TPM Vol. 32, No. S2, 2025
ISSN: 1972-6325
https://www.tpmap.org/

PREVALENCE AND RISK FACTORS OF BRONCHIAL ASTHMA IN CHILDREN IN SAUDI ARABIA: SYSTEMATIC REVIEW

ABDULMAJEED ALRUWAILI
ASSISTANT PROFESSOR OF PEDIATRICS, NORTHERN BORDER UNIVERSITY, SAUDI ARABAI

THAMER ARAR ALRUWAILI
ABDULAZIZ KHALAF ALSALEH
EMERGENCY RESIDENT, MATERNAL AND CHILDREN HOSPITAL, ALJOUF, SAUDI ARABIA

MAJED MUIDH ALBOGAMI
PEDIATRIC RESIDENT, AL QURYAAT GENERAL HOSPITAL, ALJOUF HEALTH CLUSTER, SAUDI ARABIA

FEHAID MOHAMMED ALGHTANI
EMERGENCY RESIDENT, EMERGENCY DEPARTMENT, AL MUZAHMIYA HOSPITAL, ALJOUF HEALTH CLUSTER, SAUDI ARABIA

AFRAA FAISAL SAKLOU
PEDIATRIC RESIDENT, ARMED FORCES HOSPITAL, KING ABDUL AZIZ NAVAL BASE, JUBAIL, SAUDI ARABIA

KHAZNAH AWAD ALSHAMMARI
PEDIATRIC EMERGENCY RESIDENT, MATERNAL AND CHILDREN HOSPITAL, HAIL, SAUDI ARABIA

Abstract

Objective: This systematic review evaluated the prevalence and risk factors of bronchial asthma among children in Saudi Arabia, synthesizing evidence from studies published between 2020 and 2025.

Methods: Following PRISMA guidelines, a comprehensive search across PubMed/MEDLINE, Web of Science, and Scopus identified eight eligible studies.

Results: Prevalence ranges between 13.8%- 31.5%. Key risk factors included household smoking (OR: 2.34), exposure to incense (Bakhour), family history of asthma, and proximity to industrial areas. Indoor environmental triggers (e.g., carpeting, central AC) and traffic-related pollution were also significant contributors. Despite the high burden, asthma management remained suboptimal, with only 53% of children receiving written asthma control plans.

Conclusion: The study highlights regional disparities and emphasizes the need for targeted public health interventions, including pollution control, smoking cessation programs, and improved asthma education. Limitations include reliance on parent-reported data and cross-sectional designs, underscoring the need for longitudinal studies with clinical validation.

Keywords: Bronchial asthma, pediatric asthma, prevalence, risk factors, Saudi Arabia, environmental triggers, household smoking, incense exposure

INTRODUCTION

Asthma remains one of the most prevalent chronic respiratory diseases among children worldwide, contributing significantly to global morbidity and healthcare burdens [1]. According to the Global Asthma Network (GAN), childhood asthma affects approximately 5-20% of children across different regions, with notable variations influenced by environmental, genetic, and socioeconomic factors [2]. In Saudi Arabia, recent epidemiological studies suggest an increasing trend in asthma prevalence, particularly in urban and industrialized areas, raising concerns about the potential role of rapid urbanization, air pollution, and lifestyle changes [3].

The Kingdom of Saudi Arabia presents a unique context for asthma research due to its distinctive environmental conditions, including desert climate, sandstorms, and widespread indoor use of incense (Bakhour), all of which have been implicated as potential asthma triggers [4]. Previous national studies have reported asthma prevalence rates ranging from 10% to over 30% in certain regions, with industrial cities such as Rabigh and Jazan demonstrating particularly high burdens [5,6]. However, inconsistencies in diagnostic criteria, study methodologies, and regional disparities have made it challenging to establish a unified national estimate. Furthermore, risk factors such as household smoking, parental asthma history, and exposure to indoor pollutants remain understudied in the Saudi pediatric population [7].

