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Study of Obesity in Relation to Blood Groups in a Randomly Selected Population of College Students

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ABSTRACT
In this particular study, the basic information of around 512 individuals was collected, such as their blood group, height, weight, age. The BMI of each person was calculated and then checked with their blood groups. The objective of this study was to find out which is major blood group, which blood group has a relatively high BMI and to know if there is any association between blood groups and BMI.

The blood group O (Rh+) was found to be more common, while A (Rh-) blood group was found to be insignificantly less in number. There is no strong association between blood groups and obesity (found by chi square probability). However, AB (Rh+) blood group individuals show a relatively higher mean BMI value than the others.

Keywords: *ABO, BMI, Obesity, chi square*

INTRODUCTION
Obesity is a multifactorial medical condition in which excess body fat has accumulated to the extent that it may have an adverse effect on health. It might be due to effects of many genes or is some cases a single gene is responsible (ref. Genes and obesity – Leif B. Anderson) or in few cases the environmental factors play a role. Environmental factors include such as food, lifestyle that alter the BMI of an individual. A gene known as FTO gene (fat, mass and obesity associated gene) is responsible for causing the problem. People with two copies of FTO gene are found on average to weigh 3-4 kgs more for a given age and have a 1.67% increased risk of obesity. Obesity is measured with the help of body mass index (BMI). Dividing a person's weight in kilograms (kg) by his/her height in meters (m), then divide the answer by height again gives the BMI. The normal BMI range of an individual is 18.5-25 kg/m^2. If the range is more than 25 and less than 30, it is considered as overweight. If the BMI value is more than 30, it indicates than the person is obese. Obesity is a major phenotype in several syndromes, such as PraderWilli syndrome, BardetBiedl syndrome, Cohen syndrome, and MOMO syndrome. Studies that have focused on inheritance patterns rather than on specific genes have found that 80% of the offspring of two obese parents were also obese, in contrast to less than 10% of the offspring of two parents who were of normal weight.

There are various studies previously conducted coupled with the correlation of blood groups and BMI (Ref. Association of ABO Blood Group and Body Mass Index: A Cross-Sectional Study from a Ghanaian Population – Samuel Smith, Isaac Okai, Chrissie Stansie Abaidoo, and Emmanuel Acheampong). ABO blood groups have been associated with various different diseases which have come to cause many risks, mostly chronic diseases and many cancers (ref. Relation between ABO blood groups and obesity in a Saudi Arabian population – Turki A. Alwasaidi, Akram A. Alandijani, Correlation between the blood groups; BMI and pre-hypertension among medical students – S. Bhattacharyya, Ganaraja Bolumbu, M. Ramesh Bhat).

Though many previous studies have been attempted to establish a relation between these diseases and obesity and its inheritance, very few have been known to be successful in establishing its familial aggregation (Saikruthi ref.).

The ABO gene is present on the 9th chromosome; responsible for the different blood types. According to

some previous reports, there are certain antigens present that monitor the food habits in individuals. ABO antigen has been reported to be a risk factor for cardiovascular & infectious diseases, allergies and some cancers (ref. Blood group, hypertension, and obesity in the student population of northeast bosnia and herzegovina – Amela Hercegovac, Edina Hajdarević, Snježana Hodžić, Emir Halilović, Aldijana Avdić, Mirela Habibović). Over the past five decades, blood grouping have acquired immense importance, the reason being the reported association of ABO groups and certain diseases. However, a full association is yet to be established scientifically.

METHODOLOGY

As this is a study based survey, a questionnaire has been prepared which consisted of several questions briefing about the individuals' name, age, height, weight, BMI and blood group (ref. A research on relationship between ABO blood groups and body mass index among Turkish seafarers – Nas S, et al. Int Marit Health 2017). After the information has been gathered the major blood group in the survey is checked for.

