Mental Well-being and General Health in Adolescents with Asthma: The Prevention and Incidence of Asthma and Mite Allergy Birth Cohort Study

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Objectives To assess whether adolescents with asthma experience a lower mental well-being and lower general health than their peers without asthma.

Study design Data from the Prevention and Incidence of Asthma and Mite Allergy study were used. At the ages of 11, 14, 17, and 20 years, 2651, 2522, 2094, and 2206 participants, respectively, completed questionnaires. Their parents completed questionnaires at the ages of 11 (n = 2660), 14 (n = 2338), and 17 years (n = 1872). Asthma was defined according to the Mechanisms of the Development of Allergy criteria. Mental well-being was measured using the Mental Health Index-5 and was reported by the adolescents. General health, measured on a 4-point Likert scale, was reported by the adolescents and their parents. We estimated associations of asthma with mental well-being and perceived general health using generalized estimating equations.

Results At ages 11, 14, 17, and 20 years, 6.7%, 6.9%, 5.0%, and 6.6%, respectively, of the adolescents had asthma. Adolescents with asthma did not score differently on the Mental Health Index than their peers without asthma. Adolescents with asthma were less likely to experience good or excellent health than their peers without asthma (aOR, 0.37; 95% CI, 0.26-0.51 for intermittent asthma and 0.33; 95% CI, 0.25-0.41 for persistent asthma). These results remain similar across the different ages.

Conclusions The mental well-being of adolescents with asthma is similar to that of their peers without asthma, although adolescents with asthma are less likely to perceive a good or excellent general health. *(J Pediatr 2021;233:198-205)*.

In the US one-fourth of youth have a chronic disease.[1] Similarly, in the Netherlands 26% of the children and adolescents grow up with a chronic disease.[2] In Dutch youth aged 0-25 years, asthma is the most common chronic disease (4.6%), followed by anxiety and mood disorder (4.1%), attention deficit hyperactivity disorder (3.6%), stomach ache/fecal issues (2.8%), eczema (2.8%), learning disorder (2.0%), congenital skeleton deformities (1.5%), migraine (1.4%), morbid obesity (1.4%), and autism spectrum disorders (1.1%).[2]

Children and adolescents with a chronic disease face more challenges in daily life compared with their healthy peers, often resulting in fatigue, participating less in sports, worrying more about their future, and being more prone to dropping out of school.[2-4] Therefore, quality care for affected youth encompasses more than only treating physical symptoms, it also includes looking after their overall well-being.[2,5] The positive health concept defines health as being able to adapt and to self-manage, instead of defining health as the absence of a disease.[6-8] Positive health focuses on resilience and therewith on positive challenges, such as maintaining mental well-being and a good perceived general health.[7]

Investigating well-being and health in adolescents is important, knowing that these aspects strengthen essential developmental tasks, including maturation of emotional and cognitive abilities to become independent, completion of education, and transition to employment, civic engagement, and establishment of lifelong relationships.[9] Adolescence is a key developmental time period marked by rapid neurocognitive and social developmental changes, as well as the first emergence of mental health disorders.[10-12] In general, previously published studies reported that youth with asthma perceived a lower general health compared with their peers without asthma.[13,14] Additionally, prior research mainly focused on

GEE	Generalized estimating equation
MHI	Mental Health Index
PIAMA	Prevention and Incidence of Asthma and Mite Allergy
QoL	Quality of Life

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the association between asthma and quality of life (QoL). Silva et al reported that youth with asthma presented an overall lower QoL compared with healthy controls.[15] However, QoL is a broader concept than mental well-being, including multiple domains such as physical, psychological, emotional, and social and school functioning. Some studies used a QoL instrument, such as the health-related QoL questionnaire, that explicitly measure mental well-being as a separate domain. Studies using these instruments presented different results: some studies reported a lower mental well-being in adolescents with asthma, others observed a similar mental well-being for adolescents with asthma and adolescents without asthma.[14,16,17]

Asthma severity and medication use are seen as predictors of mental being in patients with asthma.[18] Moreover, adolescence could influence the course of asthma, and overall well-being.[2,19,20] Therefore, repeated measurements within the same individual during adolescence, and also testing for interaction effects of "asthma and age" and "asthma and gender" will give more robust results than using only one measurement at one time point. Longitudinal data were not available in most of the previously mentioned studies.[13,14,16,17] Our study used a large adolescent sample from a national birth cohort with data from age 11 to 20 years; using longitudinal data, we aim to investigate whether adolescents with asthma experience a lower mental well-being and lower general health compared with their peers without asthma.

