

BMJ Open Association of ABO blood groups with allergic diseases: a scoping review

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ABSTRACT

Objective The objective of this study was to map evidence of the association of ABO blood groups with allergic diseases such as allergic rhinitis (AR), atopic dermatitis (AD) and asthma.

Design A scoping review.

Data sources PubMed, Scopus, Direct Open Access Journal, Medline, Cumulative Index to Nursing and Allied Health Literature, ScienceDirect and SpringerLink were searched from October 2017 until May 2018.

Eligibility criteria for selecting studies We selected all types of studies including case-control studies, prospective or retrospective cohort studies, cross-sectional studies and experimental studies, and we included reviews such as literature reviews, systematic reviews with or without meta-analysis and scoping reviews that were published in English and associated the ABO blood group with the three allergic diseases (asthma, AR and AD) in humans of all age groups.

Data extraction and synthesis Two reviewers independently screened the titles and abstracts and assessed the full-text articles of the abstracts that met the eligibility requirements. Data from the included studies were extracted, evaluated and reported in the form of narrative synthesis.

Results Of the 10 246 retrieved titles, only 14 articles were selected for a scoping review based on the eligibility criteria. The majority of the studies demonstrated a significant association between ABO blood groups and allergic diseases. We found that blood group O is prominent in patients with AR and asthma, while a non-O blood group is common in patients with AD.

Conclusion This scoping review serves as preliminary evidence for the association of ABO blood groups with allergic diseases. Further studies need to be conducted so that the relationship between ABO blood groups and allergic diseases can be fully established. This could be helpful for clinicians and health professionals in consulting and managing patients who suffer from allergic diseases in the future.

INTRODUCTION

Allergic diseases are common in human populations and can lead to morbidity and mortality among individuals who suffer from allergic diseases.¹ The incidence of people suffering from allergic diseases continues to rise worldwide, especially in countries with low and intermediate socioeconomic status.^{2,3} Allergic

Strengths and limitations of this study

- The temporal period of review for the publications was broad (ie, from 1970 to present), and all potentially relevant English-language articles were captured.
- Only English articles were included; thus, relevant articles published in other languages were not part of the study.
- Quality appraisal assessment was not conducted.

diseases develop from abnormal reactivity of the immune system, whereby the immune system becomes hyper-responsive to allergens that are not harmful to the body.¹ Allergic diseases include anaphylaxis, food allergies, asthma, rhinitis, conjunctivitis, angioedema, urticaria, eczema, eosinophilic disorders (including eosinophilic oesophagitis) and drug and insect allergies.² According to the World Allergy Organization, allergic diseases are quite common, and an estimated one in five people suffers from some sort of allergic disease, such as allergic rhinitis (AR), asthma, conjunctivitis, atopic dermatitis (AD) and other allergic reactions.⁴ Therefore, allergic diseases are of great concern to governments and communities because they can cause serious health problems if they remain unrecognised and underestimated.

The antigen of the ABO blood group system is a complex carbohydrate molecule that acts as a surface marker on the membrane of red blood cells,⁵ and it is also highly expressed in body fluids and several cell and tissue types, such as epithelial cells of the gastrointestinal tract, salivary glands and the skin.⁶ Although the biological function of blood groups is not fully understood, Chigira⁷ reported that most blood group antigens play crucial roles in cell-cell recognition and in self-declaration mechanisms by functioning as receptors or surface markers. Therefore, these antigens may behave as potential receptors for microorganisms or substances such as toxins or

allergens that could influence the susceptibility of individuals to diseases.⁸

Certain genetic and environmental factors have been identified as risk factors for developing allergic diseases. The most important risk factor is family history. If a parent has allergies, the risk of their children developing allergies is approximately 15%–20%.⁹ Moreover, the risk is doubled when both parents have allergies.¹⁰ Indoor and outdoor pollutants are also significantly correlated with the development of allergic diseases.¹¹ Examples of indoor pollutants include house dust mites, animal dander, cockroaches and moulds, while examples of outdoor pollutants include tobacco smoke, transportation smoke, factories and plant pollen.^{11–13} To date, ABO blood type has not been considered a risk factor for developing allergies.

However, numerous associations between particular ABO blood groups and an increased susceptibility to diseases such as cardiovascular disease, cancer and parasite infection have been reported. For example, blood group O was reported to be protective against pancreatic cancer (OR=0.53),^{14 15} whereas blood group A, which is relative to other blood types, is more commonly observed in gastric cancer (OR=1.20, 95% CI 1.02 to 1.42).^{16 17} Furthermore, people with non-O blood types have a higher risk of developing cardiovascular disease (OR=1.79, 95% CI 1.41 to 2.26) compared with those with type O blood.

