

Anxiety, depression and self-esteem in children with well-controlled asthma: case-control study

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ABSTRACT

Objective Although asthma has been linked to psychological morbidity, this relationship may be confounded by poor asthma control. We aimed to compare the prevalence of anxiety, depression and low level of self-esteem in children with well-controlled asthma with that of healthy peers.

Setting Dedicated asthma clinic in a general hospital.

Patients 70 patients with mostly well-controlled asthma and 70 matched healthy controls.

Interventions Comprehensive asthma education, management and follow-up for asthma patients.

Main outcome measures Validated Dutch versions of the Childhood Depression inventory (CDI), Revised Fear Survey for Children (RFSC), Self Perception Profile for Children (SPC-C) and Adolescents (SPC-A) and State-Trait Anxiety Inventory for Children (STAIC). Asthma control assessed by asthma control questionnaire.

Results No significant differences were found in total scores between asthmatics and controls (95% CI for difference -0.2 to 2.9 for CDI, -5.9 to 11.2 for RFSC, -19.9 to 6.3 for SPC-C, -24.1 to 5.0 for SPC-A and -2.7 to 0.01 for STAIC). There were also no significant differences between asthmatics and controls in the prevalence of scores exceeding cut-off levels for clinically relevant anxiety (13.3 vs 13.0%, $p=0.605$), depression (12.9 vs 5.7%, $p=0.243$) or low self-esteem (21.4 vs 12.9%, $p=0.175$). A significant correlation was found between poorer asthma control and CDI ($p=0.012$) and anxiety trait symptoms ($p<0.001$).

Conclusions Children with well-controlled asthma enrolled in a comprehensive asthma management programme do not have an increased risk of anxiety, depression and poor self-esteem. Earlier reports of psychological comorbidity in asthma may have been related to inadequately controlled asthma.

INTRODUCTION

An increased risk of psychological comorbidity has been found in children with chronic conditions in general,^{1 2} and in children with asthma specifically.^{3 4} This association should be interpreted cautiously, however, for a number of reasons. First, the risk of anxiety and depression differed considerably between studies, and there have also been studies showing no increased risk of anxiety and depression in asthma.^{5 6} Second, there were large differences between studies in measurement instruments and definitions of psychological comorbidity. Finally, even in studies observing an association between anxiety/depression and asthma, it remained unclear which was the cause and which was the effect. Although the risks of anxiety and depression appear to increase with increasing asthma severity^{7 8} in a dose-dependent fashion,⁹

What is already known on this topic?

- ▶ Asthma has been associated with increased risk of psychological comorbidity such as anxiety and depression.
- ▶ In studies observing an association between anxiety/depression and asthma, it remained unclear which was the cause and which was the effect.

What this study adds?

- ▶ Children with well-controlled asthma enrolled in a comprehensive asthma management programme in a hospital-based clinic were no more likely to have anxiety, depression or low self-esteem than their healthy peers.
- ▶ Anxiety and depression scores were higher in children with poorer asthma control and those with asthma exacerbations.
- ▶ Poor asthma control appears to contribute to psychological comorbidity in asthma.

the methodological differences between studies limit the possibility to address this important issue in the available literature. No studies to our knowledge have examined the relationship of psychological comorbidity to the level of asthma control, which has become the main focus of asthma management in contemporary guidelines. We hypothesised that anxiety, depression and low self-esteem may be consequences of poor asthma control, and that the prevalence of these psychological conditions in children enrolled in a comprehensive asthma self-management programme with close follow-up, good adherence and good asthma control would be comparable to those of their healthy peers. The present study was designed to test this hypothesis.

METHODS

This was a cross-sectional patient-control study, investigating the prevalence of anxiety, depression and low self-esteem in children with completely or partly controlled asthma managed and followed up at our paediatric asthma clinic, compared with healthy peers matched for age, gender and socioeconomic status (SES).