Methods

Data were obtained from the Dutch Prevention and Incidence of Asthma and Mite Allergy (PIAMA) birth cohort study. In 1996/1997, pregnant women were recruited from the general population and their children (n = 3963 at baseline) have been followed since.[21] The study protocol was approved by the medical ethics committees of the participating institutes and all parents gave written informed consent. For this study, we used data that was collected when the adolescents were 11, 14, 17, and 20 years of age. At these years, respectively 2651, 2522, 2094, and 2206 participants completed questionnaires about health, lifestyle, and environment. Parents completed questionnaires at the participants' ages of 11 (n = 2660), 14 (n = 2338), and 17 years (n = 1872).

Definition of Outcome

Our outcome measures were mental well-being as reported by adolescents, and general health as reported by adolescents and their parents. Mental well-being was measured by the Mental Health Index-5 (MHI-5).[22,23] The MHI-5 is a short, simple set of 5 questions and is widely used as an instrument to assess mental well-being in large questionnaire-based population studies.[24] The MHI-5 contained the question "How often during the last 4 weeks, did you feel: nervous, calm and peaceful, downhearted and blue, happy, and so down in the dumps that nothing could cheer you up?" For each of these 5 items, answers could be given on a 5-point Likert scale: all the time, mostly, often, sometimes, and never. These answers were converted in a score, ranging from 0 to 100. This questionnaire was completed by the adolescent himself or herself at the ages of 11, 14, 17, and 20 years.

Perceived general health was measured by the question: "What do you think about your health?" and for the parents: "Would you describe your child's health in general as excellent, good, fair or poor?" A 4-point Likert scale was used: excellent, good, fair, or poor. The number of participants in the poor category was very low in all age categories (adolescents with asthma and adolescents without asthma combined): 0.1%, 0.8%, 1.5%, and 2.2%, at ages 11, 14, 17, and 20 years respectively. Therefore, we decided to construct 3 categories, in which the categories poor and fair were combined. The question was answered by the adolescent at the ages of 11, 14, 17, and 20 years and by their parents at the participants' ages of 11, 14, and 17 years.

Definition of Exposure Variables

The exposure variable of interest was asthma (severity). Asthma was defined as reported presence of at least 2 of the 3 following criteria: (1) doctor diagnosed asthma ever, (2) wheezing or whistling in the chest in the last 12 months, and (3) prescribed asthma medication during the last 12 months. This asthma definition has been developed by a panel of experts within the Mechanisms of the Development of ALLergy consortium.[25] To obtain the needed information, we used data from questionnaires completed by the parents at the participants' ages of 11, 14, and 17 years and data reported by the 20-year-old participants. Asthma severity varies and as differences in asthma severity could influence our outcome measure, we created an asthma variable with 3 categories, based on medication use: (0) no asthma, (1) intermittent asthma, and (2) persistent asthma. Adolescents with asthma using no medication, or using only short- acting bronchodilators or antihistamine were classified as having intermittent asthma. Adolescents with asthma using (in addition to their short acting bronchodilators or antihistamine) either (inhalation) corticosteroids, long-acting bronchodilators, and/or leukotriene receptor antagonists were classified as having persistent asthma (**Appendix**; available at www.jpeds.com). Intermittent asthma is considered to be a milder asthmatic phenotype, whereas persistent asthma is assumed to be more severe. The classification of asthma severity was based on the Global Initiative for Asthma and Guidelines of the US National Heart, Lung and, Blood Institute.[26,27] The asthma severity classification could vary (for a specific individual) over time because medication use (of this individual) could vary over time.

Potential Confounders

Based on literature and clinical reasoning we a priori selected potential confounders: sex (male/female), age (11, 14, 17, and 20 years), parental allergy, pubertal development, ethnicity, parental educational level as an indicator for family socioeconomic status, and educational level of the adolescents

themselves. Parental allergy is a strong risk factor for having a child with asthma and parents with allergy/asthma are more used to self-management of asthma.[28] It might be conceivable that parental allergy could affect mental well-being of the child. Pubertal development changes the prevalence of asthma.[29]

The ethnicity of the child was divided into Dutch, non-Dutch Western, and non-Western, based on the country of birth of both parents. Pubertal development was assessed using the self-administrated rating scale for pubertal development.[30] An overall score, based on puberty characteristics, was calculated and divided into 4 categories: puberty has not yet started, barely started, definitely started, and is complete. We classified the latter 2 as puberty started. Parental educational level was categorized into low, intermediate, and high. Low was defined as primary school, lower vocational or lower secondary education; intermediate as intermediate vocational education or intermediate/higher secondary education; and high as higher vocational education and university. The educational level of the adolescents themselves was also categorized into low, intermediate, and high, where low was defined as prevocational secondary education or secondary vocational education, intermediate as higher general secondary education, and high as preuniversity education, higher vocational education, and university.