Chi square analysis is utilized to understand if there is any relation between blood groups and obesity. A chi-squared test, also written as χ^2 test, is any statistical hypothesis test where the sampling distribution of the test statistic is a chi-squared distribution The chi-squared test is used to determine whether there is a significant difference between the expected frequencies and the observed frequencies in one or more categories. The observed values are the values that are known to us. The expected value can be calculated as

$$\text{Expected value} = \frac{Row\ total\ x\ column\ total}{N}$$

Chi square analysis is done using the formula

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

That is, $X^2 = \sum \frac{(Observed\ value - Expected\ value)^2}{Expected\ value}$

X^2 follows the χ^2 distribution with $k-$ 1 degrees of freedom.

Degrees of Freedom = (no. of rows – 1) x (no. of columns – 1).

RESULTS

Mean/Relative BMI

1. AB – ve = 21.15
2. A – ve = 21.90
3. B – ve = 22.93
4. O – ve = 22.12
5. AB + ve = 23.44
6. A + ve = 23.22
7. B + ve = 23.27
8. O + ve = 22.81

Blood group distribution table

Observed Value	A	B	AB	O	Row Total
Normal	60	91	10	122	283
Underweight	9	18	6	32	65
Overweight	19	51	8	61	139
Obese	5	12	2	8	27
Column Total	93	172	26	223	514

Degrees of freedom = (4-1) x (4-1)
= 3 x 3 = 9

Expected Value	A	B	AB	O
Normal	51.2	94.7	14.31	122.78
Underweight	11.76	21.75	3.28	28.2
Overweight	25.14	46.51	7.03	60.3
Obese	4.88	9.03	1.36	11.71

χ2=(OBSERVED-EXPECTED) 2/EXPECTED				
	A	B	AB	O
	1.51	0.14	1.298	0.005
	0.64	0.646	2.25	0.51
	1.499	0.433	0.133	0.008
	0.0029	0.976	0.3	1.17
Total (χ2)	**3.6519**	**2.195**	**3.981**	**1.693**

χ^2 = 3.6519 + 2.195 + 3.981 + 1.693 = **11.5209**

Rh distribution table

Observed Value	Rh +Ve	Rh -Ve	Row Total
Normal	271	13	284
Underweight	63	4	67
Overweight	132	4	136
Obese	27	0	27
Column Total	298	13	514

EXPECTED VALUE	Rh +ve	Rh -ve
NORMAL	164.65	7.18
UNDERWEIGHT	38.84	1.69
OVERWEIGHT	78.84	3.43
OBESE	15.65	0.68

Degrees of freedom = (2 – 1) x (4 – 1)
= 1 x 3 = 3

$\chi 2$=(OBSERVED-EXPECTED)2/EXPECTED		
	Rh +ve	Rh -ve
	0.646	4.717
	15.02	3.157
	35.84	0.0947
	8.231	0.68
TOTAL($\chi 2$)	59.737	8.6487

$\chi^2 = 59.737 + 8.6487 =$ **68.3857**

Discussion

According to the percentage point's chi square distribution table, taking the probability of χ^2 as 0.05 and degrees of freedom as 9, the predictable table value is 16.92. If the calculated chi square value is greater than the hypothetical value, then the assumptious association is not held true. Hence it is deduced that there is no proper association between blood groups and obesity. Same is the case with the Rh antigen. The degrees of freedom in the Rh distribution table are 3. The predictable table value is 7.81; the calculated value is very much higher indicating significant effect of Rh on obesity (chi square value with probability).

Conclusion

- There is no strong association between blood groups and obesity.
- However, when individual group values are compared AB blood group is showing the highest value of χ^2 (3.981), which could indicate the role of A and B antigens together in influencing the obesity.
- When the mean/relative BMI values are analyzed, AB positive group mean is showing highest value (23.44) amongst all the groups.
- Major blood group seen in the survey is O (Rh +ve) blood group (ref. Distribution of Blood groups and BMI Evaluation among school students of Tiruchirappalli, Tamil Nadu – Soundarya N., Suganthi Palani, Ramachandran. N., Jothi.N.)
- Rh locus is found to influence obesity significantly.