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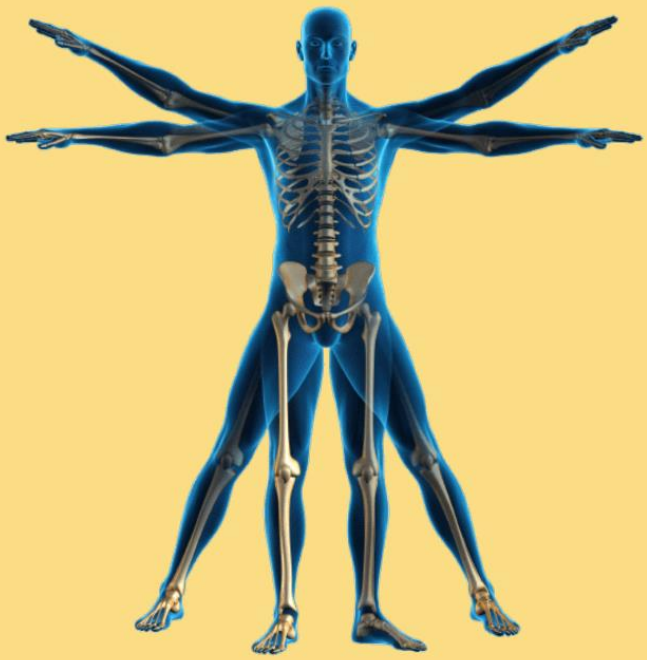

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Dear Readers,

It is the matter of immense pleasure to inform that volume 1/Issue 1 (April, 2018) of our International Association of Scientists and Researchers (IASR) journal has been published as decided. The remarkable feature is that with each coming issue, the journal is acquiring more strength with increased visibility. With this first issue entire fraternity of the journal and the respected members of editorial and advisory board are filled up with great joy and happiness. The members of IASR board, rich in experience and are varied expertise that provide immense assistance in propelling the journal to acquire a desirous position in the areas of research and development.

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Dr. Ranjeet K Singh
President
International Association of Scientist & Researchers

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Anthropological Studies cover the meticulous study of development of human societies and evolution. The journal AJAS aims to encourage the advance anthropological researches and made a platform for researchers, scientist for dissemination and exchange of anthropological knowledge internationally.

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Middle Childhood Health with Special Reference to Nutritional Status and Body-Mass Index

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Abstract:

The middle childhood years are a unique developmental time when children undergo critical physical, cognitive, and social changes. Monitoring of growth and development during this stage is important for improving overall health. Further, culturally based interventions are known to have better success rate in improving access and utilization of health services. In this regard, the present paper has been conducted to know about the status of the middle childhood health with reference to nutritional status and BMI among the Pasi of Lucknow city, which is one of the largest scheduled caste (SC) groups of Uttar Pradesh, India. The study includes sample of 300 Pasi children, belonging to age group of 6 - 11 years, selected through random sampling. It is found that in these people intake of food is to fill the stomach or overcome the hunger rather than for health. It is fact of quantity versus quality and need versus awareness. The reflection of nutritional intake in food through body mass index shows that there is an imbalance not only in the kind of nutrient intake but also in the quantity (calorie intake). The findings of the study have also been compared with other significant national and international studies.

Key Words: *Middle Childhood, Scheduled Caste, Health, Nutrition, BMI.*

Authors:

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Introduction

Middle Childhood: The middle childhood years are a unique developmental time when children undergo critical physical, cognitive, and social changes. During this time, children enter school, and their social context broadens beyond their families. This is the age of critical development falling between infancy and adolescence.

Middle childhood is a period of continued neurophysiologic changes, particularly synaptogenesis and myelination in the prefrontal cortex (PFC), the brain center responsible for a range of execution of functioning including attention control, working memory, reasoning, behavioral self-regulation and monitoring, inhibition, information processing, and goal-setting.

Socially, this period is characterized by new and defining social structures that involve increasing levels of independence, development and maintenance of peer relationships, increased self-regulation needs, intellectual challenges, and pubertal changes, all of which have implications for health and functioning, and employ some degree of executive functioning.

There is no exact consensus regarding an age range defining middle childhood. Middle childhood has also been differentiated from adolescence cross-culturally, largely by the onset of puberty (Collins, 1984). Middle childhood has been delimited differently by many scholars, as ages 6 to 10 (Eccles, 1999), and ages 6 to 12 (Collins, 1984).

Due to early start of formal schooling nowadays in India and sometimes early onset of puberty (between age 10–12) the middle childhood period may vary. The study propose to undertake 6 - 11 year old children, as most children start primary schooling at about 6 years of age and enter middle or junior high school around 11 years of age, which many also use to mark the beginning of adolescence.

Health and development research has largely focused on early childhood (i.e., 0–5 years old) and adolescence (12–17 years old). Very little is known about health and functioning during middle childhood. This has been due to critical development occurring in the first five years of life and high morbidity and mortality accompanying risky behavior in adolescence. But there are substantial health issues in middle childhood which need increased focus.

By traditional definitions of health, the middle childhood population is often considered healthier than any other age group (Collins, 1984). However, by a broader definition — one that includes health problems that have behavioral and social origins (Guyer, et.al., 2000) — there are a significant number of health problems affecting this age group related to mental health, health risk behaviors, and child victimization. In addition, some unhealthy behaviors of adolescence (e.g., poor nutritional habits, smoking) may have antecedents in middle childhood and some behaviors actually begin in middle childhood. These behaviors are linked to many diseases (e.g., hypertension, cancer and diabetes) that are unlikely to emerge clinically until adolescence and adulthood. Thus, the middle childhood years present an opportunity for early intervention to encourage healthy behaviors and prevent disease among adolescents and adults.

The health and wellbeing of the middle childhood population is part of a continuum that depends on what happens during infancy and early childhood and influences the behaviors and outcomes of adolescents and adults. Promoting the health of the middle childhood population, through research and policy development, would complement progress made in the areas of early childhood and adolescence, leading to a comprehensive approach for ensuring healthy development throughout childhood.

Monitoring of growth and development during middle childhood is important for improving overall health. Further, culturally based interventions are known to have better success rate in improving access and utilization of health services.

Body Mass Index (BMI): Body Mass Index is an index between the two body measurements, viz., the height in meters and weight in kilograms. The index is predictive of the health conditions and the effect of related socio-economic factors. Hence, the results of BMI can be verified by the results of dietary intake-adequacy (Kulkarni, V.S. & Alizad, S.S., 2010).

Body mass index must be calculated according to 'Quetelet's' Index, which is statistical correlation of the relationship between the height and weight of an individual arrived at by dividing body weight (kilogram) and height in meter2. In people older than 20 years a BMI of <18 is considered underweight, 18-25 is normal, 25-30 is overweight and a BMI of greater than 30 is considered obese. But in children the underweight, normal, overweight or obese BMI number is not the same as in adults. For children, BMI-for-age percentile is used, as amount of body fat changes with age and sex.

The present paper discusses the status of the middle childhood health with reference to nutritional status and BMI among the Pasi of Lucknow city, which is one of the largest scheduled caste (SC) groups of Uttar Pradesh, India.

Methodology

The study includes sample of 300 Pasi children, belonging to age group of 6 - 11 years, selected through random sampling.

Per day calorie intake has been calculated through 'Twenty-four Hour Recall Method' and has been compared with standard values given by Swaminathan, M. (1982).

To assess nutritional and health status of the children, some anthropometric measurements, height vertex and weight, have been performed with the use of standard methods described by Weiner and Lourie (1981). After that Body Mass Index has been calculated for the purpose.

At the international level, 'WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age' (World Health Organization, 2006) and "Anthropometric Reference Data for Children and Adults: United States, 2003-2006" (National Health Statistics Report, 2008) are referred for comparison.

While, on national level, the comparison has been done with "Nationwide Reference Data for Height, Weight and Body Mass Index of Indian Schoolchildren" (Marwaha, R.K., et.al, 2011) and 'Weight (Kg), Height (cm) and BMI by age and gender: Rural India (16 States)' given in "Nutrient Requirements and Recommended Dietary Allowances for Indians" (National Institute of Nutrition, Indian Council of Medical Research, 2009).

Result & Discussions

Pasi Children:-

Socio-Economic Background

In any study, personal information of the respondents is of great importance, which includes age, sex, educational level, occupation, family structure, number of siblings, parent's educational & occupational level, family income, pattern of residence and such other variables, which impact directly on one's living conditions and overall health.

S. No.	Socio-demographic Aspects	Percentage
1	**Age Groups (in Years)**	
	6-7	20
	7-8	20
	8-9	20
	9-10	20
	10-11	20
2	**Sex**	
	Male	50
	Female	50
3	**Educational Status**	
	Going to School	58.67
	Not Going to School	41.33
4	**Occupation**	
	Doing Nothing	38.00
	Studying + Indulge in Economic Activities	5.00
		6.67
	Indulge in Economic Activities	53.67
	Studying	
5	**Family Structure**	
	Joint Family	25.33
	Nuclear Family	65.00
	Living with Relative	9.67
6	**Siblings in the Family**	
	Only child	4.67
	2-4	32.00
	4-6	51.00
	6+	12.33
7	**Parents' Education**	
	Paternal Educational Status	
	Illiterate	26.00
	Primary	13.00
	Junior high School	17.00
	High School	14.00
	Intermediate	12.67
	Graduate	10.33
	Post Graduate	4.33
	Technically Qualified	2.67
	Maternal Educational Status	
	Illiterate	42.67
	Primary	23.33
	Junior high School	18.00
	High School	4.33
	Intermediate	2.00
	Graduate	6.00
	Post Graduate	3.00
	Technically Qualified	0.67
8	**Parent's Occupation**	
	Father	
	Working	92.00
	Not Working	5.67
	Not Alive	2.33
	Mother	
	Working	33.00
	Not Working	5.67
	Not Alive	2.33

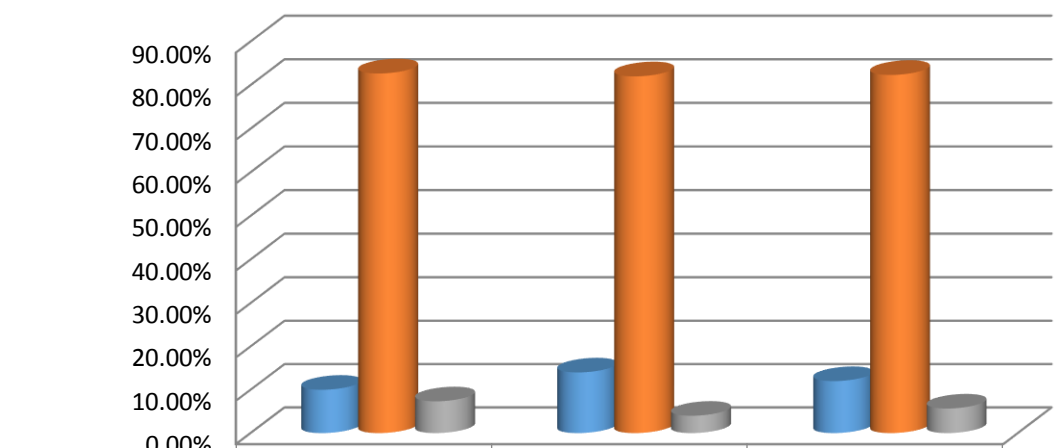
9	**Family Income (in Rs.)** Up to 2,000/- 2,000/- - 4,000/- 4,000/- - 6,000/- 6,000/- - 8,000/- 8,000/- - 10,000/- 10,000/- - 12,000/- 12,000/- -1 4,000/- 14,000/- - 16,000/- 16,000/- - 18,000/- 18,000/- - 20,000/- 20,000/- +	 27 19 8 16 11 6 2 4 4 1 2
10	**Pattern of Residence** Kaccha House (Structure of Mud) Pucca House (Structure of Brick and Cement)	 32.33 67.67
	TOTAL	100% (300 Pasi Children)

Food Habits and Nutrition

These people are both vegetarian as well as non-vegetarian. The food comprises wheat, rice, arhar (yellow pulse), jowar (Maiz) and bajara (Millet). In non-vegetarian food they take fish, mutton and chicken. In lower income group families, people take pork also. They do not take non-vegetarian food daily, as most of them cannot afford it. Their daily diet consists of roti, daal, chawal and sabji. They use mustard oil as cooking medium. They cook non-vegetarian food on special occasions, i.e., social gatherings, ceremonies, feasts and festivals. Normally males take heavy diet than female. Due to scarcity and lack of awareness, the lower income group families are deprived of nutrients, like, milk and fruits in their regular diet, even, no special care is taken for the diet of children and pregnant women.

It was reported that, generally, in middle income group families, it is believed that three meals (including breakfast) are the sufficient food for the whole day, while lower income group families believe that two meals are sufficient. Another criteria of sufficient food intake is related with 'Satisfaction', i.e., whether the person is satisfied or not. The number of meals in the regular diet of the Pasi children is shown in the Figure no.1..

Figure No. - 1
Diet Pattern



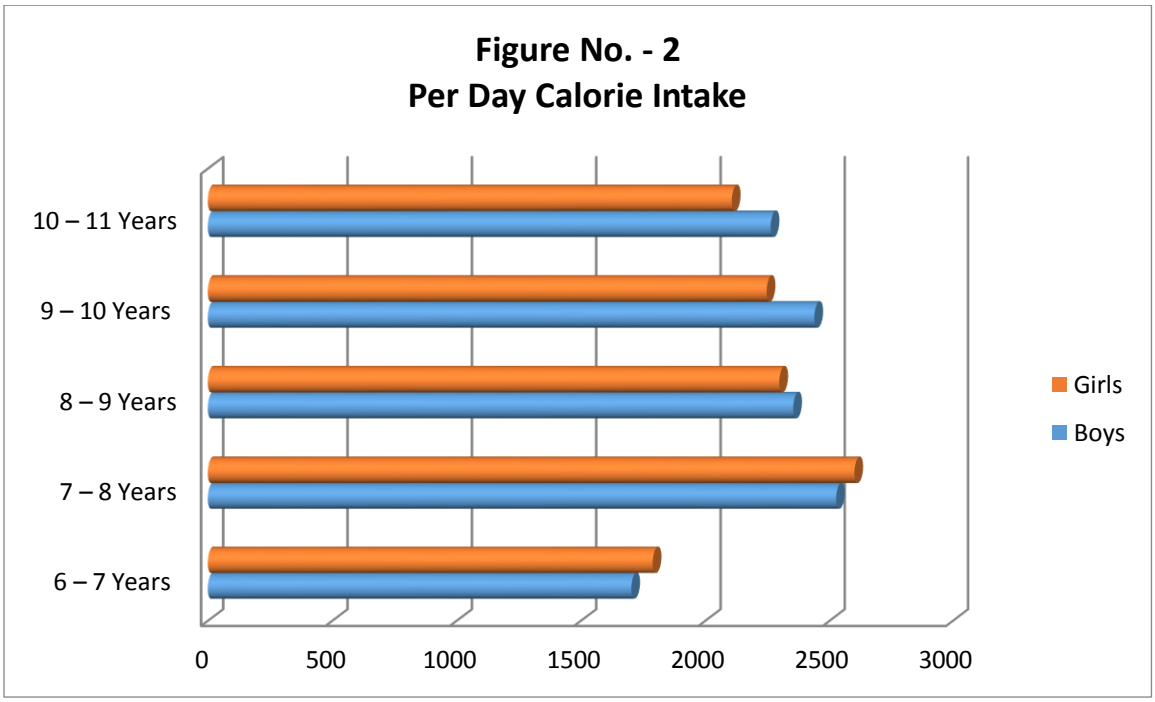
	Boys	Girls	Total
One meal	10.00%	14.00%	12.00%
Two meals	82.67%	82.00%	82.33%
Not regular meals	7.33%	4.00%	5.67%

According to Figure no.1, a majority of the children (82.33%) are taking two meals in a day, followed by those who are taking one meal in a day (12%). While, 5.67% children have reported that there is no restrict diet pattern, as the meals depend upon the availability of the food and time.

However, 82.33% children are taking two meals in a day, but due to the unawareness, most of the children are not properly nourished (Table no.-1). Nourishment and balanced diet go hand to hand and a little knowledge about the balanced diet resulted in improper nourishment.

Table No. – 1: Per Day Calorie Intake

S. No.	Age Groups	Sex	Number of Individuals	Mean (Calorie)	Standard Deviation	Standard Error of Standard Deviation	Standard Error of Mean
1	6-7 Years	Boys	30	1703.02	316.80	129.33	182.90
		Girls	30	1789.01	201.91	82.43	116.57
2	7-8 Years	Boys	30	2527.26	239.26	97.68	138.13
		Girls	30	2601.23	273.73	111.75	158.04
3	8-9 Years	Boys	30	2354.16	213.81	87.29	123.44
		Girls	30	2298.15	227.16	92.74	131.15
4	9-10 Years	Boys	30	2439.07	346.80	141.58	200.22
		Girls	30	2247.20	349.29	142.60	201.66
5	10-11 Years	Boys	30	2263.26	224.91	91.82	129.85
		Girls	30	2107.18	369.48	150.84	213.32



Per day calorie intake, which has been calculated through 'Twenty-four Hour Recall Method', shown in Table no.-1 & Figure no.-2. Following conclusions are drawn:

1. 6-7 Years Age Group

- The boys take 1703.02 ± 316.80 calorie per day which is less than the standard value 1800.00 calorie (Swaminathan, M., 1982).
- The girls take 1789.01 ± 201.91 calorie per day which is less than the standard value 1800.00 calorie.

2. 7-8 Years Age Group

- The boys take 2527.26 ± 239.26 calorie per day which is more than the standard value 2400.00 calorie.
- The girls take 2601.23 ± 273.73 calorie per day which is more than the standard value 2400.00 calorie.

3. 8-9 Years Age Group

- The boys take 2354.16 ± 213.81 calorie per day which is less than the standard value 2400.00 calorie.
- The girls take 2298.15 ± 227.16 calorie per day which is less than the standard value 2400.00 calorie.