Statistical Analyses

Descriptive statistics were used to summarize the characteristics of the study population. We estimated associations of asthma severity with mental well-being and perceived general health using generalized estimating equations (GEE). The GEE estimate associations of asthma with the outcome measures, taking correlations within participants into account. While using the GEE, we chose an independent correlation structure that enables the GEE to handle time-dependent variables (in our case asthma) to change over time. In this way, valid inferences can be ensured.[31] We used the GEE with an identity link function to estimate the associations between asthma severity and MHI scores (continuous outcome) and the GEE with a logit link function to estimate associations between asthma severity and general health (categorical outcome). For the outcome measure general health, reported by parents, we used data of 3 time points (at 11, 14, and 17 years). Associations with the MHI-5 score were expressed as differences (βs) and associations with general health were expressed as odds ratios, with no asthma as the reference category.

As secondary analyses, we tested for interactions between sex and asthma severity, and between age (11, 14, 17, and 20 years of age) and asthma severity. For an interaction term, we considered a P value of less than .1 as significant. We adjusted for a priori selected potential confounders (see subhead Potential Confounders). A P value of less than .05 was considered statistically significant. Both crude and adjusted differences or odds ratios are reported. All analyses were done with SPSS 25.0 (SPSS Inc).

Results

Study Population

The study participants of the PIAMA birth cohort were followed over time. For this study, we used data of 11-, 14-, 17-, and 20-year-old adolescents. Asthma data of at least one of the 4 measurement points was available for 3051 participants. Asthma data at least 3 of the four measurement points was available for 2022 participants.

The **Figure** shows the follow-up flowchart of the PIAMA birth cohort study. The number of complete cases could differ from the number of available questionnaires in age categories 11, 14, 17, and 20 years old, because a complete case is composed of a combination of variables. **Table I** shows the characteristics of the study population; adolescents in age categories 11, 14, 17, and 20 years old, of which 6.7%, 6.9%, 5.0%, and 6.6%, respectively had asthma according to the Mechanisms of the Development of ALLergy definition. As is well-known from the previous literature and clinical practice, the prevalence of asthma was greater in boys than in girls up to the age of 14 years.[32] At ages 17 and 20 years, girls had a higher prevalence of asthma. **Table II** shows the outcome measures—the self-reported score on the MHI-5, and self- and parent-reported general health—per age category for adolescents with and without asthma. In both adolescents with asthma and adolescents without asthma, the MHI score and perceived general health decreased with age.

Associations between Asthma Severity and the MHI-5 Score

Adolescents with intermittent asthma scored 0.51 point (95% CI, −1.49 to2.52) higher on the MHI-5 than adolescents without asthma, whereas adolescents with persistent asthma scored −0.50 points (95% CI, −2.24 to 1.25) lower on the MHI-5 than adolescents without asthma (**Table III**). On the MHI-5 scale of 0 to 100, these differences are very small and they were not statistically significant. Secondary analyses did not reveal differences in the association of asthma with score on the MHI between boys and girls ($P_{\text{interaction}}$ = .75), and between different ages ($P_{\text{interaction}}$ = .86) More information about the interaction term, age specific associations and sex specific association is shown in **Table IV** (available at www.jpeds.com).

Associations between Asthma Severity and General Health: Self and Parent Report

Adolescents with asthma were less likely to experience good or excellent health than their peers without asthma (aOR, 0.37; 95% CI, 0.26-0.51 for intermittent asthma and 0.33; 95% CI, 0.25-0.41 for persistent asthma) (**Table III**). Secondary analyses identified no differences in the associations of asthma with perceived general health between boys and girls ($P_{\text{interaction}}$ = .69) and between different ages ($P_{\text{interaction}}$ = .74) (**Table V**; available at www.jpeds.com).