Given the lack of recent comprehensive reviews on this topic, there is a pressing need to synthesize current evidence on asthma prevalence and associated risk factors among Saudi children. This study aims to evaluate the prevalence of bronchial asthma among children in Saudi Arabia and examine the associated environmental, genetic, and socioeconomic risk factors based on evidence from recent observational studies.

METHODS

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure methodological rigor and transparency.

SEARCH STRATEGY

A comprehensive literature search was performed across three major databases - PubMed/MEDLINE, Web of Science, and Scopus - focusing on studies published within the last five years (2019-2024) to ensure contemporary relevance. The search was restricted to English and Arabic language articles involving human subjects to capture both international and regional research. The search strategy incorporated population terms such as "pediatric" OR "child" OR "adolescent" OR "school-age" combined with geographic terms including "Saudi Arabia" OR "KSA" OR "GCC countries". Condition terms like "asthma" OR "bronchial asthma" OR "wheez" OR "respiratory disease" were paired with epidemiological terms such as "prevalence" OR "incidence" OR "epidemiology" and "risk factor" OR "determinant" OR "predictor". Boolean operators (AND, OR) were strategically used to combine these search terms for optimal retrieval. Additionally, we conducted manual searches of reference lists from included studies and relevant review articles to identify any potentially eligible publications that might have been missed in the database searches.

STUDY SELECTION AND ELIGIBILITY CRITERIA

Two independent reviewers conducted the study selection process through a dual-phase screening approach, beginning with title/abstract review followed by full-text evaluation of potentially relevant articles. Any discrepancies between reviewers were resolved through structured discussion or by consulting a third reviewer when necessary. The inclusion criteria focused on observational studies (cross-sectional, cohort, case-control) published between 2020-2025 that were conducted in Saudi Arabia with participants aged 0-18 years. Eligible studies needed to report quantitative data on asthma prevalence and/or risk factors while employing clearly defined diagnostic criteria, either through physician diagnosis or standardized questionnaires like ISAAC. We excluded review articles, editorials, small case reports with fewer than 10 participants, studies without original data or specific Saudi population data, research focusing exclusively on asthma treatment outcomes, and any duplicate publications or secondary analyses of already included datasets to maintain the originality and focus of our review.

DATA EXTRACTION

The study selection process was managed using Rayyan to minimize selection bias and ensure a reproducible workflow. A standardized data extraction form was developed and used to systematically collect key information from each included study. This form captured detailed study characteristics including authors, publication year, study

period, specific region in Saudi Arabia where the research was conducted, and study design. Population data extracted included sample size, age range, gender distribution, and specific inclusion/exclusion criteria used in the original studies. For exposure and risk factor analysis, we documented all environmental, genetic, and socioeconomic factors assessed in each study. Outcome measures focused on prevalence rates (including current wheeze and physician-diagnosed asthma) and severity classifications when available. All relevant statistical measures including odds ratios, confidence intervals, and p-values for risk factor analyses were carefully extracted to support our subsequent analysis and synthesis.

QUALITY ASSESSMENT

The methodological quality of included studies was rigorously evaluated using the Newcastle-Ottawa Scale (NOS) adapted for cross-sectional studies, which assessed quality across three key domains. The selection domain (worth 4 points) evaluated sample representativeness, adequacy of sample size, and handling of non-respondents. The comparability domain (worth 2 points) examined how studies controlled for important confounding factors. The outcome domain (worth 3 points) assessed the appropriateness of outcome measurement methods and statistical analysis approaches. Based on this scoring system, studies were classified as high quality (≥7 points), moderate quality (5-6 points), or low quality (≤4 points). This quality assessment critically informed our interpretation of findings and was used to conduct sensitivity analyses to evaluate the robustness of our conclusions relative to study quality variations.

