

Atopic conditions and mental health problems: a 3-year follow-up study

Lars Lien · Kristian Green · Magne Thoresen ·
Espen Bjertness

Received: 17 August 2009 / Accepted: 17 March 2010
© Springer-Verlag 2010

Abstract The aim of this study was to test the hypothesis that atopic conditions at 15/16 years of age affect both internalized and externalized mental health problems 3 years later. Combined school and postal survey was conducted in urban and rural settings. A total of 3,674 adolescents (70.1% response rate) were followed at two time points and interviewed with similar questionnaires at baseline and follow-up. Hopkins Symptoms Checklist (HSCL-10) was used to assess internalized problems, and two subscales (conduct problems and hyperactivity) from the Strength and Difficulties Questionnaire to measure externalized mental health problems. The atopic conditions investigated were asthma, hay fever and eczema by asking the adolescents whether these conditions were present or not. There was an increase in the prevalence of internalized mental health problems from about 17–25% and a decrease in externalized mental health problems and number of atopic conditions in the follow-up period. Of the atopic conditions, hay fever was most prevalent with about 34% at

15 years of age and 20% at 18. The asthma prevalence was at 10 and 5% and eczema at 25 and 10%, respectively. Internalized mental health problems among girls were significantly associated with atopic conditions 3 years earlier, also after controlling for confounding variables. To live with atopic conditions seem to affect the mood and level of anxiety among adolescent girls. This should be kept in mind by health professionals treating young girls with atopic conditions.

Keywords Atopic conditions · Mental health · Longitudinal study · Adolescence

Introduction

Mental health problems are common during adolescence [2, 27]. Major depressive disorder among 13- to 18-year-olds has an estimated point prevalence of 2–5%, and the prevalence is twice as high among girls as compared to boys [29]. Anxiety disorders occur frequently in adolescence, with an estimated prevalence of 18.6% in a German study, while other disorders had prevalences of 1–2% [12].

Atopic conditions such as asthma (giving rise to severe breathing problems and cough), hay fever (with running nose and red itchy eyes) and atopic eczema (characterized by severe itch) are also common among youth. In a multi-center study of 463,801 children aged 13–14 years in 56 countries, the prevalence of asthmatic symptoms and hay fever ranged from 1.6 to 36.8%, and atopic eczema ranged from 0.3 to 20.5% [4]. A new sampling in the same areas 5 years later showed an increase for all atopic conditions among young children, but not adolescents [3]. In Norway, the lifetime prevalence of asthma was 9.4% in Oslo [23] and 13.8% in the northern region of Norway, while the

L. Lien (✉)
Institute of Psychiatry, University of Oslo,
Box 1130, Blindern, 01318 Oslo, Norway
e-mail: lars.lien@medisin.uio.no

L. Lien
Department of Research, Innlandet Hospital Trust,
Brumunddal, Norway

K. Green · E. Bjertness
Institute of General Practice and Community Medicine,
University of Oslo, Oslo, Norway

M. Thoresen
Department of Biostatistics, University of Oslo, Oslo, Norway

E. Bjertness
Tibet University Medical College, Lhasa, Tibet, China

prevalence of self-reported atopic eczema and hay fever were 20.8 and 29.6%, respectively [30].

Patients with chronic somatic disorders have higher probability of mental health problems [33], and depression and anxiety are the most common mental health symptoms related to chronic disease [9, 16]. Vila et al. [34] found that up to 35% of asthmatics aged 8–15 years presented with mental disorders, of which anxiety was the dominant diagnosis. Bell et al. [5] reported that in a sample of 379 college students, individuals prone to clinical depression had more allergies and asthma than the non-depressed ones. Stevenson observed that very young children with asthma had more behavior problems than non-asthmatics, and that behavior problems in children with atopic eczema indicated risk for development of asthma [31]. Roth et al. [28] found an association between atopic conditions and ADHD, and assumed a common predisposing factor for both; however, later research has not confirmed this association [13]. Among British school children aged 5–15 years, the eczema group had twice the rate of psychological disturbances compared with the control group [1]. Lien [20] found associations between atopic conditions and mental distress, while the association with externalized mental health problems was somewhat weaker.

