

REGULAR ARTICLE

Asthma and allergies correlate with mental health problems in preschool children

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Abstract

Aim: To explore the relations between asthma, allergies and mental health problems in preschool children, aged 3-5 years.

Methods: In this cross-sectional Swedish study, we used data on 4649 children in Uppsala municipality whose parents and preschool teachers had responded to questions measuring asthma and allergies, and the Strengths and Difficulties Questionnaire (SDQ) for assessment of mental health problems. Logistic regression models were used to explore the relations between asthma and allergies and mental health problems.

Results: Children with asthma (8.5%) had elevated odds of having emotional symptoms as rated by parents (OR: 1.34; 1.02-1.76) and teachers (OR: 1.44; 1.09-1.91). According to parents' ratings, these children also had elevated odds of showing mental health problems in general according to the SDQ total score (OR: 1.42; 1.05-1.94). Children with food allergies or intolerance (4.4%) only had elevated odds of having emotional symptoms (OR: 1.64; 1.16-2.33), as reported by parents. These results remained significant after adjustment for parental background factors.

Conclusion: Preschool children with asthma and food allergies or intolerance are at risk of having concurrent mental health problems. Mental health problems should be assessed in children with these disorders. Adequate support and/or referral to specialised services should be offered when needed.

KEYWORDS

asthma, food allergy, mental health problems, Strengths and Difficulties Questionnaire

1 | INTRODUCTION

Asthma and allergies are common conditions, usually beginning in early childhood. In Swedish contexts, the prevalence of asthma has been estimated to range between 7% and 10% in schoolchildren, and approximately 9% among preschool children,^(1,2) whereas viral wheeze, that is asthma symptoms in combination with a viral infection, has been

shown to affect about 20%-30% of Swedish preschool children at least once in their childhood. Moreover, the prevalence of food allergies has been demonstrated in 5%-8% of Swedish schoolchildren, and in 7% of children 1-6 years of age.⁽²⁻⁴⁾ In addition, allergic rhinoconjunctivitis, caused by allergy towards pollen/fur or dust mite, has been reported to range between 6% and 11% in Swedish children in general, and demonstrated in approximately 6% of preschool children, in particular.^(1,5)

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; CHC, Child Health Centres; OR, odds ratios; SDQ, Strengths and Difficulties Questionnaire.

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Asthma and allergies can also correlate with mental health problems in children. Most research on this topic has studied school-aged children and/or adolescents, and showed that those with asthma and allergies have higher risks for neurodevelopmental problems, behavioural and emotional problems, and learning disabilities, compared to their healthy peers.(6-9) Studies on preschool children have found that a considerable proportion (up to 20%) suffer from mental health problems,(10,11) and have demonstrated associations between asthma and depressive symptoms, impaired social functioning, peer rejection, exposure to bullying, anxiety problems and elevated risk of attention-deficit hyperactivity disorder (ADHD).(12-14) Similarly, preschool children with allergic rhinoconjunctivitis have demonstrated more internalising problems and sleeping problems compared with healthy children. Further research on the role of asthma and allergies on mental health problems in preschool children could provide important knowledge for clinicians and facilitate support and referral for specialised services. The aim of this study was to explore relations between asthma, allergies and mental health problems in preschool children in a Swedish context. We focused on asthma, food allergy and pollen/fur or dust mite allergy since they are common conditions in young children.(1-5)

2 | METHODS

2.1 | Study design

This is a cross-sectional study based on data from the *Children and Parents in Focus* project which is a population-based intervention study (in short the Focus study), for which data were collected in Uppsala, Sweden, between 2013 and 2017.(15) The project has a twofold aim: to investigate the mental health of preschool children and their parents, and to evaluate the effects of a parenting programme. To investigate the current study aim, population data from the Focus study were used.(16,17)

2.2 | Procedure

Guardians of all children aged 3-5 years were recruited at participating Child Health Centres (CHC) in connection with their child's annual check-up visit (for convenience, we refer to guardians as parents or mothers/fathers throughout the paper). CHC nurses attached three sets of questionnaires to the invitation letter that is routinely sent home to each child about three weeks before their annual visit. Parents were requested to fill in one questionnaire each and bring them to the visit, and give the third questionnaire to the preschool to be filled in by the child's teacher and sent directly to the CHC in a pre-paid envelope that was provided.