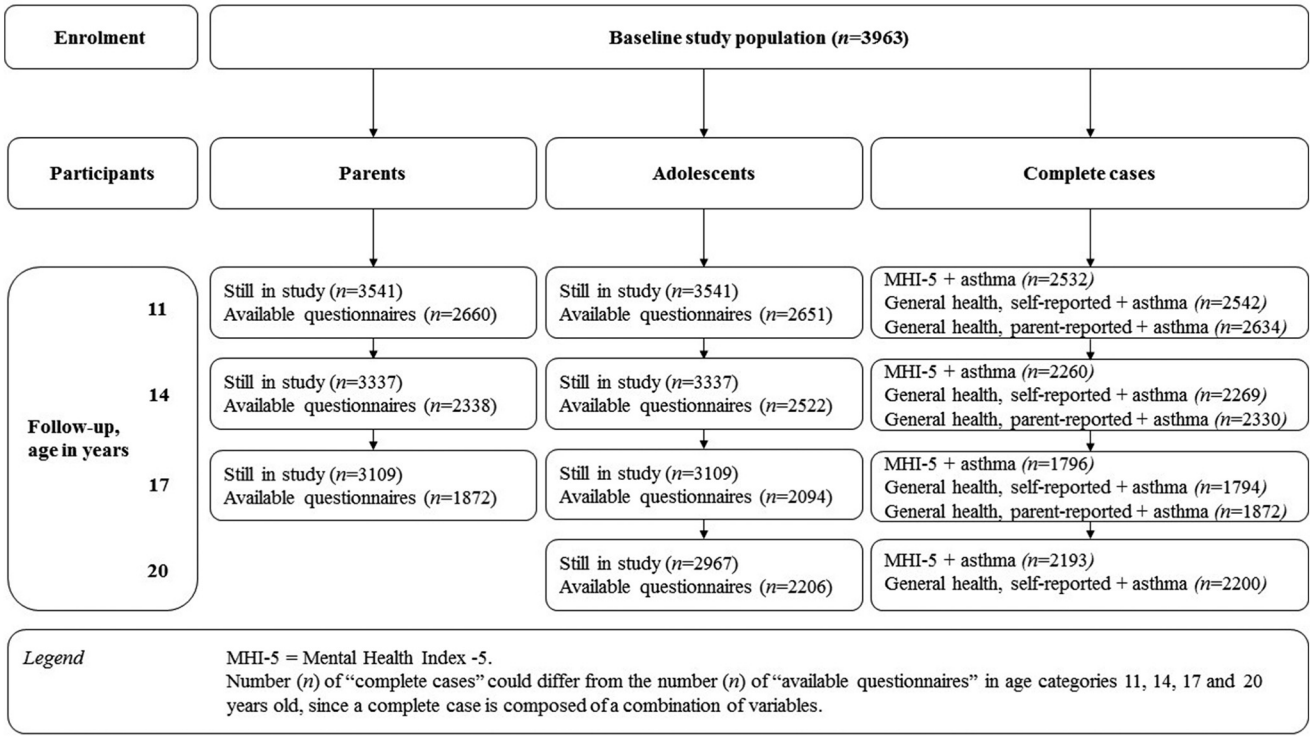

Figure. Follow-up flowchart of the PIAMA birth cohort study. The number (n) of complete cases could differ from the *n* of available questionnaires in age categories 11, 14, 17, and 20 year of age, because a complete case is composed of a combination of variables.

A comparable pattern emerges when we analyzed the parental reports. Parents of adolescents with asthma were less likely to rate their child's health as good or excellent, compared with parents of adolescents without asthma (aOR, 0.26; 95% CI, 0.17-0.41 for intermittent asthma, and 0.21; 95% CI, 0.15-0.28 for persistent asthma respectively) (**Table III**). Secondary analyses identified no differences in the associations of asthma with parent-reported general health between boys and girls ($P_{interaction}$ = .99) and between different ages ($P_{interaction}$ = .18) (**Table VI**; available at www.jpeds.com).

Discussion

This study, using data from a general population-based cohort, showed no significant differences in mental well-being between adolescents with asthma and their peers without asthma. However, adolescents with asthma and their parents were both less likely to perceive the adolescent's health as good or excellent than adolescents without asthma and their parents. All associations were similar for boys and girls and across different ages. Our findings provide insight into adolescents' experience with asthma and are hopeful and highlight the positive health approach: having asthma does not restrain them from feeling mentally well during adolescence.

Despite differences in asthma definition, previous studies also reported that youth with asthma perceived a lower general health.[13,14] However, the MHI-5 has not been used in previously published studies to measure mental well-being in adolescents with asthma and we therefore could not compare our results directly. In the previously published literature, much attention has been paid to the association between asthma and QoL. With a meta-analysis in their systematic review on QoL in pediatric patients with asthma, Silva et al analyzed the association of asthma with psychological functioning.[15] Because overall mental well-being is part of the definition of psychological functioning, next to individual's behavior, emotions, and social skills, we compared the results of this meta-analysis with our results.[33] A slightly lower psychological functioning was reported for the adolescents with asthma aged 11-18 years (mean difference −2.73 on a scale from 0 to 100; 95% CI, −5.38 to −0.09) compared with controls without asthma.[15] This meta-analysis included 4 studies from Turkey, Sri Lanka, Finland, and Germany, and all studies had a cross-sectional study design.[17,34-36] The latter study used a QoL-instrument that measured mental well-being (in the meta-analysis interpreted as psychological functioning) as one of their domains and found no differences in mental well-being between adolescents with and without asthma.[17] Two studies that were not included in this meta-analysis, both using a QoL instrument that explicitly