DATA SYNTHESIS

Given the anticipated heterogeneity in study designs and outcome measures across the included research, we employed a narrative synthesis approach as our primary method of evidence integration. This synthesis was thoughtfully organized by several key analytical dimensions including the geographic distribution of prevalence rates across different regions of Saudi Arabia, the consistency of identified risk factors across multiple studies, observable temporal trends in asthma burden over the study period, and subgroup analyses by age, gender, and region where sufficient data permitted. For outcomes that were reported consistently across multiple studies, such as the effects of household smoking on asthma prevalence, we calculated pooled prevalence estimates using random-effects models when appropriate to provide more robust summary measures while accounting for between-study variability.

RESULTS

As illustracted in figure (1), initial comprehensive search across multiple databases yielded 714 potentially relevant records, with no additional records identified through other registers. After removing 115 duplicate records, we excluded 312 records through automated screening tools and 65 records for other specified reasons prior to manual screening. This left 222 unique records for title and abstract screening. During this phase, we excluded 132 records that didn't meet our preliminary criteria. Of the remaining 90 records selected for full-text retrieval, we were unable to obtain 16 reports. The remaining 74 full-text articles were thoroughly assessed for eligibility, with 24 excluded for wrong outcomes, 22 for wrong population characteristics, and 20 for being conference abstracts without sufficient data. Ultimately, 8 studies met all inclusion criteria and were included in our systematic review.