The relationship between physical and mental health is sensitive to parental socioeconomic factors and family structure [17]. Both poverty and the stress of rearing chronic ill children might lead to negative parenting and later mental health problems in the offspring [18]. Likewise, family impacts such as greater family strain and family conflict, as well as greater financial strain, have been associated with hospitalization in asthma patients aged 4–15 years [10]. Among adolescents, immigrants are considered to be at particular risk for development of psychiatric disorders. Adolescent immigrants are caught between two cultures: that of their parents and homeland and that of their peers in their new country [22] and have a greater risk of mental health problems [24].

A recent systematic review and meta-analysis of the bidirectional relationship between atopic disorders and psychosocial factors [11] found that the effect of atopic diseases on future mental health was stronger than the psychosocial factors on atopic disease development and progression. The authors therefore suggested that greater attention should be paid to mental health outcomes in patients with atopic disorders. In their review, only six longitudinal studies investigated the impact of atopic condition on mental health. Of these studies, one was on adolescents, two included hay fever, none on eczema and the rest on asthma only. All the mental health outcome measures were either on depression or anxiety and none measured any externalizing mental health problems.

There is therefore clearly a need for more studies incorporating all atopic conditions and external as well as internal mental health problems as outcome measures. In the present study, we followed participants from the youth part of the Oslo Health Study and from a study in a rural part of Norway including those from the age of 15/16 to 18/19 years. The objectives of the present study are:

1. To investigate the cross-sectional associations between different atopic conditions and mental health problems among 15- to 16-year-olds and among 18- to 19-year-olds;
2. to investigate the longitudinal association between the number of atopic conditions reported by 15- to 16-year-olds and mental health problems reported 3 years later, adjusted for ethnicity, family structure and self-perceived socioeconomic status at age 15–16 years.

Patients and methods

Data source and subject selection

The surveys from which we obtained data were joint collaboration projects between the Norwegian Institute of Public Health and the University of Oslo, and parts with support from the Oslo Municipality and the Regional Centre for Child and Adolescent Psychiatry (regions, east and west).

Fifteen/sixteen-year-olds in 2001 (tenth graders)

We used data from the youth part of the Oslo Health Study and from the Hedmark part of UNGOPPHED (conducted in the rural area of Hedmark County). All students in the tenth grade in all primary schools in Oslo and Hedmark were invited. The data collection was performed in the last quarter before the end of the school year in 2001. All parents received written information and the students completed a consent form before participation. The students completed two-four-page questionnaires during two school hours. A project assistant was present in the classroom to inform the students about the survey and to administer the questionnaires. Questionnaires were left at school to be completed by students not present on the day of the survey. Those who did not respond were sent a copy by mail to their home address, together with a prestamped, return envelope. Ten years at school is compulsory in Norway; hence, the study includes all 15/16-year-olds in the study areas. A more detailed description has been published elsewhere (<http://www.fhi.no/>).

Eighteen/nineteen-year-olds in 2004 (13th graders)

A 3-year follow-up study of the two cross-sectional samples of tenth graders in Oslo and Hedmark was conducted in 2004, partly in school and partly through mail. In both instances, the participants were invited to give consent to linkage between the two studies. The data collection was performed in the last quarter before the end of the school year.

In Oslo, we conducted a school-based study similar to the baseline, inviting all the final year, 13th grade students, in all secondary high schools. The school system in Norway gives all inhabitants the possibility of 13 years of school free of charge, and most students utilize this opportunity. The students filled out one-four-page questionnaire during one school hour. Because a number of students were not present when the study was conducted, schools were visited several times. Those students not reached in school were invited by mail and included in the school-based part of the follow-up study.