Table I. Characteristics of study population according to asthma status at ages 11, 14, 17, and 20 years

Characteristics	Adolescents with asthma, No. (%)				Adolescents without asthma, No. (%)			
Age category (years)	**11**	**14**	**17**	**20**	**11**	**14**	**17**	**20**
No. (% of total per age category)	178 (6.7)	160 (6.9)	94 (5.0)	165 (6.6)	2464 (93.3)	2172 (93.1)	1778 (94.9)	2036 (93.4)
Age in years, mean (SD)	11.4 (0.3)	14.8 (0.3)	17.7 (0.3)	20.9 (0.4)	11.3 (0.3)	14.8 (0.3)	17.7 (0.3)	20.9 (0.3)
Asthma*								
Intermittent	44 (24.7)	58 (36.3)	36 (38.3)	86 (52.1)	na	na	na	na
Persistent	134 (75.3)	102 (63.7)	58 (61.7)	79 (47.9)	na	na	na	na
Sex								
Female	69 (38.8)	74 (46.3)	55 (58.5)	95 (57.6)	1214 (49.3)	1076 (49.5)	887 (49.9)	1062 (52.2)
Male	109 (61.2)	85 (53.1)	39 (41.5)	70 (42.4)	1247 (50.6)	1094 (50.4)	887 (49.9)	970 (47.6)
Ethnicity								
Dutch	158 (88.7)	138 (86.3)	82 (87.2)	143 (86.7)	2242 (91.0)	1978 (91.1)	1621 (91.2)	1845 (90.6)
Western	8 (4.5)	12 (7.5)	8 (8.5)	10 (6.1)	106 (4.3)	95 (4.4)	79 (4.4)	93 (4.6)
Non-Western	6 (3.4)	6 (3.8)	4 (4.3)	8 (4.8)	62 (2.5)	55 (2.5)	44 (2.5)	56 (2.8)
Education								
Mother								
Low	37 (20.6)	35 (21.7)	18 (18.8)	41 (24.8)	483 (19.7)	377 (17.4)	299 (16.9)	377 (18.6)
Intermediate	73 (40.8)	70 (43.5)	36 (37.5)	66 (40.0)	1027 (41.8)	899 (41.5)	708 (40.0)	823 (40.6)
High	68 (38.0)	55 (34.2)	40 (41.7)	58 (35.2)	948 (38.6)	890 (41.1)	763 (43.1)	825 (40.7)
Father								
Low	42 (23.5)	41 (25.8)	24 (25.0)	42 (25.5)	561 (23.0)	464 (21.6)	360 (20.4)	440 (21.9)
Intermediate	59 (33.7)	60 (37.3)	25 (26.3)	61 (37.0)	816 (33.1)	712 (33.3)	574 (32.6)	669 (33.3)
High	73 (41.7)	57 (35.8)	44 (45.8)	59 (35.8)	1065 (43.6)	971 (45.2)	828 (48.0)	900 (44.8)
Adolescent								
Low	na	64 (40.0)	27 (28.7)	48 (29.1)	na	722 (33.2)	532 (32.3)	497 (24.4)
Intermediate	na	36 (22.5)	13 (13.8)	29 (17.6)	na	593 (27.3)	288 (16.2)	271 (10.3)
High	na	56 (35.0)	46 (48.9)	59 (35.8)	na	781 (36.0)	819 (46.1)	815 (40.0)
Puberty started								
Female	21 (11.7)	70 (98.6)	55 (100.0)	86 (100.0)	412 (16.7)	1020 (97.8)	886 (99.9)	1062 (100.0)
Male	6 (3.4)	69 (81.2)	39 (100.0)	79 (100.0)	70 (2.8)	924 (87.7)	885 (99.8)	970 (100.0)

na, not applicable.
*See **Supplement 1** for classification asthma severity.

measures mental well-being as a separate domain, reported (just as the meta-analysis) a lower mental well-being in adolescents with asthma.[14,16] In our study, we observed no differences in mental well-being between asthmatic and adolescents without asthma.