Details of our asthma management programme have been reported previously.^{10 11} Briefly, the

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programme includes children with chronic persistent asthma, referred by general practitioners because of insufficient asthma control despite treatment with inhaled corticosteroids (ICS). After confirming the diagnosis of asthma, a treatment plan consisting of ICS and additional controller therapy if needed is being agreed by patients, parents and medical team. Asthma nurses provide comprehensive self-management education, including repeated inhalation instruction and discussion of parental views, beliefs and concerns. We have previously reported high adherence to ICS therapy and good asthma control in patients enrolled in this programme at our clinic.^{10–13}

Study subjects

Patients

Consecutive children with asthma, who fulfilled the inclusion criteria for this study, were asked to participate in the study during a scheduled follow-up visit. The inclusion criteria were age between 8 and 15 years, daily ICS maintenance treatment for at least 1 year and regular follow-up by a paediatrician. We excluded children with serious respiratory comorbidity (history of neonatal chronic lung disease, tracheobronchomalacia or other congenital lung and heart abnormalities) and children with insufficient understanding of the Dutch language (including developmental problems or mental retardation).

Controls

Each participating child with asthma was asked to invite a friend or classmate, matched for age, gender and SES as a healthy control subject. For this group, the same inclusion and exclusion criteria applied.

Ethics

This study was approved by the hospital's medical ethics committee, a licensed subsidiary of the Dutch national ethics review board for research involving human subjects. All parents provided written informed consent. Children aged ≥ 12 years completed separate informed consent forms.

Psychological questionnaires

Participants (patients and controls) completed questionnaires under supervision and guidance of a researcher (SLL) who had been trained to work with the instruments by child psychologists. Parents were allowed to be present during the session, but were asked to refrain from giving input on their child's responses. We used validated Dutch translations of four commonly used self-report questionnaires for depression, anxiety and self-esteem. Children only completed questionnaires validated for their age.

The *Children's Depression Inventory* (CDI) is a 27-question self-report questionnaire that covers the cognitive, affective and behavioural symptoms of depression in children 8–17 years of age. Each item is scored as absence (0 points), mild presence (1 point) or clear presence (2 points) of the symptom, leading to a total score from 0 to 54, which can be converted into percentile scores, adjusting for age, gender and educational level. A total score ≥ 16 indicates possible clinical depression for which further investigation is recommended.¹⁴

The *Revised Fear Survey for Children* (RFSC) quantifies subjectively experienced anxiety in children 6–12 years of age. It consists of 80 potentially fear-inducing objects or situations, to be scored on an ordinal scale ranging from not frightening (1 point) to very frightening (3 points). Items are grouped into five subscales: fear of failure and criticism, of the unknown, of small injuries or small animals, of danger and death, and fear of

medically related situations. The total anxiety score (80–240) describes the general tendency of a child to react anxiously to certain situations or objects (fear disposition). Scores can be converted into decile scores. Decile scores ≥ 8 are considered to be within the clinical range.¹⁵

The *Self-Perception Profile for Children*, a self-report questionnaire for children 8–12 years (SPC-C) and adolescents 12–18 years of age (SPC-A), uses 36 four-choice items to assess the child's self-perception of competence on seven subscales: school competence, social acceptance, sports capacity, physical appearance, behaviour and attitude, global self-esteem and, in 12–18 year olds, close friendships. Scores can be converted into percentile scores using norm tables. Scores below the 15th centile are considered to be abnormal.¹⁶

Finally, the *State-Trait Anxiety Inventory for Children* (STAIC) consists of two 20-item self-report questionnaires: one focusing on the child's present level of anxiety (anxiety state) and the other focusing on the child's general anxiety level (anxiety trait). The instrument is validated for children 8–15 years of age. The total score (ranging from 20 to 60) is obtained by adding all individual item scores and can be converted into centile scores.¹⁷