Participants from the baseline study who were not enrolled in the final year of secondary high school (13th graders) in Oslo and who had consented to participate in a follow-up were invited by mail to participate. The invitation included an invitation letter, an information brochure, a consent form, the questionnaire and a prestamped return envelope. Two reminders were sent to those who did not respond. Similar methods as in the Oslo *postal part* were applied for the whole 3-year follow-up of all participants from the 2001 baseline study in rural Hedmark. The youth studies are described more thoroughly elsewhere (http://www.fhi.no/eway/default.aspx?pid=238&trg=mainArea_5811&mainArea_5811=5895:0:15,4562).

The samples constituting the present study included data from two cross-sectional surveys of 5,750 (88.9% response) 15/16-year-old 10th graders from Oslo and Hedmark obtained in 2001, and one cross-sectional survey of 3,308 (90.4% response) 18/19-year-old 13th graders from Oslo obtained in 2004. Additionally, we had cross-sectional data from the postal surveys in Oslo (467) and Hedmark (952), giving a total of cross-sectional, questionnaire data on 4,727 18/19-year-olds. Finally, based on two longitudinal studies from Oslo and Hedmark in 2004, we had 3-year follow-up data for a total of 3,674 (70.1% response) 18/19-year-olds, which were the data analyzed in this study.

Outcome variables

Internalizing mental health problems were measured by the ten-item version of Hopkins Symptoms Checklist (HSCL-10). The ten items included in this short version are: feeling panicky, anxious, dizzy, tense, sleepless, sad, worthless, hopeless, faulting oneself and finding everything a burden, all during the previous week. The reliability was high

(Cronbach α : 0.86 at age 15/16 years in the present data). Each item was rated on a scale of 1 (not at all) to 4 (extremely). An average score for all ten items of equal or above 1.85 was shown to be a valid predictor of mental distress among subjects aged 16–24 years of age, corresponding to the 1.75 cutoff of HSCL-25 [32].

Externalizing mental health problems were measured by ten items about hyperactivity and conduct problems from the Strength and Difficulties Questionnaire (SDQ) [14, 15]. SDQ is a questionnaire for assessing mental health in children and adolescents. The rating scale for SDQ is from 1 to 3 with the options of not correct, partly correct and completely correct. As a cutoff point, we used the 90th percentile of the youth part of the Oslo Health Study, which has been previously applied in other studies [21].

Exposure variables

In the questionnaires at baseline and follow-up, the participants were asked: “Do you have or have you had asthma, allergy or eczema?” Response categories were “yes” and “no” at baseline, and “yes, now”, “yes, earlier”, and “no” at follow-up (dichotomised into “yes, now” vs. “yes, earlier” and “not at all”). In some of the analyses, these variables were transformed to an index of atopic conditions, with the following categories: zero condition, 1 condition and 2–3 conditions.

Background variables

Among the immigrant adolescents, a majority were born in Norway and are second-generation immigrants. Minority status was therefore determined on the basis of their parents’ country of birth. In this study, we applied the Statistics Norway’s definition of immigrants (or ethnic minorities), namely having both parents born in a country other than Norway.

Data on family structure was obtained from the participants’ response to the item: “Who do you live together with at present?” We categorized their responses into “both parents” (corresponding to having marked “mother and father”), “one parent” (including the responses “mother only”, “father only”, “about the same time with mother and father”, and “mother or father and new partner or husband/wife”), “foster parents” and “other”.

Self-perceived socioeconomic status was obtained from the participants’ response to the item “I think that our family, seen in relation to other families in Norway, has: poor, moderate, good, or very good economy”.

Missing data

The number of observations included in each analysis varied due to different numbers of missing data in the

variables. In Table 1, all missing is included in the table text. In Table 2, the number of observations in the various logistic regression analyses ranged from 1,441 to 1,455 for boys aged 15/16 years, from 1,535 to 1,554 for boys aged 18/19 years, from 1873 to 1898 for girls aged 15/16 years and from 1954 to 1996 for girls aged 18/19 years. In Table 3, 1,474 boys and 1,934 girls were included in the analyses, compared to 1,479 boys and 1,940 girls in Table 4.