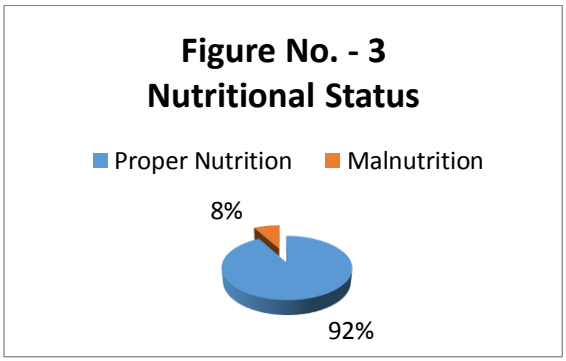
4. 9-10 Years Age Group

- The boys take 2439.07 ± 346.80 calorie per day which is more than the standard value 2400.00 calorie.
- The girls take 2247.20 ± 349.29 calorie per day which is less than the standard value 2400.00 calorie.

5. 10-11 Years Age Group

- The boys take 2263.26 ± 224.91 calorie per day which is less than the standard value 2400.00 calorie.
- The girls take 2107.18 ± 369.48 calorie per day which is less than the standard value 2400.00 calorie.

Thus, the absence of proper nutrition retards their physical and cognitive growth. As a result, these undernourished children can fail to grow up to their full genetic potential. Malnutrition was reported among most of the children, which is not only one of the largest causes of morbidity, but is also interrupting their complete and balanced mental-physical growth. In most of the cases, it was in the form of under-nutrition and imbalanced diet, while in several cases the children were suffering from specific nutritional deficiency.



Nutritional status of the children shows that only 8% are taking proper diet, while overwhelming majority, i.e., 92% are malnourished and taking imbalanced diet (Figure no.-3).

Table No. 2: Measurement No. – 1: Height Vertex

S. No.	Age Group (Years)	Sex	Number of Respondents	Mean (Cm.)	Standard Deviation	Standard Error of Standard Deviation	Standard Error of Mean
1	6 – 7	Boys	30	114.00	7.11	2.90	4.11
		Girls	30	113.70	7.26	2.96	4.20
2	7 – 8	Boys	30	119.87	2.72	1.11	1.57
		Girls	30	116.83	9.61	3.92	5.55
3	8 – 9	Boys	30	130.67	6.51	3.66	3.76
		Girls	30	128.83	13.30	5.43	7.68
4	9 – 10	Boys	30	133.13	6.14	2.51	3.55
		Girls	30	133.11	5.24	2.14	3.08
5	10 – 11	Boys	30	138.53	4.41	1.80	2.55
		Girls	30	136.73	5.35	2.18	3.09

Figure No. - 4
Mean Height by Age and Sex

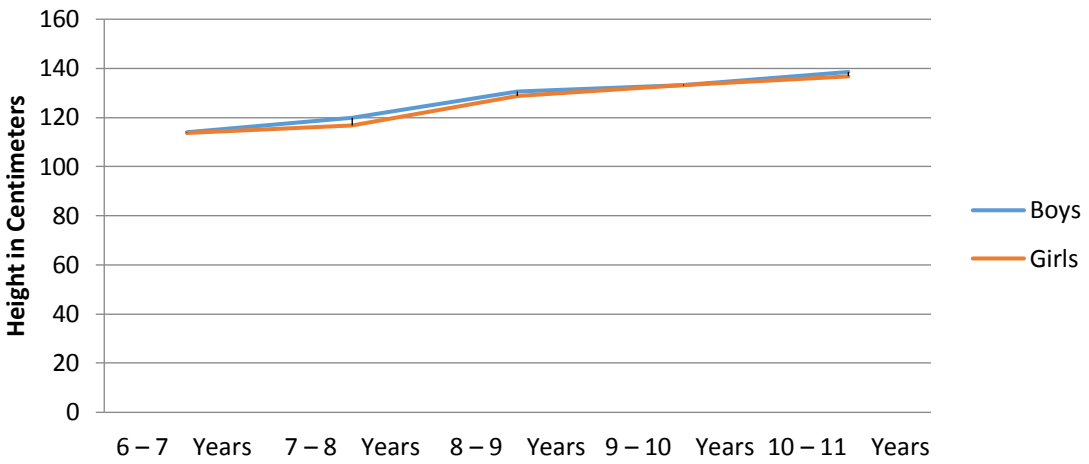
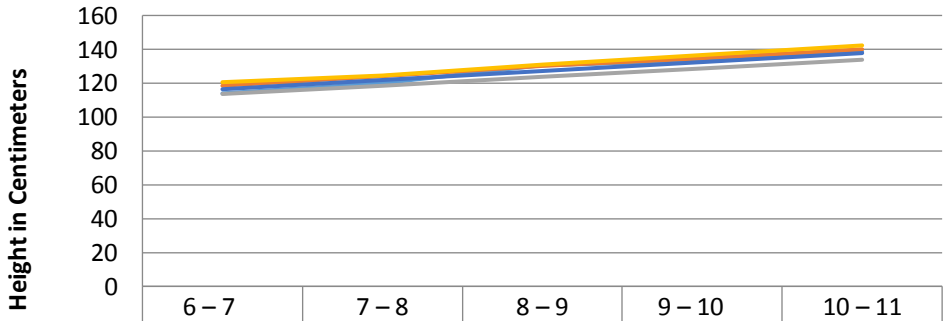
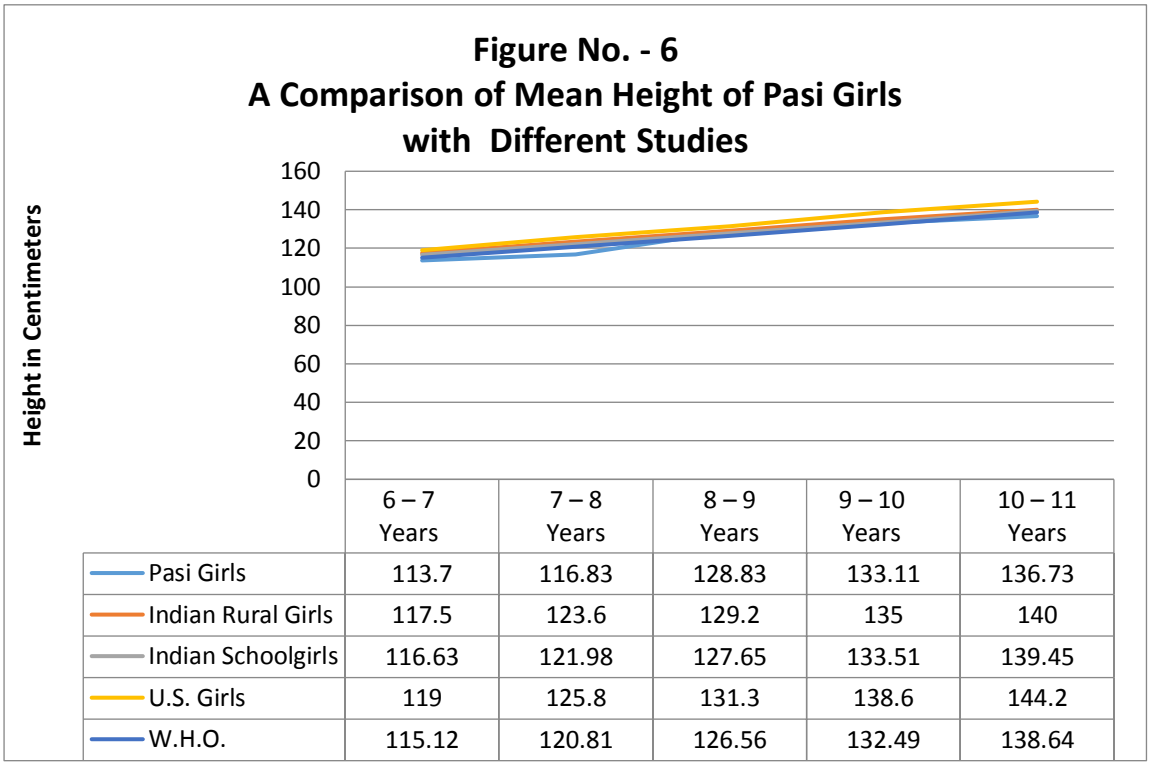


Figure No. - 5
A Comparison of Mean Height of Pasi Boys with Different Studies



	6 – 7 Years	7 – 8 Years	8 – 9 Years	9 – 10 Years	10 – 11 Years
Pasi Boys	114	119.87	130.67	133.13	138.53
Indian Rural Boys	118.5	124.3	130.1	134.6	140
Indian Schoolboys	113.63	118.66	123.68	128.7	133.86
U.S. Boys	120.6	124.7	131.1	136.8	142.3
W.H.O.	116.44	121.73	127.27	132.57	137.78



In the age group of 6 to 8 years, the mean values are less than the height-for-age standards given by World Health Organization. While, from 8 to 11 years of age this value are more than the standard reference values.

Figure no.-5 & 6 reveals the comparison of mean height of Pasi children with different studies. According to these figures, the height of Pasi boys in the age group of 6 to 8 years, is higher than the Indian schoolboys (Marwaha, R.K., et.al., 2011), while less than all other categories. In the age group of 8 to 9 years, their mean height is higher than both, Indian rural boys (National Institute of Nutrition, Indian Council of Medical Research, 2009) and Indian schoolboys. In the age group of 9 to 11 years, they are smaller than Indian rural boys and U.S. boys (National Health Statistics Report, 2008) and taller than Indian schoolboys and W.H.O. standards (World Health Organization, 2006).

In case of girls, in the age groups of 6 to 8 years and 10 to 11 years, the Pasi girls are smaller than all other categories. While in the age group of 8 to 9 years, they are taller than Indian schoolgirls and W.H.O. standards and in 9 to 10 years age group their height is more than W.H.O. standards.

2. Body Weight

Table no.-3 & Figure no.-7 reveals that the body weight of Pasi children is increasing with the age from 6 to 11 years. Boys are, on the average, slightly heavier than girls between 7 to 11 years. However, from 6 to 7 years of age, girls are slightly heavier. Except for boys of 8 to 10 years and girls of 8 to 9 & 10 to 11 years, in all the age groups of both the sexes, the mean value of weight is less than the weight-for-age standards of W.H.O.

Table No. 3: Measurement No. – 2: Body Weight

S. No.	Age Group (Years)	Sex	Number of Respondents	Mean (Kg.)	Standard Deviation	Standard Error of Standard Deviation	Standard Error of Mean
1	6 – 7	Boys	30	19.07	1.25	0.51	0.72
		Girls	30	19.37	3.35	1.37	1.92
2	7 – 8	Boys	30	22.60	2.13	0.87	1.22
		Girls	30	21.33	3.01	1.23	1.74

3	8 – 9	Boys	30	26.67	5.13	2.09	2.96
		Girls	30	25.07	0.90	0.37	0.52
4	9 – 10	Boys	30	28.30	3.75	1.33	2.17
		Girls	30	28.00	0.87	0.36	0.50
5	10 – 11	Boys	30	29.33	2.89	1.18	1.67
		Girls	30	28.53	4.01	1.04	2.31

Figure No. - 7 Mean Weight by Age and Sex

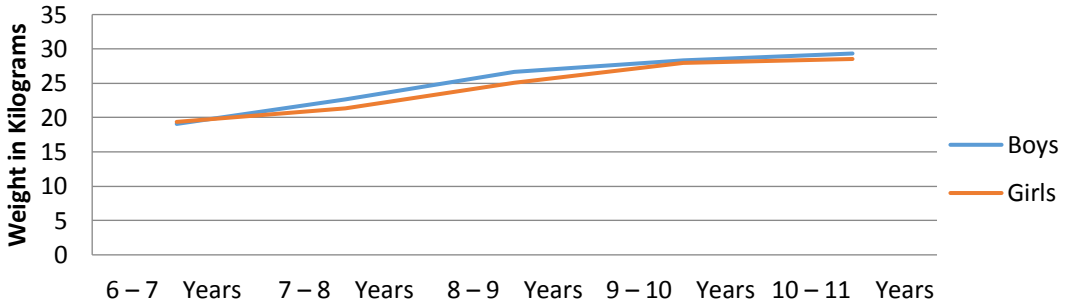
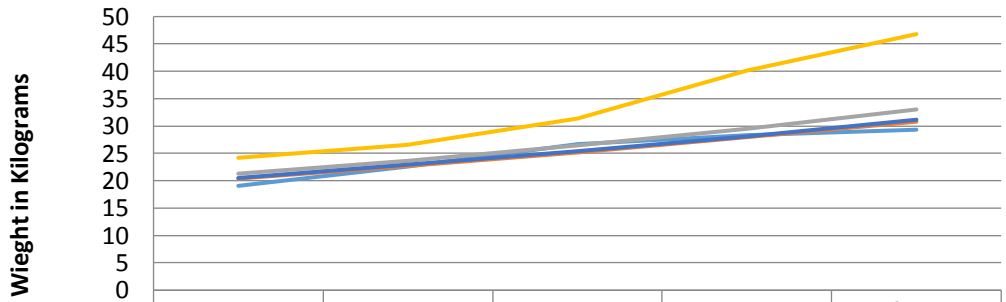
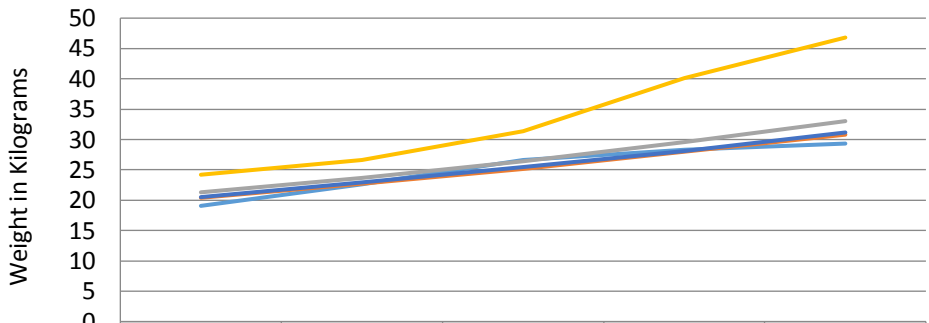


Figure No. - 8 A Comparison of Mean Weight of Pasi Boys with Different Studies



	6 – 7 Years	7 – 8 Years	8 – 9 Years	9 – 10 Years	10 – 11 Years
Pasi Boys	19.07	22.6	26.67	28.3	29.33
Indian Rural Boys	20.4	22.7	25.2	28	30.8
Indian Schoolboys	21.3	23.69	26.43	29.54	33.03
U.S. Boys	24.2	26.6	31.4	40.1	46.8
W.H.O.	20.51	22.89	25.42	28.11	31.16

Figure No. - 9
A Comparison of Mean Weight of Pasi Girls with Different Studies



	6 - 7 years	7 - 8 years	8 - 9 years	9 - 10 years	10 - 11 years
Pasi Girls	19.07	22.6	26.67	28.3	29.33
Indian Rural Girls	20.4	22.7	25.2	28	30.8
Indian Schoolgirls	21.3	23.69	26.43	29.54	33.03
U.S. Girls	24.2	26.6	31.4	40.1	46.8
WHO	20.51	22.89	25.42	28.11	31.16

The comparison with various international and national studies (Figure no.-8 & 9) shows the mean weight in kilograms of Pasi boys are lighter from all other categories in the age group of 6 to 8 and 10 to 11 years. In the age group of 8 to 9 years, they are heavier than Indian rural boys, Indian schoolboys and W.H.O. standard. In the age group of 9 to 10 years, they are again heavier than both, Indian rural boys and W.H.O. standards. The same pattern is apparent in case of Pasi girls.

Thus there is, however, linear and gradual increase in growth rate of body weight, but it is not completely satisfactory according to age.

Body Mass Index (BMI)

In the present study the value of BMI-for-age used is based on reference data of the World Health Organization (WHO) report. A child is considered underweight or having low BMI when his BMI-for-age is >5th percentile, normal weight when his BMI-for-age is between 5th to 85th, overweight when his BMI-for-age is between 85th to 95th and obese when his BMI-for-age is ≥95th percentile.

Table No. 4: Body Mass Index

S. No.	Age Group (Years)	Sex	Number of Respondents	Mean	Standard Deviation	Standard Error of Standard Deviation	Standard Error of Mean
1	6 – 7	Boys	30	14.70	0.82	0.33	o.47
		Girls	30	14.89	0.63	0.26	0.36
2	7 – 8	Boys	30	15.67	0.82	0.33	0.47
		Girls	30	15.68	3.43	1.40	1.98
3	8 – 9	Boys	30	15.50	1.63	0.67	0.94
		Girls	30	15.43	2.96	1.21	1.71
4	9 – 10	Boys	30	15.94	0.93	0.38	0.54
		Girls	30	15.82	1.65	0.67	0.95
5	10 – 11	Boys	30	15.36	1.81	0.74	1.05

		Girls	30	15.21	1.06	0.43	0.61

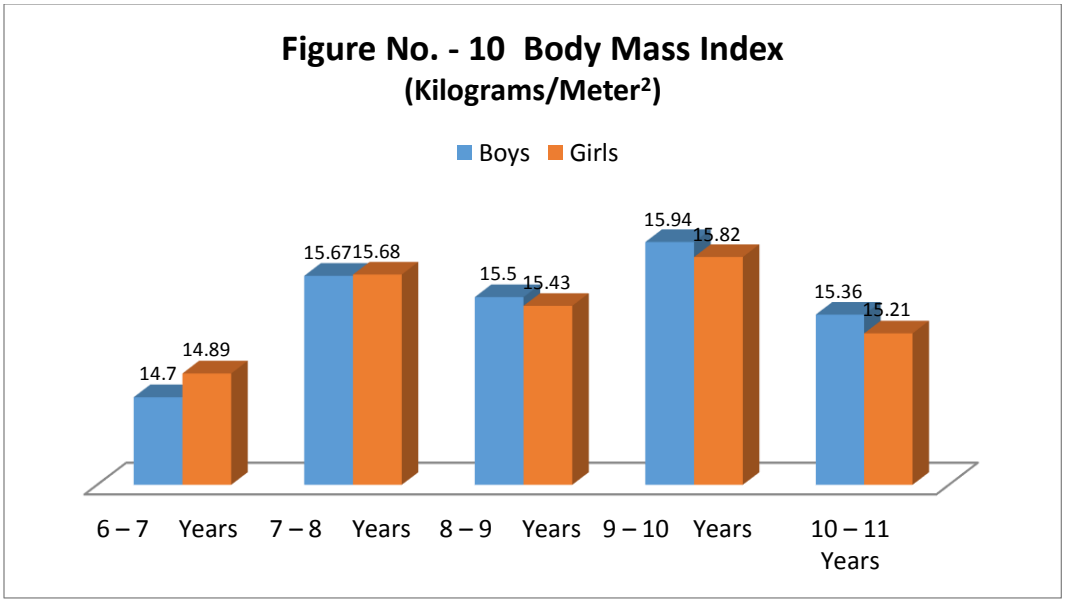
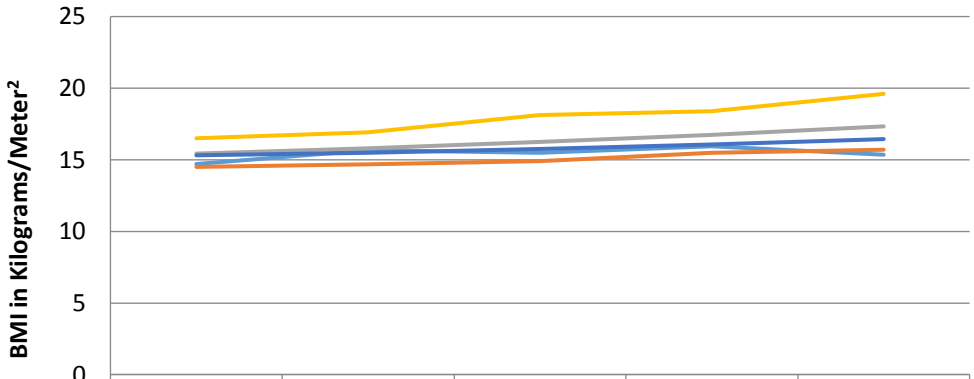


Table no.-4 & Figure no.-10 shows the mean value of BMI of Pasi children. It shows that in case of both the sexes, its value is increased from 6 -7 years to 7-8 years of age group, but decreased again in the age group of 8-9 years. Again the value is increased in all the age group of 9-10 years and decreased in the age group of 10-11 year. In most of the age groups, i.e., from 8 to 11 years, the BMI value of girls is less than the boys. It may be due to gender discrimination prevalent in the society.