In the 1960s, an observational study suggested that the ABO agglutinins that are present in a wide variety of pollens from grasses, flowers and trees might interact with cells containing blood group antigens in the respiratory epithelium.³ This may raise the possibility of a relationship between ABO blood groups and allergic diseases. To date, only a few studies have reported a relationship between ABO blood groups and susceptibility to allergic diseases such as AR,³ AD,¹⁸ asthma^{19 20} and food allergies.^{21 22} However, the association of specific ABO blood types with AR, AD and asthma is poorly understood, and the susceptibility of people with specific blood types to these diseases has not been comprehensively explored. Therefore, we conducted a scoping review to explore and map evidence for the association of ABO blood type with susceptibility to AR, AD and asthma. This review may act as a precursor for a full systematic review and help improve doctors' consultations and management of treatment for patients who suffer from allergic diseases in the future.

METHOD

This study was conducted using the scoping review framework and followed the guidelines outlined by Arksey and O'Malley.²³ The five stages included in this framework are (1) identification of research questions, (2) identification of related studies, (3) selection of studies, (4) charting of data and (5) collating, summarising, and reporting the results. The International Prospective Register of

Systematic Reviews (PROSPERO) registration is not required for scoping reviews. The protocol followed for the scoping review in this study is as follows:

Stage 1: identification of research questions

The following research questions were developed based on the objective of the study:

- Is there any association between ABO blood groups and AR, AD and asthma?
- Which ABO blood type is susceptible to AR, AD and asthma?

Stage 2: identification of related studies

One reviewer performed the search for related studies based on eligibility criteria, electronic databases and search strategies.

Eligibility criteria

In this study, the inclusion criteria were articles that (1) were originally published in English or had been translated into an English version, (2) included all age groups, (3) included human subjects, (4) involved three specific allergic diseases (asthma, AR and AD), (5) were limited to developed and developing countries and (6) had a publication period from January 1970 to May 2018.

Types of studies

All types of studies, such as case-control studies, prospective or retrospective cohort studies, cross-sectional studies and experimental studies, were included. Reviews such as literature reviews, systematic reviews with or without meta-analysis and scoping reviews were also included. The references from the relevant studies that were related to the study were also included.

Databases

Studies corresponding to the aim of this research were found by searching the following electronic databases: PubMed, Scopus and Direct Open Access Journal were searched from October 2017 until January 2018, followed by Cumulative Index to Nursing and Allied Health Literature, ScienceDirect and SpringerLink, which were searched from February 2018 until May 2018. The reference lists of the included studies were searched to identify other potentially relevant studies.

Search strategy

The searches were guided using the Boolean operators 'AND' and 'OR'. The results from each search were documented, and all references from the search were imported into the Endnote X8 reference management software programme. Duplicate articles were removed. **Table 1** lists the keywords used to construct the search strategy. The full search strategy for one database is provided (refer to online supplementary file 1).

Stage 3: selection of studies

The selection of relevant studies was based on the research questions and the eligibility criteria. The studies

Table 1 Keywords used in the study

ABO Blood Groups	Asthma	Allergic Rhinitis	Atopic Dermatitis
A Blood Group	Asthma Attack	Rhinitis	Dermatitis
B Blood Group	Bronchial Asthma	Hypersensitivity	Atopic Eczema
AB Blood Group	Respiratory Diseases	Hay Fever	Eczema
O Blood Group	Lung Diseases	Allergen Induced Hypersensitivity	Inflamed Skin
	Pulmonary Diseases	Allergic Diseases	Skin Diseases

were selected and recorded following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram for the scoping review process.²⁴ At this stage, two levels of article screening were used. In the first screening process, two reviewers independently screened the title and abstract of the retrieved articles; they both read and analysed the abstracts to determine the eligibility of the selected studies. The abstracts that did not match the scope of the study were excluded. Discrepancies between the two reviewers at the abstract stage were resolved by a third reviewer. In the second screening process, the full-text articles were assessed independently by the two reviewers to determine whether they met the inclusion criteria and whether the research questions were answered. Non-relevant articles and those that did not consider the association of ABO blood groups with the three allergic diseases were excluded.

