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A Survey and Evaluation of Human Genetic Traits in Female Population of Chandigarh and Adjoining States of India

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Abstract: Physical traits are observable characteristics determined by specific segments of DNA called genes. Genes store the information needed for the cell to assemble proteins, which eventually yield specific physical traits. Most genes have two or more variations, called alleles. An individual may inherit two identical or two different alleles from their parents. In the present study eight traits were analysed among 1000 girl students of PGGCG-11, Chandigarh. Genetic analysis has revealed that in the present study 6% population is with colourblindness,28% population has blood group O+ and B+, 92% population with Rh +ve blood group, 78% population with normal cheek , 42% population with fused earlobes, 1% population with polydactyly, 55% non-rollers, 46% with hitchhiker's thumb and 69% with straight hair. The study of human genetics trait has practical value for human welfare and also gives us a powerful tool for understanding and describing human evolution.
Keywords: Colour blindness, curly hairs, roller tongue, polydactyly, genetic traits

I. INTRODUCTION

Physical traits are observable characteristics determined by specific segments of DNA called genes. Multiple genes are grouped together to form chromosomes, which reside in the nucleus of the cell. Every cell (except eggs and sperm) in an individual's body contains two copies of each gene.

This is due to the fact that both mother and father contribute a copy at the time of conception. This original genetic material is copied each time a cell divides so that all cells contain the same DNA. Genes store the information needed for the cell to assemble proteins, which eventually yield specific physical traits. Most genes have two or more variations, called alleles. An individual may inherit two identical or two different alleles from their parents.

When two different alleles are present they interact in specific ways. For the traits included in this activity, the alleles interact in what is called a dominant or a recessive manner.

The traits due to dominant alleles are always observed, even when a recessive allele is present. Traits due to recessive alleles are only observed when two recessive alleles are present.

For example, the allele for roller is dominant and the allele for non-roller is recessive. Every human being is unique having distinctive sets of traits. These traits are transmitted from generation to generation in the various patterns like Mendelian inheritance, co-dominance, sex-linked genes and polygenes.

In the present study eight traits were analysed among 1000 girl students of PGGCG-11, Chandigarh. These include eye vision, Rh factor, cheek, earlobes, fingers, tongue, thumb and hair texture.

It was concluded that 6% students were found to be colourblind, 8% students were with Rh-ve blood group, 22% with dimpled cheek, 42%with fused earlobes, 1% with polydactyl fingers, 55% with non-roller tongue, 45% showed Hitchhiker's thumb and 69%were with straight hairs.

II. MATERIALS AND METHODS

The present study was conducted on 1000 girls students of Post Graduate Govt. College for Girls, Sector-11, Chandigarh. Twenty students were selected and trained about the various human genetic traits. Through a Questionnaire these students themselves filled different traits under study. Then the data was interpreted and analyzed. The sample Questionnaire is as follows:

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MORPHO-GENETIC PARAMETERS OF ADOLESCENT GIRLS-2

1) Name:
2) Blood group Testing of blood group was analysed by ABO testing Kit by students
3) Hair a) Straight b) Curly
4) Cheek a) Normal b) Dimpled
5) Ear lobe a) Free b) Fused
6) Red-green color blindness a) Yes b) No
7) Thumb a) Straight Thumb b) Hitchhiker's Thumb
8) Finger/Toe a) Extra finger/toe b) Normal five fingers/toe
9) Tongue a) Roller b) Non roller

Signature of Student

III. RESULTS AND DISCUSSION

A. Colour Blindness In Human Population (Sample Size: 1000)

Eye vision is controlled by two alleles in the population for:

1. Normal vision 2. Color blind vision

Colour blindness is a recessive sex linked trait. It shows criss cross inheritance. The gene is present on X chromosomes.The father transmits the trait to daughter whereas mother gives traits to both son and daughter.Ishihara color test was used to diagnose red–green color deficienciesas explained by Gordon (1998).In the current survey, studies suggested that individuals carrying CC and Cc genotypes accounted for 94% with normal vision, while only 6% were found to be colorblind carrying homozygous recessive cc condition in females.The genotypes of the type of eye vision are depicted in Table1.