Children's mental health problems were assessed with the Strengths and Difficulties Questionnaire (SDQ),(18) posed to all the three informants, that is mothers, fathers and preschool teachers. Information about socio-demographic background and parental

Key notes

- We explored the relations between asthma, allergies and mental health problems in 4649 preschool children in Sweden.
- Children with asthma and food allergies or intolerance were at risk of having concurrent mental health problems.
- Our findings point to the importance of early detection and interventions aimed at this population.

health was collected from both parents. Other questions including the items about children's physical health were addressed to both parents in the first year of data collection; from the second year, these items were only addressed to one parent.

2.3 | Participants

During the project years 2013-2017, a total of 7185 unique children from Uppsala municipality were included in the Focus study. Over the four years, more than 28,000 questionnaires were distributed in total, including three SDQs, two for parents and one for the preschool teacher. The average overall yearly consent rate in the study from which data were extracted was 39.1%.

Since data were collected annually during a four-year period, some children were represented twice or three times in the project. For these children, we chose the most recent data point. This approach was taken to increase the percentage of children with asthma or allergies, which is more likely to be detected as the child gets older. Additionally, if the information was available from both parents, we randomly chose the questionnaire from one parent only.

Mental health problems can be situational; thus, a multi-informant approach has been emphasised when assessing mental health problems in children.(18,19) In the current study, we used data from both parents and preschool teachers, providing more objective reports and reduced informant bias on the outcomes, as the teacher reports were also included in the study. Previous findings from the Focus study have shown that the teachers reported significantly lower levels of mental health problems in the children compared with the parents, even if correlations between parent and teacher ratings showed good interrater agreement.(16,20) Additionally, the Focus study has provided norms for the SDQ, based on parents, and preschool teachers,(17) and shown that the CHC nurses found the SDQ useful for their clinical evaluation of the children.(21) Further findings based on Focus data have demonstrated that the combination of somatic and mental health problems predicted higher service use in the children.(11)

In total, we excluded 2391 children from the analyses as they did not have SDQ scores available from at least one parent and from the preschool teacher. We used a series of ANOVAs to compare children

with only parental or teacher SDQ available to those with SDQ available from both parents and teachers. The results showed that lack of teacher data was associated with no (three subscales) or very small differences in parental SDQ ($r^2 = 0.001-0.003$ for total difficulties, hyperactivity/inattention and peer problems). However, lack of parental SDQ was associated with worse mental health reported by teachers. This might be partially due to a higher proportion of children with lower educated and non-Swedish parents having teacher data available only. Another 145 children were excluded due to missing data on other variables of interest. Thus, a total of 4649 unique children were included in the current study.

2.4 | Measures and variables

The Swedish version of the Strengths and Difficulties Questionnaire (SDQ), completed by parents and preschool teachers, was used for the assessment of mental health problems.(18) The SDQ comprises 25 items and is a widely used screening tool for child emotional and behavioural problems. The four symptom subscales measure emotional symptoms, conduct problems, hyperactivity/inattention and peer relationship problems, and a fifth subscale measures prosocial behaviour. Each item is rated on a three-point scale, with 0 = 'not true', 1 = 'somewhat true' and 2 = 'certainly true'. Each subscale score ranges from 0 to 10. Additionally, the four symptom subscales can be summed to generate a total difficulty score that ranges from 0 to 40. The SDQ has demonstrated adequate psychometric properties elsewhere,(19,22) and previous findings from the Focus study have shown good interrater reliability, internal consistency and construct validity for the SDQ when used among preschool children.(16,20)