Statistical methods

Statistical analyses were performed with SPSS v.12-14 and SAS v. 9.1. All analyses were stratified by gender, except for analyses of interaction effects between atopic conditions and gender that were carried out in the multivariate logistic regressions. Cross tables were analyzed with crude odds ratios (OR) and 95% confidence intervals (CI). Logistic regression models with internalized and externalized

Table 1 Characteristics of sample

	Boys (<i>N</i> = 1,590)		Girls (<i>N</i> = 2,084)	
	Age 15–16 years	Age 18–19 years	Age 15–16 years	Age 18–19 years
Parents' country of birth				
At least one from Norway	1,262 (79.4)	1,262 (79.4)	1,643 (78.8)	1,643 (78.8)
Both from another country	240 (15.1)	240 (15.1)	344 (16.5)	344 (16.5)
Missing	88 (5.5)	88 (5.5)	97 (4.7)	97 (4.7)
Living with				
Both parents	1,112 (69.9)	1,024 (64.4)	1,415 (67.9)	1,235 (59.3)
One parent	370 (23.3)	415 (26.1)	555 (26.6)	538 (25.8)
Foster parents	10 (0.6)	12 (0.8)	8 (0.4)	7 (0.3)
Other	8 (0.5)	133 (8.4)	13 (0.6)	293 (14.1)
Missing	90 (5.7)	6 (0.4)	93 (4.5)	11 (0.5)
Self-perceived socioeconomic status				
Poor	36 (2.3)	65 (4.1)	51 (2.4)	100 (4.8)
Moderate	411 (25.8)	492 (30.9)	626 (30.0)	689 (33.1)
Good	862 (54.2)	825 (51.9)	1,094 (52.5)	1,078 (51.7)
Very good	184 (11.6)	195 (12.3)	194 (9.3)	201 (9.6)
Missing	97 (6.1)	13 (0.8)	119 (5.7)	16 (0.8)
Internalized mental health problems				
Yes	110 (6.9)	190 (11.9)	477 (22.9)	672 (32.2)
No	1,390 (87.4)	1,391 (87.5)	1,511 (72.5)	1,396 (67.0)
Missing	90 (5.7)	9 (0.6)	96 (4.6)	16 (0.8)
Externalized mental health problems				
Yes	152 (9.6)	124 (7.8)	171 (8.2)	181 (8.7)
No	1,349 (84.8)	1,461 (91.9)	1,810 (86.9)	1,894 (90.9)
Missing	89 (5.6)	5 (0.3)	103 (4.9)	9 (0.4)
Asthma				
Yes	171 (10.8)	68 (4.3)	255 (12.2)	140 (6.7)
No	1,292 (81.3)	106 (6.7)	1,640 (78.7)	253 (12.1)
Missing	127 (8.0)	44 (2.8)	189 (9.1)	123 (5.9)
Hay fever				
Yes	526 (33.1)	340 (21.4)	754 (36.2)	425 (20.4)
No	937 (58.9)	1,218 (76.6)	1,154 (55.4)	1,574 (75.5)
Missing	127 (8.0)	32 (2.0)	176 (8.4)	85 (4.1)
Eczema				
Yes	334 (21.0)	106 (6.7)	696 (33.4)	253 (12.1)
No	1,118 (70.3)	1,433 (90.1)	1,202 (57.7)	1,741 (83.5)
Missing	138 (8.7)	51 (3.2)	186 (8.9)	90 (4.3)

Figures show the numbers (percentages)

Table 2 The cross-sectional associations between atopic conditions and mental health problems