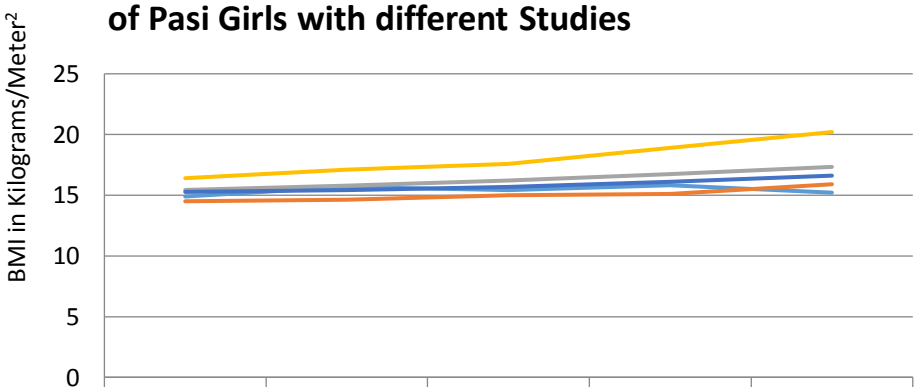
When the mean value of BMI of age group is compared with BMI-for-age, reference data of W.H.O. report, it is found that the mean value of all the age groups of both sexes reveals the normal weight category, i.e. from 15th to 50th percentile value. As the normal category ranges from 5th percentile to 85th percentile, therefore, values are too far from overweight values.

Figure No. - 11 A Comparison of Mean BMI of Pasi Boys with Different Studies



	6 – 7 Years	7 – 8 Years	8 – 9 Years	9 – 10 Years	10 – 11 Years
Pasi Boys	14.7	15.67	15.5	15.94	15.36
Indian Rural Boys	14.5	14.7	14.9	15.5	15.7
Indian Schoolboys	15.43	15.79	16.23	16.74	17.33
U.S. Boys	16.5	16.9	18.1	18.4	19.6
W.H.O.	15.31	15.48	15.74	16.05	16.44

Figure No. - 12
A Comparison of Mean BMI of Pasi Girls with different Studies



	6 - 7 years	7 - 8 years	8 - 9 years	9 - 10 years	10 - 11 years
Pasi Girls	14.89	15.68	15.43	15.82	15.21
Indian Rural Girls	14.5	14.6	15	15.1	15.9
Indian Schoolgirls	15.43	15.79	16.23	16.74	17.33
U.S. Girls	16.4	17.1	17.6	18.9	20.2
WHO	15.27	15.43	15.68	16.1	16.61

However, the BMI value in all the age group shows the normal category, but comparison with different studies (Figure no.-11 & 12) reveals that, generally its value is higher than Indian rural children, but less than Indian school children belonging to upper socio-economic strata, American children and even its value

is lesser than 50th percentile value of W.H.O reference report. This less BMI value may be attributed to the poor dietary intake, large family size, unawareness about the balanced diet, poor access to health facilities and gender discrimination.

Conclusion

In these people intake of food is to fill the stomach or overcome the hunger rather than for health. It is fact of quantity versus quality and need versus awareness. The reflection of nutritional intake in food through body mass index shows that there is an imbalance not only in the kind of nutrient intake but also in the quantity (calorie intake). Body Mass Index is an index between the two body measurements, viz., the height and weight. The former is highly influenced by genetic factors and the latter by nutrition and other environmental factors. The first measurement is relatively constant for respective age, but the second one is more fluctuating according to changing conditions. The resultant index, thus, is the predictor of genetic as well as environmental influences. Here, the height measurement of the Pasi children shows that their height is increasing linearly with the age from 6 to 11 years and as according to WHO standards. However, there is linear and gradual increase in growth rate of body weight, but it is not completely satisfactory according to age. The mean value of BMI of Pasi children varies from one age group to another and from boys to girls. While comparing the mean value of BMI with reference data of W.H.O. report, which ranges from 5th percentile to 85th percentile, in the present study it is found that the BMI value is ranging between 15th to 50th percentile values. Though the range seems normal, but is a clear picture of inadequate and imbalanced diet. In most of the age groups, the BMI value of girls is less than the boys, which is a significant fact. Comparative analysis with other studies reveals that generally its value is higher than Indian rural children, but less than Indian school children belonging to upper socio-economic strata and American children. BMI value may be attributed to the poor dietary intake, large family size, unawareness about the balanced diet, poor access to health facilities and gender discrimination.

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The distribution of fingerprint patterns with gender in Delhi, India Population –A Comparative Study

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Abstract:

Dactylography or Dactyloscopy is the study of fingerprints for the purpose of Identification. It is a progressing science and new methods are recording and developing. The potential for the examination to determine the sex and identification of an individual has been well documented and recorded. Identification using fingerprints is absolute and infallible. Few studies have been conducted and published using fingerprint patterns for the identification of distribution of fingerprint patterns among males and females. The aim of the present study is to establish the prevalent character in both sexes (male and female) in accordance to Indian population (North Delhi region) and then comparison was performed between the fingerprint patterns of the population. Material and Methods-This present study was conducted on 100 males and 100 females of Indian (North Delhi) population aged between 25-40 years. Rolled fingerprints were recorded using ink pad, and the identification of patterns was performed. Each subject was suggested to press their fingers uniformly on the ink stamp pad and then transfer the prints onto plain white paper. The major pattern and their subtypes were identified and analyzed for finding differences in gender. The data were tabulated and represented in graphical form.

Results and Conclusion -Loops were found to be of most common type of pattern in both males and females followed by whorls. Ulnar loops are predominant in finding in population. Further in the present study the patterns and their subtypes were compared and then tabulated which reveals a significant difference for each pattern.

Key Words: *Dactyloscopy, Ulnar loops, Gender Identification, fingerprint, fingerprint patterns*

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Introduction

Skin is the most important and largest organ of the body from which the entire human body is covered. Different functions were performed by skin throughout the life of an individual such as it protects and safe guards the body from unpredictable weather conditions, balance or maintains the temperature and it also prevents skin from external injuries. The appearance and texture of the skin which entirely covers the palmer surface of hand and planter surface of foot is completely different from rest of the human body. According to Hawthorne, 2009 fingerprint is an impression or reproduction left on any surface by the friction skin of the fingers. Fingerprints are considered as the most versatile and frequently found evidence at the crime scene, they can easily be found in many type of criminal cases such as burglary, murder, theft, rape etc. It is considered as a very significant and valuable evidence as this can be used in the Personal Identification for determining the suspect's identity, missing persons, victims of amnesia, mass disaster victims and insane persons etc. The elevated portion of the skin that left impression or reproduction is called friction ridges and furrows are the skin portion lower and between the ridges. Due to its permanency and uniqueness, fingerprints has highly individualistic nature, even twins do not have the same fingerprint pattern. Dermatoglyphics is the scientific study of friction ridges and their patterns produced on the palmer and the planter surfaces or the study of fingerprints that is done for the identification purpose is called as Dactylography. (Ranjan et al).The term Dermatooglyphics was first termed by Cummins and Midlo (1926) and William Herschel (1858) was the first who performed experiment with fingerprints for the Identification of an individual in India. This science is progressing and new methods are developing for recording, lifting under different field conditions in cases of deceased and living bodies (Sam et al 2015).Dr. Henry Faulds established the importance of fingerprints and an article was published in Nature 1880 and the first explainable study was performed by Sir Francis Galton in 1892 who is an English Anthropologist. The Galton's detail was further improved and classified by Sir Edward Richard Henry, Inspector General of Police for practically applying in the field of identification in 1890s (Ranjan et al, 2015).

The formation of pattern of human friction ridges starts forming when the fetus is in the womb at about 8^{th} week of gestation and completely formed at 17^{th} week. Sweat gland ducts start coming out or project upwards from the bottom of the primary friction ridges at 14^{th} week. The formation of primary ridge formation ceases after 19^{th} week and the appearance of secondary ridges are in the form of folds present in between the primary ridges. Between all primary ridges secondary ridges starts forming by 24^{th} week of pregnancy and the space was invaded by dermal papillae in the space between primary and secondary ridges, that forms double rows. With the development of friction ridges, perspiration glands form. Then fingerprints starts becoming visible on the skin surface and the ridge system geometry does not change anymore for lifetime (Siegel and Mirakovits, 2016).Fingerprints can be used as the purpose of personal Identification because of three principles,

1. Uniqueness of fingerprint
2. Permanency nature of fingerprints unless there is a damage to the skin dermal layer
3. Classification of fingerprint patterns. (James et al, 2014).

Fingerprints show unique characters as no two individuals can have an identical pattern, even for twins as they share same DNA profiles. Galton in 1892 performed research work on anatomy, classification, heredity and racial variation and he classified the distal phalanges of the fingertips into three classes, Arch, Loop and Whorl. The chances of having identical finger patterns of two individuals is 1:64 billion. (Ranjan et al, 2015). After this division the fingerprint patterns are subdivided into five classes: - Arch, loop, whorl, Accidental (No specific pattern) and Composites.

Whorl Loop Arch

Figure no.1- Patterns of fingerprint (Original)

As per according to Abdullah et al, 2015 that two type of details in fingerprints are found referred to as global feature and local feature. The global characteristics gives the idea about the fingerprint pattern from which class it belongs and local ridges and the detail of valley gives information about the peculiarity of fingerprints. In this present study the global features found on the tips of finger were found and the fingerprints class was investigated. The pattern of fingerprint comprises of ridges and valleys, the black lines are ridges and the remaining is the white area between two adjacent ridges.

The fingerprints can be associated with criminology and in 1975, it has been used and accepted as an evidence for the purpose of recognizing the sex of a person. The gender identification of criminals from the scene of crime is a vital issue in narrowing down the suspects in forensic science (Abdullah et al, 2015).The determination of gender from fingerprints has been well documented and few studies have been conducted on the basis of fingerprint patterns for population identification. The frequency of fingerprint pattern distribution can describe the group or population (Koneru, et al, 2014).

Through this collection of fingerprints, database is made and then fingerprints from these database was compared with another person especially in case of criminal ,fugitives, missing persons etc. Currently, many studies have been carried out to recording and matching of fingerprints through computational software and this study is planned to determine the association between gender and the fingerprint ridge pattern and to validate that women or men tends to have high number of fingerprint patterns. The distribution of fingerprint patterns in males and females among Indian people especially in North India region was also studied. The objective of this study was to observing the distribution of pattern on different phalanges in case of males and females and to find out if any difference occur among both sexes for both hands.

Materials and Methods

Subjects

The study was carried out among 200 subjects (100 males and 100 females) of Indian population from Delhi belonging to the age group 25-40 years of age who has voluntarily participated in the study. The informed verbal consent was taken from each and the clearance of any ethical issue was obtained to carry out the study. The subjects who were having permanent scars on their thumb or fingers, with any deformities or disease due to injury, congenital defects or any disease or having any extra finger, webbed finger or bandaged finger were excluded from the study.

Figure 2 - Materials required for examination (originals)

Recording of fingerprints

For recording of fingerprints, Ink method was suggested by Cummins was used. Each subject was requested to wash hands with soap and water, wiped and dried using a towel to remove any type of dirt, grease or any foreign material. Then the subject was recommended to press fingertip on the ink pad or ink slab or stamp pad and then the inked fingerprint impression was transferred to the paper. The method was repeated in the same manner for fingers of both hands. On the fingerprint card, there is a separate section for rolled and plain prints so these impressions of fingerprints were taken on the respective blocks on the same sheet of paper. Care must be taken while recording or printing like avoiding sliding of fingers to prevent smudging of the print. After the fingerprints were obtained of all ten fingers as and were acquired details such name, sex and age were noted.

Figure 3-Method of recording fingerprints

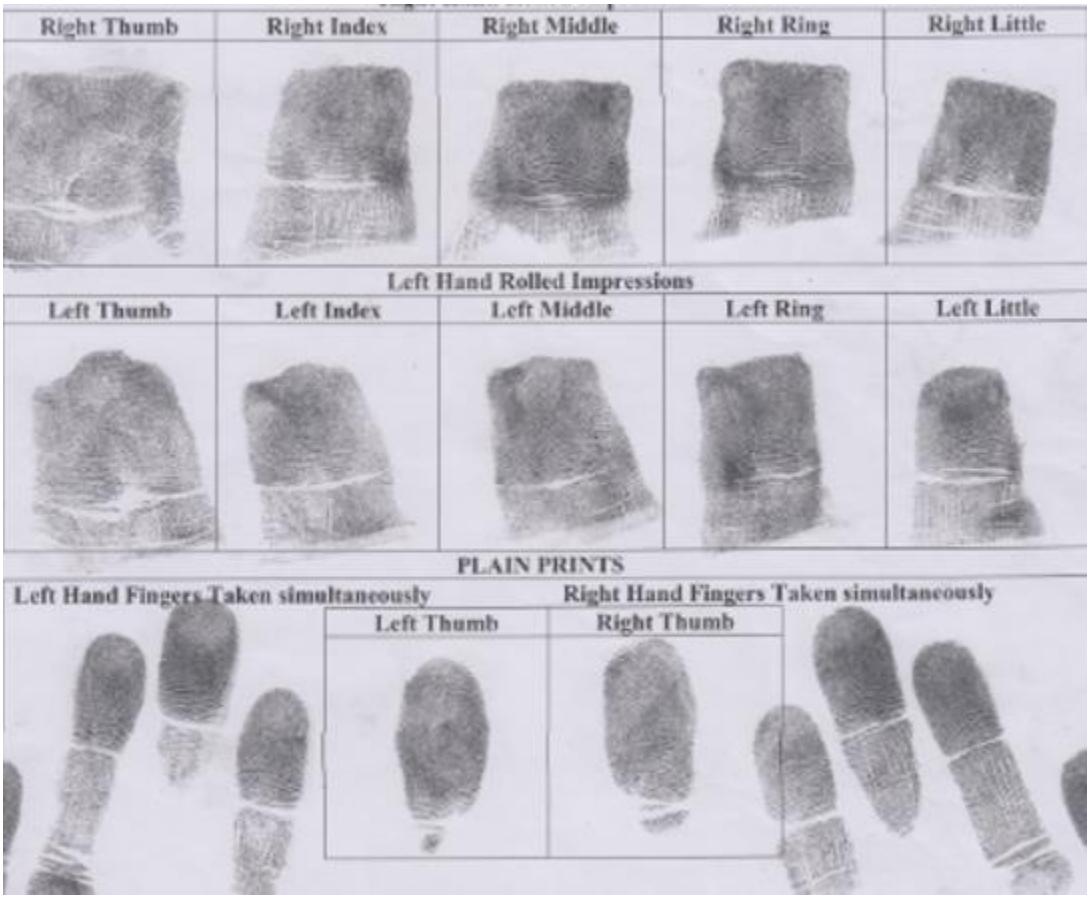

Figure 4 –Recorded fingerprints (Original)

Examination of fingerprints

The pattern of fingerprints were studied by using magnifying lens and were established as: Loop, Whorls and Arch that were studied on the basis of appearance of re curving ridges according to the Henry's system of classification. This system of Henry appoints a number to each finger according to the sequence in which it is positioned in the hand that begins with the right thumb (RT) as number 1 and ending at the little finger of left hand (LL) as number 10.The sequential distribution of fingerprint patterns in both hands of individuals and its linkage with sex of particular individual was evaluated and analyzed statistically. The data was prepared in a tabular form as the table contains different sections of Right Thumb, Right Index , Right Middle , Right Ring ,Right Little ,Left Thumb, Left Index, Left Middle , Left Ring ,Left Little fingers and the assign each section a pattern that a particular finger have.

Results

Rolled and plain impressions of fingerprints were collected of ten fingers of all the 200 subjects and a total of 200 samples were obtained. These 2000 samples were analyzed and the details of the pattern and their types are recorded for the appropriate determination. Among the 2000 fingerprint samples, 1130 were loops, 625 were whorl, 125 were Composites and 120 are arch pattern. The male and female fingerprint pattern distribution were examined and also recorded for further data arrangement. Out of 1130 patterns of loop obtained in this study, 1070 (94.69%) were Ulnar loop and 60 prints (5.31%) were belongs to Radial loop. And the same observation was observed and collected in case of both males and females.