Asthma status

We recorded information on asthma duration, medication use, atopic sensitisation, exposure to environmental tobacco smoke, asthma exacerbations in the past year for which prednisolone or hospital admission was required and forced expiratory volume in 1 s (FEV1), expressed as a percentage of predicted from the hospital chart (methods of which have been published previously¹²). Each child with asthma completed the Dutch version of the *Asthma Control Questionnaire* (ACQ) during the same visit in which the psychological questionnaires were filled out. An ACQ score < 1.0 indicates complete asthma control; scores over 1.5 suggest inadequately controlled asthma in adults.¹⁸

Other variables

An additional brief questionnaire was used to collect information about the following potential confounding factors: age, gender, medical history, number of siblings and caregiver's education as approximate measure of SES. SES was scored as low (completed basic education to age 16, no further education), moderate (completed vocational training) or high (completed applied sciences or university education).

Data analysis

We assumed a 5% prevalence of anxiety, depression or low self-esteem in healthy control subjects, and prespecified that the study sample size should allow identification of a prevalence of 25% of these psychological issues in children with asthma.^{3 5} With significance set at 2.5% to allow for multiple comparisons (anxiety, depression, low self-esteem and any of these), to detect an 18% difference in the prevalence of psychological comorbidity with 90% power required inclusion of 70 children with asthma and 70 controls.

Differences in psychological scores between asthmatic patients and healthy controls were assessed by χ^2 analysis (proportions), Student t tests (numerical data) and their 95% CIs using IBM SPSS Statistics V.19. The primary end points were the total scores of each of the four different questionnaires; subscale scores were analysed as secondary end points.

RESULTS

Description and comparability of groups

Of 156 eligible children with asthma who were asked to participate, 70 (44.9%) consented. The most common reasons cited for non-participation were lack of time and the child's unwillingness. There were no statistically significant differences between participating asthmatic children and those declining participation in age, gender, duration of asthma or use of other medication than ICS (all *p* values >0.1). Each asthma patient brought a healthy age-matched and gender-matched control. Characteristics of patients and controls are given in [table 1](#). Most patients had well-controlled asthma, with low ACQ scores, no exacerbations in the past year and normal lung function ([table 1](#)). Mean ACQ was <1, the threshold for complete asthma control; 26 children (37%) had an ACQ >1.0, of which 10 (14% of the population) had a score >1.5 (indicating inadequately controlled asthma). There were no significant differences in total questionnaire scores ([table 2](#)) or in the proportion of children with scores above the reference threshold of the instrument ([table 3](#)) between asthmatic children and healthy controls. Children with asthma showed lower scores on the competence-subscale behaviour and attitude ([table 2](#)), and were also more likely to report items fitting the CDI item loneliness (15/70, 21.4%) than their healthy peers (4/70, 5.7%, *p*=0.017).

In the 70 children with asthma, we found significant correlations of higher ACQ scores (poorer asthma control) to higher CDI scores (*r*=0.298, *p*=0.012) and higher STAIC anxiety trait scores (*r*=0.395, *p*<0.001). Although a similar trend was observed for the correlation between ACQ and RFSC (*n*=45, *r*=0.286, *p*=0.056), CBSK (*n*=42, *r*=−0.1888, *p*=0.232),

SPC-A (*n*=28, *r*=−0.309, *p*=0.110) and STAIC anxiety state (*r*=0.130, *p*=0.285), these correlations were not significant. There was no significant correlation between FEV1%pred and any of the psychological questionnaire scores (all *p* values >0.1). Patients who had had an asthma exacerbation in the past year had higher CDI scores (95% CI for difference 0.2 to 5.9, *p*=0.04) and higher anxiety trait scores (95% CI for difference 0.4 to 7.7, *p*=0.03) than children without an exacerbation; other scores did not differ between the two groups (*p* values >0.1). There were no significant correlations of the possible confounding factors age, gender, SES, number of siblings and time since the diagnosis of the asthma to our primary outcome scores (all *p* values >0.2).