	Boys						Girls					
	Age 15–16 years			Age 18–19 years			Age 15–16 years			Age 18–19 years		
	OR	CI L	CI U	OR	CI L	CI U	OR	CI L	CI U	OR	CI L	CI U
Internalized symptoms												
Asthma	1.34	0.77	2.34	0.69	0.29	1.62	1.16	0.85	1.57	1.25	0.87	1.79
Hay fever	1.66	1.12	2.47	1.02	0.71	1.47	1.44	1.16	1.79	1.46	1.16	1.82
Eczema	1.89	1.24	2.87	1.89	1.14	3.13	1.30	1.05	1.62	1.53	1.16	2.00
Externalized symptoms												
Asthma	1.08	0.64	1.81	1.13	0.48	2.68	1.38	0.90	2.12	1.61	0.95	2.71
Hay fever	1.38	0.97	1.94	1.01	0.65	1.57	1.17	0.85	1.62	1.68	1.20	2.36
Eczema	1.20	0.81	1.78	1.09	0.54	2.22	1.30	0.94	1.81	1.44	0.95	2.20

Crude odds ratios with 95% confidence intervals

Table 3 Multivariate logistic regression analysis with atopic conditions at age 15–16 years as exposure variable and internalized mental health problems at age 18–19 years as response variables

	Boys (<i>N</i> = 1,474)						Girls (<i>N</i> = 1,934)					
	Crude OR			Adjusted OR*			Crude OR			Adjusted OR*		
	OR	CI L	CI U	OR	CI L	CI U	OR	CI L	CI U	OR	CI L	CI U
Atopic conditions												
None	1.00			1.00			1.00			1.00		
One	1.28	0.90	1.81	1.25	0.88	1.79	1.07	0.86	1.34	1.05	0.84	1.33
Two to three	1.40	0.92	2.15	1.37	0.89	2.13	1.46	1.15	1.87	1.49	1.16	1.92
Ethnicity												
Norwegian	1.00			1.00			1.00			1.00		
Minority	2.00	1.38	2.90	1.95	1.33	2.86	1.86	1.45	2.38	1.93	1.50	2.49
Living with												
Both parents	1.00			1.00			1.00			1.00		
One parent	1.22	0.86	1.731	1.18	0.81	1.70	1.37	1.11	1.68	1.21	0.97	1.51
Foster parents	1.94	0.41	9.246	1.73	0.33	8.93	3.16	0.7	14.2	3.40	0.74	15.67
Other	7.77	1.92	31.44	4.28	0.98	18.72	1.48	0.48	4.56	1.06	0.33	3.41
Economic status												
Very good	1.00			1.00			1.00			1.00		
Good	0.96	0.58	1.61	0.99	0.59	1.66	1.16	0.81	1.66	1.22	0.85	1.76
Moderate	1.34	0.78	2.30	1.27	0.73	2.21	2.02	1.39	2.92	2.01	1.38	2.94
Poor	3.69	1.57	8.65	2.91	1.19	7.08	5.53	2.84	10.76	5.09	2.57	10.08

Figures are odds ratios with 95% confidence intervals

* Adjusted for all variables

symptoms above a cutoff value, respectively, as dependent variables were used to calculate OR in the multivariate analysis. A generalized estimating equations (GEE) model was used to test whether associations between atopic conditions and the risk of being mentally distressed changed from baseline (15/16 years of age) to follow-up (age 18/19 years). The level of significance was set to $p \leq 0.05$, CI = 95%.