In this study the obtained prints, out of 625 whorl patterns,383 were spiral whorls (61.28 %) ,157 were circular whorls (25.12 %) ,52 were double core whorls (8.32 %) and 33 (5.28%)were elliptical whorls.

The patterns of composite was also studied and recorded, out of 125 Composite patterns, 63 were twinned loop (50.4%) , 42 were lateral pocket loop

(33.6%) , 15 were accidental (12.00%) and 5 were central pocket loop (04.00%).

In cases of Arch pattern, out of 120 Arch pattern, 115 were Plain Arch (95.83%) and 05 were Tented Arch (4.16%).

As per according to this study, In males, the composite pattern that was not much observed is the Central pocket loop and the most observed pattern in the case of females was lateral pocket loop (9.4%).The tabulated description describes the distribution of fingerprint patterns in gender of an individual.

Table No. 1 –The distribution of fingerprint patterns

Fingerprint pattern	Occurrence of patterns	%
Loop	1130	56.5
Whorl	625	31.25
Composite	125	6.25
Arch	120	6.00
Total	2000	100

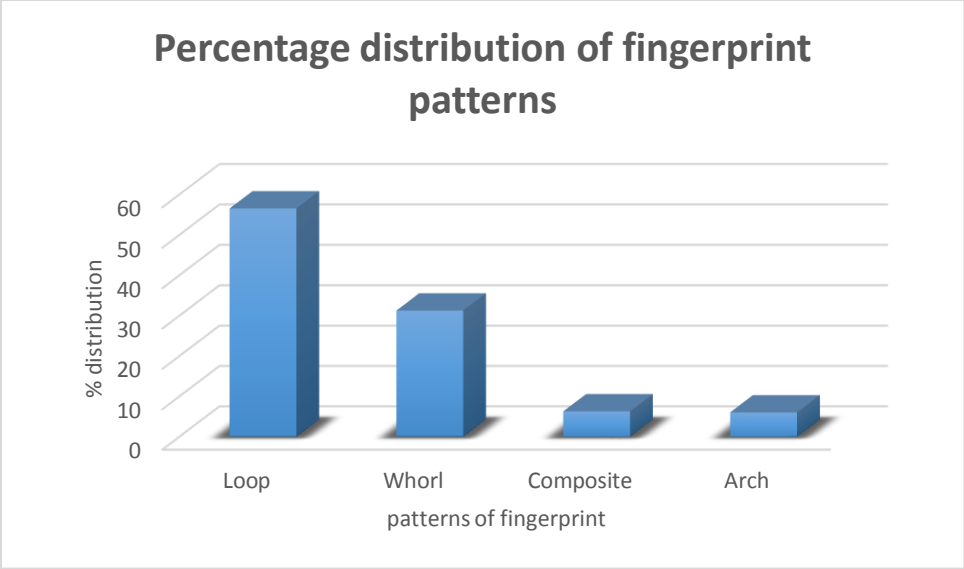

Figure 5 –Graph represents the percentage distribution of fingerprint patterns

Table No. 2-Distribution of fingerprint patterns in males and females

Fingerprint pattern	Male	Female
Loop	550 (48.67%)	580 (51.32%)
Whorl	325(52.00%)	300 (48.00%)
Composite	72 (57.6 %)	53 (42.4%)
Arch	53(44.16 %)	67 (55.83%)
Total	1000	1000

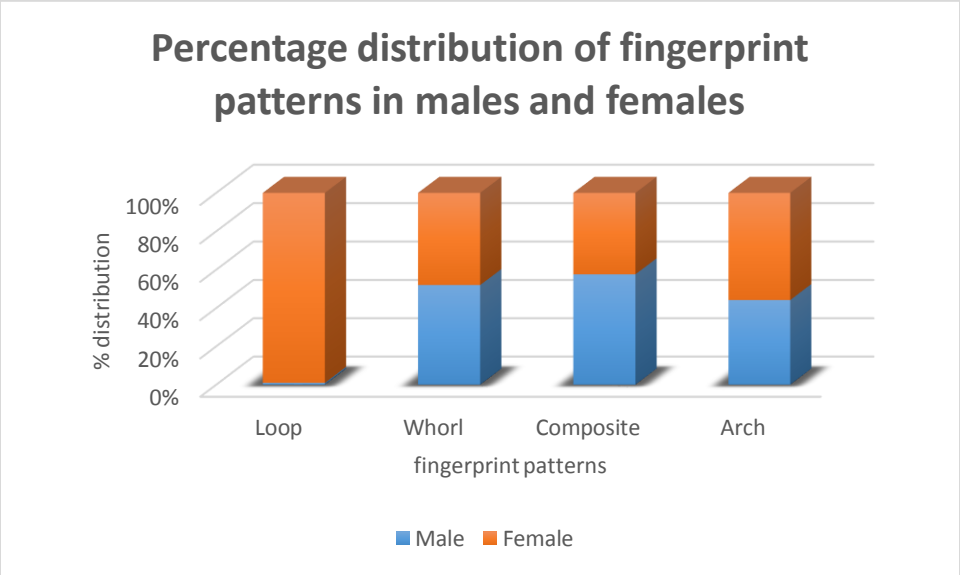

Figure 6 – Graph represents the percentage distribution of Fingerprint patterns in males and females

Table No.3 Distribution of loop patterns

Loop pattern	Males %	Females %	Total
Ulnar	520 (94.54%)	550(94.82%)	1070
Radial	30 (5.45 %)	30 (5.17%)	60
Total	550	580	1130

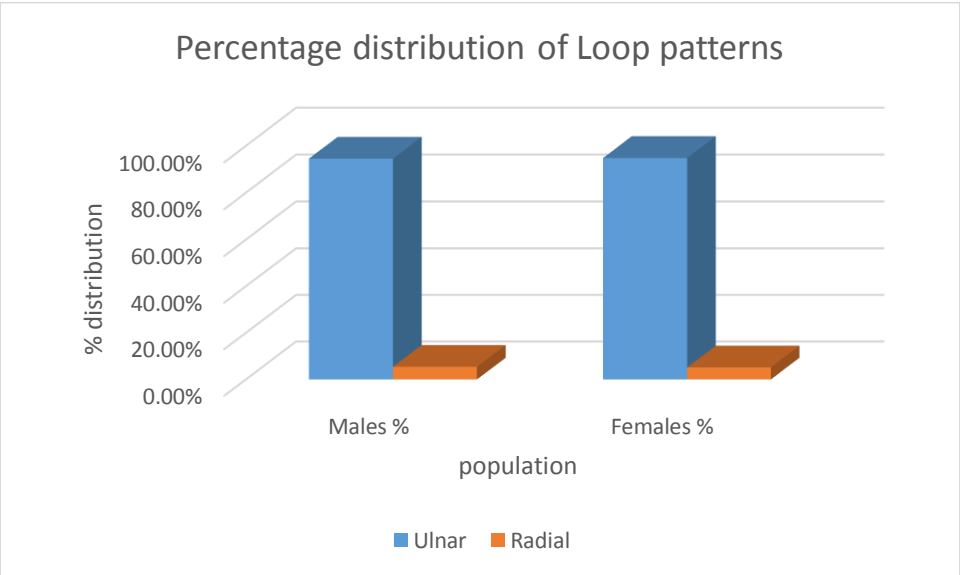

Figure 7– Graph represents the Percentage distribution of loop patterns

Table No. 4 Distribution of Whorl patterns

Whorl type	Males %	Females %	Total
Spiral	186 (57.23%)	197 (65.66%)	383
Circular	85(26.15%)	72 (24%)	157
Double core	35 (10.76%)	17 (5.66%)	52
Elliptical	19 (5.84%)	14(4.66%)	33
Total	325	300	625

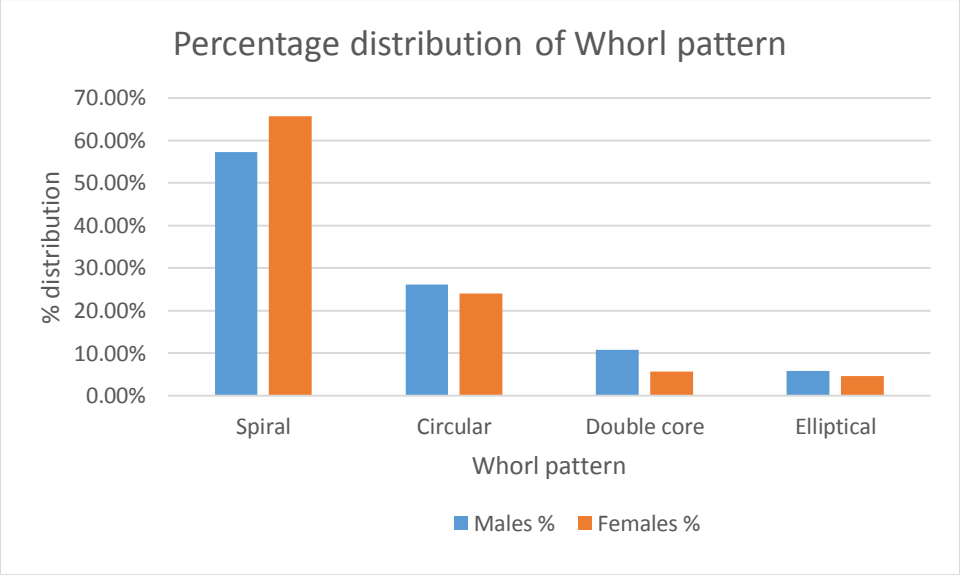

Figure 8 – Graph represents the Percentage distribution of Whorl pattern

Table No. 5 Distribution of Composite pattern

Composite pattern	Males %	Females %	Total
Twinned loop	46(63.88%)	17(32.07%)	63
Lateral Pocket loop	19(26.38%)	23(43.39%)	42
Accidental	07(9.72%)	08(15.09%)	15
Central Pocket loop	00(0%)	05(9.43%)	05
Total	72	53	

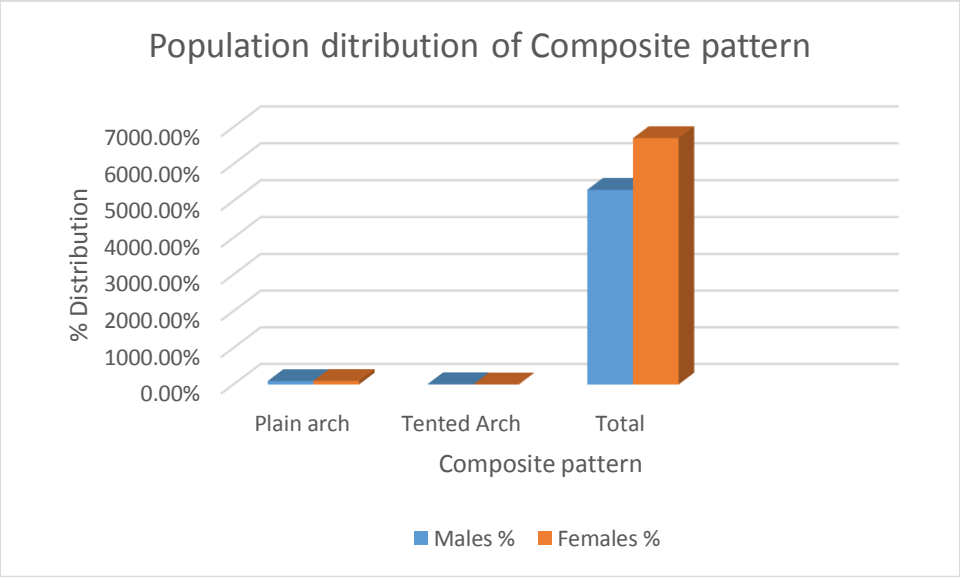

Figure 9 – Graph represents the percentage distribution of Composite pattern

Table No. 6 Distribution of Arch pattern

Arch pattern	Males %	Females %	Total
Plain arch	49(92.45%)	66(98.50%)	115
Tented Arch	04(7.54%)	01(1.49%)	05
Total	53	67	120

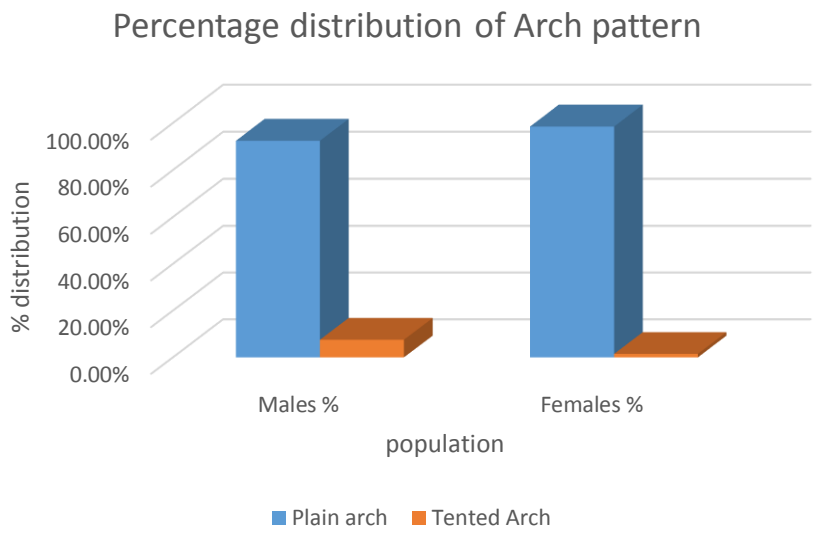

Figure 10- Graph represents the percentage Distribution of Arch patterns

Discussion

The objective of the study is to observe patterns of fingerprint patterns and their sequential distribution in Indian (North Delhi region).According to the study the more common type of pattern was found to be loop and the least common pattern was arch. Other studies were also published which deals with the prevalence of fingerprints and were compared with the present study. After comparing the previous data with the present database it was found that loop patterns are the most common patterns.

According to other researchers, the ubiquity of loop patterns is about 60-70% and the prevalence of loop patterns in case of Sam et al 2017, was 57.1% which is slightly a large figure in comparison to the present study i.e., 56.5%.

According to Sam et al 2017, The ubiquity of whorl and arch pattern is 28.9% and 7.2% respectively whereas the frequency of whorl and arch patterns is 31.25% that is greater and 06.00% that is lesser than Sam et al research.

The prevalence of composite patterns is found to be 6.25% which in comparison to other research are in between 1-5% and found higher in this study.

While determining the pattern distribution among males and females, the loop patterns are considered to be the predominant type of pattern. In males, the composite and arch are the second last and least common type of patterns.

The present study is being compared with the other studies, According to Nithin et al , 2009 who studies the distribution of fingerprint patterns in South Indians of Mysore observed and recorded the most common prevalence of Ulnar loops, followed by whorl, then composite, then arch pattern and the same study was observed in this study.

Gangadhar et al, 1993 researched the population of Karnataka state in accordance to fingerprint patterns who reported that the predominance of loop patterns followed by whorls, by Jaga and Igbigbi in Ijaw subjects of Southern Nigerians,Igbigbi and Msamati in Kenyan and Tanzanian subjects and by Eboh in Anioma and Urhobo population of Southern Nigeria where ulnar loop followed by whorls and arches patterns were reported that was same reported in this present study.

According to Ching Cho in New Zealand,who observed that whorl pattern in the population predominates (60.6%) followed by Ulnar loops (38.65%) which disagrees with this present study as this study reports that loop patterns (56.5%)are present in most of the population followed by whorls (31.25%).Ghosh et al,2011 in Sunni Muslim population of Bengal ,Karmakar et al. in Muzziena Bedouin ,Singh et al in Rajputs of Himachal Pradesh studies the same as the occurrence of whorl pattern is common.

According to this present study the arch patterns were predominantly found in females and composite pattern are found in lesser amount in comparison to males.

Conclusion

In this present study, the distribution of fingerprint patterns and their sub divisions was made from which it was concluded that loop patterns are prevalent and predominant type in both males and females and Arch pattern are the least common type. The data was concise in tabular form and the graph was plotted to show the distribution of fingerprint patterns among males and females. The subtype of loop i.e., Ulnar loop were considered as the commonest fingerprint pattern in both males and females. Central pocket loop are the least common type of patterns in males whereas in females composite and tented arch are found to be the least common. This study enhances the necessity of fingerprint as an infallible tool for establishing Identity..

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Sexual Dimorphism from Hand Measurement: A Comparative approach

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Abstract:

Sexual dimorphism is considered as the foremost and significant criteria for establishing the identity of an individual such as in the cases of mass disaster for the identification of mutilated bodies, any medico legal practices. It can be realized that the measurement of hand with the help of anthropometric measurement was used as a tool for sex determination. Hence there are various research work which is being in process for assessing the sex, stature, race etc. of an individual with the help of the anthropometric measurement. The anthropometric measurement of hand, foot, ear etc. are useful in the determination of sex of an individual.

The present study is based on the hand dimensions which is helpful in discriminating the male and female so as to investigate and predict the sex of an individual. This research work is useful in the investigation of various criminal cases, or the case related with any disaster where the determination of sex is difficult.

Key Words: *Sexual Dimorphism, Anthropometric measurement, Hand dimensions, Medico-legal practice*

Authors:

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Introduction

Sexual dimorphism is defined as the difference between the males and females on the basis of the appearance within the same species like change in the shape, color, size, structure etc. hence it is the systematic divergence in the form between individuals of different sex. According to Dey and Kapoor, 2015, sex determination is considered as one of the significant and best criteria for the establishment of the identity of an individual. It is also very important in revealing and very much required in various medico-legal practice.

The anthropometric measurement plays a very vital role in the identification of the sex of any individual. Anthropometry is known as the earliest and best known method for the measurement of various body parts for the purpose of identification which is also considered and called as the Bertillon system for the investigation and identification of an individual or any criminal identification. In the present time there are various cases related with dismembered body parts which are happened because of various mass disaster or any natural disaster caused by the man or in case of any murder where identification of the body is very difficult.

For the measurement of hand various anthropometric landmarks are considered for the analysis of hand length and hand breadth. The landmarks of hands used for the dimension of hand length and breadth.

- Stylion- is a defined as the lowest point on the styloid process of the radius if the arm hangs sidewise. For locating the exact point, one has to palpate the entire lateral margin of the radius with the thumb-tip.
- Dactylion-It is defined as the lowest point on the anterior curved top of the middle finger, provided arm hangs sidewise.
- Metacarpale radiale- it is the most medially placed point on the head of the fifth metacarpal bone (on the stretched palm).
- Metacarpale ulnare- it is defined as the most laterally placed point on the head of fifth metacarpal bone, on the stretched palm.