S.NO.	TRAIT	DOMINANT	RECESSIVE	GENOTYPE
1.	Eye vision	Normal	Colorblind	Cc, cc, cc
2.	Rh factor	+ve	-ve	HH, Hh, hh
3.	Cheek	Dimpled	Normal	Dd, dd, dd
4.	Earlobes	Free	Fused	EE, Ee, ee
5.	Fingers	Polydactyly	normal	FF,Ff,ff
6.	Tongue	Rollers	Non rollers	RR, Rr, rr
7.	Thumb	Straight	Hitchhiker’s	SS, Ss, ss
8.	Hair texture	Curly	Straight	HH, Hh,hh

Table1. Phenotype and Genotype of different Human traits

This suggested that though color blindness is a rare occurrence but it is still prevailing in population at a gradual rate which should be kept under check for future. Red green color blindness is caused by recessive gene. When mother is colorblind, all the sons will be colorblind and when father is colorblind, sons will be affected only if the mother is carrier or colorblind. Colorblind trait thus follows cris-cross inheritance. Red-green color blindness is a recessive sex linked trait, which causes more men to be colorblind than women. Color blindness is more prevalent among males because the genes are encoded on the X chromosome. Ishihara plates were used to identify color blindness. A father can’t pass his red-green color blindness on to his sons. If a woman is red-green colorblind, all her sons will also be colorblind. The percentage genotype of colorblindness (cc) trait is 6%. The percentage dominant genotype of the normal eye vision is 57.76% whereas the percentage genotype of normal but carrier trait is 36.24% indicating that in female population the percentage of recessive color blindness trait is less than 10%. The red-green colorblindness trait in the population plays an important role as the driving traffic lights have basic red, yellow and green color. The awareness about this recessive disease helps the population to find right mate so that the disease may not be expressed in the future generations.

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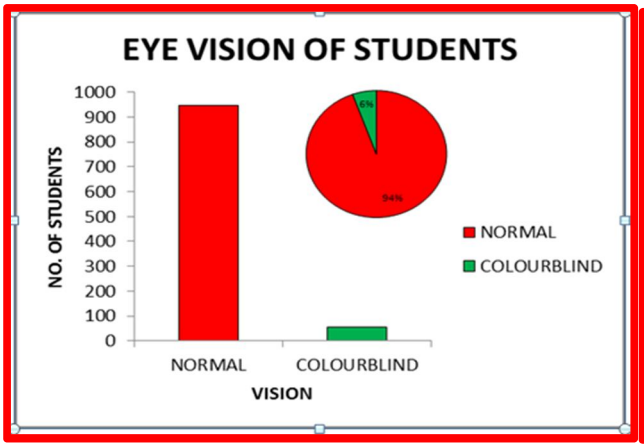

Fig.1

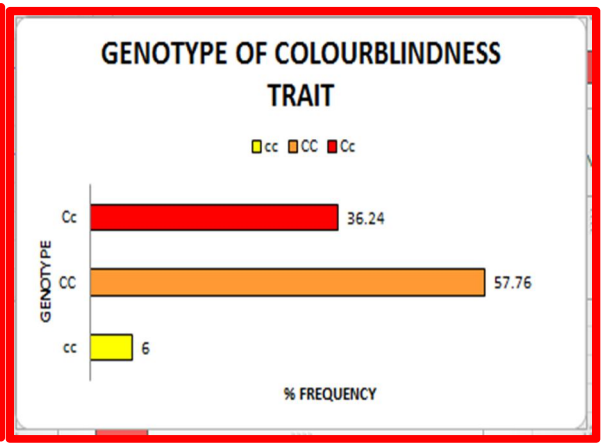

Fig.2

Fig.1 Histogram showing % of colourblind population
Fig.2 Histogram showing % of colourblind genotype in the population

B. Blood Groups In Man (Sample Size: 1000)

Tan and Graham (2013) reported that according to Karl Landsteiner there are four types of ABO blood group types present in the population.

1. A 2. B 3. AB 4.O

Blood groups are inherited from both mother and father. These blood types are controlled by three alleles (I^A, I^B, and i). Gene IA and IB are Co-dominant while gene i is recessive. According to Mohandas andNarla (2005) the antigens present on RBC are responsible foracting as receptors for extracellular ligands. The genotypes of these blood groups are depicted in Table 2

S.NO.	BLOOD GROUP	GENOTYPE
1.	O	Ii
2.	AB	I^AI^B
3.	A	I^AI^A, I^Ai
4.	B	I^BI^B, I^Bi

Table 2. Human Blood Groups

The current survey was conducted on 1000 girls at the Post Graduate Govt. College for Girls, Sector- 11, Chandigarh, the blood groups were analyzed from the girl students of age group between 19-24 years. Studies showed that blood group B was the most common blood group (31%) and blood group AB (14%) was the least common blood group. The following arrangement of genotypic frequency of blood group types among the population was recorded: ii>I^Bi>I^Ai> I^AI^B> I^BI^B>I^AI^A. Blood type showed variations in racial and ethnic differences in many countries.

