Alqalam Journal of Medical and Applied Sciences. 2025;8(3):1399-1405
https://doi.org/10.54361/ajmas.258321

Original article

Association Between ABO and Both Allergy and Body Mass Index in a Random Sample of High School Students in Al-Bayda City, Libya

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Abstract
The objective of the current study was to investigate blood type distribution and its relationship to body Mass Index (BMI) and allergic diseases. 100 students from Fatat Libya High School in Al-Bayda City, Libya, on 5/2/2025. Weight and height were measured, BMI was calculated, and types of allergies, if any, were recorded for each student individually. The result showed that the individuals with blood group (O+) had the highest number, reaching 35% followed by (A+) 30%, and (B+) group recorded 12%, A- recorded the lowest percentage, 3%, while AB- did not record any percentage. Also, 31 samples had more than one type of allergy, distributed as follows: 19 samples had allergic rhinitis (AR), 7 had chest allergies, 2 had skin allergies (one had a metal allergy(B+) and one had eczema (A+). Also, one case each of nut allergy, eye allergy (O+), and milk allergy (A+) was recorded. Meanwhile, BMI results showed normal body mass, only one sample with a normal BMI of 22.9 was recorded for blood type O+.15 samples were recorded for the first stage of obesity. The number of samples in the second stage of obesity reached 58, representing the largest percentage.26 samples were recorded for the last stage of obesity. Also, there are non-significant differences ($p>0.05$) in BMI between blood groups recorded in this study. Moreover, there is no significant association between blood type and allergy.
Keywords. ABO Blood group, allergy, Body Mass Index BMI, Allergic rhinitis AR.

Introduction

There are widespread diseases affecting individuals that pose a significant health threat and are considered a global concern. Their incidence is constantly increasing and threatens all age groups. These diseases include obesity and allergic diseases, which are constantly increasing due to an unhealthy lifestyle, eating at restaurants and cafes, lack of exercise and general activity, and spending long hours on smart devices. These diseases also increase the risk of poisoning and exposure to irritants that exacerbate various types of allergic diseases.

According to the European Academy of Allergology and Clinical Immunology (EAACI), Allergic reactions are thought to be multiple causes, heterogeneous conditions caused by a reaction of environmental and genetic factors, and can manifest in numerous organs. Common allergic symptoms include "asthma, rhinoconjunctivitis, gastrointestinal symptoms, and skin lesions"[1]. Allergic illnesses are widespread and may result in morbidity and death rates among people affected by allergies. And, they develop from abnormal reactions of the immune system, whereby they become hypersensitive to allergy-causing agents, most of which are not detrimental to the body [2]. Most antigens of blood group play critical roles in "cell recognition and self-declaration" mechanisms by performing as receptors or cell surface markers [3]. Therefore, these antigens may act as receptors for microscopic organisms or materials such as toxins or allergens that could affect the susceptibility of individuals to illness [4]. However, many connections between particular ABO and increased liability to diseases such as cardiovascular disease, cancer, and infection by parasites have been recorded [5,6]. Few studies focused on a probable connection between ABO and BMI, in addition to obesity [7-9].

On the other hand, "Body mass index (BMI)" is defined as an indicator of overweight and helps assess dimensions of health. Based on the World Health Organization (WHO) categorization of BMI, the person may be considered obese, overweight, normal, or underweight [10,11]. If BMI is between 20 and 22, that healthy body fat percentage, between 22 and 25, is correlated with a healthy life, between 25 and 30, classified as excess body weight. If over 30, this signifies a health disorder [12]. Moreover, overweight and obesity are associated with adverse health effects [13] and raise the risk of a large number of diseases and clinical conditions," such as coronary heart disease, strokes, asthma, diabetes mellitus type 2, cancers, and hypertension" [14].

Landsteiner identified blood types depending on the existence or non-existence of surface antigens (ABO) on erythrocytes (RBC) [15]. The last type was identified in 1902, is (AB) by [16]. Besides ABO, Rh blood type (Rhesus) is ranked after ABO in its prominence in blood transfusion. And, the highest medically relevant polymorphism is the existence or absence of the Rh (D) antigen on RBCs [17-19]. However, various efforts were observed to show a possible association between ABO as well as Rh and multiple metabolic disorders from the 1800s. The association between disease and the ABO susceptibility has drawn great attention [20, 21]. The current study aimed to examine the distribution of blood types and the association between blood type and body mass and allergic diseases.

Received*: 14-05-2025 -* ***Accepted****: 08-07-2025 -* ***Published****: 15-07-2025*

Methods

This study was conducted on a random sample of 100 students (females) from Fatat Libya High School in Al-Bayda City, Libya, on 5/2/2025. The temperature reached 12°C.