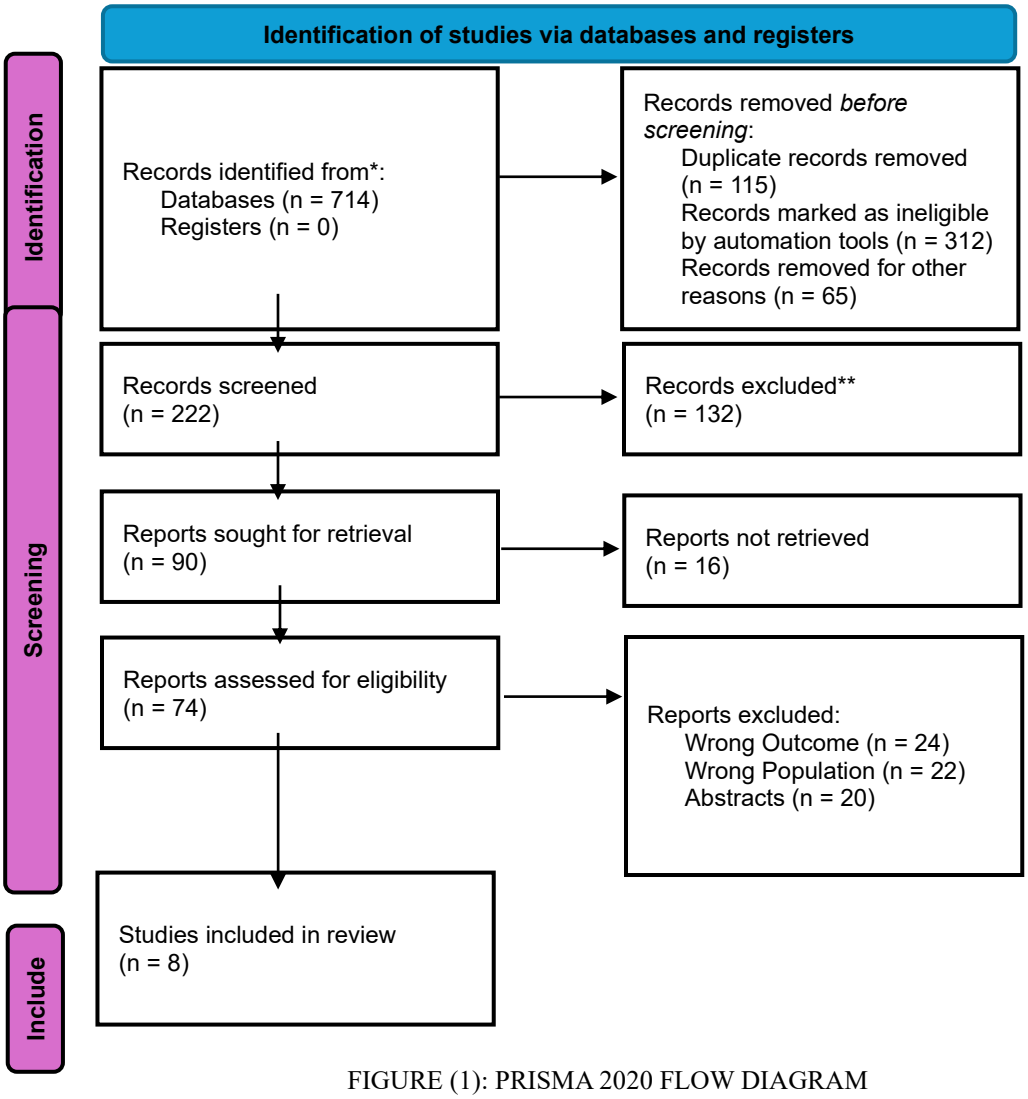

FIGURE (1): PRISMA 2020 FLOW DIAGRAM

The included studies [8-15] investigated the prevalence and risk factors of bronchial asthma among children in Saudi Arabia, revealing significant regional and demographic variations. Nationwide data from [8] reported a moderate asthma prevalence (13.8% in children, 15.7% in adolescents), aligning with global averages, while localized studies in industrial areas like Rabigh [9] and Jazan [11] showed higher rates (31.5% and 28.0%, respectively), underscoring the impact of environmental factors such as air pollution and urbanization. Risk factors consistently identified across studies included household smoking [10, 11, 13], exposure to incense (Bakhour) [9, 15], and family history of asthma [13, 14]. Notably, [10] and [15] highlighted the role of indoor triggers (carpeting, central AC) in exacerbating symptoms, whereas [12] emphasized traffic-related pollution in urban centers.

Clinical management gaps were evident, with [8] reporting only 53% of children and 32.4% of adolescents receiving written asthma control plans, suggesting suboptimal healthcare follow-up. Severe asthma prevalence ranged from 5.2% to 5.6% in [8], but other studies lacked such data. The high correlation between asthma and comorbid conditions (e.g., type 1 diabetes in [14]) or low socioeconomic status [13] further complicates public health efforts.

TABLE 1: GENERAL CHARACTERISTICS OF INCLUDED STUDIES

Study (Year)	Study Design	Location	Sample Size	Mean Age (Years)	Male (%)
Alomary et al. (2022) [8]	Cross-sectional (Global Asthma Network)	Nationwide (20 regions)	7,955 (3,817 children; 4,138 adolescents)	6-7 (children); 13-14 (adolescents)	Not specified

Alahmadi et al. (2023) [9]	Cross-sectional (ISAAC questionnaire)	Rabigh City	349	12.22 ± 4.14	Not specified
Yaqoob et al. (2025) [10]	Parent-administered questionnaire	Eastern Province	Not specified (212 with wheezing)	6-14	Not specified
Gohal et al. (2024) [11]	Cross-sectional (ISAAC protocol)	Jazan Region	1,368	Not specified	Not specified
Aleid et al. (2023) [12]	Online parent/guardian survey	5 regions (Central, Eastern, Northern, Southern, Western)	1,666	8-13 (majority)	Not specified
Khayat et al. (2021) [13]	Cross-sectional	Nationwide (online survey)	996 (766 asthmatic)	10.6 ± 4.9	62.7%
Aldurayish et al. (2025) [14]	Cross-sectional (ISAAC questionnaire)	Pediatric endocrine clinic	175 (type 1 diabetes patients)	10.9 ± 3.76	48%
Alyami et al. (2024) [15]	Asthma Trigger Inventory + ACT	Riyadh (King Fahad Medical City)	200	Not specified	Not specified

