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Original Article

A Comparative Analysis of Factors Affecting Uncontrolled Asthma among Paediatric Population in Urumqi vs Islamabad

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ABSTRACT

The prevalence of paediatric asthma, a serious worldwide health issue, varies greatly across different geographical areas. Particularly striking contrasts have been found between Islamabad, Pakistan, and Urumqi, China, prompting a comparison of the underlying causes of uncontrolled asthma. **Objective:** To determine and evaluate the variables influencing uncontrolled asthma in children in the populations of Urumqi and Islamabad. **Methods:** A comparative cross-sectional study on children with uncontrolled asthma aged 3 to 18 years old was carried out in Urumqi, China, and Islamabad, Pakistan. Analysis of hospital data were used to evaluate the uncontrolled factors related to patient's demographics, medical history, factors related to asthma control and living conditions and the environment. **Results:** In both cities, the study found important causes of uncontrolled asthma. Poor inhaler technique, raised BMI, environmental triggers such pollen allergies, poorly ventilated homes, and treatment non-compliance were also noted in both populations. In addition, the study indicated that uncontrolled asthma was present in 32% of paediatric patients in Urumqi and 56% of those in Islamabad for a variety of reasons. **Conclusions:** The results underscore the importance of context-specific interventions in managing paediatric asthma. Measures such as improving inhaler techniques, ensuring treatment compliance, healthy BMI and proper ventilation can significantly improve asthma control in paediatric populations of both Urumqi and Islamabad.

INTRODUCTION

The chronic inflammatory condition of the airways known as asthma continues to be a major public health concern on a global scale. Episodes of wheezing, chest tightness, shortness of breath, and coughing are common symptoms of the condition, which is controlled by a complex interaction of hereditary, environmental, and lifestyle variables. Developing nations are particularly affected by the disease's rising prevalence, which places a heavy burden on healthcare systems and the lives of those who are afflicted despite advances in our understanding and treatment [1, 2]. Asthma prevalence and severity are influenced by a variety of variables that varies depending on the region. Asthma occurrence has been linked to genetics, ethnicity, and the calibre of both indoor and outdoor surroundings. Given how much time individuals spend indoors and the possibility for exposure to a range of allergens and irritants, including dust mites, mildew, pet dander, and cigarette smoke, the indoor environment in particular has gained attention recently [3, 4]. Asthma prevalence has increased annually in China, where fast economic development has resulted in major changes to living conditions. These changes have had a considerable negative influence on children's physical health and placed a heavy financial strain on their families [1]. Due to its

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distinct physical and climatic features, Urumqi, the capital of the Xinjiang Uyghur Autonomous Region in northwest China, is a city of great significance. However, recent epidemiological surveys of asthma in children in Urumqi have been scarce, creating a knowledge gap in understanding the current situation and the risk factors contributing to the disease in this region. [5-8]. Children and adolescents are particularly prone to asthma attacks, which can cause them to miss school, require hospitalization, and in severe cases, even lead to death. Despite advancements in asthma management, many pediatric patients continue to suffer from uncontrolled asthma. Good asthma control is the main management goal according to current asthma management guidelines, as this decreases the risk of asthma exacerbations and improves the quality of life. [9]. However, uncontrolled asthma is still highly prevalent (26% in Western Europe) despite the availability of effective asthma treatment [10]. Several factors of uncontrolled asthma in children have been previously described such as age, male gender, maternal education level, exposure to indoor smoking, pet ownership and high use of short-acting ß2-agonists, incorrect inhaler technique, poor adherence to asthma medication and the presence of co-existing diseases. Many children with asthma have co-existing atopic diseases – including food allergy, allergic rhinitis, and atopic dermatitis – or recurrent respiratory tract infections which makes asthma uncontrollable [11-13]. The results of this study would significantly contribute in literature about asthma risk factors in developing countries, which has significant implications for public health planning and policy development. This research was built on a previous study conducted in August 2019, which investigated the prevalence of childhood asthma and indoor environmental risk factors in Urumqi across six districts, encompassing 8153 preschool children [14]. While in Islamabad the prevalence of childhood asthma is reported to be much higher than Urumqi i.e. 31.58% [8]. The current study has extended this research by comparing these findings with the situation in Islamabad, thus providing a broader perspective on the factors influencing asthma control in different geographical contexts.

