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ORIGINAL ARTICLE

The association of childhood asthma with mental health and developmental comorbidities in low-income families

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Abstract

Objective: The objective of the study was to determine the relationship of childhood asthma with mental health and developmental indicators in low-income families. **Methods:** Parents/guardians of approximately 400 children, aged 2–14 years, were recruited from a charity hospital serving low income neighborhoods in the outskirts of Karachi, Pakistan. Mothers of children were interviewed in their local language by a trained nurse. Eight self-reported comorbidities were grouped into two constructs based on factor analysis and conveniently labeled as mental health (anxiety, attention and behavioral problems) and developmental problems (learning, developmental delay, hearing impairment, sleep and speech problems). Data were analyzed using multiple logistic regression, adjusted for age, sex, presence of older siblings, number of people in the household, child birth weight, presence of mold, and family history of asthma or hay fever. **Results:** Children with asthma had 18 times greater odds of mental health problems (adjusted OR = 18.0, 95% CI: 9.2, 35.1) as compared to children without asthma. The odds of developmental problems were more than 14 times greater for children with asthma (adjusted OR = 14.3, 95% CI: 7.8, 26.1) as compared to children without asthma. **Conclusions:** This study found mental and developmental adverse consequences of childhood asthma in low-income families. Identifying and treating asthma at an early age could reduce the burden of comorbidities in this population.

Keywords

Asthma, attention problems, developmental delay, children

History

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Introduction

Asthma is the most common chronic disease among children. According to the World Health Organization estimates, 235 million people suffer from asthma worldwide [1]. Asthma has a global presence irrespective of the country's level of development. Low and lower-middle income countries account for over 80% of asthma mortality [1].

Although, deaths from asthma are rare among children [2], poor asthma control has been linked to increased mortality [3]. Poor asthma control has also been linked to the development of mental health [4] and developmental comorbidities [5,6], suggesting the importance of improving control and prevention measures to manage asthma [7].

Asthma and mental health conditions often co-exist in both children and adult patients [6,8–11]. Childhood asthma is related to higher rates of depression and anxiety symptoms [12–15]. Similarly, behavioral problems are associated with mild to persistent asthma [16] and asthma symptoms [17] in children. Children with asthma have a higher prevalence of Attention Deficit Hyperactivity Disorder (ADHD) and

learning disabilities [5,6]. In addition, children with severe asthma [6] and symptomatic asthma [8], which is indicative of poor asthma control, are more likely to experience behavioral and developmental comorbidities.

The majority of these studies were conducted in developed countries, where healthcare is relatively accessible as opposed to developing countries, where the healthcare infrastructure is not developed. The problem especially compounds for low-income families who spend a disproportionately large amount of their disposable income on food and housing [18]. The purpose of this study was to examine the relationship of asthma with mental health and developmental problems in low-income families in Karachi, Pakistan.

Methods

Karachi is the largest city in Pakistan with a population of over 20 million. In the past decade, there has been a surge in the internal migration of the population to Karachi, due to deteriorating law and order conditions in other parts of the country. The majority of the immigrants (Internally Displaced People) settled on the outskirts of Karachi in different villages called *Goths*. One of these villages, Koohi Goth, was the study site. The village is made up mainly of the Baluch ethnic minority. The Koohi Goth Women's Hospital (KGWH), a privately run non-profit hospital was the project site. KGWH

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is the only primary care hospital serving the women and children of Koochi Goth and the adjoining villages.

The study questionnaire included items that we developed and used previously [8] as well as items taken from the Pakistan Demographic and Health Survey 2006–07 [19]. Two bilingual individuals, with the help of the study site primary care physician, translated the questionnaire and the informed consent to the native language. Since we already knew that the majority of the population has no or very minimal education and would have difficulty in understanding certain questionnaire items, and keeping in view cultural sensitivity, we decided to use the “conversational” approach to interview study participants [20]. Such an approach allows interviewers to develop “rapport” with the respondents and have control over explaining/clarifying the questions if the interviewer feels that the study respondent is having difficulty understanding certain questions. The three nurses who interviewed the study participants belonged to the same community and were quite knowledgeable about local traditions. During the training sessions, the principal investigator and the local primary care physician went over each question with the nurses before agreeing on what length the interviewers can go to explain the questionnaire items to study participants. The data were collected from April 2012 to November 2012.