The present study has been concluded so as to co relate and found the determination of sex with the help of the hand measurement. The objective of the present study is to investigate and identify the sexual polymorphism with the help of the Hand length, Hand breadth and the Hand index. The basis motive is to study the variables which can more firmly predict the sex of an individual.

Material and Methodology -

The present research work was based on the sample size of 100 subjects. The 100 subjects include 50 males and 50 females. The entire subjects are free from any deformity, injury or any kind of fracture or surgical issue. The age group which is considered for the measurement of the hand were between the ranges of 18 to 40 because at this particular age group the development of hand became stable and the maximum growth of the hand was attained.

The material used for the measurement of hand length and breadth are:

- Sliding Caliper
- Sheet
- Pencil

The measurement of hand was done by measuring the hand length and hand breadth of an individual.

Hand length- measured as straight distance from interstylion to dactylion of the middle finger.

Hand breadth- measured as the straight distance between the metacarpal radialis to metacarpal ulnare.

Hand index- the hand is measure as the variation between the hand breadth and hand length.

The subject was requested to wash their hand and was made to sit in relaxed state. Now they were asked to straight their hand on a flat surface so as to take the measurement. The measurement of hand length and hand breadth was taken with the help of the measuring instrument sliding calliper. The measurement from both the hand i.e. right hand and left hand. Hence wuth the help of the hand length and hand breadth the hand index was calculated.

The value of hand index is important as it is also helpful in describing the shape of the hand. Also on the basis of the shape of the hand there is the variation is seen in the hand of the individual which is helpful in the sexual determination between the male and the female.

Figure 1: Measuring of Hand Length by Sliding Caliper

According to Martin and Saller (1957) classification system of hand, the hand is divided into five types on the basis of the measurement of the hand index.

The types of hand classified depends on the value of the hand index are:

- Hyperdolichocheir- the hand having very long fingers and narrow smaller palm
- Dolichocheir- the hand having long fingers and narrow small palm
- Mesocheir- the hand having long fingers but short small palm
- Brachycheir- the hand having short fingers and long large palm
- Hyperbrachycheir- the hand is having short fingers with the comparatively larger broader palm.

Table No.1 Hand classification on the basis of the Hand Index Value

S. No.	Hand Index	Hand Classification
1	equal and less than 40.9	Hyperdolichocheir
2	41.0 - 43.9	Dolichocheir
3	44.0 – 46.9	Mesocheir
4	47.0 – 49.9	Brachycheir
5	equal and greater 50	Hyperbrachycheir

Result-

The collected sample are utilized and helpful in giving the new information for the analysis of hand for the sexual determination between the male and female.

The analysis of hand length and hand breadth was done by the measurement and the following data was collected.

Hand length

The average range of hand length varied from 17.5cm to 21.5cm in males and 16.4cm to 18.3 in females. And it was observed that the hand length was comparatively larger in males as compare to females. (Table No. 2)

The statistical analysis was done on the basis of the maximum and minimum length the mean and standard deviation was calculated. (Table 2)

Table 2: Hand length (in cm) of both Males and Females

Variables	Minimum Length	Maximum Length	Mean	Standard Deviation
Males				
Hand Length	17.8	21.5	19.65	2.616
Females				
Hand Length	16.4	18.3	17.35	1.343

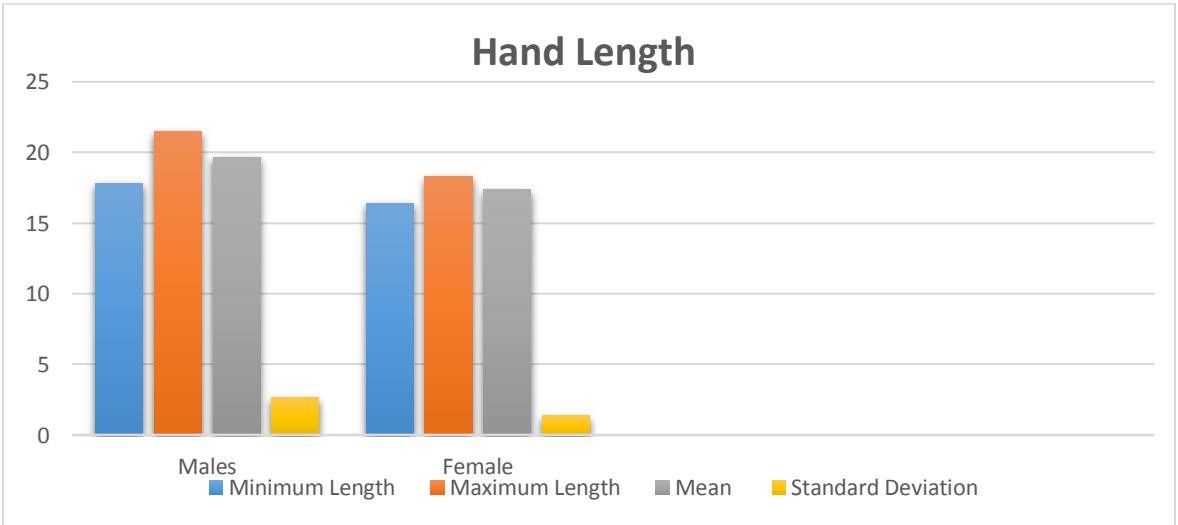

Figure No. 2 Graphical representation of Hand Length both Male and Female

Hand breadth-

Hence similar observation is done for the hand breadth analysis, the average variation of hand breadth is 7.4cm to 9.2 cm in males and 7.0cm to 8.6cm in females. It is observed that hand breadth is significantly larger in males as compare to females. (Table No.3)

Hence through the data the mean and standard deviation analysis was also calculated at which also reveals the same variation in males and females i.e. more in male and les in females. (Table 3)

Table 3: Hand Breadth (in cm) of both Males and Females

Variables	Minimum Breadth	Maximum Breadth	Mean	Standard Deviation
Males				
Hand Breadth	7.4	9.2	8.3	1.272
Females				
Hand Breadth	7.0	8.6	7.8	1.313

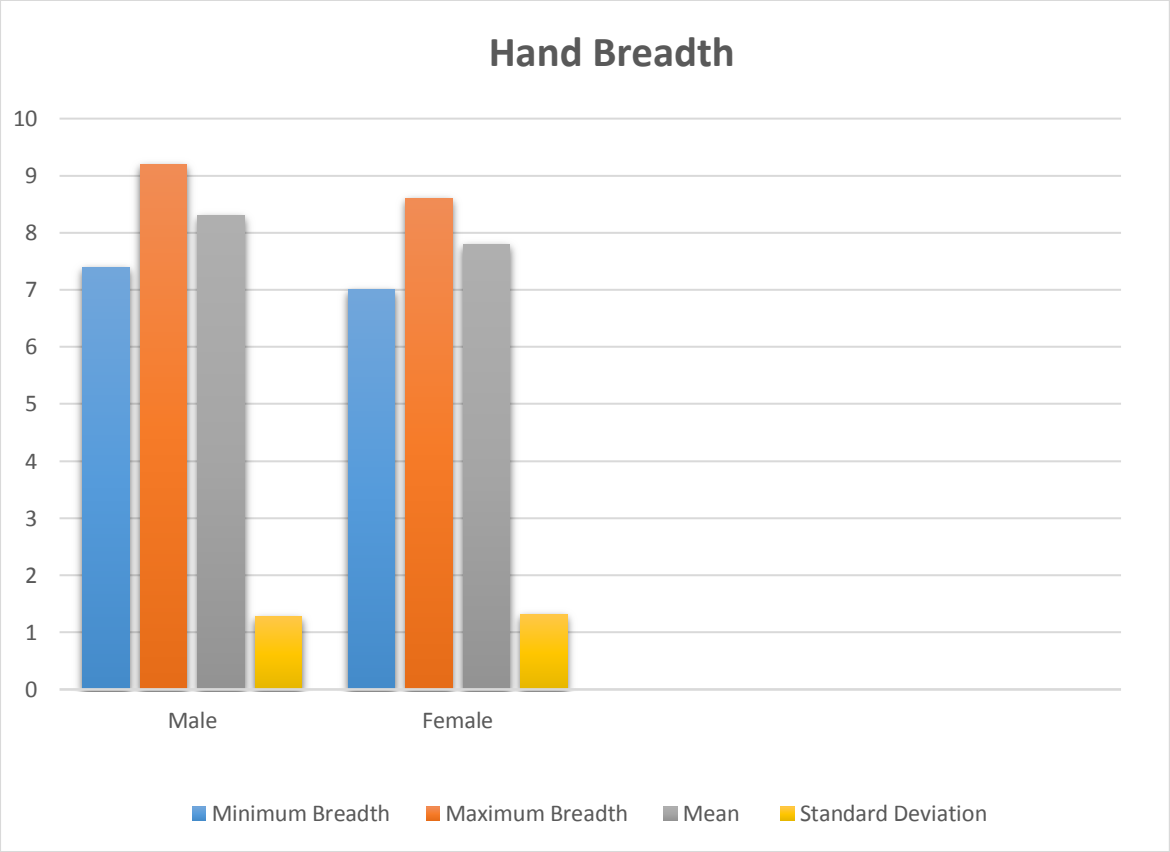

Figure 3 Graphical Representation of Hand Breadth of both Male and Female

Hand Index-

The descriptive analysis of hand index was also calculated for the classification of hand on the basis of the five categories mentioned above.

Hand index also gave variation between the male and female sample which are helpful in differentiating the male with the female. (Table 4)

Table 4: Hand Index of Male and Female

Sample	Male Hand Index	Female Hand Index
1	47.02	44.11
2	41.11	40
3	48.42	45.45
4	43.34	46.28
5	42	44.57
6	41.91	45.71
7	43.78	42.04
8	42.63	40.98
9	45.94	43.93
10	42.15	42.85
11	41.74	42.94
12	48.91	47.05
13	45.94	50
14	43.07	43.97
15	41.87	44.11
16	45.98	40.46
17	42.78	44.84
18	46.92	47.05
19	43.78	45.78
20	40.88	44.11
21	46.48	43.60
22	43.06	42.60
23	45.98	43.35
24	41.62	44.97
25	42.34	41.75
26	47.48	42.61
27	41.29	43.52
28	43.58	41.53
29	40.88	43.35
30	46.48	41.52
31	42.93	42.85
32	43.06	41.81
33	42.42	50
34	48.36	42.28
35	41.87	43.93
36	48.14	42.07
37	41.53	42.10
38	43.52	40.98
39	41.46	42.77

40	41.83	41.75
41	43.06	43.60
42	47.64	43.19
43	47.19	46.02
44	42.32	45.45
45	46.48	44.31
46	46.92	47.05
47	47.02	43.37
48	42.78	40.35
49	40.98	44.11
50	48.36	42.85

The analysis of hand index was helpful in differentiating the male and female samples and also it is later observed that the female are having the Dolichocheir type of hand more as compare to male.

Table 5 Hand Classification in Males and Females

Type of Hand	Male Hand Index	Female Hand Index
Hyperdolichocheir	4	3
Dolichocheir	26	28
Mesocheir	14	10
Brachycheir	4	9
Hyperbrachycheir	2	0

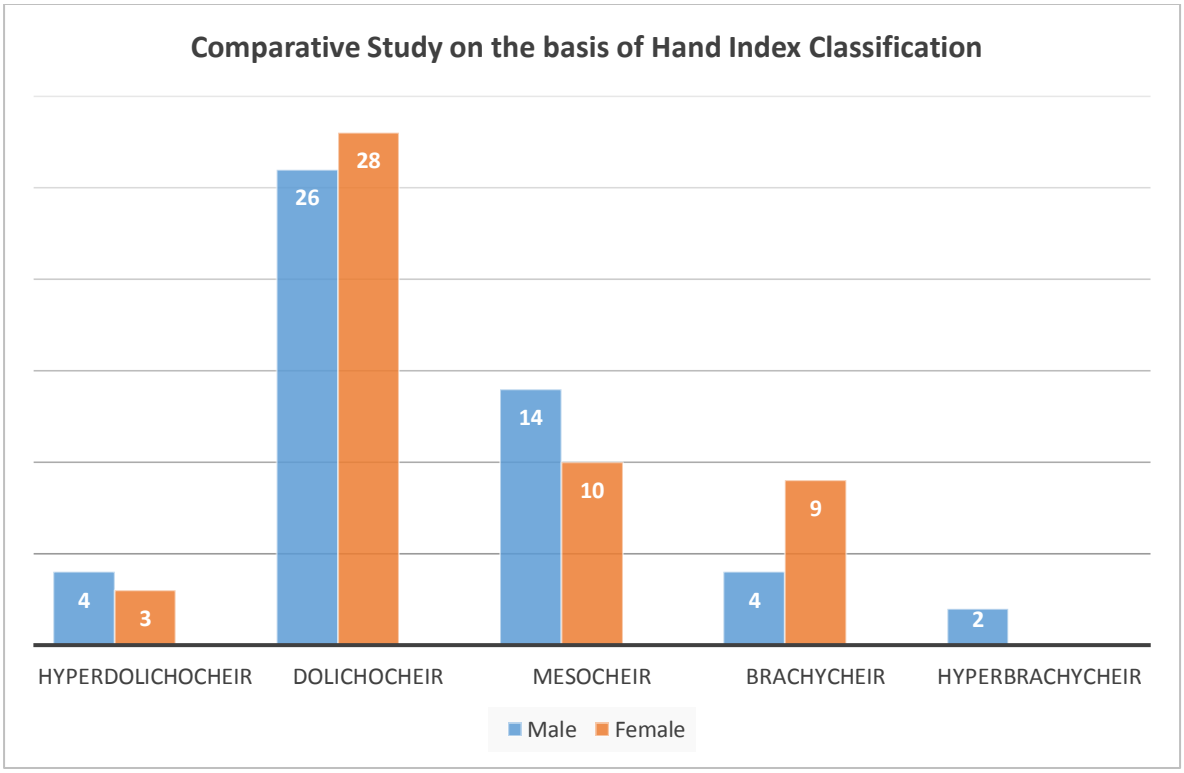

Figure 4 Graphical representation of hand index classification

Discussion

The sexual determination of an individual is such a challenging field for a forensic investigator as well as the anthropologist. Hence with the help of new methodology for the determination of sex is found a great application and is very much important in the future point of view as well. Hence the anthropometric measurement is helpful in the analysis of hand for the sexual dimorphism.

According to Dey and Kapoor in his research work use of the anthropometric measurement for the analysis of hand measurement was done. According to their study the measurement of hand length, hand breadth and hand index was used so as to differentiate the male and female sample and observed the sex determination from the hand dimensions focusing on the forensic identification. They use both the right hand and left hand dimensions for the analysis of hand and were observed that there was a bit of variation in the length of both right and left hand as well as the both left and right hand breadth whereas in the present study the sampling criteris use for the analysis was same as that of the measurement of hand length, breadth and hand index. Hence it is observed in the present study that there is no variation seen in the right and left hand dimensions, so the single hand measurement is identified in the paper which gave the same analysis. The male hand are found larger as compare to the female's ones.

Conclusion

From the present research work it is observed and concluded that the dimensions of hand can be successfully utilized and used for the determination of male and female and can be considered as the strong feature in sexual dimorphism. Among the various body parts, hand dimensions are considered as the most reliable and significant factor for the prediction of sex. Also the classification of hand type is helpful in analyzing that the females mostly belong to the dolichocheir group as compare to males. The present study is very much helpful in the detrmiantion of sex in the cases related with mass disaster, or in the cases where the body is difficult to identify. The databases is helpful in fulfilling the needs of forensic science and also as a very great evidential value in the future perspective of forensic science.

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Sexual Dimorphism Based on Comparative Study of Anthropometric Measurements of External Ear in Indian Population

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Abstract:

Anthropometric measurements are considered to be a significant part while studying physical anthropology. This branch of physical anthropology involves measurements of the human beings in order to understand the physical variations occurred in humans on the basis of measurements of their morphological and physiological traits. External ear morphometric measurement is also an attribute of such anthropological studies which helps in determining the age, gender but also leads to successful identification of an individual.

In the present study also, some physiognomic characteristics of external ear (shape of external ear and variation in ear lobe) along with the morphometric measurements and normal dimensions of total ear length and width (both right and left external ear) are taken from the population of India (North India) comprises of 100 individuals. The sampling procedure involves measurement from both males and females so as to make a comparison in such parameters which helps in determining the gender differences and thereby creates a data which leads to successful sexual dimorphism.

Key Words: *External ear, anthropometric measurements, physical variations, physiognomic characteristics, sexual dimorphism*

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Introduction

The ear is one of the significant feature of the face whose characteristics if studied cautiously proves to be highly unique. The study of ear is known as earology. The uniqueness owes to its external structure and morphology which aids in determining the age and sex of an individual. The uniqueness lies primarily in the morphological features because of the variation in the distinctive characteristics of ear shape, ear lobe shape, type of ear lobe and ear size. These characteristics are highly specific to a person and remains unchanged throughout the life of an individual except the increase in size of ear lobe during adulthood. In humans the features of external ear solely contributes to the identification of an individual and also in doing the gender differentiation (Brucker *et al*, 2003; Chattopadhyay and Bhatia, 2009).

The study of these characteristics is called Otomorphology which can also be defined as the study of physiognomy of the external ear (Singhal et al, 2016).

In humans external ear is primarily composed of auricle/pinna and external acoustic meatus, which has been used as one of the parameter for identification extensively (Murgod *et al*, 2013). This auricle is in the form of a trumpet attached to the lateral side of the skull and is directed downwards or forward to catch the sound easily. This auricle is generally made up of a yellow single elastic sheet of fibro cartilage that possesses various undulations (Singhal et al, 2016).

The auricle is further characterized by helix which represent to the edge of the ear or at the outermost rim, which begins to form in middle of ear as raised, considered as helix root. This portion is the posterior free margin of the auricle. Another part of the ear is the thick or raised ridge which is upwardly parallel with the helix in center of ear and hence also considered as the inner elevated margin (Landgren, 61-65; Csillag, 2-4).

