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Research Article

Independent distribution of blood group types and two genetically determined traits in a female population

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ABSTRACT

Certain traits in humans are known to be neutral in nature as they do not influence fitness of the individuals. Traits like ABO blood group, phenylthiocarbamide (PTC) tasting and ear lobe structure are genetically determined and follow Mendelian pattern of inheritance. Genes deciding their expression are situated on separate chromosomes and therefore would be certainly following independent assortment during gametogenesis. Data regarding association of these traits were collected from human female subjects to test whether blood group types show their dependency with other two features. An analysis in this regard clearly indicated that there exist no association between blood group type and PTC tasting and also between blood group and ear lobe structure.

Keywords: Blood group; PTC tasting; Ear lobe; Independent distribution; Female population.

1. INTRODUCTION

ABO blood group system was for the first time described by K. Landsteiner in 1900 [1]. The type of blood group in humans is decided by the presence or absence of specific antigens on the surface of red blood cell membrane [2]. The significance of ABO blood group is due to its compatible match between donor and recipient at the time of blood transfusion and organ transplantation [2]. There are reports that ABO blood grouping influences some physiological characteristics [3]. Association between blood group type and some pathological conditions have been reported, for example, people with blood group-A have been associated with increased risks of gallstones, colitis, and certain tumor types [4-6]. A number of researchers have suggested association between certain blood types and cardiovascular diseases [7-12]. Few studies have established association between ABO blood groups and oral diseases, specifically periodontal diseases (PDs) [13]. Quite early, studies indicated that there is association among blood group polymorphism with certain diseases especially between group O and peptic ulceration [14, 15]. Sporadic reports regarding association between blood group type and diseases have been received for example susceptibility to arterial and venous thromboembolism has been linked to blood group [16, 17]. There are evidences that blood group O provides a selective advantage against malaria [18-20]. There are other examples of infectious diseases in which the severity of infection can be directly linked to ABO phenotype.

Phenylthiocarbamide (PTC) is an organic substance which is also referred as phenylthiourea that contains organosulfur thiourea with a phenyl ring. This chemical can be tasted bitter or tasteless

depending on the genetic constitution of individuals. Those persons capable to tell its bitter taste are genetically dominant and could be genetically homozygous (TT) or heterozygous (Tt) whereas those who are unable to tell its taste (non-tasters) are homozygous recessive (tt) [21]. People all across the globe have been analysed for the frequency of taster and non-taster alleles (T and t respectively) and a significant variation among the individuals of different geographical origin have been recorded [22]. There are certain studies which have indicated that individuals with homozygosity of dominant alleles are able to taste this chemical more intensely than heterozygotes. The persistence of tasters and non tasters of PTC in all the populations is due to presence of heterozygotes harbouring both alleles [23].

One of the distinct morphological features of human ear is one's lower lobe (ear lobe) which may be free or attached. Ear lobe structure is a genetically determined trait and is known to follow Mendelian inheritance pattern. Persons having free ear lobe are either dominant homozygous (AA) or heterozygous (Aa) whereas, attached ear lobe results due to recessive homozygosity (aa) [2]. Association between blood group types and some genetically determined features have not been given substantial importance. A number of human morphological features have genetic basis of their inheritance and are known to follow Mendelian pattern of inheritance [24, 25].

This study was performed with an aim to see whether these three genetically determined features in human females show any relationship or not. Therefore, an association was tested between blood group type and PTC tasting to know that whether these two traits show random or non random association. Likewise, an association between blood group type and ear lobe structure was also undertaken.

2. MATERIAL AND METHODS

This study is based on observations of three genetically decided human features like one's blood group, PTC tasting ability and ear lobe structure. Females mainly students studying at Banaras Hindu University were randomly selected for this study. Blood group of the persons were determined by using A and B anti-sera procured from Biotec's blood grouping reagents. For this purpose, individual's blood was put at two spots on a cleaned glass slide to which A and B anti-sera were mixed separately. Based on the clumping of RBC of the drop of blood on the slide, blood group of the individual was decided. After knowing the blood group of the individual, a piece of paper soaked in PTC was served to her to know whether she can taste it or not. PTC is a chemical that can be tasted by a person depending on his or her genotype [26]. Those who can taste it are genetically dominant (TT or Tt) and those who do not taste this chemical are genetically recessive homozygous (tt). Females were categorized as tasters if they were clearly able to tell bitter taste of the chemical. Besides this, another feature, i.e., ear lobe was also seen in every subject undergoing this observation. Ear lobe may be free or attached showing dominant or recessive character respectively. Genetically dominant persons (AA or Aa) possess free ear lobe whereas persons bearing attached ear lobe are recessive types (aa). All the three features considered in this study follow Mendelian inheritance pattern.

Chi-square analysis was done to analyse data. Assuming that the two events occur independently, chi square was calculated following R x C contingency table. Probability less than 0.05 will indicate significant difference between observation and expectation, i.e., the two events are happening non-randomly.