The presence of asthma and/or allergies was assessed with a single question, 'Has a physician diagnosed the child to have any of the following conditions?', followed by the multiple-choice alternatives: asthma, pollen/fur and dust mite allergy, and food allergy or intolerance. We used a number of covariates to adjust for their potential confounding effects as they have previously been shown to be related to mental health problems in children.(23-25) These covariates were parental country of birth (Sweden or other), parental marital status (married/cohabiting or single/living apart/other) and level of parental education (not completed primary school/primary school, upper secondary school/training school or college/university for at least 3 years). Additionally, we adjusted the results for the responding parent's gender (female or male), as previous research based on Focus data showed that fathers assessed mental health problems to a slightly higher degree, than mothers.(20)

2.5 | Statistical analyses

Means, standard deviations, frequencies and proportions were used for descriptive purposes. The relations between asthma, allergies and mental health problems were explored through single and multiple logistic regression models. The exposure variables were (a) asthma,

(b) pollen/fur or dust mite allergy and (c) food allergy or intolerance. In separate models, children with these conditions were compared with children without these conditions; for example, children with asthma were compared with children with no asthma. The outcomes were mental health problems according to the SDQ subscales, that is emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, lack of prosocial behaviour and total difficulties, and were defined as scoring above or below the cut-off for the total score and each SDQ subscale, respectively. Sex- and age-specific Swedish cut-offs were applied to establish whether or not the children had mental health problems.(17) Only the exposure variables that were significantly associated with the outcomes, as shown by the single models, were tested in multiple models.

In the multiple logistic regression models, we added covariates, as described above. Prior to computing the regression analyses, data were checked for intercorrelations, that is associations between independent variables, through Pearson correlations. The intercorrelations between independent variables in regression models should not exceed 0.70 and none did so in our data set. The results of the regression analyses are presented as odds ratios (OR) along with respective 95% Confidence Intervals (CI). To indicate statistical significance, 95% CI for OR that did not cross one was used. All analyses were performed in *SPSS*, version 23.

3 | RESULTS

3.1 | Participant characteristics

About half of the children were five years old (50.3%), and most were rated by their mothers (78.8%) (Table 1). The distributions of demographic variables were compared with data from the same age groups in the national population and in Uppsala municipality, using data from Statistics Sweden.(26) The proportion of parents born in Sweden was 84.9%, which is higher than in the general population (71.0%) and in the population of Uppsala municipality (68.0%). In general, parents were also highly educated, with 76.0% having a college or university degree (48% in the general population, 64.0% in the population of Uppsala municipality). The vast majority of the parents (93.7%) were married or cohabiting, which is similar to the corresponding number in the general population (90.0%) and population of Uppsala municipality (91.0%).

The most common physical conditions were asthma (8.5%), followed by food allergy or intolerance (4.4%) and pollen/fur or dust mite allergy (2.4%). The mean scores of the SDQ sub-scales ranged between 0.71 and 8.36, as rated by parents, and between 0.50 and 8.42, as rated by preschool teachers. About 10% to 16% of children scored above or below the cut-off for the SDQ total difficulties score and subscales, respectively, as rated by both *parents* and *preschool teachers*.

Among children diagnosed with asthma ($n = 397$), pollen/fur or dust mite allergy ($n = 111$) and food allergy or intolerance ($n = 204$),

TABLE 1 Participants' characteristics, occurrence of asthma, allergies and mental health problems according to preschool teachers and parents of children aged 3-5 years (n = 4649)