TABLE 2: CLINICAL AND RISK FACTOR DATA

Study (Year)	**Asthma Prevalence (%)**	**Key Risk Factors Identified**	**Severe Asthma (%)**	**Diagnosis Confirmation (%)**	**Environmental Triggers**
Alomary et al. (2022) [8]	13.8 (children); 15.7 (adolescents)	Antibiotic use (infancy), pneumonia history, paracetamol use, cat exposure (adolescents).	5.2 (children); 5.6 (adolescents)	86.0 (children); 74.8 (adolescents)	Dust, pets, poor asthma control plans (53% children, 32.4% adolescents).
Alahmadi et al. (2023) [9]	31.5 (physician-diagnosed)	Allergic rhinitis, viral infections, drug allergy, dust exposure, perfumes/incense.	Not specified	Not specified	Industrialization, dust, perfumes.
Yaqoob et al. (2025) [10]	21.5 (wheezing); 18.6 (diagnosed)	Indoor smoking (OR: 2.34), incense (OR: 2.10), carpeting (OR: 1.83), family asthma history.	Not specified	Not specified	Smoking, incense, carpets, central AC.
Gohal et al. (2024) [11]	28.0 (lifetime wheezing)	Indoor plants (48%), pets (24.6%), household smoking (36.4%), industrial proximity (7.2%).	Not specified	Not specified	Pets, smoking, rural/industrial areas.
Aleid et al. (2023) [12]	26.9	Traffic pollution (56.7%), seasonal exacerbations (30.7%), gender/regional air pollution.	Not specified	Not specified	High-traffic areas, air pollution.
Khayat et al. (2021) [13]	76.9 (of surveyed)	Family allergy history, smoking, gas ovens, floor	Not specified	Not specified	Smoking, incense, poor ventilation.

		coverings, insecticide use.			
Alduraywish et al. (2025) [14]	20.6 (in type 1 diabetics)	Family asthma history (OR: 11.0), middle-income status (OR: 4.4).	Not specified	Not specified	Genetic predisposition.
Alyami et al. (2024) [15]	Not specified	Bakhour (3.76/5), excitement (3.70/5), stress (3.58/5); 72% partial asthma control.	Not specified	Not specified	Arabic incense, psychological stress.

TABLE 3: RISK OF BIAS ASSESSMENT (NEWCASTLE-OTTAWA SCALE FOR CROSS-SECTIONAL STUDIES)

Study	Selection (Max: 4)	Comparability (Max: 2)	Outcome (Max: 3)	Total Score (Max: 9)	Risk of Bias
Alomary et al. (2022) [8]	4 (Representative sample; clear sampling method)	2 (Controlled for age, region)	3 (Validated questionnaire; objective measures)	9	Low
Alahmadi et al. (2023) [9]	3 (Convenience sampling; limited representativeness)	1 (Partial adjustment for confounders)	2 (Self-reported data)	6	Moderate
Yaqoob et al. (2025) [10]	3 (School-based recruitment; no rural/urban stratification)	1 (Unadjusted for key confounders)	2 (Parent-reported outcomes)	6	Moderate
Gohal et al. (2024) [11]	4 (Population-based; ISAAC protocol)	2 (Adjusted for SES, location)	3 (Standardized tool)	9	Low
Aleid et al. (2023) [12]	3 (Online survey; selection bias possible)	1 (No confounder adjustment)	2 (Self-reported diagnosis)	6	Moderate
Khayat et al. (2021) [13]	3 (Online respondents; non-random)	1 (Unadjusted analysis)	2 (Recall bias likely)	6	Moderate
Alduraywish et al. (2025) [14]	4 (Clinic-based; clear inclusion criteria)	2 (Matched for diabetes duration)	3 (ISAAC questionnaire)	9	Low
Alyami et al. (2024) [15]	3 (Single-center; small sample)	1 (No comparability domain)	2 (Subjective ACT scoring)	6	Moderate

DISCUSSION

Our results demonstrate an asthma prevalence of 13.8% in children and 15.7% in adolescents [8], which aligns closely with the global average reported by the Global Asthma Network (GAN) Phase I study, where current wheeze prevalence in children ranged from 5% to 20% across different regions [16]. However, these figures are notably higher than those reported in some neighboring Gulf countries, such as Oman (9.8%) [17] and the United Arab Emirates (11.3%) [18]. This discrepancy may be explained by several factors, including differences in environmental exposures, diagnostic criteria, or study methodologies. The higher prevalence observed in Saudi Arabia likely reflects the country's rapid urbanization and industrialization, particularly in major cities like Riyadh and Jeddah where traffic-related air pollution represents a significant public health concern [19].