Two hundred parents/guardians of children with asthma and an equal number without asthma meeting the eligibility criteria were enrolled by a primary care physician at KGWH among those visiting the outpatient department. The eligibility criteria were: (1) ages 2–14 years; (2) not suffering from cystic fibrosis or coronary heart disease; (3) living in the Koochi Goth and the adjacent area for at least one year; and (4) willingness to participate. Once the parents/guardians were selected, trained nurses who were blinded to study objectives interviewed them at the hospital or their residence. The nurse interviewers routinely visit the neighborhood as part of their training, and two of them lived in the same area. Each interviewer was provided with the following items: two copies of informed consent, questionnaire, pen/pencil, ink pad (to take thumb impression of study participants on the informed consent who cannot sign), cash receipt and PKR 100 in cash, an equivalent of 1 USD, to compensate study participants for their time. The informed consent was obtained from the parent/guardian before the field worker interviewed them in the native language.

The primary outcomes of interest were mental health and developmental comorbidities in children. The following items in the questionnaire were used to report comorbidities in children: “Have you ever been told by a doctor, nurse or other health professional that your child has any of the following conditions? Anxiety problems, attention problems, behavioral problems, depression, developmental delay or mental retardation, hearing impairment, learning problems, speech problems, sleep disturbances, vision problems, seizures?” Eight self-reported comorbidities were grouped into two constructs based on factor analysis and conveniently labeled as mental health (anxiety, attention and behavioral problems), and developmental problems (learning, developmental delay, hearing impairment, sleep and speech problems). The two constructs were coded as 0 and 1.

The binary exposure variable was childhood asthma as determined clinically, based on reported signs and symptoms, by the primary care physician. We included covariates based on known associations with childhood asthma from previous studies. Information on covariates was assessed using questionnaire items and include age of child, sex of child, presence of older siblings, number of people in the household, presence of mold, family history of asthma or hay fever, and child birth weight. Because of low literacy level in this population, we anticipated that study participants may not remember the exact weight of the child. Also, it is common to give birth at home and children are not weighed. We therefore decided to include the “qualitative” question on birth weight (average, larger than average or smaller than average) that was also used in the Pakistan Demographic and Health Survey 2006–07 [19].

Statistical analyses

Data were described using descriptive summary statistics. Univariable and multivariable logistic regression analyses, adjusted for potential confounders, were conducted to determine the association of childhood asthma with mental and developmental comorbidities. Both the unadjusted Odds Ratios and adjusted Odds Ratios along with their corresponding 95% confidence intervals were computed using STATA version 13.0 statistical software package (Stata Inc, College Station, TX). The study was approved by the institutional review board of the University of North Carolina at Charlotte.

Results

Table 1 describes the characteristics of the study participants. The average age of the child was 5.9 years (SD = 2.8). Fifty-two percent were female. Approximately 39% had two or more older siblings, and almost 29% were born smaller than average. Additionally, 31% of children had a family history of asthma or hay fever. The majority of respondents (59%) reported presence of mold at home and approximately 63% of households had five or more residents.

Seventy-nine percent of children with asthma had anxiety problems as compared to 21.5% without asthma ($p < 0.001$). Similarly, 48% and 48.5% respondents reported their asthmatic child had attention and behavioral problems, respectively, as compared to 2.0 and 22.0% without asthma, respectively (p value < 0.001), Figure 1). Likewise, the proportion of children with asthma had various comorbid developmental problems ranging from as low as 27.0% for hearing impairment to as high as 66.5% for sleep disturbance, all significantly greater than children without asthma (Figure 2).

The odds of mental health problems were 18 times greater for children with asthma (adjusted OR = 18.0, 95% CI: 9.2, 35.1) as compared to children without asthma. The odds ratios for individual comorbidities that formed the mental health construct—anxiety problems, attention problems, and behavioral problems, were 13.5 (95% CI: 7.3, 24.9), 37.7 (95% CI: 12.7, 111.6), and 4.7 (95% CI: 2.7, 8.4), respectively, when adjusted for potential confounders (Table 2).

Similarly, the odds of developmental problems were more than 14 times greater for children with asthma as compared to

Table 1. Socio-demographic characteristics of the study sample.