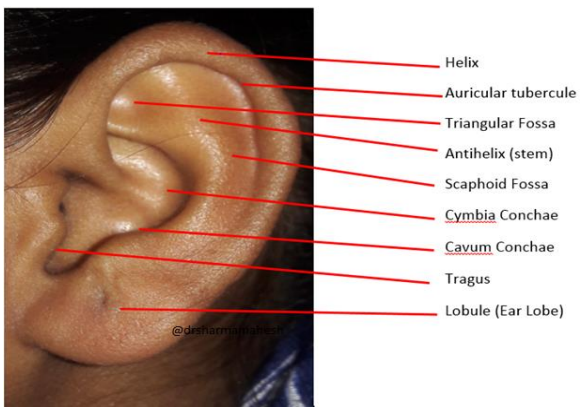

Figure 1 Morphology of External Ear (Original)

The development of ear pinna occurs during fourth to sixth weeks of gestation when the neural crest cells of first and second pharyngeal arches interacts with the surface of the ectoderm lying under these arches. During this time the arches starts developing in the pinna folds and are ready to get shifted on the head at their final position. This pinna or auricle is lined by the skin at its both sides and at its lower portion or at the base it possesses ear lobes or lobules auricular. These are composed of soft, fleshy connective tissues which is covered by the skin and the only part of the ear which is not supported by a cartilage. So, pinna or external ear is collectively composed of cartilaginous framework, connective tissues and muscles which are synthesized from the neural crest cells and head mesoderm respectively and its lateral surface faces slightly forward, irregularly shaped and shows numerous depressions (Kumar and Selvi, 2016; Ordu *et al*, 2014).

It has been studied by Adamson *et al*, (1965) that the growth of the ear occurs to its maximum before 3 years of age i.e. ear has developed up to 85% around this time period and it gets completed and the ear fully develops at the age of 20. After this age only ear lobes or auricle undergoes development due to the gravitational forces and therefore became elongated. The average length of the ear lobes is about 2cm which may vary slightly with the age (Kumar and Selvi, 2016).

These ear lobes show variations in their pattern or arrangement i.e. these may either be directly attached to the lateral side of the head called attached or fused ear lobes or these may be present hanging freely away from the lateral side of the head called as free or detached ear lobes (Ordu *et al*, 2014).

It has been reported by Altman in 1951, that the size and shape of the auricle varies from individual to individual and also in between different races. Also, the studies has been conducted which proves that existence of free ear lobule pattern among individuals is a dominant trait while the occurrence. The detached type is slightly bigger than the attached ear lobe of the attached lobule pattern is recessive trait (Verma *et al*, 2014).

Healthcote *et al*, 1995 in their research presented that the size of the external ear varies according to the ethnic groups and found that the height and width of the ear is greater in males than the females. Similar studies have been conducted on different populations to find the morphological differences in the external

ear of both males and females which provides fruitful results that help in understanding the variations.

As there exists differences in the ear length and breadth because of the variations in the ear dimensions occurred genetically or due to the increment in age the objective of this study is also the same to find out the variations in the external ear parameters of both right and left ear in males and females in order to carried out sexual dimorphism or gender differentiation based on these dimensions. Also, the pattern of ear lobe free or attached in both males and females is studied on the basis of their occurrence so that conclusive findings can be obtained which helps in gender identification among a wide group of individuals or distribution of population.

Materials and Method

Materials- a pair of Vernier Callipers, Pencil, Arm Chair, erasure etc.

Methodology

The study is conducted on Indian population comprises 50 males and 50 females belonging to age group 15-60 years with the use of vernier calliper (least count 0.01mm).

1) The subjects are allowed to sit on the chair with their head positioned natural in a way so that the subject is looked straight forward and anthropometric measurements of the external ear (pinna) are taken based on the international standard. The following measurements are taken with the help of vernier calliper.

a) Ear length/ height (both right and left ear) - It is measured as the distance between the highest point of auricle and the lowest point of ear lobe or the distance between the most superior point of pinna and most inferior point of ear lobe. The vernier calliper is placed at the defined points and the measurement is taken in both males and females.

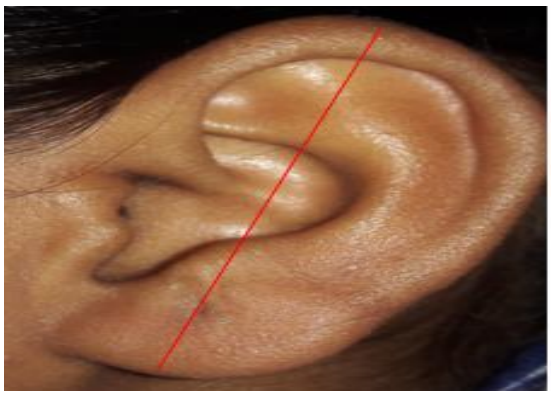

Figure 2- Measurement of Ear Length (Original)

b) Ear breadth /width (both right and left ear) - It is measured as the distance between the most anterior and the most posterior point of pinna. The measurement of the ear breadth is carried out by placing the vernier calliper on the defined points and recording of the reading in both males and females.

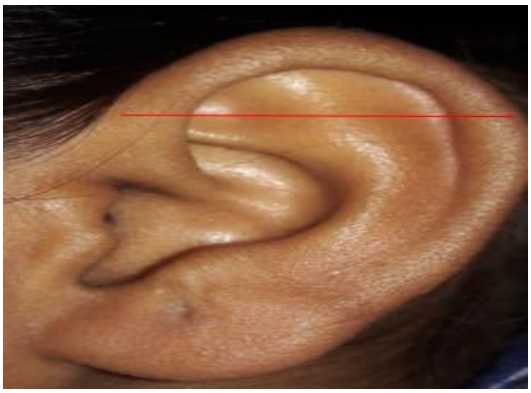

Figure 3- Measurement of Ear Breadth (Original)

2) The sampling procedure starts with the measurement of ear length first followed by the width and after these morphometric measurements the shape of the external ear along with the pattern of ear lobe free or attached is also observed and noted in both males and female ears.
3) The successful completion of the sampling is proceeded by recording the entire measurement data in a tabular form. A separate table for both males and females is prepared comprises the details of both right and left ear measurement.
4) The data collected is then studied statistically by determination of the mean and standard deviation for each measurements i.e. length and breadth of both right and left ear in both the genders.
5) At the last the data obtained for the occurrence of type of ear lobe pattern is then analysed for determining the maximum percentage of occurrence of both the patterns of ear lobe pattern in both males and females.
6) All the data collected and analysed helped in finding the differences in the gender on the basis of variation in measurable and observable parameters.

Results

In the present study conducted on the 100 samples of Indian Population (North India) the results provides valuable data related to the morphology of ear. The results obtained shows that there occurs variation in

the length of both right and left ear in both the genders which is tabularized below.

Table no. 1- Comparison of Length of Right and Left Ear in both Genders

Gender Distribution	Right Ear Length (Mean)	Left Ear Length (Mean)	Standard Deviation of Right Ear Length	Standard Deviation of Left Ear Length
Males	6.55	6.30	0.63	0.56
Females	6.1	5.92	0.47	0.48

In the table first quadrant shows the Mean of the length measurements of Right Ear in males and females i.e. 6.55 (For Males) and 6.1 (For Females), second quadrant shows the Mean of the length measurements of Left Ear in males and females i.e. 6.30 (for males) and 5.92 (for females). In the third quadrant standard deviation of the right ear length for both males and females is shown i.e. 0.63(for males) and 0.47(for females) and in the fourth quadrant also the standard deviation of the left ear length for both males and females is shown as 0.56(for males) and 0.48(for females) is shown.

The same results are shown with the help of a bar graph which shows variations in the length of right and left ear in both males and females.

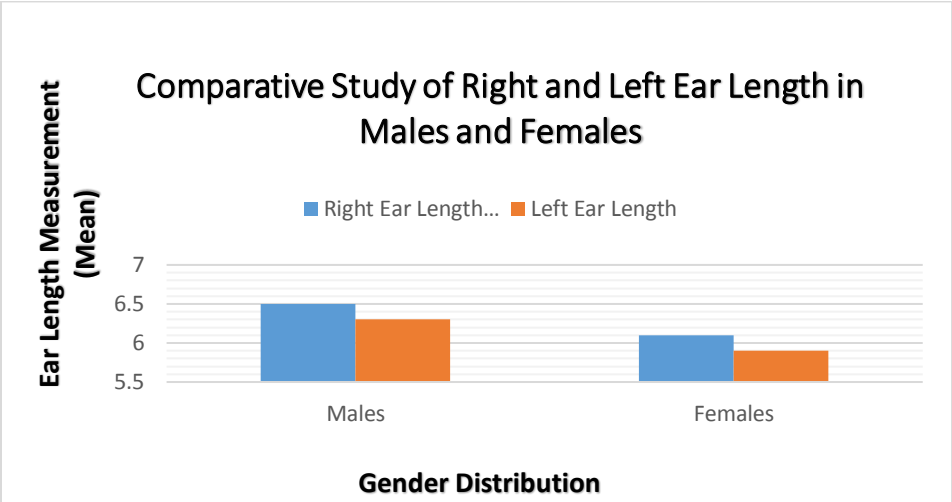

Figure 4- Graphical Representation showing Comparative Study of Right and Left Ear Length in Males and Females

Apart from the variations in length the present study also highlights the variations occurred in the ear breadth (in both right and left ear) in both males and females that have been tabularized below.

Table no. 2- Comparison of Breadth of Right and Left Ear in both Genders

Gender Distribution	Right Ear Breadth (Mean)	Left Ear Breadth (Mean)	Standard Deviation of Right Ear Breadth	Standard Deviation of Left Ear Breadth
Males	3.03	3.03	0.38	0.35
Females	2.81	2.89	0.48	0.36

The table above shows that data in the first quadrant represents the Mean of the breadth measurements of Right Ear in males and females i.e. 3.03(For Males) and 2.81(For Females), while the second quadrant shows the Mean of the breadth measurements of Left Ear in males and females i.e. 3.03 (for males) and 2.89 (for females). In the third quadrant standard deviation of the right ear breadth for both males and females is shown i.e. 0.38 (for males) and 0.48(for females) and in the fourth quadrant also the standard deviation of the left ear breadth for both males and females is shown as 0.35 (for males) and 0.36 (for females) is shown.

The same results are shown with the help of a bar graph which shows slight variations in the breadth of right and left ear in both males and females.

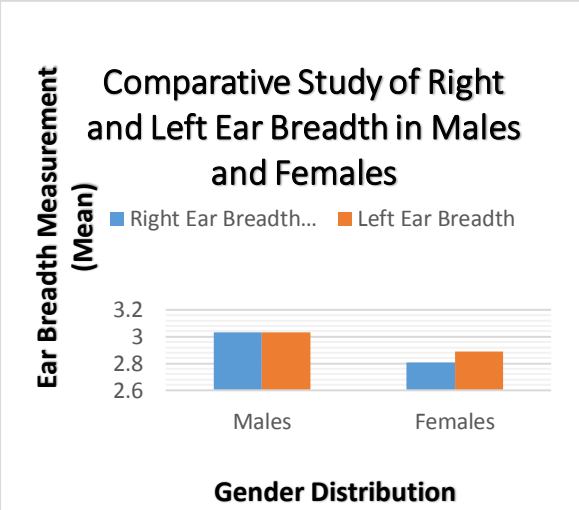

Figure 5- Graphical Representation of Comparative Study of Right and Left Ear Breadth in Males and Females

After finding variations in both the length and breadth of the ear measurements the pattern of ear lobe is studied and on the basis of the data prepared the percentage of occurrence of each free and attached type is determined in both males and females and depicted in the bar graph.

Table no. 3- Comparison of Ear Lobe Pattern in Both Genders

Percentage of Occurrence	Ear Lobe Pattern	Ear Lobe Pattern
	Free	**Attached**
Males	33 (66%)	17 (34%)
Females	19 (38%)	31 (62%)

The table shows a comparative study of the type of ear lobe pattern in both males and females based on the maximum percentage of occurrence.

In the table above the first quadrant shows the percentage of occurrence of free ear lobe pattern in males i.e. 66% in females i.e. 38% while the second quadrant shows the percentage of occurrence of attached ear lobe pattern in both genders i.e. 34% in males and 62% in females.

The same results are depicted in bar graph showing that the percentage of occurrence of free ear lobe in males is more as compared to attached ear lobe pattern i.e. 66% of males in the present study are having free ear lobe and only 34% of them is having attached ear lobe. Similarly, the frequency of females with attached ear lobe in this study is more i.e. 62% in comparison to those having free ear lobe as the rate is very low only 38%.

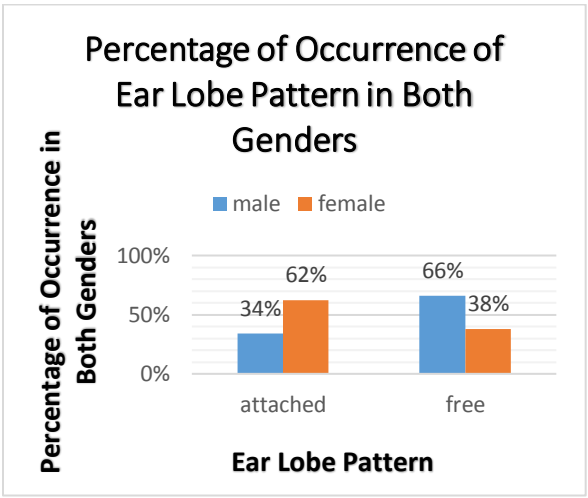

Figure 6- Graphical Representation showing Percentage of Occurrence of Ear Lobe Patterns in Both Genders

Based on the above study it is concluded that in the study the rate of occurrence of free ear lobe pattern is more in males (i.e. 66%) in comparison to females and the pattern of attached ear lobe is more in females (i.e. 62%) than in males.

Discussion

Human ear being a characteristic feature of face, helps in determination of age and sex of an individual based on the various parameters of external ear or pinna. In the present study it is determined that there occurs variations in the ear dimensions both of right and left ear in males and females respectively. The length and breadth of male ear is found to be greater than the female ear. Several studies have shown that there are differences in the ear size in both the genders and these are higher in males in comparison to females.

Healthcote *et al*, 1995 in their research presented that the size of the external ear varies according to the ethnic groups and found that the height and width of the ear is greater in males than the females and therefore in all the parameters men have larger ear then women. They also mentioned that the length and width of the ears increases with the increment of age.

Ferrario *et al*. 1999 worked on the population of Italy comprises individuals with in the age group of adolescence to mid adulthood and found that significant differences occurred in the ear dimensions of males and females. Like in males the width of the

ear males is greater than that of the females and also the mean length of ear in males is significantly higher than those of females.

Ito *et al*, 2001 have studied the morphological changes that have occurred in the adult human ear with the age shows a significant increase in the size in both men and women because the elastic fibers of human auricular cartilage undergoes development.

Brucker *et al*, 2003 in their study found that significant sex related differences occurred in the height or length of the external ear or pinna as this parameter is found to be larger in males than females by 6.5 % while only slight variations occurred in the width or breadth of right and left ears in both the genders. This difference occurs because of the expansion of the ear auricle which starts earlier in males than in males.

According to Shireen and Vrushali, 2005 there occurs differences in the external ear dimensions based on the morphometric measurements of external ear conducted on different population which showed the proof of existence of sexual dimorphism.

Murgod *et al*, 2013 in their study concluded that the external ear parameters shows variations in the length of ear in both males and females and the results of the mean length obtained are higher in males than those of females. They also suggested that the above results provides moderate to good (69–71%) sex assessment accuracy, which is considered as a useful parameter for estimation of sex in Indians.

Kumar and Selvi, 2016 in their study concluded that there occurs differences in the total ear length, width, length of cartilaginous ear and ear lobe length in Indian males and females and these parameters are higher in males than that of females. These variations in gender might occurs because of the influence of genetic factors which vary with sex.

The results obtained in the present study shows that the external ear parameters vary in both the genders i.e. there occurs differences in the measurements of mean length and breadth of both right and left ear in males and females. The study also reveals that these parameters are larger in males than in females. Apart from these features the occurrence of the pattern of ear lobe also shows variation in both the genders as it is observed that there is high frequency of occurrence of free ear lobe pattern in males i.e. 66% while the frequency of occurrence of attached ear lobe pattern is found to be greater in females i.e. 62%. This shows that majority of males possesses free ear lobe while females are found to have attached ear lobes.

Conclusion

The results of present study shows variations in the measurement of ear dimension with higher mean value of ear parameters in males than the females and also the occurrence of free ear lobe pattern is dominant in males and attached type pattern is dominant in females. These results of variation in the morphometric measurements and the distribution pattern of ear lobe of external ear helps in doing the successful gender identification and differentiation based on sexual dimorphism...

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Frequency and distribution of ABO and Rh blood group in North Indian population

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Abstract:

ABO blood group is often known as a histo - blood group system as its antigens are expressed on the surface of the red blood cells and in addition to that also present on most of the tissues and in soluble forms in the secretions. The second most important blood group system is the Rhesus system and it is categorized into two group Rh positive and Rh negative. Both the ABO and Rh blood group system are important for blood transfusion, organ transplantation, paternal testing, legal medicine, population genetic study and also in the field of forensic science investigation purposes. The study was conducted to determine the frequency of ABO and Rh blood group in Northern India Population (Delhi and nearby states). The Blood was collected from the voluntarily participated donors and blood group was determined by simple agglutination method. During the study total 584 donors were screened and the results showed that the commonest ABO blood group was O (40.70%) followed by B (30.79%), A (17.56%) and AB (10.95%), Rh positive 82.85% and Rh negative 17.15% were found. In males the O (25.75%) positive was more common while in female B (35.45%) positive blood group was more common.