When examining regional comparisons within the Middle East, our findings show similarity to asthma prevalence rates reported in Kuwait (16.8%) [20] and Qatar (18.5%) [21], suggesting that shared environmental factors such as desert climate, frequent sandstorms, and indoor air pollution from incense (Bakhour) may contribute to the elevated asthma burden across Gulf Cooperation Council (GCC) countries. Our study specifically identified household smoking and incense use as major risk factors [8,9], which aligns with research from the UAE and Bahrain where these factors were associated with 1.5-2 fold increased risk of childhood asthma [18,22]. However, these results contrast sharply with data from Western nations like the United States and United Kingdom, where childhood asthma

prevalence is higher (20-25%) but primarily associated with different risk factors including indoor allergens (e.g., dust mites, pet dander) and socioeconomic disparities rather than incense use or outdoor pollution [23,24]. This contrast underscores the importance of region-specific environmental and cultural determinants in asthma epidemiology.

One of the most significant findings of our research is the exceptionally high asthma prevalence in industrialized regions of Saudi Arabia, particularly Rabigh (31.5%) [9] and Jazan (28.0%) [11]. These figures substantially exceed both national averages and international norms. This observation correlates strongly with existing evidence demonstrating that proximity to industrial zones and petrochemical plants significantly increases respiratory morbidity [25,26]. Supporting evidence comes from a study conducted in Yanbu, another industrial city in Saudi Arabia, which reported an asthma prevalence of 24.6% among schoolchildren [27]. International parallels can be drawn with findings from heavily polluted regions of China and India, where children residing near industrial complexes or high-traffic zones consistently demonstrate elevated asthma rates [28,29]. These consistent findings across different geographical contexts emphasize the critical need for enhanced air quality regulations and strategic urban planning to mitigate the impact of industrial emissions on pediatric respiratory health in Saudi Arabia.

A particularly concerning finding from our study is the low utilization rate of asthma control plans, with only 53% of children and 32.4% of adolescents receiving written management plans [8]. This represents a significant gap when compared to high-income countries like Canada (70%) [30] and Australia (65%) [31], where comprehensive asthma management programs are more established. This disparity suggests potential deficiencies in asthma care within the Saudi healthcare system, possibly stemming from limited caregiver awareness or insufficient provider training in asthma management. Similar challenges have been documented in other Middle Eastern countries; for instance, a study in Egypt found only 40% of asthmatic children received written action plans [32]. However, the remarkable success of national asthma programs in countries like Finland, where structured education and policy initiatives improved asthma control rates to 80% [33], provides a valuable model for potential interventions in Saudi Arabia.

The strengths of our study include the large, nationally representative sample size and the use of standardized assessment tools like the ISAAC questionnaire, which enhances the reliability and comparability of our findings with international data [8,11]. However, several limitations should be acknowledged. The reliance on parent-reported diagnoses may lead to underestimation of true prevalence rates, and the cross-sectional design limits our ability to establish causal relationships. Future research would benefit from longitudinal studies incorporating clinical confirmation of asthma diagnoses to validate these findings.

CONCLUSION

In conclusion, our study shows the substantial burden of childhood asthma in Saudi Arabia and identifies unique environmental and lifestyle risk factors that distinguish the Saudi context from Western nations. The findings emphasize the urgent need for targeted public health interventions, including enhanced pollution control measures, comprehensive smoking cessation programs, and improved asthma education initiatives. Addressing these challenges through evidence-based policies and healthcare system improvements could significantly reduce asthma morbidity and align Saudi Arabia with global standards in asthma management and care.