After obtaining consent from the students, no student objected to participating in the study after a detailed explanation of the study content and the students' understanding of it. A questionnaire was completed to determine blood type and accurately record any allergies, if any. The age was also recorded.

Each student's weight was measured in kilograms using a weighing device (scale), and their height (in square meters) was measured using a metric tape measure. High and weight of every student were recorded, and then their body mass index (BMI) was calculated.

$$\text{BMI} = \frac{\text{weight in kilograms (kg)}}{\text{square of height in meters (m2)}}$$

Statistical analysis was carried out using the Minitab software ANOVA analysis with Tukey multiple comparisons, and $P < 0.05$ was considered significant, and Chi-square tests X^2) were used. Differences at p value 0.05 or less were considered significant.

Results

The results of a study which was conducted on a random sample of 100 students from Fatat Libya High School on 5/ 2/ 2025, with an air temperature of 12 °C, at 11 am, the result showed. The blood group (O+) individuals had the highest number, reaching 35% compared to the rest of the blood groups. The (A+) group recorded the second highest rate, reaching 30%, and the lowest number of the random sample groups was (A-) recorded only 3; were (AB-) groups did not record any ratio. The distribution of blood groups was as follows Table 1.

Table 1. The percentage of blood groups was recorded in the study.

Blood group	Percentage
O+	35%
A+	30%
B+	12%
AB+	9%
O-	6%
B-	5%
A-	3%

The average age ranges between 14 and 17 years, and the largest percentage was recorded for students aged 16 years. Figure 1.

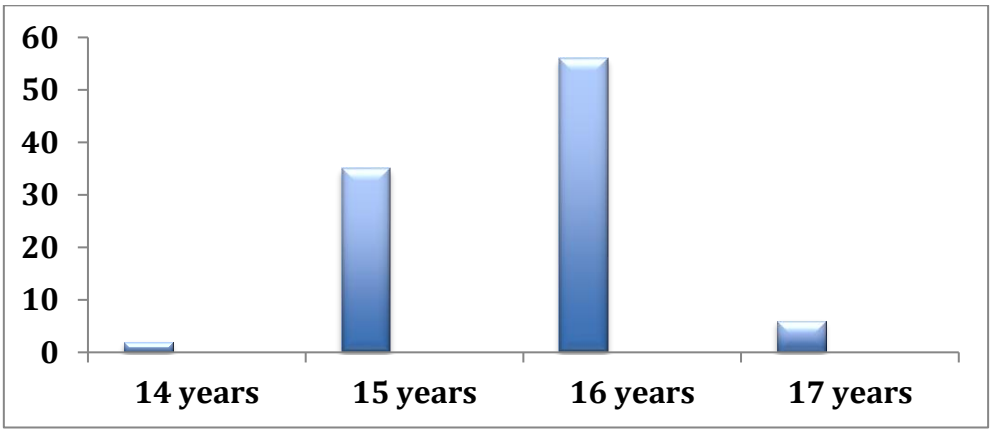

Figure 1: The age dispersion in the study sample.

ABO and anemia

The results showed that five students had anemia, two samples were O+, and one sample was A+, AB+, and O (Figure 2).

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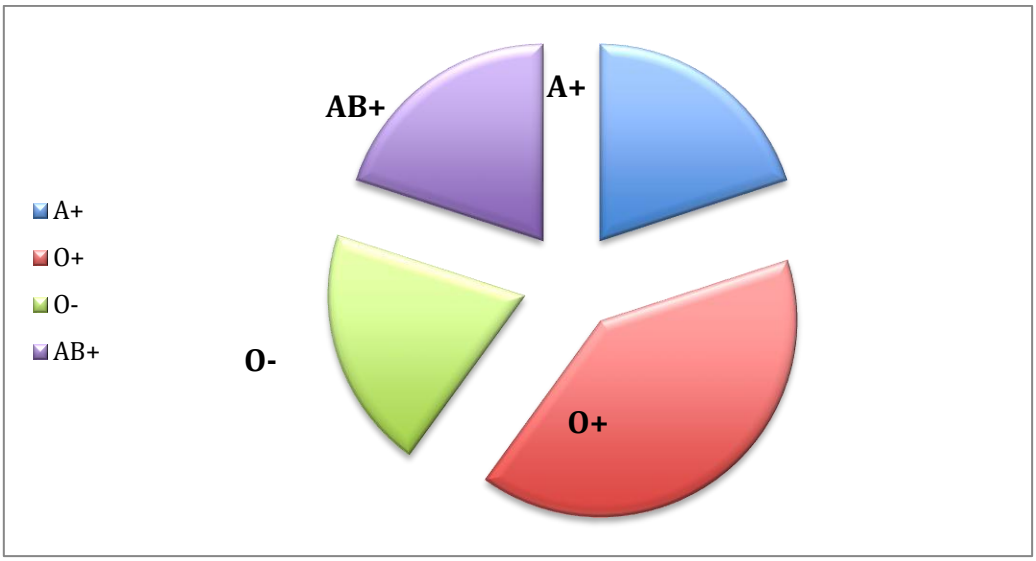

Figure 2. The distribution of anemia according to blood type.