***Key Words**: ABO, Rhesus factor, Blood groups, Antigens, Agglutination.*

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Introduction

The surface of the human red blood cell possesses various glycoproteins and glycolipids content which forms a variety of antigens (Faduyile F.A. et. al., 2016). Once these antigens formed during the fetal life it remains unchanged throughout the life until death. These blood group genes are inherited genetically from the both the parents to the child in Mendelian fashion (Bhavani et.al, 2016; Deepthi et. al., 2015). According to Bhavani et.al, 2016 around 400 different antigens are present on the surface of RBC in human blood and these antigens are divided into 30 blood group system by International Society of Blood Transfusion (ISBT). Therefore the blood group of an individual is the description of antigens that are presents on the surface of red blood cells (Faduyile F.A. et. al., 2016). Out of these 30 blood group systems, the ABO and Rhesus factor (Rh) are the two common and most important classification system. The ABO blood group system was first discovered in 1900 by Karl Landsteiner whereas the Rh system was discovered by Landsteiner and Weiner in 1941(Agrawal et. al., 2014).The ABO and Rh genes are located on chromosome 9 and 1 respectively (Deepthi et. al., 2015). These two systems together have a great importance in blood diffusion and organ transplantation purposes as many transfusion accidents results into high immunological responses, may even cause death of a person (Faduyile F.A. et. al., 2016).In addition to this it is also useful for the population genetic studies, population migration studies, resolving many medico legal issues, disputed paternity and plays a most vital role to narrow down the search area during criminal investigation in forensic the field of forensic science (Agrawal et. al., 2014, Das et. al, 2001).

On the basis of presence and absence of A and B antigens on the surface of RBC's the ABO blood group system is divided into four blood types i.e. A, B, AB and O. In this system A and B are strongly antigenic and are dominant alleles (when present in blood, expresses its character) whereas anti A and anti B are antibodies that are naturally present in the plasma of those individuals that does not contains A and B antigens on the surface of RBC's. These antibodies have the capability of produce hyperactive immunological responses during mismatch blood transfusion or organ transplantation (Garg et. al., 2014). Below is the table showing ABO blood grouping system.

Table 1: ABO blood grouping system

Blood Type	Antigen on RBC's surface	Antibodies in plasma	Compatible with	Incompatible with
A	A	Anti- B	O and A	A and AB
B	B	Anti- A	O and B	B and AB
AB	A and B	Neither	O, A, B and AB	AB only
O	Neither	Anti- A and Anti- B	O only	O, A, B, and AB

Apart from ABO blood grouping, the second most important system is Rh blood group system which comprises approximately 49 highly immunogenic antigens and the most significant antigen is D antigen. Individuals with D antigens are Rh positive and those who lacks D antigens are Rh negative individuals. D negative Individuals produces anti- D antibodies in their plasma and if they encounters the D antigen through blood transfusion then these antibodies causes hemolytic transfusion reactions. This becomes a problematic issue during pregnancy if the mother is Rh negative and the fetus have Rh positive cells. This condition causes hemolytic disease in the new born babies/fetus. So these types of problems can only be solved when blood group is prior and thoroughly checked in blood donors before transfusion and in mothers who are pregnant (Garg et. al., 2014; Singh et.al., 2015). Below is the table showing combined ABO and Rh blood grouping system.

Table 2: Combined ABO and Rh blood grouping system

Blood Type	Antigens present	Antibodies present	Compatible with	Incompatible with
Type A+	A and Rh antigens	B antibodies	A+, A-, O+, O-	B+, B-, AB+, AB-
Type A-	A antigen	B and Rh antibodies	A-, O-	A+, B+, B-, AB+, AB-, O+
Type B+	B and Rh antigens	A antibodies	B+, B-, O+, O-	A+, A-, AB+, AB-
Type B-	B antigen	A and Rh antibodies	B-, O-	A+, A-, B+, AB+, AB -, O+
Type AB+	Both A and B antigens and Rh antigen	None	A+, A-, B+ ,B-, AB+, AB-, O+,O-	None
Type AB-	Both A and B antigen	Rh antibodies	A-, B-, AB-, O-	A+, B+, AB+, O+
Type O+	Rh antigen	Both A and B antibodies	O+, O-	A+, A-, B+, B-, AB+, AB-
Type O-	None	A, B, and Rh antibodies	O-	A+, A-, B+, B-, AB+, AB-, O+

The entire human populations share the same blood group systems; although they differ only in the frequencies of occurrence of specific types. The distribution of ABO and Rh groups varies markedly in different races, ethnic groups, and socio-economic groups in different part of the world.

The data of availability of different blood groups in a region provide significant helps at various levels thus arises need of such studies and our research will definitely strengthens others studies. The aim of the present study is to determine the frequency and distribution of AB and Rh blood group patterns in North Indian population (Delhi and nearby states)and also compares the most frequent blood groups occurred in males and females (comparative analysis) within North India population India.

Material and Methods

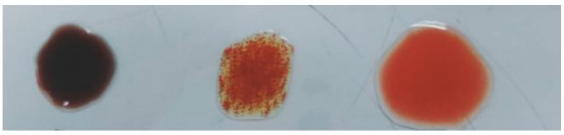
The study was carried out among 484 Individuals of North Indian population (Delhi and nearby states). The individuals of age group between 20 to 45 years, who has voluntarily participated were included in this study. The blood group was determined purely on the basis of agglutination formation.

Subjects – Out of 484 individuals, 264 (54.5%) were males and 220 (45.4%) were females, screened for their blood groups.

Collection of blood samples – The finger was firstly cleaned by cotton (dipped in ethanol) and then was pricked by a clean/ sterile lancet. The first drop was discarded or wiped by the cotton and then the next blood drops was taken on three different location on the same slide marked as A, B, Rh (D). The commercially available standard antisera's anti-A, anti-B and anti- D sera were used.

Table 3: Antisera used for respective blood group identification

Blood Group	A	B	Rh (D)
Anti-sera Used	Anti B	Anti A	Anti D



A B Rh (D)

Figure 1: ABO blood grouping by agglutination method (original)

Determination of Blood group – The blood grouping, (ABO) and Rhesus factor (Rh) was done using slide antigen-antibody agglutination method. Such as if anti-B agglutinates with blood and anti- D also agglutinates with Blood then the blood group of the person is A+. Similarly with B+ blood group, Blood will agglutinates with both anti-A and anti-D antisera. In case of AB+, all the three antisera will show agglutination with the blood. If blood drop is not agglutinated with anti-A or anti-B then it was considered as O blood group.

In case of Rh negative individuals the blood will not show agglutination with Anti-D.

Statistical Analysis – The percentage of individual blood group were calculated and then determined the most frequent blood group occurred in the population. In addition to this the comparative analysis was also done between males and females.

Observations and Results

The data was collected from 484 individuals. The frequency distribution of the ABO blood groups is shown in Table 4.

Table 4: Showing Frequency of ABO blood group system in north Indian population

S. No.	Blood Group	Subjects (male &female)	Percentage (%)
1.	A	85	17.56 %
2.	B	149	30.79 %
3.	AB	53	10.95%
4.	O	197	40.70%
5.	TOTAL	484	100%

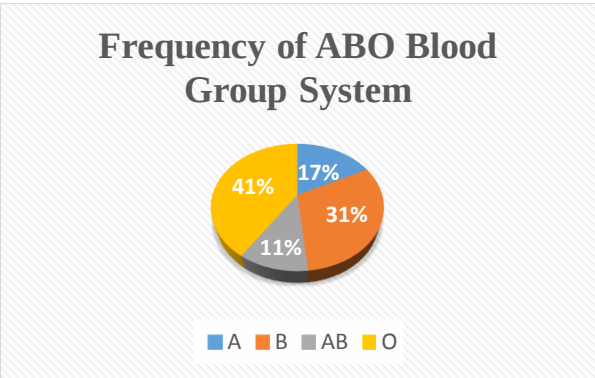


Figure 2: Pie chart representing Percentage distribution of ABO blood group system in North Indian population

The frequency distribution showed that the blood group O is the most common which has the highest frequency i.e. 40.48%, whereas the blood group AB has the lowest frequency i.e. 10.95 % among the North Indian population.

Based on Rh factor, it was found that the Rh positive individuals have high frequency than the Rh negative individuals. As shown in Table 5.

Table 5: Percentage distribution of Rh factor among North Indian population

Blood Group	Subjects	Percentage
Rh +	401	82.85%
Rh -	83	17.15 %
Total	484	100%

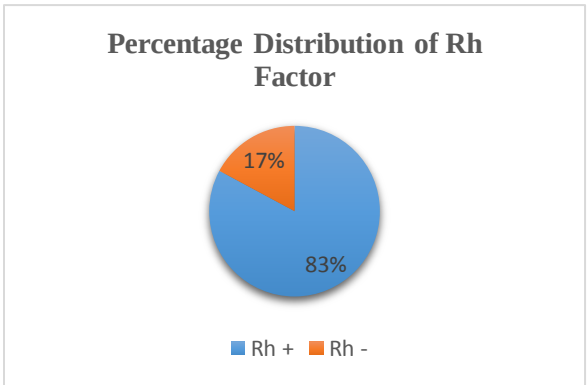


Figure 3: Piechart representing Percentage distribution of Rh factor among the individuals of North Indian population

Based on the overall analyses the frequency and distribution of ABO blood group and Rh factor in North Indian population it was found that the B+ blood group was the most common and has high frequency whereas the lowest frequency was found in blood group B- and AB-, shown in Table 6.

Table 6: Showing combined percentage data of ABO blood group and Rh factor in north Indian population

Blood Group	Subjects	Percentage
A+	77	15.9%
A-	8	1.65%
B+	145	29.95%
B-	4	0.83%
AB+	49	10.12%
AB-	4	0.83%
O+	130	26.96%
O-	67	13.84%
Total	484	100%

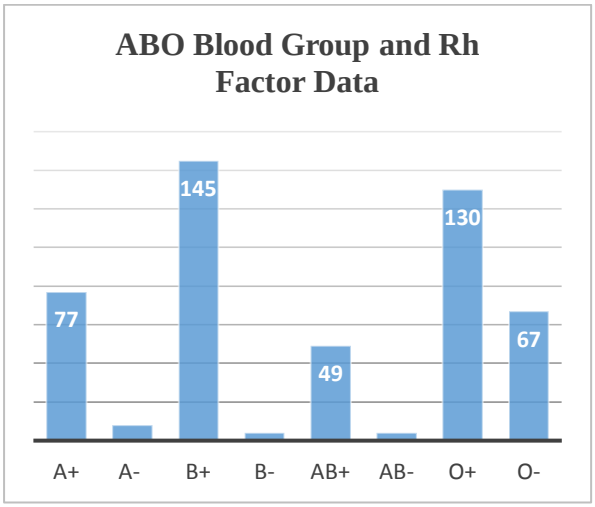


Figure 4: Graphical representation of Frequency and Distribution of Occurrence of ABO and Rh system in population.

The comparative study was also performed between the males and females. This has made to figure out the most common blood group (whether same or different) that occurs in males and females. After analyses, it was found that B+, O+, and O- were the most common Blood groups that occurred in males out of which the O+ has the highest frequency. In females the most commonly occurring blood group was B+ and O+ and the highest frequency was showed by blood group B+, shown in Table 7.

Table 7: Showing a comparative data of frequency and distribution of occurrence of ABO blood group and Rh factor in males and females of north Indian population

	Blood Group	Subjects	Percentage
Males	A+	35	13.26%
	A-	2	0.75%
	B+	67	25.38%
	B-	1	0.38%
	AB+	27	10.23%
	AB-	1	0.38%
	O+	68	25.75%
	O-	63	23.86%
	Total	264	100%
Females	A+	42	19.09
	A-	6	2.73
	B+	78	35.45
	B-	3	1.36
	AB+	22	10
	AB-	3	1.36
	O+	62	28.18
	O-	4	1.82
	Total	**220**	**100%**

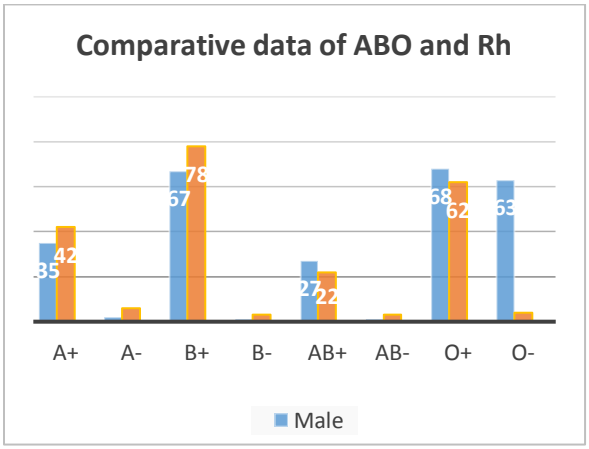


Figure 5: graphical representation of Frequency and Distribution of Occurrence of ABO and Rh in males and females

Discussion

The study of blood group and its frequency in a population has a great importance because of its clinical importance not only for the blood transfusion and organ transplantation cases but also has a vital role in the field of forensics, research studies, genetics, anthropology, pathology, determining migration of races etc. (Fauduyile et. al. 2016). The knowledge of ABO and Rh blood group and its distribution across the states, country and world plays an essential role in effective management of blood bank. There is a wide variation in the frequency of occurrence of different

types of blood group from place to place in different parts of the world.

All other studies has very less number of female donors such as 0.3% in Andhra Pradesh population (Bhavani et. al. 2016), 16% in Jammu population (Gupta et. al., 2016) and 0.23% in Kumaon Region of Uttarakhand (Garg et. al., 2014) but in our study female donors has also participated almost the same percentage as that of male donors. In our study it was observed that female donors has also a significant percentage 45.45% as that of males 54.5%.

In the present study, the ABO blood group in the total sample collected from north India population showed the same prevalence of occurrence as most of the other studies conducted in India i.e. blood group O has the highest frequency followed by B then A and the least frequent is AB blood group (O (40.70%) > B (30.79%) > A (17.56%) > AB (10.95%) in the population (Bhavani et.al., 2016;. Deepthi et. al., 2015; Handoo et. al., 2014: Periyavan et. al., 2010) but in some north Indian population studies the prevalence order is different i.e. B>O>A>AB (Gupta et. al., 2016; Singh et. al., 2015; Raja et. al., 2016). According to Fauduyile et. al. 2016 there were more people with blood group A than group B among blood group donor but in our study blood group B individuals are more than the Blood group A individuals among the blood group donor.

In our study the frequency of Rh positive was 82.85% whereas Rh negative was 17.15%. Our data is consistent and are similar to the data of other studies that have been carried out in different states of India. Rh positive group was found to be the predominant group (Deepthi et. al, 2015; Fauduyile et. al. 2016; Gupta et. al., 2016; Kaur et. al., 2016; Periyavan et. al., 2010; Raja et. al., 2016).

According to Giri et. al., 2011 amongst Rh positive male subjects, blood group B was found to be the most prevalent group (29.31%) followed by group O (27.89%), group A (26.42%) and group AB (7.75%) but in our study the most prevalent blood group was O (25.75%) followed by group B (25.38%), group A(13.26%) then group AB (10.23%). Amongst Rh-positive female subjects, blood group O was found to be the most prevalent (1.35%) followed by B (1.22%), A (0.89%) and group AB (0.50%) whereas in in this study the most prevent blood group was B (35.45%), O(28.18%), A (19.09%) and group AB (10%).

Conclusion

The present study concludes that the most common blood group is O and the least common is AB amongst the blood donors. Regarding Rhesus blood group system, Frequency of Rh+ were greater than the Rh- frequency. In males O+ have high Frequency and in Female B+ has high frequency in north Indian Population. This information helps other studies of different geographical regions in India and mostly in the field of transplantation and forensic medicine etc. However, it is suggested that further study shall be carried out over a course of long time interval so as to get a standardized data...

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Histomorphological comparison of human hair among Brahmins and Domars of Uttar Pradesh

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Abstract:

Scene of crime is rich in information that reveals the nature of the criminal activity and the identities of those person involved. During the course of a criminal investigation, many types of physical evidence are encountered from the scene of crime. One of the most commonly recovered evidence is hair in different cases like sexual assault, murder, mass disaster etc. Hairs help the investigators in scrutinizing the valuable information for potential leads. Human hair has both anthropological as well as forensic identification significance. Morphological and histological characteristics of human scalp hair have found its importance for racial classification, in forensic investigations, nutritional aspects and other biological studies. Anthropologists for a long time have recognized the colour, form and texture of the human scalp hair as a criterion for racial classification. In the present study, two diverse population groups (Brahmins and Domars) of Uttar Pradesh, India were considered and 823 individual's samples were collected. In which 418 were Brahmins and 415 were Domar ranging in the age of 10 to 70. Every single hair has been examined for the thirteen different features such as hair colour, hair shaft form, hair texture, hair quantity, hair distal end characteristics, medulla distribution, hair shaft diameter, medulla diameter, medullary index, scale shape, number of scales per unit (2mm) length, scale count index, hair index for studying the range of variability that exists in terms of histomorphological characters of hair among population of Uttar Pradesh, India.

Key Words: *Human Hair, Hair Colour, Hair Shaft Form, Hair Texture, Hair Quantity, Hair Distal End Characteristics, Medulla Distribution, Hair Shaft Diameter, Medulla Diameter, Medullary Index, Scale Shape, Number of Scales Per Unit (2mm) Length, Scale Count Index, Hair Index.*

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Introduction

During the course of a criminal investigation, many types of physical evidence are encountered as Sir Edmund Locard's principle (1930) also states that "whenever two objects come into contact, a transfer of material will occur. Trace evidence that is transferred can be used to associate objects, individuals, or locations" (Scientific Working Group on Materials Analysis, 1999). With the increasing rate of crime, identification of the person is the concern of the police and the identification is entirely based on fingerprints, hair samples, birth mark, eyes, voice etc. In all evidences, hair is one of the most common found evidence in majority of crime scenes. Human hair has been of interest to anthropologists, biologists and forensic scientists for establishing the identity or studying the variation. Human hair identifications are subjective interpretations of objective criteria. The variability and distribution of the microscopic characteristics are useful in determining whether or not a questioned hair could have originated from a particular individual.

It is recognized that hair comparisons do not constitute a basis for absolute personal identification. Whereas hairs cannot be positively identified as originating from a particular individual, it is unusual to find different people having the same hair characteristics.

In spite of processing like ageing, digestion and change in environment, hair is chemically most stable than any other biological sample. The microanatomy of the hair is characterized on its histological traits such as the cuticle, medulla, cortex, pigment granules, cortical fusi and others is important in the description of hair (Joshi *et al.,* 2012). Hair analysis can indicate whether the source is human or animal, and also whether the source is a member of a particular race. It can determine if the hair has been dyed, cut in a certain way or pulled out, and where on the body it was located. In some cases, evidence of poisoning shows up in the hair. Vernon J. Gerberth, in Practical Homicide Investigation, points out that hair (and fiber) evidence is useful in helping to establish the scope of the crime scene, placing a perpetrator at a scene, connecting a suspect with a weapon, supporting witness statements, connecting crime scene areas (abduction, vehicle used, dump site). Many chemicals and biological substances that accumulate in hair can be detected and measured and makes hair samples good resource biomaterials in forensic science and physical anthropology (Chang *et al.*, 2005).