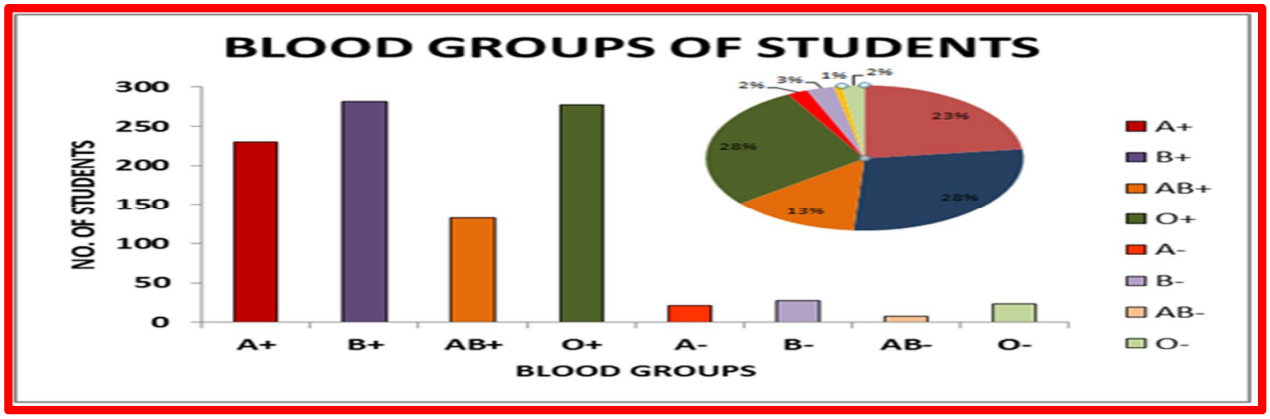

Fig. 3

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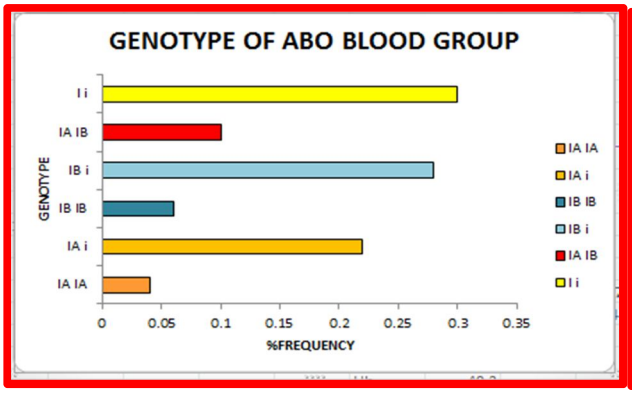

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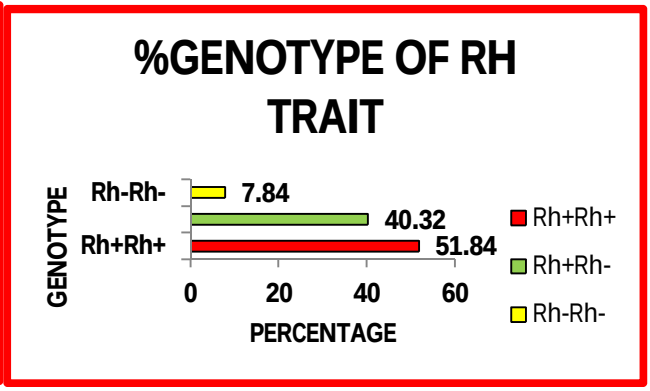


Fig. 5

Fig. 3, 4, 5. Genotype and phenotype of ABO Blood Group types

According to Bucher *et al.* (1976) in Asians population blood group O (43%), A (27%), B (25%) and AB (5%) was reported while in Blacks group O (49%), A (27%), B (20%) and AB (4%) and in Caucasians, group O (44%), A (43%), B (9%) and AB (4%). The frequency with which Blood types is determined by the frequency of three alleles of the ABO gene found in different parts of the world and its variation reflects the social tendency of populations to marry and reproduce within their national or regional groups The ABO blood group system is very excellent example of polymorphism, blood transfusion and paternitytesting,