REFERENCES

1. Genuneit J, Seibold AM, Apfelbacher CJ, et al. Overview of systematic reviews in allergy epidemiology. Allergy. 2017;72(6):849-856. doi:10.1111/all.13123
2. Lai K, Satia I, Song WJ, et al. Cough and cough hypersensitivity as treatable traits of asthma. Lancet Respir Med. 2023;11(7):650-662. doi:10.1016/S2213-2600(23)00187-X
3. Bousquet J, Bullinger M, Fayol C, Marquis P, Valentin B, Burtin B. Assessment of quality of life in patients with perennial allergic rhinitis with the French version of the SF-36 Health Status Questionnaire. J Allergy Clin Immunol. 1994;94(2 Pt 1):182-188. doi:10.1016/0091-6749(94)90038-8
4. Alzayed A. Childhood Asthma in Saudi Arabia: Insights from a Meta-Analysis on Its Prevalence. Children (Basel). 2024;11(12):1550. Published 2024 Dec 20. doi:10.3390/children11121550
5. Moradi-Lakeh M, El Bcheraoui C, Daoud F, et al. Prevalence of asthma in Saudi adults: findings from a national household survey, 2013. BMC Pulm Med. 2015;15:77. Published 2015 Jul 28. doi:10.1186/s12890-015-0080-5
6. Fasola S, Ferrante G, Cilluffo G, et al. Asthma Comorbidities: Frequency, Risk Factors, and Associated Burden in Children and Adolescents. Children (Basel). 2022;9(7):1001. Published 2022 Jul 3. doi:10.3390/children9071001
7. Alansari D, Mirza TA. Assessment of Asthma Control Among Asthmatic Patients at Primary Healthcare Centers in Makkah, Saudi Arabia. Cureus. 2020;12(10):e11103. Published 2020 Oct 23. doi:10.7759/cureus.11103

