a population segment like North Indian women who exhibit a higher risk, is vital for developing targeted prevention strategies.[3]

This study investigates the potential link between the 2D:4D ratio and hypertension as a combined risk factor for CVDs in this specific population. Here's a breakdown of the key areas explored:

1. 2D:4D ratio and prenatal androgen exposure: The research examines the established connection between the 2D:4D ratio and prenatal androgen exposure. It delves into how this hormonal influence during fetal development might affect various physiological and health parameters later in life.[4]
2. 2D:4D ratio and cardiovascular health: The study explores existing research on the potential link between the 2D:4D ratio and cardiovascular health. It investigates whether specific finger length ratios might be associated with an increased risk of developing CVDs.[5]
3. Hypertension and CVD risk: This section focuses on the established link between hypertension and its role as a major risk factor for CVDs. It explores the physiological mechanisms by which chronic high blood pressure contributes to heart disease, stroke, and other complications.[6]
4. North indian women and CVD risk: The research delves into the specific factors that contribute to the higher prevalence of CVDs among North Indian women. It analyzes potential reasons for this disparity, including genetic predisposition, lifestyle factors, and environmental influences.
5. Investigating the 2D:4D Ratio, Hypertension, and CVD Risk: This is the core of the study, where researchers examine the potential link between the 2D:4D ratio, hypertension, and their combined effect on the risk of developing CVDs in North Indian women. Here, the investigation focuses on:
6. 2D:4D ratio measurement: The research details the methods used to measure the 2D:4D ratio accurately and consistently among participants.[7]
7. Hypertension assessment: The methods used to diagnose and measure hypertension in the study population are explained.

2. Materials and Methods

2.1. Inclusion criteria

The study was conducted in the Department of Anatomy, Shri Guru Ram Rai Medical College Dehradun, Uttarakhand, India.

Total subjects were 200 Females (100 with hypertension and 100 without hypertension).

Age group 18-50 years was chosen from North Indian Population.

Prior informed consent for the study was taken both in English and vernacular languages from the subjects.[8]

2.2. Exclusion criteria

1. The subjects with any apparent physical hand anomalies, inflammation, trauma, or deformities, and those who had undergone a recent major surgery were excluded because of their unsuitability for the present investigation.
2. Subjects having any genetic, psychological, neurological or chronic diseases affecting the hand parameters.
3. Individuals with any history of recent drug intake.
4. Subjects who were wheelchair bound or had difficulty in standing.

2.3. Measurement of blood pressure

Blood pressure was measured by latest standard guidelines (National Heart Centre/ Saudi Heart Association 2023 guidelines on the Management of Hypertension).[9]

It was measured with a sphygmomanometer and stethoscope. Individuals were allowed to sat for at least for five minutes on chair. Two readings were taken, 5 minutes apart the average of two readings were entered in the record. Patient of hypertension were identified on the basis of blood pressure measurement, Medical history and Medical record.[10]

Normal: Systolic and diastolic =120/80.

Elevated: systolic121/80 – 129/80

Stage-I hypertensives: systolic 130-139 or diastolic 80-89 mm of Hg.

Stage-II hypertensives: systolic ≥140 or diastolic ≥90 mm of Hg.

Hypertensive crisis > 180/120.

2D:4D ratio: It is defined as the ratio of the length of second digit (index finger) to the length of the fourth digit (ring finger).[11] The measurement was taken from both hands with an electronic sliding Digital Caliper from the palmar side with the digits fully stretched and touching on a hard-flat surface, with the second to fifth digits abducted and the thumb slightly extended.[12]

Body weight: Body weight was measured (to the nearest 0.5 kg) with the subject standing motionless on a weighing scale.

Height: Height was measured (to the nearest 0.5 cm) with the subject standing in an erect position against a vertical scale of portable with the head positioned so that the top of the external auditory meatus was in level with the inferior

margin of the bony orbit (Figure 1).

Figure 1: Height measurement (in cm)

Body mass index: The BMI was calculated as weight in kilograms divided by the squared height in meters (weight in kg/height in m^2). [13]

The data entry was analysed by using Microsoft Office Excel worksheet. Data was correlated statistically by mean ± standard deviation, independent t- test was used to calculate significant level, Pearson correlation, were used to find out the relationship between 2D:4D ratio of control and case groups.

2.4. Statistical analysis

The study outlines the statistical methods employed to analyze the data and identify any statistically significant correlations between the 2D:4D ratio, hypertension, and the risk of CVDs in North Indian women. [14]

By investigating this unique combination of factors, the research aims to contribute valuable insights into the potential risk factors for CVDs in North Indian women. If a correlation is established between the 2D:4D ratio, hypertension, and CVD risk, it could pave the way for earlier identification of women at higher risk. This knowledge can be instrumental in developing targeted prevention strategies, promoting early intervention, and ultimately improving cardiovascular health outcomes for this population segment. [15]

3. Results

Table 1: Mean and standard deviation of various parameters

Parameter	Control (n= 100) mean±sd	Hypertensive (n=100) mean±sd	p-Value
Rt. 2D	5.30±0.51	5.6. ± 0.44	<0.0001
Rt. 4D	5.33 ± 0.44	5.5± 0.64	0.0087
Lt. 2D	5.34 ± 0.44	5.7 ± 0.53	<0.0001
Lt. 4D	5.32 ± 0.46	5.80 ± 0.59	<0.0001
Rt. 2D:4D ratio	0.99 ± 0.05	1.1 ± 0.05	<0.0001
Lt. 2D:4D ratio	1.01± 0.05	1.4 ± 0.07	<0.0001