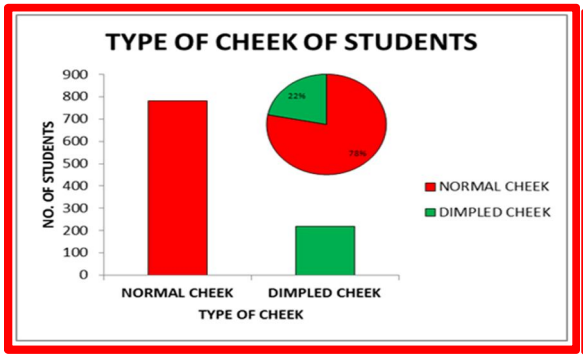
Distribution of Rh-blood group data in the survey also indicated that Rh-positive blood group (Rh^+ Rh^+) individuals contributed to about 51.84%, Rh^+ Rh^- (40.32%) and Rh^- Rh^- to about only 8%.The study revealed that the blood group B and O were the most abundant blood groups among girls in the region of Chandigarh, Punjab, Haryana, Himachal Pradesh, Uttaranchal, Uttar Pradesh and Delhi. 92% adolescent girls were with Rh+ blood group and 8% were with Rh- blood group (Table1).Rh incompatibility caused Erythroblastosisfetalis. Basu et al. (2011) explained that erythroblastosisfetalis occurred when an Rh-negative mother was impregnated by an Rh-positive father. The first Rh-positive baby survived but the second Rh+ child died due to this disease. Rh0(D) immune globulin at 28 week gestation were given to protect the child. For the healthy society the sensitization to the girls regarding Erythroblastosisfetalis is a very important issue. A lecture was organized to teach students regarding the problems faced due to blood group incompatibility and how to remain safe and healthy under different circumstances. Now it is very important in this generation to match the blood groups than the horoscope.

C. Types Of Cheeks In Man (Sample Size: 1000)

There are two phenotypes of cheek types in the population.

1. Normal cheek 2. Dimpled cheek

Cheek traits are controlled by genes that pass from parent to childas illustrated by Pessa*et al.* (1998). Dimples are small indentations on one or both sides of cheek. Cheek types are represented by two multiple alleles (D and d). Gene DD is homozygous dominant, Dd is heterozygous dominant and dd is homozygous recessive conditions persisting in human population.The genotype of these types are depicted in Table1. In the current survey on 1000girls, studies showed that 22% girls were with dimpled cheeks while 78% girls were with normal cheeks. dd was the most common type of genotype for simple cheeks accounting for about 78%, while homozygous DD and Dd heterozygous condition existed only in 1.44% & 21.12% population respectively.



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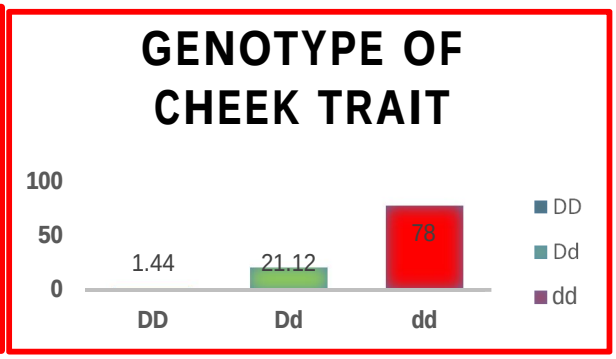

Fig. 7

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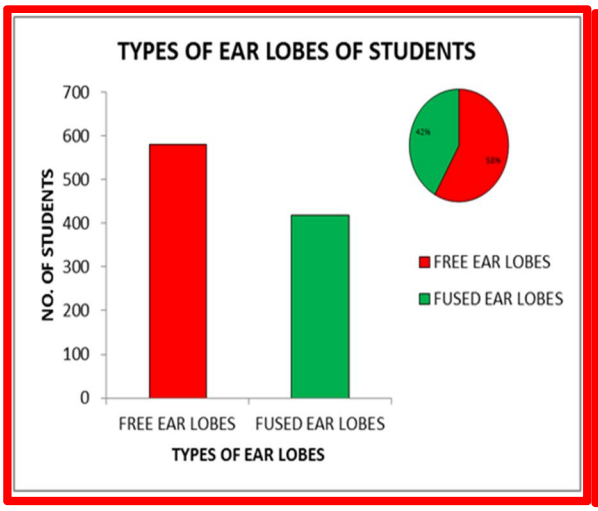
D. Types Of Ear Lobes In Man (Sample Size: 1000)