Results

The gender distribution was 43.3% boys and 56.7% girls (Table 1). Among the boys, 16.0% had both their parents born outside Norway, compared to 17.3% of the girls. One out of four adolescents lived with one of their parents, while 1% lived with foster parents. The vast majority perceived their family's economic status as

Table 4 Multivariate logistic regression analysis with atopic conditions at age 15–16 years as exposure variable and externalized mental health problems at age 18–19 years as response variables

	Boys (<i>N</i> = 1,479)						Girls (<i>N</i> = 1,940)					
	Crude OR			Adjusted OR*			Crude OR			Adjusted OR*		
	OR	CI L	CI U	OR	CI L	CI U	OR	CI L	CI U	OR	CI L	CI U
Atopic conditions												
None	1.00			1.00			1.00			1.00		
One	0.74	0.47	1.15	0.74	0.47	1.15	0.96	0.65	1.41	0.92	0.62	1.36
Two to three	1.14	0.69	1.88	1.12	0.67	1.88	1.54	1.04	2.28	1.48	0.99	2.21
Ethnicity												
Norwegian	1.00			1.00			1.00			1.00		
Minority	1.88	1.21	2.94	1.77	1.12	2.81	1.05	0.69	1.62	1.05	0.68	1.64
Living with												
Both parents	1.00			1.00			1.00			1.00		
One parent	1.14	0.74	1.763	1.12	0.71	1.77	1.82	1.30	2.54	1.63	1.15	2.32
Foster parents	5.35	1.36	21.08	4.37	1.05	18.26	10.36	2.29	46.99	10.29	2.16	49.09
Other	4.16	0.83	20.94	2.47	0.43	14.16	2.51	0.55	11.50	2.29	0.49	10.74
Economic status												
Very good	1.00			1.00			1.00			1.00		
Good	0.60	0.35	1.04	2.11	0.80	5.59	0.59	0.34	1.02	0.99	0.36	2.71
Moderate	0.78	0.43	1.41	0.78	0.42	1.42	1.30	0.76	2.24	1.18	0.68	2.06
Poor	2.54	1.01	6.38	0.62	0.36	1.07	1.30	0.49	3.48	0.57	0.33	0.99

Figures are odds ratios with 95% confidence intervals

* Adjusted for all variables

moderate or good, while 2.4–2.6% considered their family as poor.

Cross-sectional results

The percentage reporting internalized mental health problems (HSCL ≥ 1.85) increased from 15/16 years to 18/19 years, from 7.3 to 12.0 among boys and from 24.0 to 32.5 among girls, respectively (Table 1). Among 15/16-year-olds, 10.1% of the boys reported externalized symptoms, decreasing to 7.8% among 18/19-year-olds; the comparable figures for girls were 8.6 and 8.7%, respectively.

The most prevalent atopic condition was hay fever, reported by 36.0% of the boys and 39.5% of the girls aged 15/16 years (Table 1). Hay fever, asthma and eczema were less prevalent in the age group of 18/19-year-olds as compared with 15/16-year-olds, with similar patterns among boys and girls (Table 1). The separate analyses of the age groups 15/16 and 18/19 years did not show significant associations between asthma and mental health problems (Table 2). Hay fever was significantly associated with internalized symptoms among 15/16-year-olds of both genders (OR_{crude} = 1.7; 1.1–2.5 and 1.4; 1.2–1.8, respectively). Among 18/19-year-olds, hay fever was associated

with internalized as well as externalized symptoms in girls (OR_{crude} = 1.5; 1.2–1.8 and 1.7; 1.2–2.4, respectively) but not in boys. Eczema was associated with internalized symptoms in both age categories for both genders.

Longitudinal results

By means of a GEE model, we wanted to test whether the associations between atopic conditions and mental health problems changed from the age 15–16 to 18–19 years. Regarding internalized symptoms, we found a weakly significant change in the association with hay fever for boys ($p = 0.05$). The association that was present at age 15–16 years disappeared at age 18–19 years. Regarding externalized symptoms, no significant changes in associations were found, although we also had a nearly significant change in the association with hay fever for boys ($p = 0.09$) (not shown in Table).