Allergic diseases

More than one type of allergy was recorded during the study. After questioning the students, it was revealed that one or both parents had the same type of allergy. In some cases, first-degree relatives were also affected. Besides, the results showed that 31 samples had more than one type of allergy, distributed as follows: 19 samples had allergic (rhinitis) (AR), 7 had chest allergies, 2 had skin allergies (one had a metal allergy(B+) and one had eczema (A+)). Also, one case each of nut allergy, eye allergy (O+) and milk allergy (A+) was recorded.

Allergic rhinitis

AR (Allergic rhinitis) was distributed among various blood groups, with the majority recorded for blood group O+, followed by A+ with four cases, two for blood group B+, and one case for each of AB+, A-, O-, B-, Figure 3.

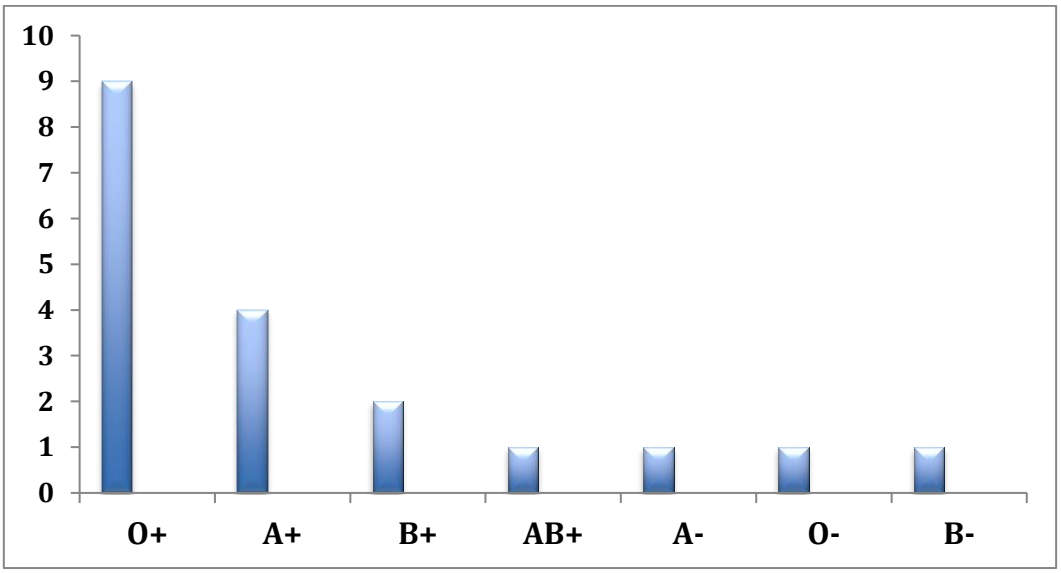

Figure 3: The distribution of AR according to blood type.

Chest allergies

The results of chest allergy showed a slight difference from the results of nasal allergy. 4 cases were recorded for blood type A+ and one case each for O+, B+ and AB+ Figure 4.

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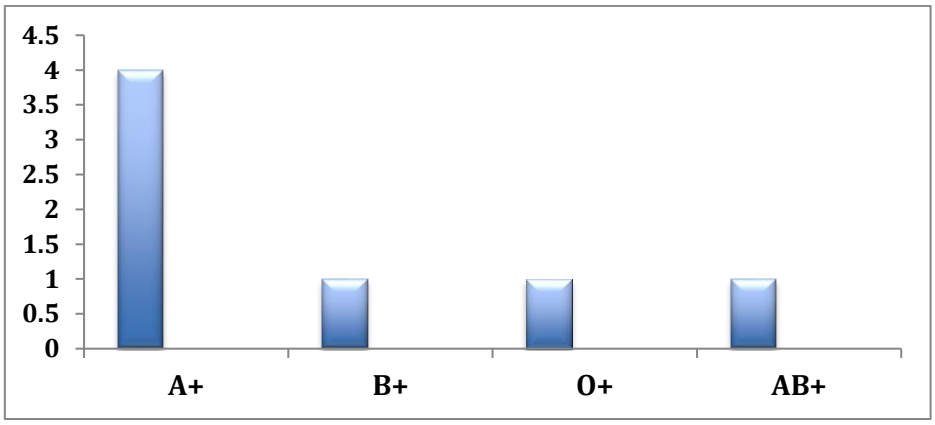

Figure 4: The distribution of Chest allergies according to blood type.