Ear lobes are controlled by two alleles E & e in the population for:

1. Free ear lobes 2. Fused ear lobes

Cruz-Gonzalez and Lisker (1982) reported that earlobe inheritance showed a simple Mendelian inheritance. The genotypes of the type of ear lobes are depicted in Table1. In the current survey, studies suggested that individuals with homozygous recessive allele ee type accounted for 42% with fused ear lobes, while persons carrying even one dominant allele E showed free ear lobes with 58%. This suggested that fused and free ear lobes occurs in almost the same ratio in the population. In fact, the heterozygous condition appears to prevail in maximum number in the population.



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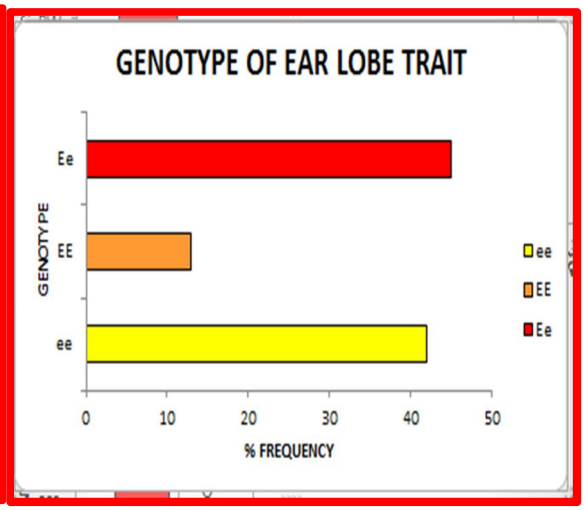


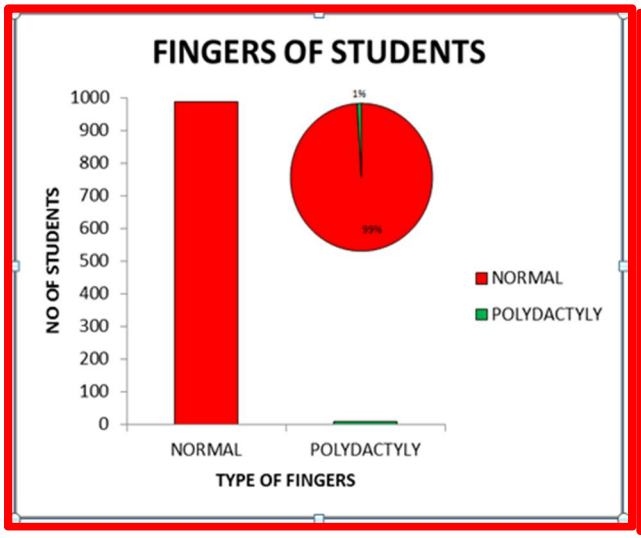
Fig.9

E. Types Of Fingers In Man (Sample Size: 1000)

Types of fingers are controlled by two alleles F & f in the population for:

1. Normal fingers 2. Polydactyl condition

In humans this condition can be present on one or both hands. The genotypes of the type of fingers are depicted in Table1. In the current survey, out of 1000 girls, 99% individuals with genotypes type ff showed normal fingers, while only 1% individual represented polydactyly as a rare condition in human population. It is caused by FF, Ff genotype in the population. According to Temtamy and McKusick (1978) the incidence of all types of polydactyly in Caucasian males was 2.3 per 1000 while in Caucasian females it was 0.6 per 1000.African males showed higher incidence of polydactyly (13.5 per 1000)than African females (11.1 per 1000).



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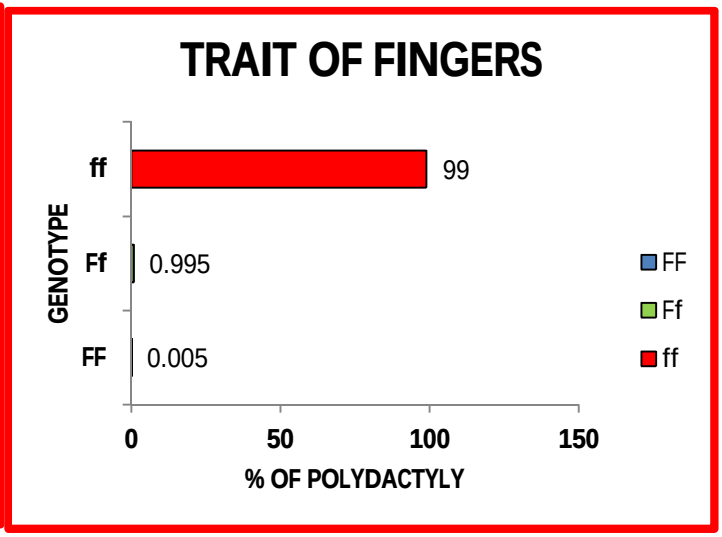