METHODS

This comparative study was conducted in two cities, Urumqi, China, and Islamabad, Pakistan. The study aimed to investigate uncontrollable factors related to asthma among children aged 3-18 years in these cities. This study utilized data collected from hospital record databases at two major healthcare institutions, namely the First Affiliated Hospital of Xinjiang Medical University in Urumqi, China, and the Pakistan Institute of Medical Sciences in Islamabad, Pakistan. For both sites, the data collection period ran from 1st July 2021, to 31st December, 2022. A controlled period from 1st January to 30th June of 2021 was also taken into account for comparison. The datasets from Urumqi and Islamabad each contained 874 cases, while the dataset from Urumqi had 738 cases. Both in Urumqi, China, and Islamabad, Pakistan, the data gathering procedure was conducted in accordance with the same guidelines to maintain uniformity. Information about children's health status was gathered using a thorough proforma, with an emphasis on asthma symptoms in particular. The proforma contained questions on demographic information, BMI, medical history, history and treatment of allergies, family history of asthma and allergy, the number of follow-ups in the last 6 months, the number of asthma attacks in the last 6 months, the number of hospitalizations due to asthma in the last 12 months, the number of antibiotics used up to 12 months and possible triggering factors for asthma participation, use of corticosteroids, inhaler technique, forced expiratory volume in 1 second (FEV1) at first diagnosis, treatment for asthma, treatment compliance and information on living conditions and the environment like ventilation in house, quality of indoor air, the number of rooms in the house, and the number of people living in one room. Statistical analyses were performed using the SPSS software. Descriptive statistics were used to summarize the characteristics of the study population. The association between potential risk factors and asthma control was evaluated using logistic regression models, adjusting for potential confounders. Differences in asthma control and associated risk factors between the two cities were analyzed using Chi-square tests for categorical variables and t-tests for continuous variables. Ethical approval for the study was obtained from the respective local research ethics committees in both countries. Confidentiality of the participants' information was ensured throughout the study.

RESULTS

There were significant variations between the data of two cities. Data from Urumqi had a higher percentage of boys compared to Islamabad with a higher prevalence of overweight children. Moreover, there were more children in Urumqi with history of allergies, family history of allergies and a higher proportion of children receiving treatment for allergies compared to Islamabad (Table 1).

Table 1: Demographic variables

Variable	URUMQI N (%)	Islamabad N (%)
Age Group		
3-7 years	230 (26.35%)	195 (26.47%)
7-12 years	356 (40.74%)	289 (39.19%)
12-18 years	288 (32.91%).	254 (34.43%)

Gender		
Boy	392 (44.85%)	431 (58.40%)
Girl	482 (55.15%)	307 (41.60%)
Height (cm)		
Mean ± SD	136.5 ± 12.3	138.2 ± 11.9
Weight (KG)		
Mean ± SD	31.4 ± 6.8	32.1 ± 6.5
BMI		
Mean ± SD	19.9 ± 3.7	17.3 ± 2.6
Underweight	104 (11.91%)	87 (11.79%)
Normal weight	446 (51%)	470 (63.67%)
Overweight	290 (33.2%)	157 (21.29%)
Obesity	34 (3.89%)	24 (3.25%)
Age at The Time of Diagnosis		
Mean ± SD	6.2 ± 2.1	6.4 ± 2.2
Gestational Age of The Child		
Mean ± SD	38.2 ± 1.9	38.5 ± 1.8
Family History of Asthma		
Yes	502 (57.44%)	262 (35.50%)
No	372 (42.56%)	476 (64.50%)
Presence of Family Members with Asthma		
Yes	663 (75.85%)	173 (23.44%)
No	211 (24.15%)	565 (76.56%)

Medical history of participants shown in table 2.

Table 2: Medical history

Variable	URUMQI N (%)	Islamabad N (%)
History of Allergies		
Yes	562 (64.30%)	237 (32.11%)
No	312 (35.70%)	501 (67.89%)
Family History of Allergies		
Yes	566 (64.75%)	277 (37.53%)
No	308 (35.25%)	461 (62.47%)
Treatment for Allergies		
Yes	589 (67.36%)	179 (24.25%)
No	285 (32.64%)	559 (75.75%)
Number of Follow-Ups in the Last 6 Months		
0	81 (9.27%)	73 (9.89%)
1	205 (23.48%)	181 (24.53%)
2	341 (39.04%)	283 (38.36%)
3 or more	247 (28.21%)	201 (27.22%)
Number of Asthma Attacks in the Last 6 Months		
0	368 (42.10%)	76 (10.29%)
1	179 (20.48%)	193 (26.14%)
2	226 (25.89%)	312 (42.30%)
3 or more	101 (11.54%)	157 (21.27%)
Number of Hospitalizations in the Last 12 Months Due to Asthma		
0	679 (77.75%)	34 (4.61%)
1	134 (15.34%)	583 (78.99%)
2	46 (5.27%)	112 (15.18%)
3 or more	15 (1.72%)	9 (1.22%)
Allergen Test Results		
Positive	612 (70.02%)	295 (39.95%)
Negative	262 (29.98%)	443 (60.05%)
Allergen Test Results		
1	653 (74.71%)	295 (39.95%)
2	221 (25.29%)	262 (35.52%)

3 or more	0	181 (24.53%)
Prevalence of Uncontrolled Asthma		
Uncontrolled Asthma	32%	56%

Regarding factors related to asthma control, Urumqi and Islamabad exhibit differences in the reported triggering factors (Table 3).