DISCUSSION

This study of children with persistent but mostly well-controlled asthma enrolled in a comprehensive asthma management programme showed no significant differences in depression, anxiety and self-esteem scores compared with a group of healthy control peers. There were also no significant differences in the prevalence of children with depression, anxiety or low self-esteem scores in the clinical range between asthmatics and controls. In the asthmatic children, we observed a significant relationship of poorer asthma control and exacerbations to depression and anxiety trait scores. These results support the hypothesis that psychological comorbidity in children with asthma is at least partly determined by poor asthma control.

Although some of the available literature agrees with our results,^{4 6} the majority of previous studies showed an increased prevalence of psychological comorbidity in children with asthma.^{3 5 19–24} The interpretation of these conflicting results is hampered by the differences in study design and methods. Patients came from different ethnic backgrounds, which may have influenced the degree of psychological morbidity observed.^{4 25 26} There is also considerable variety between studies in the assessment methods of psychological symptoms. For example, in the largest survey performed to date, the presence of psychological symptoms was recorded by telephone interviews using a screening instrument (diagnostic interview schedule for children).³ In contrast, we used instruments validated for personal interview application that are widely used in clinical practice as screening instruments for depression, anxiety and low self-esteem.^{14–17}

In addition to such methodological differences, the prevalence of psychological comorbidity in children with asthma is also likely to be influenced by differences in asthma severity and control. In 104 American children with asthma, increasing asthma symptom severity was associated with negative affect scores in a dose-dependent fashion.⁹ This confirmed results from an earlier meta-analysis, in which increasing asthma severity was associated with higher risk of behavioural problems.⁷ Unfortunately, however, many previous studies failed to provide information about asthma severity and control.^{4 5 27} Our results support the hypothesis that poor asthma control contributes to the risk of psychological comorbidity in children with asthma in two ways. First, the prevalence of psychological comorbidity in the children with asthma in our study did not significantly differ from that observed in our control group ([tables 2 and 3](#)). The children with asthma in our study had a high overall level of asthma control and normal lung function ([table 1](#)). Second, even in this cohort of children with well-controlled asthma, a significant correlation between asthma control (ACQ scores and exacerbations) and depression and anxiety symptoms was observed. These results underscore the importance of achieving

Table 1 Participant characteristics

	Asthma* (n=70)	Controls* (n=70)	p Value
Gender			
Male	43 (61.4%)	39 (55.7%)	0.49
Age (years)	11.3 (±2.3)†	11.3 (±2.3)†	0.95
Non-Caucasian origin	6 (8.6%)	2 (2.9%)	0.54
Only child	4 (5.7%)	2 (2.9%)	0.404
Divorced parents	10 (14.3%)	16 (22.9%)	0.28
Level of education father			
Low	21 (30.0%)	13 (18.6%)	0.28
Moderate	32 (45.7%)	36 (51.4%)	
High	17 (24.3%)	21 (30.0%)	
Level of education mother			
Low	40 (57.1%)	28 (40.0%)	0.09
Moderate	20 (28.6%)	32 (45.7%)	0.50
High	10 (14.3%)	10 (14.3%)	
Smoking parents			
No smoking	49 (70.0%)	52 (74.3%)	
Smoking outside the house	15 (21.4%)	10 (14.3%)	
Smoking inside the house	6 (8.6%)	8 (11.4%)	
Duration of asthma (years)	8.0 (3.5)	–	–
Asthma exacerbations‡	16 (22.9%)	–	–
Allergy	62 (88.6%)	–	–
ACQ-score	0.95 (0.55)†	–	–
FEV1%pred	97.9 (9.7)†	–	–

*Data in numbers (%).

†Data as means (± SEM).

‡Number (%) of patients with an exacerbation requiring hospital admission or oral prednisolone in the past year.