3. RESULTS

Table 1 shows distribution of ABO blood types with those who could taste phenyl thiocarbamide (PTC). Interestingly the numbers of taster were found to be 65% than nontasters (35%) and tasters were always more in number for all the four different blood types in comparison to their respective non tasters types. Chi square (χ^2) analysis revealed that that there is nonsignificant difference between observation and expectation ($p>0.05$) indicating that these two features (blood group and PTC tasting) are independent in occurrence. Table2 depicts association between blood group types and ear lobe phenotypes. In this case also, the numbers of individual with dominant phenotypes (free ear lobe) were found to be significantly more than recessive types. Individuals with free ear lobe were

comparatively more than attached ear lobe with all the four different blood group types. Statistical analysis (χ^2) performed for this also indicated non significant difference between observation and expectation types ($p>0.05$) denoting that the two phenotypes are independent in occurrence.

Table 1. Number of observed and expected (in parentheses) ABO blood group types and tasters and non-tasters in a female population.

	Blood group				
	A	B	AB	O	Total
PTC tasters	17 (17.55)	16 (14.95)	13 (15.6)	19 (16.9)	65
PTC non-tasters	10 (9.45)	7 (8.05)	11 (8.4)	7 (9.1)	35
Total	27	23	24	26	100

$\chi^2 = 2.244$; d.f. =3; P = 0.52

Table 2. Number of observed and expected (in parentheses) ABO blood group types and free and attached ear lobe females in a female population.

	Blood group				
	A	B	AB	O	Total
Free ear lobe	19 (19.72)	15 (14.28)	12 (12.92)	22 (21.08)	68
Attached ear lobe	10 (9.28)	6 (6.72)	7 (6.08)	9 (9.92)	32
Total	29	21	19	31	100

$\chi^2 = 0.5258$; d.f. =3; p = 0.91

4. DISCUSSION

Although Anstee (2010) elaborated relationship between blood groups and diseases [27], ample information regarding association between different blood groups and some genetically determined traits have not been given any attention. This study was done with an objective to see whether blood group of individuals show dependency with certain traits like PTC tasting and ear lobe structure. In fact, all the three features, blood group type, PTC tasting and ear lobe structures (like free ear lobe and attached ear lobe) are genetically determined traits. Gene determining ABO blood group is located on chromosome 9, PTC taste determining gene on chromosome 5 and ear lobe gene found on chromosome 21. A number of human populations, all across the world have been screened for the allelic frequency of the ABO blood group (I^A, I^B and I^O), PTC tasters and non tasters alleles (T and t) and attached and free ear lobe (A and a) alleles. Since genes determining these three features are located on different autosomal chromosomes, one can expect their independent assortment during gametogenesis. A random occurrence of different combinations between blood group vs. PTC tasting and blood group vs. ear lobe structure was expected to exist in human populations. This analysis revealed exactly the same as there is no dependency between blood group and PTC tasting. Likewise, when ear lobe phenotype was considered along with individual's blood group, no such dependency was recorded. All the three traits chosen for this study are neutral traits, that is, they do not affect the fitness of the individual. Further, these three traits are also not of consideration when a couple selects each other for marriage. Therefore, these traits are not influenced by the phenomenon of selection. The distribution of ABO blood group people in specific population show a definite ratio like, persons of blood group-O always outnumber other types. Individuals with AB blood group are known to occur in less frequency than remaining others (A, B and O) [24]. The trend of occurrence of least fluctuating allele frequency exists in the population due to random mating and large size of human population. However, their associations with PTC tasting and ear lobe have not been determined so far. This observation enables us to explain that interdependency among blood group combinations and PTC tasting does not exist at all. Similarly the other associations tested between blood group and ear lobe also exist in random distribution. It can also be anticipated that other genetically determined morphological or behavioral traits like dimple in chin, tongue rolling, widow's peak etc., may not be dependent with blood group, provided the genes responsible for such traits do not show linkage with human blood group deciding gene.

Indian human populations have been considered for the distribution of different genetically determined features, for example, widow's peak, ear lobe structure, blood group types, dimple in chin,

rolling of tongue etc. [28-30]. These studies were done not only in urban people but also in a large number of ethnic groups and castes to see variation at the level of allelic distribution among such groups [31]. There are certain studies through which it has been stated that those who could strongly taste PTC were less likely to be smokers. This is an indication that those people who taste PTC bitter find the taste of cigarettes bitter and may be less likely to smoke. Likewise, results of certain research also suggest that there may be correlations between the ability to taste PTC and preferences for certain types of foods [26, 32].

AUTHOR'S CONTRIBUTION

AKS: Manuscript writing and statistical analysis. PY: Performing blood, PTC and ear lobe analysis (data collection). All authors read and approved the final manuscript.

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TRANSPARENCY DECLARATION

The authors declare that they have no conflict of interest.

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