Some studies have stated that adolescents are more mature and, therefore, may experience the emotional impact of asthma differently resulting in an improvement of mental well-being during the transition from childhood to adolescence. [20] Other investigators state that adolescence goes along with a negative impact on mental well-being because treatment adherence is often a problem in adolescents with asthma.[37] In our study, we did not see any interactions between asthma and age, and therefore could not confirm the suggestion that the association between asthma and mental well-being might change in the course of adolescence.

Our results showed that adolescents with asthma and their parents were less likely to perceive the adolescent's health as good or excellent than the adolescents without asthma and their parents. The association between asthma and perceived general health was stronger for the parent-reported general health than for the self-reported general health. Parents and

Table II. MHI and perceived general health according to asthma status at ages 11, 14, 17, and 20 years

	Adolescents with asthma, No. (%)				Adolescents without asthma, No. (%)			
Age category (years)	**11**	**14**	**17**	**20**	**11**	**14**	**17**	**20**
No. (% of total per age category)	178 (6.7)	160 (6.9)	94 (5.0)	165 (6.6)	2464 (93.3)	2172 (93.1)	1778 (94.9)	2036 (93.4)
Age, years, mean (SD)	11.4 (0.3)	14.8 (0.3)	17.7 (0.3)	20.9 (0.4)	11.3 (0.3)	14.8 (0.3)	17.7 (0.3)	20.9 (0.3)
MHI-5, 0-100, mean (SD)	79.7 (11.4)	77.6 (13.0)	74.7 (14.1)	70.2 (17.6)	80.1 (10.5)	77.4 (12.7)	74.2 (14.5)	71.9 (15.6)
General health, self-reported								
Excellent	34 (19.1)	24 (15.0)	13 (13.8)	14 (8.5)	1017 (41.3)	838 (38.6)	548 (30.8)	497 (24.4)
Good	126 (70.8)	110 (68.8)	62 (66.0)	123 (74.5)	1294 (52.5)	1205 (55.5)	1046 (58.8)	1367 (67.1)
Fair/poor	15 (8.4)	22 (13.8)	14 (14.9)	28 (16.0)	55 (2.2)	69 (3.2)	110 (6.2)	171 (8.4)
General health, parent-reported								
Excellent	35 (19.7)	27 (16.9)	13 (10.6)	na	1349 (54.7)	1114 (51.3)	743 (41.8)	na
Good	132 (74.2)	116 (72.5)	64 (68.1)	na	1079 (43.8)	1000 (46.0)	941 (53.0)	na
Fair/poor	11 (6.2)	17 (10.6)	17 (18.1)	na	27 (1.1)	55 (2.5)	93 (5.2)	na

Table III. MHI and perceived general health: Differences and associations between adolescents with no asthma (reference), mild asthma, and severe asthma

Asthma status	Crude β	(95% CI)	Adjusted β	(95% CI)
MHI-5, self-reported				
No asthma	ref	–	ref	–
Intermittent asthma	−0.37	(−2.44 to 1.70)	0.51	(−1.49 to 2.52)
Persistent asthma	−0.51	(−2.37 to 1.36)	−0.50	(−2.24 to 1.25)
	Crude OR	**(95% CI)**	**aOR**	**(95% CI)**
General health, self-reported				
No asthma	ref	–	–	–
Intermittent asthma	0.32	(0.23 to 0.44)	0.37	(0.26 to 0.51)
Persistent asthma	0.32	(0.25 to 0.41)	0.33	(0.25 to 0.41)
General health, parent reported				
No asthma	ref	–	–	–
Intermittent asthma	0.24	(0.16 to 0.36)	0.26	(0.17 to 0.41)
Persistent asthma	0.21	(0.16 to 0.28)	0.21	(0.15 to 0.28)

Adjusted for sex, age, parental allergy, pubertal development, ethnicity, parental educational level, and educational level of the adolescents themselves.

children often have different perceptions of the child's well-being, especially when it comes to emotional and social domains. Chronically ill children and adolescents generally score higher on these domains than their parents.[38,39] In contrast, healthy adolescents report lower scores on emotional and social domains than their parents.[40] In our study, the latter observation could explain why the association was stronger for parent-reported general health. Parents of children without asthma perceived their children's general health more often as excellent or good than the children did themselves (shown in **Table I**).