Variables	Mean (SD)	n (%)
Child gender		
Boy		2344 (50.4)
Girl		2305 (49.6)
Child age		
3 y		919 (19.8)
4 y		1227 (26.4)
5 y		2503 (50.3)
Parental gender		
Male		986 (21.2)
Female		3663 (78.8)
Parental country of birth		
Sweden		3947 (84.9)
Other		702 (15.1)
Parental education level		
Not completed primary school/primary school		73 (1.6)
Upper secondary school/training school		1040 (22.4)
College/university degree		3536 (76.0)
Parental marital status		
Single		229 (4.9)
Married/cohabiting		4358 (93.7)
Living apart		54 (1.2)
Other ^a		8 (0.2)
Occurrence of asthma and allergies		
Asthma		397 (8.5)
Pollen/fur or dust mite allergy		111 (2.4)
Food allergy or intolerance		204 (4.4)
Number of conditions		
Zero		4054 (87.2)
One		495 (10.6)
Two		83 (1.8)
Three		17 (0.4)
Mental health problems ^b rated by parents		
Emotional symptoms	1.16 (1.33)	673 (14.5)
Conduct problems	1.84 (1.67)	706 (15.2)
Hyperactivity/inattention	2.00 (2.02)	673 (14.5)
Peer relationship problems	0.71 (1.17)	740 (15.9)
Lack of prosocial behaviour	8.36 (1.68)	612 (13.2)
Total difficulties	5.71 (4.25)	483 (10.4)
Mental health problems ^b rated by preschool teachers		
Emotional symptoms	0.50 (1.04)	569 (12.2)
Conduct problems	0.87 (1.52)	655 (14.1)
Hyperactivity/inattention	1.44 (2.12)	526 (11.3)
Peer relationship problems	0.47 (1.05)	524 (11.3)
Lack of prosocial behaviour	8.42 (2.08)	710 (15.3)
Total difficulties	3.28 (4.17)	489 (10.5)

^aFor example divorced or separated.

^bDefined as mean SDQ scores and proportions of participants scoring above or below the cut-off for the total difficulties score and each SDQ subscale, respectively.

the most common mental health problem was emotional symptoms as rated by *parents* (15.3%–21.1%) and *preschool teachers* (10.8%–16.4%) (Table 2). Among children with no asthma or allergies ($n = 4054$), *parents* most commonly reported peer relationship problems (15.9%) and *preschool teachers* most commonly reported lack of prosocial behaviour (15.6%).

3.2 | Asthma and allergies in relation to mental health problems

The results from single logistic regression models with the SDQ sub-scales above or equal to cut-off as outcome variables showed that having asthma was associated with emotional symptoms, and total difficulties, and that having food allergy or intolerance was associated with emotional symptoms, as rated by *parents* (Table 3). Additionally, having asthma was related to emotional symptoms, hyperactivity/inattention and total difficulties, as rated by *preschool teachers*.

In multiple logistic regression models, the associations between having food allergy or intolerance and emotional symptoms (OR: 1.64), and between having asthma and emotional symptoms (OR: 1.34) and total difficulties (OR: 1.42), as rated by *parents*, remained significant when controlling for covariates (Table 4). Additionally, in terms of significant covariates, mothers rated their children lower than fathers regarding children's total difficulties, and children who had parents born outside Sweden had elevated odds for both emotional symptoms and total difficulties. Children of parents with lower educational levels also had elevated odds for these outcomes.

Furthermore, the association between having asthma and emotional symptoms (OR: 1.44), as rated by *preschool teachers*, also remained significant after adjustment for confounders. In terms of significant covariates, children of parents born outside Sweden had elevated odds for both hyperactivity and total difficulties. Finally,

children whose parents were single or living apart had elevated odds for emotional problems, and lower parental education levels were associated with hyperactivity/inattention and total difficulties, when rated by *preschool teachers*.

3.3 | Sensitivity analyses

In the main analyses, we compared children with and without a specific condition regardless of whether children had any other condition. As sensitivity analyses, we rerun all the regression analyses, both the single and multiple models, comparing children with a specific condition with children who did not have any of the three conditions. The sample size for children with asthma, pollen/fur allergy and food allergy/intolerance was reduced to 4451, 4165, and 4258, respectively. The results remained the same with one exception. Hyperactivity/inattention as reported by *preschool teachers* was no longer related to asthma.

4 | DISCUSSION

The current study aimed to investigate the relations between asthma, allergies and mental health problems in preschool children in a Swedish context. The results demonstrated that asthma was associated with an increased risk for mental health problems in general and emotional symptoms in particular. Food allergy or intolerance was associated with increased emotional symptoms, but only as rated by parents, not teachers. These results remained significant after adjusting for confounders and were confirmed by the results from the sensitivity analyses.