	<i>n</i>	%
All	398	100
Age of Child (Mean, SD)	398	5.9 (2.8)
Gender of child		
Male	191	47.8
Female	209	52.3
Number of older siblings		
None	138	34.5
One	105	26.3
Two or more	155	38.8
Birth weight of the child		
Average or larger than average	262	65.5
Smaller than average	115	28.8
Family history of asthma or hay fever		
No	268	67.0
Yes	122	30.5
Mold in house		
No	162	40.5
Yes	233	58.3
Number of people living in house		
1–4	147	36.8
5–7	193	48.3
8 or more	57	14.3

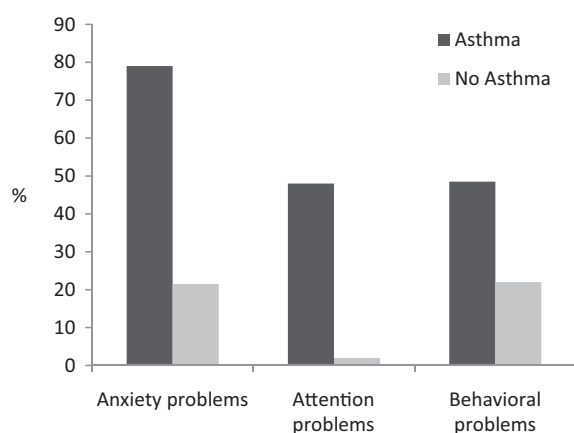


Figure 1. Percentage of comorbid mental health problems among children with and without asthma.

children without asthma (adjusted OR = 14.3, 95% CI: 7.8, 26.1) and the odds ratios for individual comorbidities that formed the developmental construct ranged from as low as 6.8 (95% CI: 1.8, 25.9) for hearing impairment to as high as 19.0 (95% CI: 7.5, 48.1) for speech problems in the multivariable logistic regression analyses (Table 2).

Discussion

The results of this study indicate increased odds of mental health and developmental comorbidities among children with asthma. Asthma may co-occur with other medical conditions in children, which includes developmental and neurobehavioral disorders [12,21]. Children with severe asthma have an increased risk of emotional, developmental and behavioral problems [6]. Children with symptomatic asthma suffer from a wide range of mental health problems, and such problems increase with asthma severity [4,8]. Anxiety disorders and depression are common in both adults and children with

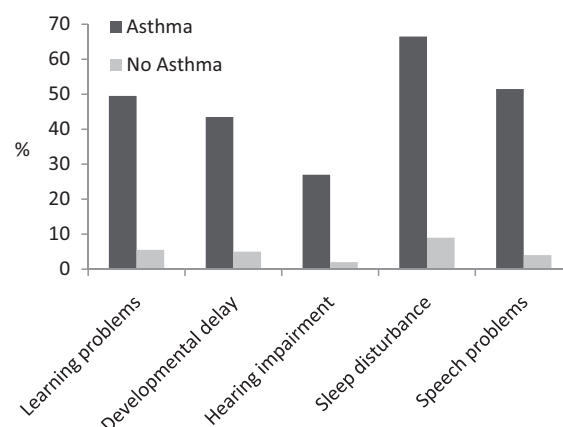


Figure 2. Percentage of developmental comorbidities among children with and without asthma.

Table 2. Unadjusted and adjusted odds ratios and 95% confidence intervals for the association of asthma with mental health and developmental indicators.

	Unadjusted OR	95% CI	Adjusted* OR	95% CI
Mental health construct	14.6	8.9–23.9	18.0	9.2–35.1
Anxiety problems	14.0	8.6–22.6	13.5	7.3–24.9
Attention problems	45.4	16.2–127.1	37.7	12.7–111.6
Behavioral problems	3.4	2.2–5.2	4.7	2.7–8.4
Developmental construct	21.5	12.8–36.1	14.3	7.8–26.1
Learning problems	16.9	8.7–33.0	11.0	4.9–24.7
Developmental delay	14.7	7.3–29.4	8.9	4.0–19.8
Hearing impairment	18.2	6.4–51.3	6.8	1.8–25.9
Sleep disturbance	20.3	11.5–35.7	14.3	7.3–28.1
Speech problems	25.6	12.0–54.8	19.0	7.5–48.1

*Adjusted for age, sex, presence of older siblings, number of people in the household, child birth weight, presence of mold and family history of asthma or hay fever.

asthma [22,23]. Asthma attacks can trigger anxiety, which may cause patients to hyperventilate, further aggravating asthma symptoms [24].

Katon et al. [11] found that 16.3% of asthmatic children met the Diagnostic and Statistical Manual of Mental Disorders (DSM)-IV criteria for one or more anxiety or depressive disorders in the past year, compared to 8.6% of those without asthma. Anxiety is associated with an increased perception of asthma symptoms in children with mild asthma [25]. Both over and under perception of asthma symptoms could play a vital role in maintaining poor asthma control [11]. Anxiety and depression are common in severe asthma [26], and asthmatic children have been reported to experience more mental health problems than healthy subjects in several studies [27,28], consistent with our findings.