The relation between allergy and blood type:
There was no significant correlation between the ABO and allergy, X^2 = 1.573 P=0.665, <0.05 DF=3. The positive and negative monospecies blood types were merged due to small frequencies in some species.

BMI and blood type:
Height and weight were measured to calculate body mass, with the lowest height being 142 cm in blood type A+ and the highest height being 170 cm in blood type O+. Weights were distributed as follows: the lowest weight was 39 kg in blood type O+, and the highest weight was 100 kg in blood type O+ Figure 5.

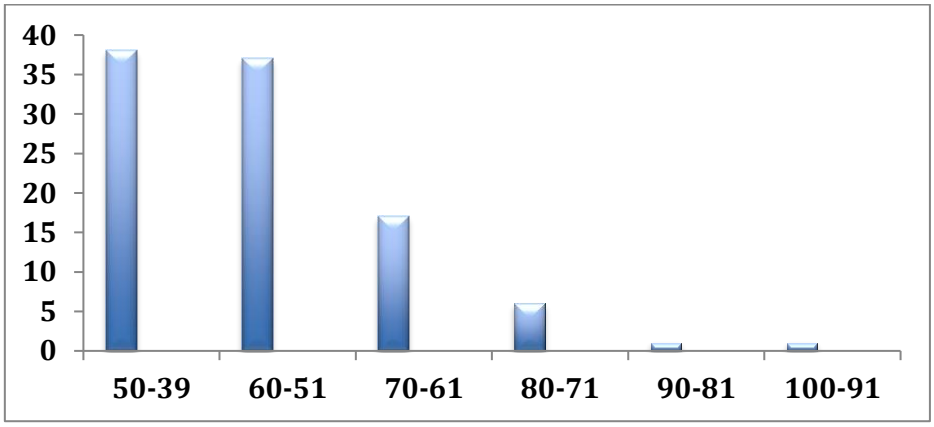

Figure 5. The weights were recorded in the study.

Furthermore, the lowest BMI was recorded at 22.9 for blood type O+, and the highest BMI was 64.5 for blood type O+. As for normal body mass, only one sample with a normal BMI of 22.9 was recorded for blood type O+.15 samples were recorded for the first stage of obesity. The number of samples in the second stage of obesity reached 58, representing the largest percentage.26 samples were recorded for the last stage of obesity Figure 6**.**

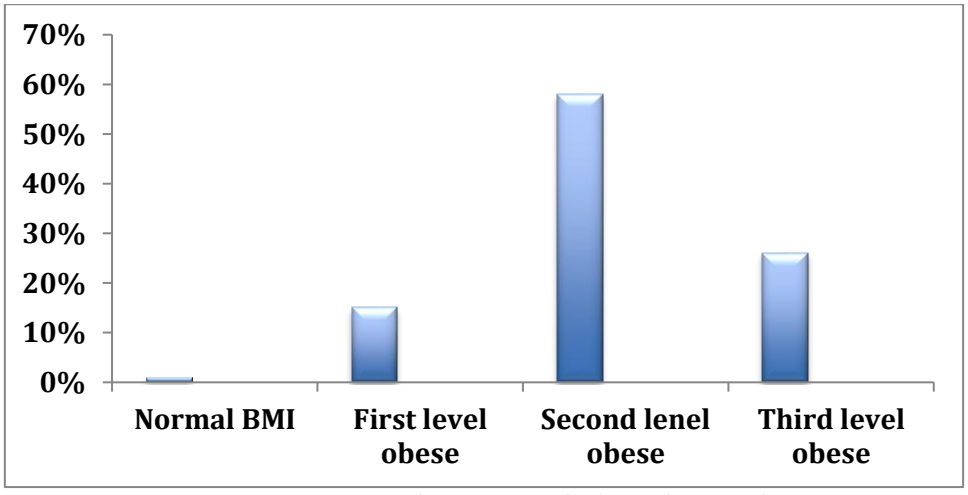

Figure 6: BMI values recorded in the study.

Received*: 14-05-2025 -* ***Accepted****: 08-07-2025 -* ***Published****: 15-07-2025*

Besides, there are no significant difference (p>0.05) in BMI between blood groups recorded in this study, Table 2.

Table 2. BMI values of blood types recorded in the study.