Our results are in line with previous findings showing associations between asthma and emotional problems in preschool children.^(12–14) Based on our knowledge, the relation between

TABLE 2 Number and proportion of children with concurrent mental health problems in relation to asthma and allergies ($n = 4649$)

	As rated by <i>parents</i>				As rated by <i>teachers</i>			
	Asthma	Pollen/fur/ dust mite allergy	Food allergy/intolerance	None	Asthma	Pollen/fur/ dust mite allergy	Food allergy/intolerance	None
	($n = 397$)	($n = 111$)	($n = 204$)	($n = 4054$)	($n = 397$)	($n = 111$)	($n = 204$)	($n = 4054$)
Mental health problems ^a	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Motional symptoms	71 (17.9)	17 (15.3)	43 (21.1)	561 (13.8)	65 (16.4)	12 (10.8)	27 (13.2)	482 (11.9)
Conduct problems	58 (14.6)	15 (13.5)	31 (15.2)	616 (15.2)	54 (13.6)	10 (9.0)	24 (11.8)	577 (14.2)
Hyperactivity/inattention	70 (17.6)	13 (11.7)	33 (16.2)	570 (14.1)	57 (14.4)	10 (9.0)	23 (11.3)	451 (11.1)
Peer relationship problems	64 (16.1)	14 (12.6)	35 (17.2)	646 (15.9)	54 (13.6)	7 (6.3)	16 (7.8)	456 (11.2)
Lack of prosocial behaviour	44 (11.1)	15 (13.5)	26 (12.7)	539 (15.3)	48 (12.6)	11 (9.9)	25 (12.3)	633 (15.6)
Total difficulties	54 (13.6)	10 (9.0)	27 (13.2)	405 (10.0)	54 (13.6)	6 (5.4)	16 (7.8)	422 (10.4)

^aDefined as proportions of participants scoring above or below the cut-off for the total difficulties score and each SDQ subscale, respectively.

TABLE 3 Single logistic regression analyses for associations between asthma, allergies^a and mental health problems (n = 4649)^b

	As rated by parents					As rated by teachers						
	Emotional symptoms	Conduct problems	Hyperactivity/ inattention	Peer relationship problems	Lack of prosocial behaviour	Total difficulties	Emotional symptoms	Conduct problems	Hyperactivity/ inattention	Peer relationship problems	Lack of prosocial behaviour	Total difficulties
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Asthma and allergies												
Asthma	1.32 (1.01-1.73)	0.95 (0.71-1.27)	1.30 (0.99-1.70)	1.02 (0.77-1.35)	0.81 (0.58-1.12)	1.40 (1.04-1.90)	1.46 (1.10-1.93)	0.96 (0.71-1.29)	1.35 (1.01-1.82)	1.27 (0.93-1.71)	0.75 (0.55-1.02)	1.38 (1.02-1.87)
Pollen/fur/ dust mite allergy	1.07 (0.63-1.81)	0.87 (0.50-1.51)	0.78 (0.43-1.40)	0.76 (0.43-1.34)	1.03 (0.60-1.79)	0.85 (0.44-1.64)	0.87 (0.47-1.59)	0.60 (0.31-1.15)	0.77 (0.40-1.49)	0.52 (0.24-1.13)	0.60 (0.32-1.13)	0.48 (0.21-1.10)
Food allergy/ intolerance	1.62 (1.14-2.29)	1.00 (0.67-1.48)	1.15 (0.78-1.68)	1.10 (0.76-1.60)	0.96 (0.63-1.47)	1.33 (0.88-2.02)	0.66 (0.73-1.66)	0.81 (0.52-1.24)	1.00 (0.64-1.55)	0.66 (0.39-1.11)	0.77 (0.50-1.17)	0.72 (0.43-1.20)

Bold numbers indicate significant findings.

^aChildren with conditions were compared with children without conditions (eg children with asthma were compared with children with no asthma).