Ever since the formulation by Huxley (1865) several anthropologist (Deniker 1900, Martin 1928, Hooton 1946, Koonz 1945, Garn 1948) have used morphological traits of hair for differentiation of human races. Interest in the microscopic aspects of hair was a relatively late phenomenon (Hausman 1925, Wynkoop 1929) and population variations in this world have not drawn much emphasis (Hrdy 1973, Das- Chaudhari & Chopra 1984). Marx (1906), metric and microscopic characters of humans have attracted the attention of forensic scientists, particularly due to its better chemical stability and resistance to decomposition as compared to other body tissues. It has been realized that hair evidence can provide useful clues to race, sex and site of the body. Das-Chaudhuri & Chopra (1983) have suggested the involvement of significant genetic component in the histo-morphological variables of human scalp hair thus highlighting their utility for studying population variations. Various histo-morphological hair parameters, such as medullation, hair index, medullary and scale count index have forensic applications for individualization (Chowduri 1963, Bhatis *et al.* 1971, 1976, 1980, Banerjee & Banerjee 1986) (Gaur *et al.*, 2007). The present study was undertaken on two diverse population groups (Brahmins and Domars) of Uttar Pradesh, India in which 823 individual's samples were collected for studying the range of variability that exists in terms of histomorphological characters of hair among population of Uttar Pradesh, India.

Materials and Methodology

Materials Required

In the present study, two diverse population groups (Brahmins and Domars) of Uttar Pradesh were considered and 823 individual's samples were collected. In which 418 were Brahmins (206 male and 212 female) and 415 were Domar (202 male and 203 female) ranging in the age of 10 to 70. For examination, a total of 25 scalp hair strands from different part of head were taken either by plucking or cutting methods after the written consent given by the subject. Every single hair has been examined for the thirteen different features such as hair colour, hair shaft form, hair texture, hair quantity, hair distal end characteristics, medulla distribution, hair shaft diameter, medulla diameter, medullary index, scale shape, number of scales per unit (2mm) length, scale count index, hair index. Below are the material used during examination:

1. Packets to collect sample
2. Stickers (to label the packet)
3. Marker
4. Tweezers (to pluck the hair)
5. Cotton
6. Methanol
7. Gloves
8. Magnifying Glass (to check the hair bulb)
9. Slides

10. Cover Slips
11. Tape
12. Dropper
13. Nail Polish (Transparent)
14. Compound Microscope
15. 5x, 10x, 15x eye Piece of Compound Microscope

The data were mainly collected from a house-to-house survey during October - November, 2010-2011. Hair samples were plucked from five different places i.e. Frontal, Temporal left, Temporal Right, Vertex Anterior, and Vertex Posterior on the scalp with the help of tweezers. The samples were collected in the transparent packets after numbering and mentioning all details by the marker. During collection of the sample care has been taken that the subject must be mentally and physically fit and were not blood relatives. The subject were grouped into six age groups of 10 years each. Age wise distribution of the sample is presented in Table 1.

Table 1: Distribution of the present sample in various age categories according to population groups and sex

	Population Groups		
Age	**Sex**	**Brahmins**	**Domars**
10-19	♂	44	36
20-29	♂	29	31
30-39	♂	66	59
40-49	♂	22	23
50-59	♂	11	16
60 &<70	♂	34	37
	Total	**206**	**202**
10-19	♀	37	37
20-29	♀	37	28
30-39	♀	63	63
40-49	♀	33	31
50-59	♀	20	18
60 &<70	♀	22	26
	Total	**212**	**203**

Methodology

Collected hairs samples were washed in tap water followed by soap water and then they were kept in distilled water. After blotting the dry hair were steeped in a mixture of Ether and absolute alcohol in equal proportions for 10 minutes. Then they were washed in xylene for 5 minutes and mounted in Canada balsam under square cover. The presence of artificial treatment such as dyes or rinses were identified through microscopical examination. After trace debris had been removed from items of evidence, appropriate types and number of hairs for examination were selected.

First the washed hair samples were visually examined for under the magnifications of 6X to 20X. All hairs strands were used for mounting on microscope slides for further examination. For proceeding further collected hairs sample were cut into the length of approx. 15 mm and covered with cover slip of 24mm x 40 mm. Each hair strand was examined under a microscope for hair shaft diameter, diameter of medulla, scale count, type of medulla, hair index, medullary index and scale-count index. Various measurements of the hair strands were taken in microns (0.001 mm) with the help of a monocular microscope fitted with a mechanical stage and having a calibrated ocular micrometer in the eyepiece. The scale of the ocular micrometer (having 100 small divisions) was calibrated against a stage micrometer (using a 15 x eye piece and a 40 x objective) the smallest division of which was 0.01 mm or 10-5 m or 10 μ.

Results

Collected 823 hair samples were examined for thirteen different features such as hair colour, hair shaft form, hair texture, hair quantity, hair distal end characteristics, medulla distribution, hair shaft diameter, medulla diameter, medullary index, scale shape, number of scales per unit (2 mm) length, scale count index, hair index for studying ethnic variation among Uttar Pradesh population. After visual and microscopic examination of all hair samples, the

statistical result was obtained for checking the significant and non-significant difference "ANOVA Analysis".

1. **Hair Colour –** Fischer–Saller scale is used to determine the shades of hair colour and the hair colour is classified into 4 categories as black, brown, grey and white. Table 2 shows the percentage wise distribution of hair colour, in which it's clearly visible that the brown colour is predominant in Brahmins and Domars (43.30 and 47.16 respectively) both, in comparison to other shades of hair colour.

Table 1: Percentage wise distribution of Hair Colour

S.NO	POPULATION	Black	Brown	White	Grey
1	**Brahmins**	31.10	43.30	13.39	12.20
2	**Domars**	32.84	47.16	11.60	8.40

2. **Hair Shaft Form –** According to Mollison's (1938), the hair shaft form is classified into Straight, Smooth, Flat Wavy, Broad Wavy, Narrow Wavy, Curly. Table 2 shows the percentage wise distribution of hair shaft form, in which it's clearly visible that the broad wavy hair shaft form (50.37) is predominant in Domars whereas smooth hair shaft form (38.84) is predominance in Brahmins in comparison to other type of hair shaft form.

Table 2: Percentage wise distribution of Hair Shaft Form

S.NO	POPULATION	Straight	Smooth	Flat Wavy	Broad Wavy	Narrow Wavy	Curly
1	**Brahmins**	5.89	38.84	26.98	19.87	12.12	1.95
4	**Domars**	1.23	7.41	11.36	50.37	25.93	3.70

3. **Hair Texture** – Hair texture was classified into three types as coarse, medium and fine. Table 3 shows the percentage wise distribution of hair texture in which it's clearly visible that the medium type of hair texture is predominant in Brahmins and Domars (49.76 and 67.65 respectively) both, in comparison to other type of hair texture.

Table 3: Percentage wise distribution of hair texture

S.NO	POPULATION	Coarse	Medium	Fine
1	**Brahmins**	15.07	49.76	35.16
4	**Domars**	24.69	67.65	7.65

4. **Hair Quantity** – Hair quantity is classified into five categories as Thin (100 or less), Medium (100-150), Normal (150-200), Thick (200-250), and Dense (250 or more) which is measured by the occurrence of hair strand in per-square-inch area. Table 4 shows the percentage wise distribution of hair quantity, in which it's clearly visible that the normal hair quantity (55.06) is predominant in Domars while Brahmins have predominance in medium hair quantity (29.66) in comparison to others hair quantity.

Table 4: Percentage wise distribution of hair quantity

S.NO	POPULATION	Thin	Medium	Normal	Thick	Dense
1	**Brahmins**	28.70	29.66	26.55	12.91	2.15
4	**Domars**	24.20	16.30	55.06	3.46	0.99

5. **Hair Distal End Characteristics –** Hair distal end characteristics were observed in each hair sample as following tapered tips (uncut), rounded or abraded, angular cut, and split. Table 5 shows the percentage wise distribution of hair distal end characteristics, in which it's clearly visible that the rounded or abraded hair distal end characteristics (45.43) is predominant in Domars while Brahmins have predominance in angular cut characteristics (29.43) in comparison to other hair distal end characteristics.

Table 5: Percentage wise distribution of Hair Distal End Characteristics

S.NO	POPULATION	Tapered Tips	Rounded or Abraded	Angular Cut	Split
1	**Brahmins**	18.42	22.97	29.43	29.19
4	**Domars**	25.68	45.43	4.44	24.44

6. **Medulla Distribution –** Medulla distribution are categorized into following types as continuous type, discontinuous type, fragmented type, and absent type. Table 6 shows the percentage wise distribution of medulla distribution in which it's clearly visible that the medulla is absent in Brahmins and Domars (34.92 and 32.84 respectively) both, in comparison to other type of medulla distribution.

Table 6: Percentage wise distribution of Medulla Distribution

S.No.	Population	Absent	Continuous	Dis-continuous	Fragmented
1	**Brahmins**	34.92	11.72	22.24	30.10
4	**Domars**	32.84	13.33	23.21	30.62

7. **Hair Shaft Diameter –** Hair shaft was the average of the shaft diameters of a hair strand recorded at five different places. Table 7 shows the percentage wise distribution of hair shaft diameter in which it's clearly visible that the Brahmins shows maximum hair shaft diameter (52.34 – male, 54.56 – female) whereas Domars shows the minimum hair shaft diameter (40.69 – male, 38.71 - female) in male and female both.

Table 7: Percentage wise distribution of Hair Shaft Diameter

S. No.	Population	Male		Female	
		Mean	S.D.	Mean	S.D.
1	**Brahmins**	52.34	4.425 (206)	54.56	2.082 (212)
4	**Domars**	40.69	2.356 (202)	38.71	2.349 (203)

8. **Medulla Diameter –** Medulla Diameter, if present, is the average of the diameters recorded at five different places over the entire length of each hair strand. Table 8 shows the percentage wise distribution of medulla diameter, in which it's clearly visible that the Brahmins shows the maximum medulla diameter (13.56 – male, 12.87 – female) whereas Domars shows minimum medulla diameter (12.59 – male, 10.91 – female) in male and female both.

Table 8: Percentage wise distribution of Medulla Diameter

S. No.	Population	Male		Female	
		Mean	S.D.	Mean	S.D.
1	**Brahmins**	13.56	0.186	12.87	0.265
4	**Domars**	12.59	0.983	10.91	0.872

9. **Medullary Index –** Medullary Index is the ratio between the mean diameter of the medulla and the mean diameter of the hair shaft. Table 9 shows the percentage wise distribution of medullary index in which it's clearly visible that the medulla index is higher in male in comparison to female in both the populations such as Brahmins and Domars.

Table 9: Percentage wise distribution of Medullary Index

S. No.	Population	Medullary Index	
		Male	Female
1	Brahmins	0.26	0.24
4	Domars	0.31	0.28

10. **Scale Shape –** Scale shape were categorized into following such as smooth-having, crenate- having and rippled-having. Table 10 shows the percentage wise distribution of scale shape in which it's clearly visible that the crenate scale shape is predominant in Domars and Brahmins (68.64 and 58.61 respectively) both in comparison to other scale shape

Table 10: Percentage wise distribution of Scale Shape

S. No.	Population	Smooth	Crenate	Rippled
1	Brahmins	23.20	58.61	18.18
2	Domars	22.72	68.64	8.64

11. **Number of Scales Per Unit (2mm) Length –** Table 11 shows the percentage wise distribution of medulla diameter in which it's clearly visible that the medulla diameter is maximum (25.91 – Brahmins, 27.91 – Domars) in male whereas minimum (24.0 – Brahmins, 25.81 – Domars) in female.

Table 11: Percentage wise distribution of Medulla Diameter

S. No.	Population	Male		Female	
		Mean	S.D.	Mean	S.D.
1	Brahmins	25.91	2.126	24.0	1.459
4	Domars	27.13	2.943	25.81	2.953

12. **Scale Count Index -** Scale count index was computed as the ratio between the diameter of hair in microns and the number of scales per unit length (2mm in this study) following Bhatia et al. (1976). Table 12 shows the percentage wise distribution of medullary index in which it's clearly visible that the scale count index is maximum (1.55 – Brahmins, 1.43 – Domars) in female whereas minimum (1.30 – Brahmins, 1.33 – Domars) in male.

Table 12: Percentage wise distribution of Scale Count Index

S. No.	Population	Scale Count Index	
		Male	Female
1	Brahmins	1.30	1.55
4	Domars	1.33	1.43

13. **Hair Index –** Hair index is the ratio between the lesser diameter of the hair and the greater diameter of the hair multiplied by 100 (Chowdhuri 1963). Table 13 shows the percentage wise distribution of hair index in which its clearly visible that the Brahmins male has maximum number (86.28) of hair index in comparison to Domars male whereas Domar females has maximum number (90.91) of hair index in comparison to Brahmins female.

Table 13: Percentage wise distribution of Hair Index

S. No.	Population	Hair Index	
		Male	Female
1	**Brahmins**	86.28	84.55
4	**Domars**	86.41	90.91

Discussion

Hair is most commonly encountered physical evidence in numerous crime scene and has both anthropological as well as forensic identification significance. In the present study, 823 hair samples of two diverse population groups (Brahmins and Domars) of Uttar Pradesh, India were collected for studying the range of variability that exists in terms of histomorphological characters of hair among population. Every single hair samples has been examined for thirteen different features such as hair colour, hair shaft form, hair texture, hair quantity, hair distal end characteristics, medulla distribution, hair shaft diameter, medulla diameter, medullary index, scale shape, number of scales per unit (2mm) length, scale count index, hair index.

In the present research, study on hair colour, hair texture and hair distal end characteristics in Indian population has been proposed. Brown hair colour is predominant in Brahmins and Domars both in comparison to other shades of colour but the occurrence percentage is more in Domars (47.16%). The medium type hair texture is predominant among Brahmins and Domars both in comparison to other type's hair texture but the occurrence percentage is more in Domars (67.65%). The rounded or abraded hair distal end characteristics (45.43) is predominant in Domars while Brahmins have predominance in angular cut characteristics (29.43) in comparison to other hair distal end characteristics.

There are few studies which is already present in the reference of the other traits like Das (1971) had studied on eight population groups from Assam and observed hair shaft form and hair density. In hair shaft form he observed that no population group showed straight and curly type hair whereas **Banerjee (1965)** had studied on seven different population groups and found that Pahira and Sabara shows a very high frequency of smooth type of hair. In Hair density, there was not a single population groups which fall under the 'thin' and 'dense' hair quantity type whereas in present study the Brahmins and Domars have 'thin' as well as 'dense' type of hair quantity. In present study, the broad wavy hair shaft form (50.37%) is predominant in Domars whereas the smooth hair shaft form (38.84%) is predominance in Brahmins in comparison to other type of hair shaft form. The normal hair quantity (55.06%) is predominant in Domars while Brahmins have predominance in medium hair quantity (29.66%) in comparison to others types of hair quantity.

Banerjee (1957), reported that the lowest incidence of medullation in Onge females (21.5%) and males (31.6%) whereas the highest incidence of medullation has been reported among Jarwas males (90.67%) by **Das-Chaudhari (1979).** Sharma et al. in 2002 studied on twins on Punjab and reported to have low incidence of medulla (32.54%). Altogether data on 35 population groups is available on the type of medulla property. **Banerjee (1962),** reported the highest incidence of the 'absent' medulla type among Onge males (91.00%) and the least among the Jarwas (9.63%). In present study, the medulla is absent in Brahmins and Domars both, 34.92% and 32.84% respectively, in comparison to other type of medulla distribution.

Das-Chaudhari & Chopra (1984) studied Indian population and reported that the highest shaft diameter was shown among the Oraons (95.95 µ) whereas least shaft diameter shown among Rajput's of Punjab (M=27.975 µ, F=29.573 µ), reported by Jasuja & Minakshi (2002). All other studied population also have diameter between 60 µ to 91.90 µ. But in present study the Brahmins and Domars shows shaft diameter below the normal range of other Indian population

studied. The hair shaft diameter in Brahmins is 52.34 µ – male, 54.56 µ– female whereas Domars shows the hair shaft diameter 40.69 µ – male, 38.71 µ - female.

According to the reports of Jasuja & Minakshi (2002), Gaur et al. (2007) and Sharma et al. (2002), medulla diameter among the males ranges from 7.28 µ (Rajputs of Punjab) to 15.68 µ (General population of Punjab). In the present study, Brahmins (13.56 µ) and Domars (12.59 µ) have their medullary diameters within range of those of other studied populations. As per the different survey, medullary index among the human populations is always below 0.33. Mistry et al. (2010) studied population of Bengalees and reported the least medullary index (0.09) whereas the highest medullary index (0.31 – M, 0.28 – F) has been reported in the present study among the population of Domars of Uttar Pradesh. Mistry et al., (2010) studied Benagalees population and reported that the crenate shape scale is predominant. Similar type of result was reported in present also. The Crenate shape scale is predominant in both the population's i.e Brahmins (58.61 %) and Domars (69.75 %).

Gaur et al., 2007 studied number of scales per unit length (2mm) and scale count index among the population of Punjabi Banias and Brahmins and reported that the mean number of scales per unit length does not show much variation among the studied population. In present study, scale count index is higher in females as compared to the males in both the population such as Brahmins and Domars whereas populations of Punjab show a reverse result the males show a higher scale count index as compared to their female. As per Gaur et al. (2007), Jasuja & Minakshi (2002) and Sharma et al. (2002) reported relatively lower hair indices among the general population of Punjab, Rajputs and some twins from Punjab males as compared to the presently studied Brahmins population groups. In present study, Domars female shows higher hair indices in comparison to Domar male.

Conclusion

Observation obtained in the present study support the work done previously by different researchers that the histomorphological traits such hair shaft form, hair quantity, medulla distribution, hair shaft diameter, medulla diameter, medullary index, scale shape, number of scales per unit (2mm) length, scale count index, hair index shows a significant variation and can be used to investigate inter-population variations...

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