Table 3: Factors Related to Asthma Control

Variable	URUMQI N (%)	Islamabad N (%)
Possible Triggering Factors for Asthma Participation		
Tobacco Smoke	234 (26.79%)	209 (28.35%)
Dust/Air Pollution	417 (47.73%)	149 (20.19%)
Flower/Pollen	168 (19.23%)	632 (85.64%)
Strong Odor	112 (12.83%)	95 (12.88%)
Child Exercise	385 (44.09%)	311 (42.16%)
Child Sports	279 (31.95%)	235 (31.86%)
Cold Air / Cold Weather	168 (19.23%)	144 (19.52%)
Medicines	197 (22.55%)	168 (22.77%)
Use of Corticosteroids		
Yes	563 (64.46%)	613 (83.06%)
No	311 (35.54%)	125 (16.94%)
Inhaler Technique		
Adequate	591 (67.62%)	45 (6.10%)
Inadequate	283 (32.38%)	693 (93.90%)
Age at The Time of Diagnosis		
Mean ± SD	78.5 ± 12.4	77.2 ± 11.8
Treatment for Asthma		
Yes	657 (75.23%)	558 (75.74%)
No	217 (24.77%)	179 (24.26%)
Treatment Compliance		
Good	721 (82.49%)	268 (36.33%)
Poor	153 (17.51%)	470 (63.67%)

Dust/air pollution is more commonly reported in Urumqi, while flower/pollen is reported more frequently in Islamabad. Furthermore, there are variations in the use of corticosteroids for asthma treatment, with higher usage in Islamabad compared to Urumqi. Moreover, Islamabad has a higher percentage of non-ventilated houses and a slightly higher proportion of houses with poor indoor air quality compared to Urumqi which may contribute to poor asthma control. 70.66% of the participants in Urumqi had good ventilation in their houses in comparison to the Islamabad. Air quality was measured by the presence of withering, discolorations, unpleasant smells in and around the houses. Good air quality was labelled where there was no smell, satisfactory was labelled when there was presence of foul smell occasionally while moderate air quality means presence of smell sometimes (Table 4).

Table 4: Living conditions and the environment

Variable	URUMQI N (%)	Islamabad N (%)
Ventilation in house		
Ventilated	592 (70.66%)	512 (58.64%)
Non-Ventilated	246 (29.35%)	362 (41.36%)

Indoor Air Quality Index		
Good	195 (22.34%)	162 (21.97%)
Satisfactory	305 (34.91%)	264 (35.80%)
Moderate	237 (27.14%)	199 (26.97%)
Poor	87 (9.97%)	78 (10.57%)
Very Poor	38 (4.35%)	29 (3.93%)
Severe	12 (1.37%)	6 (0.81%)
Number of Rooms in The House		
1 – 3 rooms	642 (73.46%)	476 (64.53%)
4 – 6 rooms	232 (26.54%)	194 (26.25%)
7 or more rooms	0	68 (9.22%)
Number of people living in one room		
1	721 (82.49%)	108 (14.64%)
2	153 (17.51%)	420 (56.91%)
3 or more	0	210 (28.45%)

The table depicts the key factors related to uncontrolled asthma. The chief factor for uncontrolled asthma in Islamabad was reported to be of poor inhaler techniques, followed by Flower/pollen allergies and non-compliance to treatment compared to Urumqi, which has the chief factors of High BMI (Table 5).

Table 5: Factors relating to uncontrolled asthma

Factor	URUMQI (32%)	Islamabad (52%)
Poor Inhaler Techniques	32.38%	93.9%
	(Not Significant)	(p<0.05)
High BMI	37.09%	24.54%
	(Not Significant)	(Not Significant)
Non-Compliance to Treatment	17.51%	63.67%
	(p<0.001)	(p<0.005)
Flower/Pollen Allergy	19.23%	85.64%
	(Not Significant)	(p<0.001)
Poor Ventilation	29.35%	41.36%
	(Not Significant)	(Not Significant)