^bDefined as proportions of participants scoring above or below the cut-off for the total difficulties score and each SDQ subscale, respectively.

food allergy or intolerance and emotional symptoms has not been demonstrated previously in preschool children, but earlier research has found food allergy to be related to anxiety symptoms in adolescents.(9) Furthermore, the occurrence rates of asthma (8.5%) found in the current study are similar to those previously reported in young children,(2,27) whereas the occurrence rates of food allergy (4.4%) and pollen/fur or dust allergy (2.1%) are lower than previously reported.(1-4)

Our main findings suggest that preschool children with asthma are at risk of having concurrent mental health problems. The underlying causal mechanisms are not established; however, research suggests that potential mechanisms may be stress, medication usage or a combination of the two.(28) Furthermore, previous findings suggest that these relations are bidirectional and that a common pathophysiology is responsible for the associations. More specifically, studies have proposed that stress associated with asthma and allergies triggers neuroimmunological pathways, resulting in worsening symptoms, and that such stress also influences the brain negatively, impairing mental health.(13) Recently, researchers have also proposed that low diversity of gut microbiota, that is the microorganisms that harbour the digestive tracts, is associated with higher risk of developing asthma and allergies (29) and that low diversity of gut microbiota also influences the central nervous system through the gut-brain axis, thereby affecting the development of mental health problems.(30) Thus, a common pathophysiology through stress and/or gut microbiota could influence the risk of developing both asthma and allergies as well as mental health problems.

As mentioned above, asthma was related to emotional symptoms, according to both parents and teachers whereas food allergy or intolerance was associated with emotional problems, merely as rated by parents. These findings might have several explanations such as limited power as children with food allergy (4.4%) were fewer than those with asthma (8.5%). Additionally, mental health problems in children can vary between different settings, for example home and school, causing differences in ratings between parents and teachers.(19) Nonetheless, our results highlight the importance of using a multi-informant approach in order to make a comprehensive assessment of mental health problems in children. By including assessments from preschool teachers, our study adds to the previous literature on the relations between asthma, allergies and mental health problems in preschool children.(12-14)

Overall, the associations between asthma, allergies and mental health in children are connected with poor outcomes, including reduced quality of life, which are of great clinical importance, especially for young children.(6) The Swedish child health services reach the majority of 0- to 5-year-old children in Sweden. Thus, it is important that these services pay special attention to potential mental health problems in children treated with asthma and allergies. To detect mental health problems in preschoolers, the SDQ is a useful tool. In addition, paediatricians working in a community setting need to be aware of the relation between asthma, allergies and mental health problems in this population

TABLE 4 Multiple logistic regression analyses for associations between asthma, allergies^a and mental health problems (n = 4649)^b

	As rated by parents			As rated by teachers		
	Emotional symptoms	Emotional symptoms	Total difficulties	Emotional symptoms	Hyperactivity/Inattention	Total difficulties
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Asthma and allergies	Food allergy/intolerance	Asthma	Asthma	Asthma	Asthma	Asthma
Condition not present (ref)						
Condition present	1.64 (1.16-2.33)	1.34 (1.02-1.76)	1.42 (1.05-1.94)	1.44 (1.09-1.91)	1.30 (0.96-1.75)	1.35 (0.99-1.83)
Parental gender						
Father (ref)						
Mother	0.94 (0.77-1.15)	0.94 (0.77-1.15)	0.65 (0.53-0.81)	0.98 (0.79-1.22)	1.23 (0.98-1.56)	1.33 (1.00-1.71)
Parental country of birth						
Born in Sweden (ref)						
Born outside Sweden	1.59 (1.29-1.95)	1.59 (1.29-1.96)	1.72 (1.36-2.17)	0.94 (0.73-1.21)	1.42 (1.12-1.79)	1.44 (1.13-1.83)
Parental marital status						
Married/cohabiting (ref)						
Single/living apart/other ^c	1.32 (0.97-1.80)	1.33 (0.98-1.81)	1.19 (0.83-1.70)	1.68 (1.23-2.29)	1.13 (0.80-1.61)	1.41 (1.00-1.98)
Parental education						
College/university (ref)						
Upper secondary school/training school	1.20 (0.99-1.46)	1.18 (0.97-1.41)	1.64 (1.32-2.02)	1.04 (0.84-1.28)	2.04 (1.12-3.71)	1.40 (1.13-1.73)
Not completed primary school/primary school	2.04 (1.20-3.46)	2.07 (1.22-3.52)	3.74 (2.22-6.31)	1.55 (0.84-2.86)	1.77 (1.44-2.16)	1.35 (0.68-2.68)