Stage 4: data charting

Data from the selected articles were extracted independently by two of the same reviewers. These data included standard information such as author, year of publication, objective of the study, study location, subject characteristics, sample size and study design (refer to table 2). The extracted data were compared between the two reviewers to ensure consistency, and any disagreement that arose between the two reviewers was discussed. The data charting process provided a summary of the articles that corresponded to the research questions and the objectives of the study.

Table 2 Description of data extracted from each included study

Type of data	
Study characteristics	Year of publication Authors Country of study Sample size Objectives Types of allergy
Sample characteristics	Age Gender
Findings/results	Association of ABO blood groups

Stage 5: collating, summarising and reporting the results

The PRISMA flow diagram of the scoping review framework was used so that the review search results could be reported accurately.²⁴ The findings of the selected articles were summarised in a table format and analysed to elucidate the relationship between blood groups and the selected diseases.

Patient and public involvement

No patients and public were involved in the planning, design and conception of this study.

RESULTS

Characteristics of the selected studies

The first screening of the databases and other resources produced 10246 records (figure 1). After removing the duplicate records, 8415 records were left. Only 78 records were included after the removal of abstracts and titles that did not meet the eligibility criteria. After the second

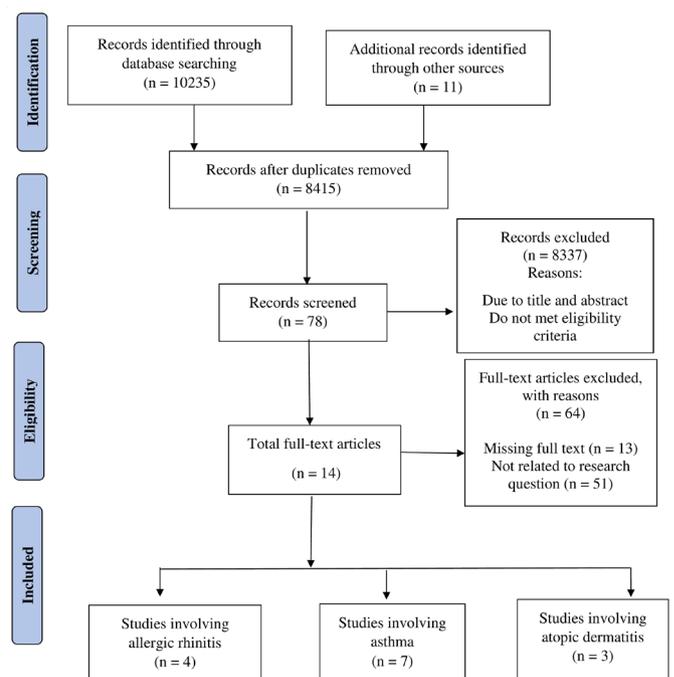


Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram for the selection of related articles.

Table 3A Summary of studies and their associations

No	Author (year)	Study design	Types of allergy	Purpose	Sample size and group comparison	Subjects characteristics	Association with ABO blood groups
1	Falsarella <i>et al</i> ²⁵ Country: Brazil Year: 2011	Case control	Allergic rhinitis	To determine if ABO phenotypes are associated with allergic rhinitis.	168 patients and 168 controls	Age: 18–85 years, patients matched by age and gender with controls	The O phenotype was associated with susceptibility to allergic rhinitis for men but not for women (p=0.016; OR= 1.735; 95% CI 1.127 to 2.673).
2	Hamad ²⁶ Country: Iraq Year: 2016	Cross sectional	Allergic rhinitis	To determine the prevalence of ABO blood groups and to investigate their association with allergic rhinitis and relate this association with genetics.	109	Age: 18–60 years (female and male)	Group O is the most common and has a high level of risk for developing allergic rhinitis (p=0.049).
3	Topno <i>et al</i> ²⁷ Country: India Year: 2017	Case control	Allergic rhinitis	To study the correlation of ABO phenotypes in patients with allergic rhinitis.	100 patients and 100 controls	Outpatient department Ear,Nose and Throat (ENT) Age: 11–70 years, patients matched by age and gender with controls	The O blood group phenotype is associated with allergic rhinitis (OR 3.63, p=0.006).
4	Kauffmann <i>et al</i> ¹⁹ Country: France Year: 1996	Cross sectional	Asthma	To assess the role of all three systems—Lewis, secretor and ABO—in lung function, wheezing and asthma.	228 males	Age: 34–50 years, coal miners	Non-secretor subjects of blood group O have significantly lower lung function and higher prevalence of wheezing and asthma (p<0.01).
5	Ronchetti <i>et al</i> ²⁰ Country: Italy Year: 2001	Case control	Asthma	To analyse the joint phenotype ABO/secretor in a cohort of asthmatic children in an attempt to confirm the association observed in adult subjects.	165 children (109 males and 56 females) 362 newborn infants as controls	Outpatients of a paediatric pulmonary clinic or patients who were admitted to a ward of the same clinic for acute respiratory episodes. Age: 1 month–15 years	O/non-secretor in asthmatic male children was higher than the controls (p<0.025).
6	Chen <i>et al</i> ²⁸ Country: Taiwan Year: 2005	Case control	Asthma	To analyse the histo-blood groups of ABO, Lewis and secretor in a cohort of asthmatic children in Taiwan.	136 asthmatic children and 161 age-matched controls	Age: 6–13 years	Blood group O/secretors were associated with childhood asthma (OR=2.7, 95% CI 1.126 to 6.033, p<0.02)
7	Saini and Yadav ²⁹ Country: India Year: 2014	Case control	Asthma	To investigate the association of ABO and Rh (D) allele frequency in patients with asthma.	180 subjects (120 asthmatics and 60 controls)	Patients matched by age, sex and socioeconomic status with controls	A possible association between blood group O and asthma prevalence was noted (p<0.05).