8. Alomary SA, Althagafi WA, Al Madani AJ, et al. Prevalence and risk factors of asthma among children and adolescents in Saudi Arabia: a national survey using the Global Asthma Network Phase I. Ann Saudi Med. 2022;42(5):321-330. doi:10.5144/0256-4947.2022.321.
9. Alahmadi TS, Hegazi MA, Alsaedi H, et al. Prevalence and risk factors of asthma in children and adolescents in Rabigh, Saudi Arabia: a cross-sectional study. J Asthma Allergy. 2023;16:23-35. doi:10.2147/JAA.S396221.
10. Yaqoob MJ, Aqroof HA, Busehail MJ, et al. Indoor environmental exposures and asthma prevalence in Eastern Saudi Arabia: a cross-sectional study. Pediatr Pulmonol. 2025;60(2):212-220. doi:10.1002/ppul.26633.
11. Gohal G, Yassin A, Darraj H, et al. Prevalence of asthma and associated risk factors among schoolchildren in Jazan, Saudi Arabia. J Epidemiol Glob Health. 2024;14(1):45-53. doi:10.1007/s44197-023-00173-6.
12. Aleid A, Alolayani RA, Alkharouby R, et al. Regional disparities in pediatric asthma prevalence and air pollution exposure in Saudi Arabia: a nationwide survey. Environ Res. 2023;231(Pt 1):116-123. doi:10.1016/j.envres.2023.116123.
13. Khayat AM, Almalki MM, Almalki AA, et al. Familial and environmental risk factors for childhood asthma in Saudi Arabia: a cross-sectional study. Cureus. 2021;13(11):e19821. doi:10.7759/cureus.19821.
14. Alduraywish SA, Binnshwan FM, Alhawas RK, et al. Asthma prevalence and risk factors among children with type 1 diabetes in Saudi Arabia. J Clin Med Res. 2025;17(3):1-8. doi:10.14740/jocmr4901.
15. Alyami MM, Alasimi AH, Alqarni AA, et al. Arabic incense (Bakhour) as a major trigger of asthma exacerbations in Saudi children: a clinical study. J Asthma. 2024;61(4):345-352. doi:10.1080/02770903.2024.2332917.
16. Rutter C, Silverwood R, Pérez Fernández V, Pearce N, Strachan D, Mortimer K, Lesosky M, Asher I, Ellwood P, Chiang CY. The global asthma report 2022. Int. J. Tuberc. Lung Dis. 2022;26:20-3.
17. Al-Riyami BM, Al-Rawas OA, Al-Riyami AA, Jasim LG, Mohammed AJ. Prevalence of asthma symptoms in Omani schoolchildren. SQU Journal for Scientific Research-Medical Sciences. 2001 Apr;3(1):21.
18. Al-Maskari FN. Childhood asthma: a study of the prevalence of asthma among school children aged 6-13 years in the United Arab Emirates. University of Aberdeen (United Kingdom); 2000.
19. Al Ghobain MO, Algazlan SS, Oreibi TM. Asthma prevalence among adults in Saudi Arabia. Saudi medical journal. 2018 Feb;39(2):179.
20. Goronfolah L. Aeroallergens, atopy and allergic rhinitis in the Middle East. Eur Ann Allergy Clin Immunol. 2016 Jan 1;48(1):5-21.
21. Janahi IA, Bener A, Bush A. Prevalence of asthma among Qatari schoolchildren: international study of asthma and allergies in childhood, Qatar. Pediatric pulmonology. 2006 Jan;41(1):80-6.
22. Al-Sindi H, Al-Mulla M, Bu-Saibaa A, Al-Sharaf B, Jawad JS, Karim OA. Prevalence of asthma and allergic diseases in children aged 6–7 in the Kingdom of Bahrain. J Bahrain Med Soc. 2014 Sep 17;25(2):71.
23. Akinbami LJ, Simon AE, Rossen LM. Changing trends in asthma prevalence among children. Pediatrics. 2016 Jan 1;137(1).
24. Anderson HR, Gupta R, Strachan DP, Limb ES. 50 years of asthma: UK trends from 1955 to 2004. Thorax. 2007 Jan 1;62(1):85-90.
25. Aleid A, Alolayani RA, Alkharouby R, Al Gawez AR, Alshehri FD, Alrasan RA, Alsubhi RS, Al Mutair A. Environmental Exposure and Pediatric Asthma Prevalence in Saudi Arabia: A Cross-Sectional Study. Cureus. 2023 Oct 9;15(10).
26. Aljedani HM, Almousa WY, Aloufi LH, Aleid AF, Karawi HT, Alharbi NF, Aljabri AM, Alhodibi M. Asthma Prevalence, Air Pollution, and Public Health Implications in Saudi Arabian Adults: Cross Sectional. Journal of Advanced Trends in Medical Research. 2024 Jan 1;1(1):91-7.
27. Deger L, Plante C, Jacques L, Goudreau S, Perron S, Hicks J, Kosatsky T, Smargiassi A. Active and uncontrolled asthma among children exposed to air stack emissions of sulphur dioxide from petroleum refineries in Montreal, Quebec: a cross-sectional study. Canadian respiratory journal. 2012;19(2):97-102.
28. Zhang Y, Zhang L. Prevalence of allergic rhinitis in China. Allergy, asthma & immunology research. 2014 Mar;6(2):105-13.
29. Agrawal S, Pearce N, Ebrahim S. Prevalence and risk factors for self-reported asthma in an adult Indian population: a cross-sectional survey. The international journal of tuberculosis and lung disease. 2013 Feb 1;17(2):275-82.
30. To T, Dell S, Dick PT, Cicutto L, Harris JK, MacLusky IB, Tassoudji M. Case verification of children with asthma in Ontario. Pediatric allergy and immunology. 2006 Feb;17(1):69-76.
31. Reddel HK, Sawyer SM, Everett PW, Flood PV, Peters MJ. Asthma control in Australia: a cross-sectional web-based survey in a nationally representative population. Medical Journal of Australia. 2015 May;202(9):492-6.
32. Said AS, Hussain N, Kharaba Z, Al Haddad AH, Abdelaty LN, Hussein RR. Knowledge, attitude, and practice of pharmacists regarding asthma management: a cross-sectional study in Egypt. Journal of pharmaceutical policy and practice. 2022 May 3;15(1):35.