Bold numbers indicate significant findings.

^aChildren with conditions were compared with children without conditions (eg children with asthma were compared with children with no asthma).

^bDefined as proportions of participants scoring above or below the cut-off for the total difficulties score and each SDQ subscale, respectively.

^cFor example divorced or separated.

and refer for evaluation by a psychologist when deemed appropriate. Given that young children with concurrent physical and mental health problems have been shown to have high use of healthcare services, resulting in high societal costs,⁽¹¹⁾ early detection enabling early preventive interventions or treatment are likely cost effective.

Moreover, according to our findings on the relations between the *covariates* and mental health problems, children whose parents were born outside of Sweden and with lower educational levels had increased risks of emotional symptoms and mental problems according to the SDQ total score, as rated by parents. In addition, these children had increased risks of hyperactivity/inattention and mental problems according to the SDQ total score, rated by preschool teachers. Children of parents who were single/living apart or with other marital status also had elevated odds of emotional symptoms according to the teacher ratings. Overall, these results are consistent with

previous findings⁽²³⁻²⁵⁾ and highlight the importance of considering multiple background variables when assessing children's mental health problems.

4.1 | Strengths and limitations

One limitation of this study refers to the cross-sectional study design, which does not allow for any conclusions about causality. Thus, the relations between asthma, allergies and mental health problems should be regarded as correlational. Given that the proportions of parents with a high educational level and with Swedish origin were higher than those in the Swedish general population and in the population of Uppsala municipality,⁽²⁶⁾ generalisations of the results should be made with caution. Additionally, we had no information about severity of the asthma and allergic conditions. Hypothetically,

severity of these conditions could have differential impact on the mental health problems. Furthermore, we did not have access to data on additional diagnoses such as developmental disability or premature birth, which also could have influenced the mental health of the children.

The presence of asthma and/or allergies was assessed with a single self-report question, 'Has a physician diagnosed the child to have any of the following conditions?', and the following response options: asthma, pollen/fur and dust mite allergy, and food allergy or intolerance. Thus, we were not able to separate food allergy from intolerance. As these two conditions differ in terms of both pathogenesis and clinical appearances, this should be considered a limitation. Also, as the presence of allergies and asthma was assessed using parental report, a wide variability of diagnostic methods may have been included. This should also be considered a limitation.

The main strength is the large population-based sample of preschool children rated by multiple informants. Another strength is the use of the Swedish version of the SDQ for assessment of mental health problems, which has demonstrated good psychometric properties in other samples and among children in the Focus study. (16,22) Last but not least, given the few studies that have previously explored the relations between asthma, allergies and mental health problems in preschool children, our findings contribute to more knowledge on this topic.

5 | CONCLUSION

The current study demonstrated associations between asthma, food allergies and mental health problems, especially emotional symptoms, in preschool children. Our findings point to the significance of a clinical awareness of the potential comorbidity between asthma, food allergies and mental health problems in this population, and the importance of assessing mental health problems in those with such conditions.

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CONFLICT OF INTEREST

The authors have no conflict of interests to declare.

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ETHICAL APPROVAL

Parents or legal guardians of all participating children gave their written informed consent on behalf of their children, prior to inclusion in the study. The study was approved by the Regional Ethical Review Board in Uppsala (document number 2012/437), and the trial was registered with an international trial registry (ISRCTN16513449).

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