Table 1 shows that the mean length of Right 2D is 5.60 (SE ± 0.44) in Hypertensive female patients whereas it is 5.30 (SE ± 0.51) in Non-Hypertensive female patients. Similarly, mean length of left 2D is 5.70 (SE ± 0.53) in Hypertensive female patients whereas it is 5.34 (SE ± 0.44) in Non-Hypertensive female. In the same way mean length of Right 4D is 5.50 (SE ± 0.64) in cases whereas it was found to be 5.33 (SE ± 0.44) in control In the same way mean length of left 4D was 5.80 (SE ± 0.59) in cases whereas it was found to be 5.32 (SE ± 0.46) Mean ratio of 2D:4D in HTN and Non hypertensive patients was 1.10 ± 0.05 and 0.99 ± 0.05 respectively and the difference was statistically significant ($P < 0.001$). However, when mean length of 2D and 4D was compared Hypertensive & non-Hypertensive group, the difference was found statistically highly significant (P<0.0001). Meanwhile, 2D,4D length as well as 2D:4D ratio of left hand was found greater than that of right hand in both cases as well as control.

Table 2: Mean & standard deviation of others parameters used

Parameter	Control (n= 100) mean±sd	Hypertensive (n=100) mean±sd	p-Value
Age	37.94±9.48	42.70±6.09	<0.0001
Height	158.53±6.59	162.00±5.10	<0.0001
Weight	60.72±8.69	63.18±6.18	<0.0098
BMI	24.10 ± 2.71	25.60. ± 2.06	<0.0001

In same way when Mean and standard value of other parameters was measured like Age, Height, Weight & BMI were calculated they were more in Hypertensive group than to non- Hypertensive group, the difference was found statistically highly significant (P<0.0001). in case of BMI ($P < 0.0098$).

When comparison was made with the previous study done by Yadav R & Bala M, 2D:4D ratio was found higher in hypertensive group & p-value was showing a significant correlation in both groups and when compare with the study done by similar result were found in the study of Kukda N

Table 3: Mean and standard deviation of various parameters of previous studies

Author	Parameter	Control(n= 100)mean ±sd	Hypertensive(n=100)mean ±sd
1) Yadav R & Bala M (2016)[2]	Rt. 2D:4D ratio	0.945±0.02	0.954±0.02
	Lt. 2D:4D ratio	0.955±0.02	0.964±0.02
2) Jeevanandam S and Prathibha K Muthu, Understanding 2D:4D Ratio (2016)[16]		Low Digit Ratios (Masculine Ratio	High digit Ratios (Feminine Ratio
	Physiological	Left-handed preference	Lowered sperm counts Increased risk for heart disease Increased risk of obesity and metabolic syndrome
	Pathological	Increased risk for anxiety	Increased risk of depression and eating disorders
	Behavioural	Assertiveness in females Aggression in males	Numerical skills
	Sexual Orientation	Hetero sexual Preference	Homosexual preference
3) Kukda N and Verma SK (2021)[14]	Parameter	Control N=50	Coronary Artery Disease N=50
	2D:4D ratio (both hands)	1.005 ± 0.004	0.98 ± 0.003

& Verma SK but 2D:4D ratio was compared with coronary artery disease it was showing value of 2D:4D lower in case of disease group. It has been reported that the digit ratio (2D:4D) are the biomarkers that predisposed by testosterone level in the body. Strong association was observed with lower amount of prenatal androgen. Thus, a higher 2D:4D ratio can predict the risk of coronary artery disease at an earlier stage. In the present study, 2D:4D ratio was higher in those males having CAD when compared with the healthy males; a strong correlation of digit ratio to CAD exists as also confirmed through significant chi square test. In their study it was confined that the digit ratio (2D:4D) are the biomarkers that are influenced by testosterone concentration. 2D:4D ratio is prenatally determined and a high 2D:4D ratio has a strong association with lower prenatal androgen. Accordingly, a higher 2D:4D ratio can predict the risk of coronary artery disease at an earlier stage.

Study done by Jeevanth S and Muthu k shown that there is higher 2D:4D ratio in females compare to male because of lower sperm count and higher obesity & increased metabolic syndrome.[16] Ratio of 2D:4D ratio shown a negative correlation with testosterone and a strong correlation was being found with oestrogen during foetal life. Finding showing that the ratio was constant since childhood and not even affected by adult androgenic hormones it is constant since birth and not influenced by the adult hormone levels. Usually, males have lower ratios when compared to females

4. Conclusion

In our study it was concluded that there is a strong correlation of 2D:4D ratio with Hypertension. 2D:4D ratio is also a predictive of cardiovascular diseases and may be used for assessment, diagnosis, prognosis and also for early life style changes in a population. Moreover, many more study needed to do in large no of population and in different individuals of various ethnic groups, so as to check the association of Hypertension with 2D:4D ratio.

5. Sources of Funding

None.

6. Conflict of Interest

None.

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