This study had several strengths. We prospectively collected data in a large study population and we took the severity of asthma into account, which is a potential influencer of mental well-being and perceived general health. Furthermore, we used repeated measurements of mental well-being and general health during adolescence and therefore, did not draw conclusions based on 1 measurement at 1 time point. Last, we analyzed both self- and parent-reported outcomes, which are highly relevant as parents and children often report differently on these outcomes.[38,39]

The participants of the PIAMA cohort were recruited from the general population from several parts from the Netherlands.[41] However, in the PIAMA birth cohort and therefore in this study, parents from non-Western countries were under-represented. This factor implies that our results may not be generalizable to populations with different ethnic or cultural backgrounds.

The prevalence of chronic diseases among youth is high.[1,2] Adolescents with and without asthma may (also) have non-asthmatic chronic illnesses that might (negatively) impact their mental well-being and perceived general health. However, we think that our results are not affected by the presence of non-asthmatic chronic illnesses specifically in the participants without asthma, because it is unlikely that these non-asthmatic illnesses are more prevalent in adolescents without asthma than in the adolescents with asthma.

In long-term follow-up studies, selective loss to follow-up of low socioeconomic status participants is a common phenomenon. Attrition bias could, therefore, be introduced. The percentage of participants with highly educated parents was only slightly higher at age 20 years than at baseline; 40.3% of the mothers and 44.2% of the fathers were highly educated at the participants age of 20 years, whereas 35.0% of the mothers and 39.7% of the fathers were highly educated at baseline (**Table VII**; available at www.jpeds.com). This finding indicates that selective loss to follow-up of participants from low socioeconomic status families has been limited and is, therefore, unlikely to have biased our results.

In our study, the severity of asthma was defined by medication use.[26,27,42] Having asthma symptoms under control, irrespective of frequency, type, or dose of medication, might have a favorable effect on the burden of disease and subsequently on perceived mental and general health. This finding would suggest that asthma severity would be best defined by the level of asthma control. We do think that the type of asthma medication is a good proxy to define asthma severity. Strong asthma medication, prescribed for persistent asthma, can cause side effects and might provoke a feeling of dependency on the medication in the patient. This could have a negative effect on perceived mental and general health and will be less prominent in adolescents with intermittent asthma using milder medication such as short acting bronchodilators.

Our conclusions on mental well-being are based on the MHI-5, which assesses anxiety and depressed moods well,[23,24,43] but it is less suitable as an indicator of behavioral and addiction problems. The MHI-5 is not designed to establish a clinical diagnosis. The MHI-5 is well-known and often

used as a measure of general mental well-being and it has been shown that the MHI-5 performs remarkably well against other often-used and longer mental health questionnaires, such as the Mental Health Component Summary, the General Health Questionnaire, and the Hopkins Symptom Checklist.[24,44-46]

This study highlights the positive health approach by showing that despite growing up with asthma, affected adolescents can still experience a good mental well-being. ■

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50 Years Ago in *The Journal of Pediatrics*

Inflammation and Vasculitis: Changing Paradigms

Chamberlain JL, Perry LW. Infantile periarteritis nodosa with coronary and brachial aneurysms: a case diagnosed during life. J Pediatr 1971;78:1039-42.

Prior to the recognition of Kawasaki disease, or mucocutaneous lymph node syndrome, as it was originally called, an entity entitled periarteritis nodosa existed, to capture infants and others presenting with rash and vasculitis, including infants with coronary aneurysms and no other known etiology. Chamberlain and Perry described a case of this rare, and often undiagnosed ante-mortem condition, based on a combination of clinical history, physical examination (including palpation of brachial aneurysms), and angiography of the coronary arteries and arterial tree, a daunting task in a 20-week old infant in 1971. The child survived after weeks of chronic inflammatory symptoms. I had a similar patient, treated in an era when gamma globulin was not available to dramatically shorten the clinical course, who suffered for weeks with inflammation, lost a digit to vaso-occlusion, and required a coronary artery bypass.

Periarteritis nodosa still exists, but is much rarer and more circumscribed, as the etiology of overlapping conditions has been identified, or syndromic identification has replaced use of that term. Unfortunately, our perplexity regarding the etiology of acute pediatric inflammatory conditions associated with vasculitis. remains as well. The patient in this report, as was mine, would now be diagnosed with Kawasaki disease; the description of that cluster of clinical findings was a clinical revelation, as have been related diagnostic and therapeutic innovations over the last 40 years. Nonetheless, the cause remains unknown. And now, in the last year, comes another revelation, multisystem inflammatory syndrome in children, re-energizing conversations on the etiology, mechanism, and treatment of childhood inflammatory vascular injury.[1]

The extraordinary effort undertaken by Chamberlain and Perry, with the tools at their disposal, to provide knowledge about a perplexing condition, was repeated by the early investigators of Kawasaki disease, with results benefitting many children. Nature has thrown us another curve, and we have newer anti-inflammatories and cardio-respiratory support to improve outcomes. Maybe we will find some causes too.