Fig.11

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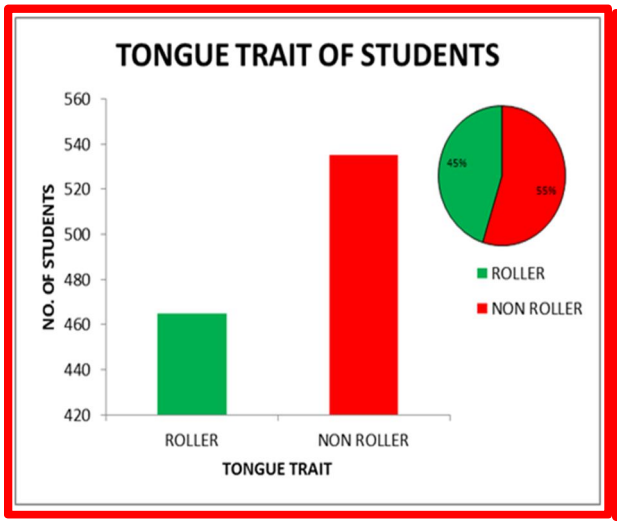
F. Types Of Tongue Trait In Man (Sample Size: 1000)

Human population is known to show two kinds of tongue traits as rollers and non-rollers represented by two alleles R & r in the population for:

1. Rollers 2. Non-rollers

Tongue rolling is the ability to roll the lateral edges of the tongue with the help of intrinsic muscles upwards into a tube. It was a dominant trait with simple Mendelian inheritance as explained by Mader (2000). The genotype of the tongue trait is depicted in Table1. In the current survey, the rollers accounted for about 45% with phenotype controlled by homozygous dominant alleles (RR) and heterozygous allele Rr, while the non-rollers individuals were represented by rr allele with a percentage of 55%.



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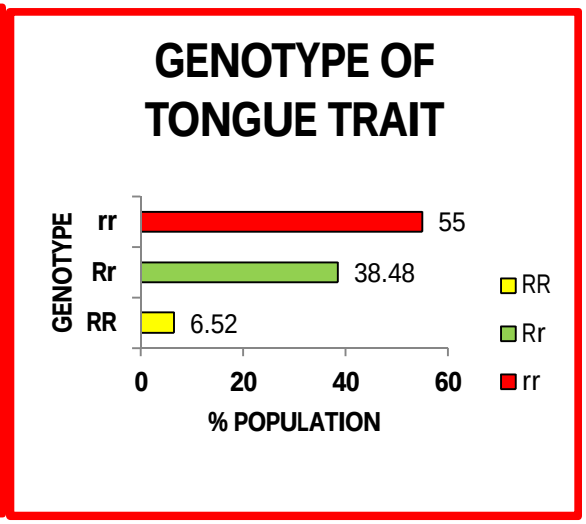
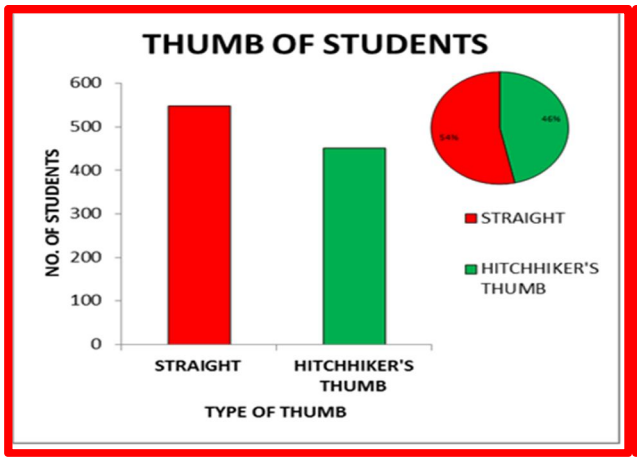


Fig.13

G. Types Of Thumb Trait In Man (Sample Size: 1000)

Hitchhiker's thumb is a thumb which is able to bend backward. It is a simplemendalian inheritance caused by recessive geneas reported by Beckman et al. (1960). The phenotypic expression of straight and Hitchhiker's thumb is represented by two alleles S & s in the human population.