DISCUSSION

Asthma is a chronic disease that affects a large number of children worldwide [15]. Although it can occur at any age, it is primarily considered a childhood condition, with children being more susceptible than adults [16]. This disease imposes a significant burden on millions of children and their families, and its prevalence is on the rise [17]. While asthma cannot be cured, it can be managed effectively through adherence to a comprehensive medical management plan, including the treatment of coexisting conditions such as rhinitis, and by preventing exposure to environmental triggers [18]. Despite ongoing efforts, the exact reasons for the increasing prevalence of asthma remain unknown. Researchers have explored various factors, both genetic and environmental, in their quest to identify the risk factors associated with asthma. Some confirmed risk factors include a family history of asthma, personal history of allergic rhinitis, exposure to passive smoking during childhood, and living in smaller houses with inadequate ventilation and sunlight [19]. The present study

aimed to identify and assess these factors in relation to asthma in 2 different cities i.e. Urumqi and Islamabad, representative of 2 countries China and Pakistan, respectively. In Urumqi, poor inhaler techniques account for 32.38% of asthma cases, while in Islamabad, it is significantly higher at 93.9% which was statistically significant. Such high prevalence of improper use of inhalers in Islamabad, is strongly suggestive of need of inhaler technique education and training for asthma patients as reported by the study conducted by Almomani et al., in Jordan which yielded that only 13.4% of paediatric asthma patients were using inhalers appropriately [20]. Urumqi, high BMI contributes to 37.09% of uncontrolled asthma cases, but it is not statistically significant. Similarly, in Islamabad, high BMI is not a significant factor, accounting for 24.54% of asthma cases. While not significant, it is important to consider weight management as a part of overall asthma management, as obesity can impact respiratory health. The prevalence of obesity has reached epidemic levels in many populations in recent years and has been identified as a risk factor for asthma [21]. Furthermore, overweight and obese individuals tend to experience more severe asthma symptoms compared to those of normal weight [22]. High BMI among children is a modifiable risk factors which can be dealt with targeted interventions that improve asthma control and overall management. Non-compliance to treatment is a significant factor in both Urumqi and Islamabad. In Urumqi, it accounted for 17.51% of asthma cases. While in Islamabad, the non-compliance was reported to be at 63.67%. Low adherence is a significant contributor of poor asthma control which may be addressed through patient education, support systems, and interventions to improve asthma management outcomes [23]. Pollen allergy is reported to be a major cause for both allergic asthma and uncontrolled asthma [24]. In our study, in Urumqi 19.23% of participants identified flower/pollen as a triggering factor for asthma, while in Islamabad, a significantly higher percentage of 85.64% reported the same. Apart from pollen, other triggering factors were also assessed in the study. Other factors such as Tobacco smoke, strong odors, child exercise, child sports, cold air/cold weather, and medicines showed relatively similar prevalence rates between the two cities while dust/air pollution was reported as a triggering factor by a higher proportion of participants in Urumqi (47.73%) compared to Islamabad (20.19%), suggesting that air pollution may be more prevalent in Urumqi and could contribute to asthma exacerbations in that area. Dust/air pollution is reported to be a potent risk factor for respiratory problems [25]. These results highlight the need for targeted interventions to manage allergies and reduce exposure to allergens in both

cities. The comparison between Urumqi and Islamabad reveals some variations in housing conditions and indoor air quality. Among children with uncontrolled asthma, poor ventilation was found present in 41.36% in Islamabad as compared to 29.35% cases in Urumqi. The differences in housing characteristics can influence indoor air quality and potentially increaring the risk of uncontrolled asthma as reported by Majeed *et al.,* [26]. These findings align with existing literature that details numerous risk factors for uncontrolled asthma and poor symptom control, including treatment adherence, environmental triggers, family history of asthma, and poor inhaler techniques. The high rates of uncontrolled asthma found in Urumqi and Islamabad are concerning. For example, in the United States, about 44% of children with current asthma had uncontrolled asthma from 2018 to 2020 [27]. The higher rates in Islamabad suggest a more significant burden of disease in that city, more likely to be attributed to controllable factors like compliance issues and use of inhaler techniques. Adherence to asthma medication is a critical aspect of controlling the disease. However, medication non-adherence is a significant concern, especially among urban minority patients. [28]. Several risk factors undermine medication adherence in children, including factors like male gender, non-Asian ethnic background, living in a larger household, older age at diagnosis, living in rural areas, and lower socio-economic status [29]. Both unintentional and intentional factors contribute to non-adherence, including lack of parental involvement, lack of access to appropriate medications, improper inhaler technique, child psychological distress, caregiver psychological distress, issues in family functioning, poor child and family understanding of asthma and asthma medications, and a lack of community support [30].

CONCLUSIONS

In both cities, the study found important causes of uncontrolled asthma. Poor inhaler technique, raised BMI, environmental triggers such pollen allergies, poorly ventilated homes, and treatment non-compliance were also noted in both populations. In addition, the study indicated that uncontrolled asthma was present in 32% of paediatric patients in Urumqi and 56% of those in Islamabad for a variety of reasons.

Authors Contribution

Conceptualization: MIA, LR
Methodology: LR
Formal analysis: MIA, YW
Writing-review and editing: YW

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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