ABO	Mean±SD	N
O+	35.25±8.22[a]	35
A+	37.36±6.47[a]	30
B+	36.60±7.04[a]	12
AB+	36.54±4.48[a]	9
O-	39.48±9.85[a]	6
B-	36.45±8.49[a]	5
A-	34.17±2.14[a]	3
P=0.841		

Values are expressed as means ± SD; n = 100 for blood group type.

Discussion

Allergies are widespread among all age groups, and their severity varies from person to person. Obesity has also become increasingly prevalent recently, particularly among adolescents, due to an unhealthy lifestyle and a decline in exercise and healthy movement.

This study was conducted to assess obesity levels and determine the correlation between obesity and allergic diseases and blood type. The investigation revealed that the highest rate of AR was recorded among those with blood type O+, which agrees with [22-24] studies that found blood group O is correlated with AR and previous studies have found that blood group O is more prone to allergic disorders, especially asthma and AR [22-28]. And with [24] who found that a bulk of the patients had blood group O, revealing a connection between ABO "phenotype" and AR. In addition [29] found of 239 sufferers in Germany who had atopic conditions (hay fever, atopic dermatitis, AR acute urticarial and asthma), showed that the occurrence of blood group antigens A and B were higher in these patients this agrees with our study where we recorded two skin allergies with A and B blood types and agree with [30] who found the same results.

A handful of studies found that when exposed to a strong allergen, bronchial asthma starts relatively consistently and faster in blood group O than in the case of sensitizing with a less potent allergen. Also, during studies, patients with arthritic diseases and bronchial asthma, an association with blood-type O was shown; meanwhile, the impact of patients with diabetes and asthma was more frequently observed in blood-type A [29]. This similarity to our result was a record chest allergy with A, B, and O blood types. However, the same study suggests there a bond with blood group O could be shown among patients who suffer from asthma and arthritis. This explains our result and clarifies the relationship between blood type O and most types of allergies, and another study found there is an overlap between antigens, blood antibodies, and allergic diseases.

Besides, "The existence of possible biological, genetic and physical mechanisms (inflammatory substances like factor-alpha, tumor necrosis, leptin or adiponectin) that are common to obesity and asthma has been observed". Depending on this, studies performed worldwide have exhibited a connection between a couple of disorders [31-36]. In agreement with our result, the individual with O blood type recorded the highest percentage compared to the rest blood types. This agreement with a study in India [37] where the highest percentage of blood donors carrying O was recorded, followed by B and then A. This is similar to other studies in Africa, where O was recorded the highest levels in Guinea, Nigeria, and Côte d'Ivoire [38-40].On the other hand, previous studies on the association between BMI and ABO are contradictory [8, 41]. The BMI of individuals with multiple ABO antigens has been increased by several authors. There was a statistically Significant association between BMI and ABO within studies sampled from Pakistan [42], Malaysia [43, 44], Denmark [45], India [8, 46, 47], and Nigeria [48]. Also, a study found an increase in BMI in teenagers, obesity in Portuguese schools, especially among males. Furthermore, this high rate of excess weight during these ages could be linked with eating practices, which impact body weight [49]. Besides, various factors can affect eating habits, such as the availability of and the extent to which foods. Also, weight complications often begin in youth and can get worse into adult life, possibly leading to conditions such as "type 2 diabetes and heart disease [50].

Conclusion

In conclusion, after conducting the study, it was found that there was a significant increase in obesity levels and high body mass in the study sample, while only one sample recorded a normal body mass. This percentage is a risk indicator for the health of society, especially since obesity is linked to diabetes, high blood pressure, strokes, and cardiovascular diseases. It is necessary to warn of the dangers of fast food of all kinds to pay attention to following a healthy lifestyle of exercise and activity, and stay away as much as

Received*: 14-05-2025 -* ***Accepted****: 08-07-2025 -* ***Published****: 15-07-2025*

possible from smart devices and spending long hours in front of screens. Moreover, there is a clear link between blood type and the tendency to develop certain diseases, especially allergies. This genetic link should be further highlighted, along with warnings about the dangers of rising levels of environmental pollution and the consequent increase in allergic reactions.

Acknowledgments
Big thanks and great gratitude to Allah for doing this study, Big thanks to all the students who cooperated in this study, but not least, the management of Fatat Libya High School and the faculty of education**.**

Conflicts of Interest. *Nil.*

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Received*: 14-05-2025 -* ***Accepted****: 08-07-2025 -* ***Published****: 15-07-2025*

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Received*: 14-05-2025 -* ***Accepted****: 08-07-2025 -* ***Published****: 15-07-2025*