ACQ, asthma control questionnaire; FEV1%pred, forced expiratory volume in the first second of expiration, expressed as percentage of the reference value.

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Table 2 Results of psychological questionnaire scores in children with asthma and healthy controls

Questionnaire	Asthma*	Controls*	p Value	95% CI difference†
CDI (completed by 70 children with asthma and 70 controls)				
Rough score [0–54]	7.6 (±5.2)	6.2 (±4.3)	0.095	1.3 (–0.2 to 2.9)
Centile [0–100]	48.1 (±27.3)	41.6 (±25.2)	0.148	6.4 (–2.3 to 15.2)
RFSC (45 asthma, 46 controls)				
Total score				
Rough score [80–240]	116.9 (±20.4)	114.3 (±20.8)	0.544	2.6 (–5.9 to 11.2)
Decile [1–10]	5.1 (±2.9)	4.5 (±3.1)	0.387	0.5 (–0.7 to 1.8)
Subscale anxiety‡				
Failure and criticism	5.3 (±2.9)	5.0 (±3.2)	0.603	0.3 (–0.9 to 1.6)
The unknown	6.9 (±2.7)	5.8 (±3.0)	0.095	1.0 (–0.2 to 2.2)
Small injuries and animals	5.5 (±3.1)	5.1 (±3.0)	0.910	0.4 (–0.9 to 1.6)
Danger and death	5.1 (±2.6)	5.0 (±2.8)	0.874	0.1 (–1.0 to 1.2)
Medical fear	5.4 (±2.7)	6.5 (±2.9)	0.852	–1.1 (–2.3 to 0.05)
SPC-C (42 asthma, 44 controls)				
Level of self-esteem				
Rough score [6–24]	60.1 (±32.7)	66.9 (±28.0)	0.305	6.8 (–19.9 to 6.3)
Centile [0–100]	20.6 (±3.6)	21.5 (±2.5)	0.188	–0.9 (–2.3 to 0.4)
Other domains§				
School skills	17.1 (±4.3)	18.2 (±3.4)	0.195	–1.1 (–2.7 to 0.6)
Social acceptance	19.1 (±3.9)	22.1 (±10.6)	0.087	–3.0 (–6.4 to 0.4)
Sporting skills	18.6 (±4.1)	19.7 (±3.1)	0.151	–1.1 (–2.7 to 0.4)
Physical appearance	20.4 (±4.2)	21.0 (±3.5)	0.460	–0.6 (–2.3 to 1.0)
Behaviour and attitude	17.6 (±3.7)	19.1 (±3.0)	0.040	–1.5 (–3.0 to –0.07)
SPC-A (28 asthma, 26 controls)				
Level of self-esteem				
Rough score [6–24]	56.5 (±27.0)	66.0 (±26.2)	0.192	–9.6 (–24.1 to 5.0)
Centile [0–100]	16.0 (±2.0)	16.9 (±2.5)	0.234	–0.9 (–2.3 to 0.6)
Other domains§				
School skills	14.3 (±2.9)	14.3 (±2.0)	0.981	0.0 (–1.4 to 1.4)
Social acceptance	15.9 (±3.3)	16.5 (±2.4)	0.464	–0.6 (–2.1 to 1.0)
Sporting skills	12.1 (±4.2)	13.4 (±2.6)	0.185	–1.3 (–3.2 to 0.6)
Physical appearance	13.9 (±3.5)	14.9 (±3.3)	0.960	–1.0 (–2.8 to 0.9)
Behaviour and attitude	15.5 (±3.2)	16.1 (±3.2)	0.484	–0.6 (–2.4 to 1.1)
Close friendships	18.1 (±2.1)	18.5 (±1.4)	0.336	–0.5 (–1.4 to 0.5)
STAIC (70 asthma, 70 controls)				
Anxiety state				
Rough score [20–60]	26.7 (±4.3)	28.0 (±3.7)	0.052	–1.3 (–2.7 to 0.01)
Decile [1–10]	3.6 (±2.6)	4.2 (±2.4)	0.219	–0.5 (–1.4 to 0.3)
Anxiety trait				
Rough score [20–60]	30.5 (±6.6)	29.2 (±6.5)	0.242	1.3 (–0.9 to 3.5)
Decile [1–10]	5.0 (±3.1)	4.3 (±2.9)	0.163	0.7 (–0.3 to 1.7)

Results on primary end points are given in bold.