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Table IV. Test of effect models, *P* values of the interaction terms

Interaction terms	Wald $\chi 2$	df	*P* value
MHI-5, self-reported			
Sex*asthma severity	0.3	2	.86
Age*asthma severity	3.4	6	.75
General health, self-reported			
Sex*asthma severity	0.7	2	.69
Age*asthma severity	3.5	6	.74
General health, parent reported			
Sex*asthma severity	0.003	2	.998
Age*asthma severity	6.3	4	.18

The asterisk indicates an interaction term.

Table V. MHI and perceived general health: Age-specific associations between adolescents with no asthma (reference), mild asthma, and severe asthma

Age categories (years)	11		14		17		20	
MHI-5	**Adjusted β**	**(95% CI)**	**Adjusted β**	**(95% CI)**	**Adjusted β**	**(95% CI)**	**Adjusted β**	**(95% CI)**
No asthma	ref		ref		ref		ref	
Intermittent asthma	1.03	(–2.31 to 4.38)	1.07	(–1.86 to 4.00)	1.12	(–3.46 to 5.69)	−0.44	(–4.09 to 3.21)
Persistent asthma	−1.22	(–3.62 to 1.16)	−0.81	(–3.55 to 1.93)	2.04	(–1.34 to 5.22)	−0.85	(–5.15 to 3.45)
	aOR	**(95% CI)**	**aOR**	**(95% CI)**	**aOR**	**(95% CI)**	**aOR**	**(95% CI)**
GH, self-reported								
No asthma	ref		ref		ref		ref	
Intermittent asthma	0.40	(0.29 to 0.82)	0.28	(0.14 to 0.55)	0.48	(0.22 to 1.04)	0.40	(0.24 to 0.65)
Persistent asthma	0.28	(0.18 to 0.42)	0.29	(0.18 to 0.43)	0.40	(0.22 to 1.73)	0.43	(0.26 to 0.69)
GH, parent reported								
No asthma	ref		ref		ref		na	
Intermittent asthma	0.42	(0.21 to 0.85)	0.60	(0.08 to 0.31)	0.34	(0.15 to 0.77)	na	
Persistent asthma	0.17	(0.12 to 0.26)	0.24	(0.16 to 0.36)	0.22	(0.12 to 0.40)	na	

na, not applicable.
Adjusted for sex (boy/girl), family history of atopic disease in mother/father, puberty scale, ethnicity, highest attained education of parents, and education of the children/adolescents themselves.

Table VI. MHI and perceived general health: Sex-specific associations between adolescents with no asthma (reference), mild asthma, and severe asthma

Characteristics	Boys		Girls	
MHI-5	**Adjusted β**	**(95% CI)**	**Adjusted β**	**(95% CI)**
No asthma	ref		ref	
Intermittent asthma	−0.10	(–2.70 to 2.49)	1.20	(–1.89 to 4.29)
Persistent asthma	−0.85	(–3.18 to 1.49)	−0.12	(–2.69 to 2.46)
	aOR	**(95% CI)**	**aOR**	**(95% CI)**
GH, self-reported				
No asthma	ref		ref	
Intermittent asthma	0.42	(0.25 to 0.68)	0.33	(0.22 to 0.50)
Persistent asthma	0.34	(0.24 to 0.47)	0.31	(0.21 to 0.45)
	aOR	**(95% CI)**	**aOR**	**(95% CI)**
GH, parent reported				
No asthma	ref		ref	
Intermittent asthma	0.26	(0.15 to 0.46)	0.27	(0.14 to 0.52)
Persistent asthma	0.21	(0.14 to 0.29)	0.21	(0.13 to 0.32)

Adjusted for sex (boy/girl), family history of atopic disease in mother/father, puberty scale, ethnicity, highest attained education of parents, and education of the children/adolescents themselves.

Table VII. Participant characteristics for all participants and those who completed the 20-year follow-up

	Baseline		20-year follow-up	
Variables	**n/N**	**(%)**	**n/N**	**(%)**
Female sex	2053/3963	(51.8)	1040/2201	(47.3)
Maternal asthma and/or hay fever	963/3923	(24.5)	505/2181	(23.2)
Paternal asthma and/or hay fever	980/3928	(24.9)	546/2181	(25.0)
Dutch nationality	3327/3684	(90.3)	1971/2159	(91.3)
High maternal education	1331/3807	(35.0)	883/2190	(40.3)
High paternal education	1493/3761	(39.7)	959/2171	(44.2)