Continued

Table 3A Continued

No	Author (year)	Study design	Types of allergy	Purpose	Sample size and group comparison	Subjects characteristics	Association with ABO blood groups
8	Yaro <i>et al</i> ³⁰ Country: Nigeria Year: 2015	Case control	Asthma	To explore the relationship of blood group type and susceptibility to asthma in Sokoto Metropolis, Nigeria.	200 asthmatic patients and 100 adults (control group)	Individuals attending the Pulmonary Unit of Usmanu Danfodiyo University Teaching Hospital, Specialist Hospital and Maryam Abacha Women and Children Hospital, all in Sokoto metropolis, Nigeria	A possible association between blood group A and asthma susceptibility was noted (p<0.05).
9	Gangopadhyay <i>et al</i> ¹⁸ Country: India Year: 2006	Cross sectional	Atopic dermatitis	To evaluate the relationship between atopic dermatitis and the ABO blood group.	30 patients with atopic dermatitis	Patients attending the Dermatology Outpatient Department (OPD) of NRS Medical College, Kolkata, over a period of 1 year Age: 6 month–65 years	Blood group O with atopic dermatitis among patients is less prevalent than among controls (p<0.05). Blood group B is the most prevalent in patients with atopic dermatitis, followed by blood group A.
10	Abid ³³ Country: Pakistan Year: 2015	Cross sectional	Atopic dermatitis	To determine the prevalence of ABO blood groups and to investigate their association with dust, pollen and skin allergy.	123 young adults (males and females)	Age: 18–21 years	Blood group B is most common and has a high risk level for developing allergies (p=0.0007774).
11	Brachtel <i>et al</i> ³⁴ Country: Germany Year: 1979	Case control	Atopy	To assess the association of atopic disease with blood group with reference to a new population sample and to include polymorphic systems.	239 patients 151 controls	Outpatients of the Dermatological Clinic of the University of Mainz	Higher susceptibility of individuals with blood groups A and B to atopic diseases such as rhinitis, bronchial asthma, dermatitis and many more.

**Table 3B** Summary of studies with no association

No	Author (Year)	Study design	Types of allergy	Purpose	Sample size and group comparison	Subjects' characteristics	Association with ABO blood groups
1	Carpeggiani Country: Italy Year: 2011 ³	Literature review	Allergic rhinitis	Not stated.	Not stated.	Not stated.	Association of blood group O with allergic rhinitis remains unknown due to limitations in some studies.
2	Dhiman <i>et al</i> Country: India Year: 1990 ³¹	Case control	Asthma	To determine whether an association exists between ABO, Rh, and MN blood groups and asthma.	125 patients (70 males and 55 females) 6204 controls	Indoor and outdoor patients Age: 16–70 years	Non-significant differences between ABO phenotypes and asthma (0.7>p >0.5).
3	Bijanzadeh <i>et al</i> Country: India Year: 2009 ³²	Case control	Asthma	To evaluate the relationship between asthma and the ABO blood group in the population of Mysore, Karnataka State, South India.	200 (adults and children) 2000 controls	Asthmatic cases from university hospitals and allergy centre controls from blood donors at the hospital Age: Children: younger than 18 years Adults: older than 19 years	ABO blood group status has a non-significant association with asthma among the population of Mysore, Karnataka, South India. (p=0.931)

ENT, Ear, Nose and Throat; OPD, Outpatient Department.

screening, 14 final full-text articles remained, and these articles were subdivided into the following three categories: four studies for AR, three studies for AD and seven studies for asthma.