The genotype of the thumb trait is depicted in Table1. The current survey of 1000 samples showed a high percentage of 45% individuals with Hitchhiker's thumb while presence of a single dominant allele S represented straight thumb trait in 54% individuals with SS genotype- 10.89% and Ss genotype – 44.11%.



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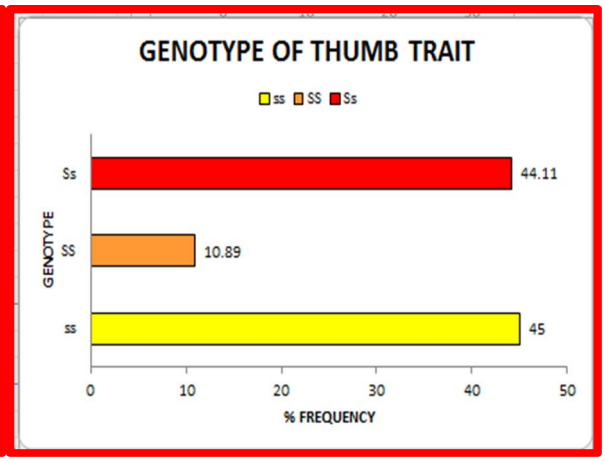

Fig. 15

H. Types Of Hair Texture In Man (Sample Size: 1000)

Hair texture in human population is controlled by two alleles H & h in human population i.e. straight hair and curly hair.The genotype of the hair texture is depicted in Table1. A sample survey of 1000 girls showed that 31% girls were with curly hair texture

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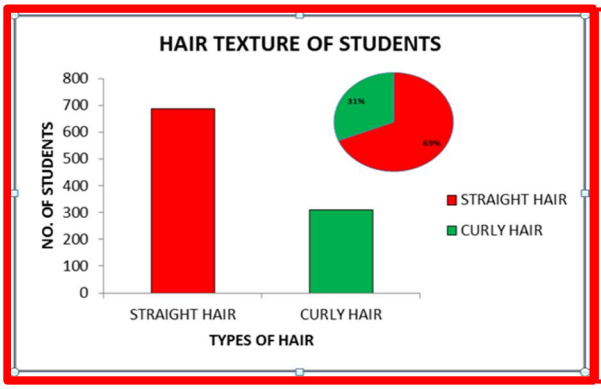
phenotype controlled by homozygous dominant and heterozygous HH and Hh genotypes respectively while straight hair accounted for recessive trait (hh). 31% students were with curly hair represented by genotype HH and Hh. 69% students showed straight hair.



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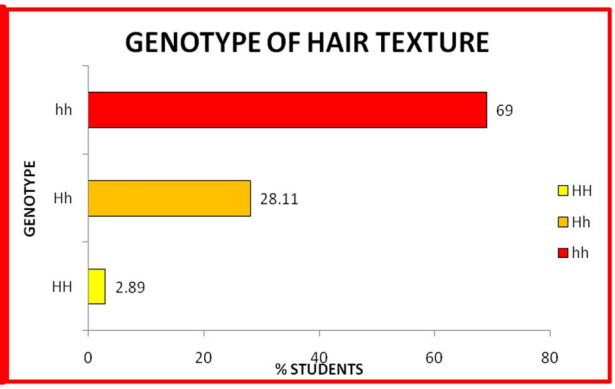

Fig.18

IV. CONCLUSION

In the present study different traits were studied like eye vision, blood groups, type of cheek, earlobes, fingers, tongue trait, thumb trait and hair texture among 1000 girl students hailing from north India studying in PG Govt. College for Girls, Sector-11, Chandigarh. These traits were easily observable and acted as good teaching tools in genetics. For example, ability to bend back the thumb (known as hitchhiker's thumb), the ability to roll tongue or whether one's earlobes are attached or free were all thought to have simple Mendelian inheritance patterns whereas the inheritance of colour-blindness showed sex linked inheritance.Red-green color blindness is a recessive, sex-linked inheritance. A woman with one recessive copy of the gene and one dominant, is "carrier" and not colour-blind. She has a 50% chance of passing the defective copy to each of her children. Half of her sons will be colorblind, and half of her daughters will be carriers. The ABO blood group system is determined by the ABO gene which behaves differently where allele I^A is dominant over i and allele I^B is also dominant over i and allele I^A and I^B when present together showed co-dominance. Genetic analysis has revealed that in the present study 6% population is with colourblindness,28% population has blood group O+ and B+, 92% population with Rh +ve blood group, 78% population with normal cheek , 42% population with fused earlobes, 1% population with polydactyly, 55% non-rollers, 46% with hitchhiker's thumb and 69% with straight hair. The study of human genetics trait has practical value for human welfare and also gives us a powerful tool for understanding and describing human evolution.