We found more than 20 times the odds of sleep disturbance in children with asthma. Children with asthma have a higher prevalence of daytime sleepiness, sleep apneas and hearing impairment as compared to children without asthma [29]. Inefficient asthma control affects sleep patterns in children and breathing problems during sleep can result in daytime sleepiness and fatigue [30]. This nocturnal dyspnea and wakefulness can lead to anxiety and poor quality of life in asthmatic children. Sleep problems have been linked with learning disabilities and other behavioral problems [31].

Appropriate control of asthma, especially during the night, can help overcome sleep and learning problems in children.

There are a relatively few studies that have documented a relationship between hearing impairment and asthma in children. We reported this relationship in our earlier study using a US rural population, where we found more than 8-fold elevated odds of hearing impairment or deafness in children with symptomatic asthma. The odds ratio in the current study is almost twice the odds ratio we reported earlier; the consistency of our results raises some concerns. Recently, Kilic and Colleagues [32] in a small clinical study of adult asthma patients and health controls reported a decline in auditory functions in asthma patients. One reason for hearing loss in asthmatics could be reduced oxygen supply to the inner ear [33]. Asthmatics have airway obstruction for a prolonged period. Such obstruction can reduce blood flow causing hypoxia in the cochlear region contributing to hearing loss [34]. Similarly, children with asthma or allergies are prone to develop inflammation of middle ear [35], which could contribute to hearing loss. Hearing problems can make asthma management a daunting task for children and their caregivers.

Our study showed that children with asthma have significantly elevated odds of speech problems than those without asthma. Altered patterns of speech, chewing and swallowing has shown to be a prominent feature of children with asthma regardless of their severity level [36]. Sound production time and efficiency, and amplitude are significantly impaired in asthmatic patients [37]. Asnaashari et al. [38] found that asthma impacted phonation by affecting a child's breathiness (air loss during phonation) and harshness (deviation from normal voice) qualities, thereby affecting speech. Asthma patients can also experience inflammation of vocal cords, which could also impair speech [35].

Several limitations to the study should be noted. In the absence of objective measures, such as spirometry to diagnose asthma, there is a possibility of misclassification bias in the study. However, such bias is likely to be non-differential resulting in underestimation of the odds ratio. Similarly, self-report of individual mental health and developmental indicators may have also resulted in a misclassification bias. The interview was conducted in the native language and due to the low educational level of the study participants, a *conversational* approach to the interview was used [20]. To the best of our knowledge, this is the first study that has used translated questions related to comorbidities in this study population. Due to limited resources, we did not test validity of the translated questionnaire items. However, there were few missing responses, which could be due to use of the *conversational* interview approach. This could imply that the study participants understood the comorbidity questions well. However, content and construct validity of these comorbidity questionnaire items, especially those related to mental health issues, needs to be established in future studies. Although, all interviewers were trained, the possibility of interviewer bias cannot be ruled out. KGWH is the main hospital that provides free of charge care to the residents of *Koochi Goth* and the adjoining areas. However, since we were not able to accurately ascertain the response rate, the possibility of selection bias cannot be ruled out.

Furthermore, there could be a possibility that caregivers of children with multiple comorbidities were more likely to participate in the study resulting in the differential misclassification bias.

The presence of comorbidities has significant implications as many of these conditions may have a bidirectional effect. Poor asthma control can lead to the development of these comorbidities and presence of comorbidities can worsen asthma severity or render asthma control more difficult to achieve, thereby affecting the child's quality of life. The magnitude of association observed in our study far exceeds those reported in studies from Western countries, where asthma patients have relatively better access to healthcare. For example, in the US, programs such as State Children's Health Insurance Program and Medicaid provide health insurance to children of families who lack access to healthcare. However, there are no comparable programs available in Pakistan. Due to a high cost of asthma medications and an average family in the current study making an equivalent of USD 50 per month, it is likely that the majority of asthmatic children have poor asthma control. This is further evident from the fact that approximately 68% of asthmatic children in the current study visited the emergency room of KGWH six times or more in the previous 12 months. In conclusion, asthma comorbidity has significant implications in terms of the evaluation and management of asthma and should be recognized, investigated and treated appropriately.

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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