Association of ABO blood groups with allergic diseases

Allergic rhinitis

Of the four studies related to AR, three studies reported that blood group O is correlated with AR^{25–27} (refer [table 3A](#)). No association was found in the fourth study³ (refer to [table 3B](#)).

Asthma

Four of the seven studies reported that patients with blood group O had greater susceptibility to asthma^{19 20 28 29} than patients with other blood groups (refer [table 3](#)). Additionally, one study found that blood group A was the predominant type in asthma patients versus controls.³⁰ Two studies did not show any association between ABO blood groups and asthma^{31 32} (refer to [table 3B](#)).

Atopic dermatitis

All three studies related to AD reported that people with non-O blood groups (A and B blood groups) were at high risk of developing AD^{18 33 34} (refer to [table 3A](#)).

DISCUSSION

The purpose of a scoping review is to map the evidence provided in the literature to specific areas of interest,²³ and this method can be used when the field or topic has not yet been reviewed extensively.³⁵ A scoping review can also be used to identify the gaps present in the existing research about a topic of interest.²³ The aim of the scoping

review conducted in this study was to provide evidence for the association of ABO blood groups with AR, AD and asthma and to help determine which blood type is predominant in each of the diseases. Most of the evidence presented in the selected studies pointed to an association of allergic diseases with ABO blood groups. However, the mechanism by which the blood type can affect the development of allergic disease remains unknown.

In this review, several important insights were gained. First, in the selected studies, participants with blood group O were more susceptible than those with non-O blood groups to allergic diseases, especially AR and asthma.^{19 20 25–29} In contrast, those with non-O blood groups were more susceptible to AD.^{18 33 34} Gangopadhyay *et al*¹⁸ found that blood group B was the most prominent type in patients with AD, followed by blood group A, and this finding was consistent with the results reported by Abid³³ and Brachtel *et al*.³⁴ These results suggest that certain ABO blood groups may act as a risk factor for developing allergic diseases in the future. ABO blood groups have been established as a risk factor for cardiovascular diseases³⁶ such as venous thromboembolism³⁷ and coronary artery disease.³⁸

Second, out of all the selected studies, only three studies focused on AD, and four studies focused on AR, whereas seven studies focused on asthma. This finding demonstrates that most studies focused on a disease that can cause mortality and is recognised as a serious global health problem. In contrast, AD and AR are not life-threatening diseases and can be controlled by medicines. Therefore, these diseases are less compelling as research topics and in clinical practice.³⁹ Overall, the search for studies regarding a relationship between ABO blood

groups and allergic diseases produced few results after the unwanted search results were eliminated.

Third, no evidence was found for the association between ABO blood groups and allergic diseases in South-east Asia, including Malaysia. Thus, this review highlights an important gap in geographic data for the link between allergic diseases and ABO blood groups. In the future, researchers should assess the relationships by conducting similar studies in Asian populations. Finally, the results of this review showed that males are significantly more predisposed to allergic diseases than females.^{20 25 28} This finding is supported by other studies that have reported that the male gender poses a significant and independent risk factor for asthma and AR.^{40 41}

This study has some limitations. First, the quality appraisal assessment was excluded; thus, the quality of some articles may have been poor. Second, we included only English language articles and excluded grey literature; thus, some relevant articles may have been overlooked. Finally, the number of studies selected was low and may have been affected by lack of availability of full-text articles (particularly old articles), coverage of databases and language barriers.

CONCLUSION

This scoping review has helped highlight the relationship between ABO blood groups and allergic diseases, although the specific role of ABO blood groups in the pathophysiology of allergic diseases remains unknown. In addition, this review also identified the gap in geographic data for the link between allergic diseases and ABO blood groups. Hence, further studies focusing on different populations and mechanisms need to be conducted so that more evidence and better knowledge on the relationship between ABO blood groups and allergic diseases can be fully established and understood. Later, these findings may help to improve the consultation and management of patients suffering from allergic diseases.

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