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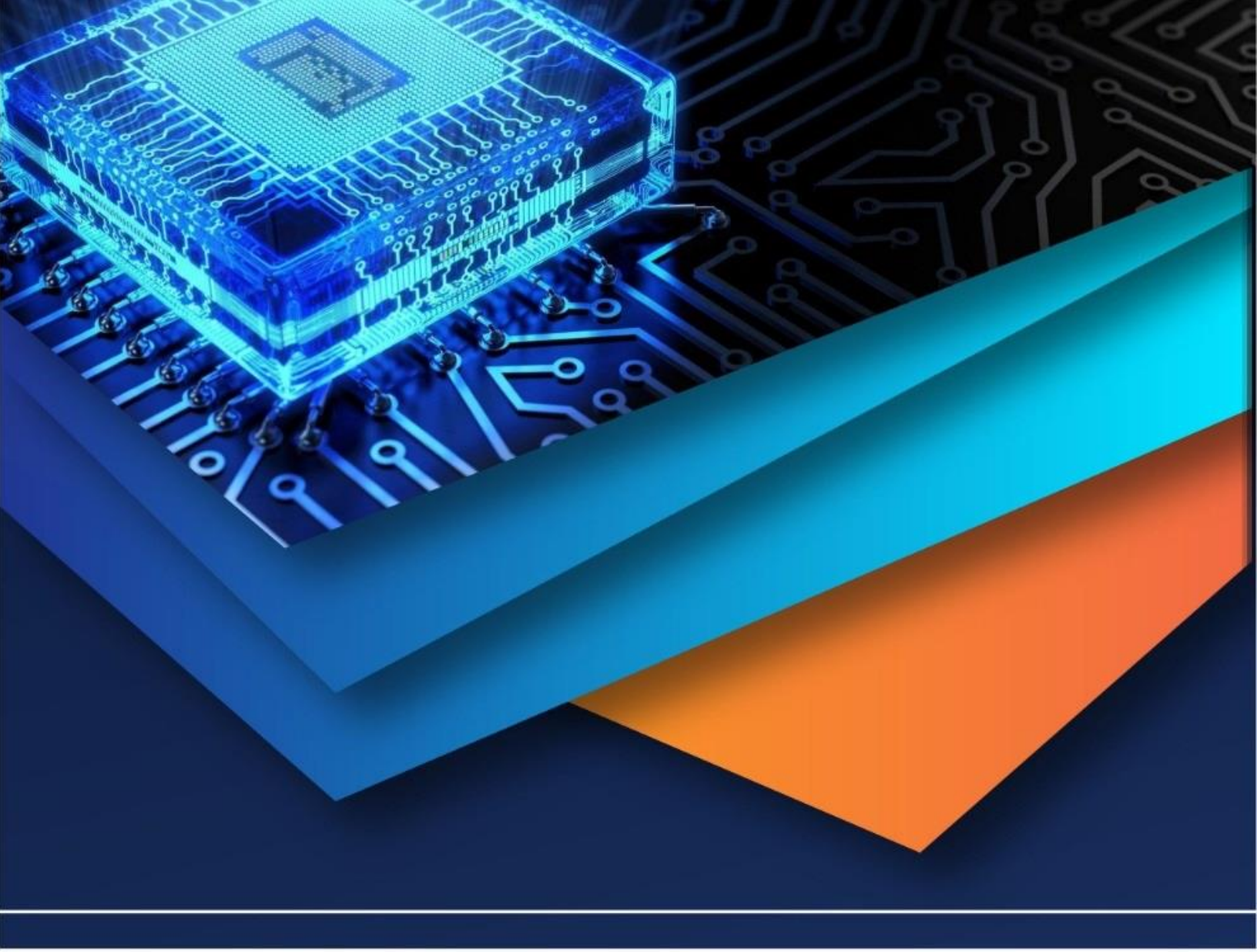

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