*Data in numbers (%) or in mean (±SEM).

†Difference in means (*Asthma*—*Control*) (confidence interval (95% CI) of the difference).

‡Decile score [0–10].

§Centile score [0–100].

CDI, Childhood Depression Inventory; RFSC, Revised Fear Survey for Children; STAIC, State-Trait Anxiety Inventory for Children.

and maintaining good asthma control by comprehensive asthma care.

The strengths of this study include the use of four separate, well-validated screening questionnaires for anxiety, depression and low self-esteem, and the careful application of these instruments in a personal setting. The well-characterised setting of a comprehensive asthma management programme also adds to the relevance of our findings.^{10–13}

We acknowledge the following limitations. Selection bias (possible low participation rate of children with behavioural or emotional problems) may have played a role, although the study sample of asthmatics was representative of the root population of asthmatic children in our programme with respect to

demographic and clinical characteristics of asthma. Second, we only obtained information from the children themselves, without input from parents or teachers. The use of such alternative sources is associated with a higher prevalence of psychological comorbidity identified.²⁸ Although we deliberately chose only to interview children themselves, further studies are needed to corroborate our findings using complementary information from parents and teachers. Third, our study sample was relatively small compared with previous studies. This was partly for reasons of feasibility because we wanted to use well-validated extensive questionnaires (which are time-consuming to administer) instead of simple short screening instruments. Our study was sufficiently powered to identify an 18% difference in

Table 3 Participants with scores exceeding reference cut-off points

	Asthma*	Controls*	p Value
CDI rough score ≥ 16	9 (12.9%)	4 (5.7%)	0.243
RFSC total score 9th or 10th decile	6 /45 (13.3%)	6 /46 (13.0%)	0.605
SPC-C/A level of self-esteem ≤ 15 th centile	15/70 (21.4%)	9/70 (12.9%)	0.175

*Numbers (%).

CDI, Childhood Depression Inventory; RFSC, Revised Fear Survey for Children.

the prevalence of psychological comorbidity between asthmatics and controls, which is below the 20% difference we predefined as being clinically relevant. There was no consistent trend towards higher prevalence of psychological morbidity between asthmatics and controls, and the 95% CIs for differences in scores between the two groups were small for all variables studied (table 2). This makes it unlikely that a larger study sample would have yielded different results, although this can never be ruled out confidently. Out of the 30 comparisons made, two subscale or item variables showed statistically significant but small differences to the disadvantage of the asthma group (table 2). This may have been caused by multiple comparisons.

Finally, our method of recruiting healthy controls through peers (friends and classmates of the asthmatic patients) may introduce selection bias: it is possible that the asthmatic children in our study selected peers of similar psychological profiles. On the other hand, this method, which we have used previously,²⁹ may help to improve matching with respect to other confounders of psychological status between patients and controls.

In conclusion, in children with well-controlled asthma enrolled in a comprehensive asthma management programme, there was no increased prevalence of symptoms of depression, anxiety and low self-esteem compared with healthy peers. Poorer asthma control was associated with higher depression and anxiety scores. These results support the hypothesis that the previously reported increased prevalence of anxiety and depression in children with asthma is at least partly explained by poor asthma control.

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Competing interests None.

Patient consent Obtained.

Ethics approval The Isala Hospital's medical ethics committee, a licensed subsidiary of the Dutch national ethics review board for research involving human subjects.

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