Regression analyses of the longitudinal data showed a significant association between the number of atopic conditions at 15/16 years of age and internalized mental health problems 3 years later for girls, adjusted for ethnicity, family structure and self-perceived socioeconomic status (OR = 1.5, 95% confidence interval 1.2–1.9 for two to three conditions vs. none, Table 3). Correspondingly, there

was a close to significant association with externalized mental health problems, also in girls. Among the factors we adjusted for, poor family economy and ethnicity were associated with internalized mental health problems for both genders (Table 3). Furthermore, ethnicity was also significantly associated with externalized mental health problems for boys (Table 4). In addition to these multivariate analyses stratified by gender, we carried out analyses of interaction effects between atopic conditions and gender within the total sample, with internalized and externalized symptoms as dependent variables, respectively. However, these analyses did not show any significant interaction effects, meaning that associations did not differ significantly between genders (not shown in Table).

We also did an analysis of each atopic condition at baseline and mental distress at follow-up after controlling for family structure, economy and ethnicity. The only statistically significant association we found was for eczema among boys [OR = 1.7 (1.2–2.6) (not shown in Table)].

Discussion

In our study, 3,674 adolescents contributed with questionnaire data at age 15/16 and 18/19 years. We found that hay fever and eczema were associated with internalized mental health problems, a finding that is in line with previous studies [1, 5, 19, 20]. Hurwitz and Morgenstern attributed this potentially increased susceptibility for depression to the effects of proinflammatory cytokines on the hypothalamic-pituitary-adrenal (HPA) axis, in which allergic reactions, as markers for inflammation-associated activation of the HPA axis, result in aberrant responses to subsequent stressors [19]. Like Goodwin et al., Vila et al. and Bell et al., we found a tendency, though not statistically significant, for asthma at age 15/16 years to be associated with internalized mental health symptoms. Furthermore, externalized mental health problems were not related to atopic conditions, except for hay fever in 18/19-year-old girls; accordingly, we could not confirm a relationship between behavior problems, ADHD, and atopic conditions [28, 31]. We observed that reporting two or three atopic conditions as compared to none gave significantly higher odds for internalized and externalized symptoms among girls. In adolescence, peer identification and conformity climax, and sports and risk taking are part of growing up. In line with Randolph and Fraser, we suspect that the more atopic conditions the adolescent has, the more problematic becomes the peer identification and the wish for conformity, and thereby the risk of mental health problems increases in a dose–response relationship to the number of atopic conditions [25]. The ability to cope with a

disabling disease during adolescence seems to be more pronounced in girls. From other studies, we also know that girls with early menarche face more mental health and behavioral problems during puberty than their peers and boys with late pubertal development, probably connected to dissatisfaction in body image [21].

Our study showed an increase in internalized symptoms from age 15/16 to 18/19 years among both boys and girls, as found in previous studies [2]. The prevalence of asthma decreased from age 15/16 to 18/19 years, in accord with earlier studies where asthma was found to improve during adolescence [26]. Our results from the GEE model indicate that the relationships between atopic conditions and mental health problems remain quite stable from age 15/16 to 18/19 years.

The clinical implication of our finding is that boys with eczema and girls with two or more atopic conditions are vulnerable to co-morbid mental distress and that possible measures should be taken to be able to detect any internalized mental health problems in these groups. It is difficult to find out why adolescents with atopic conditions are at risk for mental health problems, but one reason might be the feeling of being different. We know that body satisfaction is an important aspect of adolescents' self image and therefore also of mental distress [21]. Furthermore, a recent review of studies on allergic diseases and their impact on quality of life found that allergic diseases can deeply interfere with patients' health-related quality of life, with detrimental effects on the physical, psychological and social dimensions of life [6].

The strengths and limitations

Among the strengths of this study is the longitudinal design, allowing for observations of how the associations between atopic conditions and mental health problems change with time. The large number of participants, the homogenous age distribution of the participants, as well as the relatively even composition of girls and boys, are indicative of the results in this study being representative for adolescents in this age group.

Our longitudinal results are vulnerable to the regression toward the mean problem, a phenomenon that occurs when we select a group that is extreme for a variable *X* and then measure another variable *Y* for that group [7, 8]. The tendency of decrease in mental health problems from age 15/16 to 18/19 years that we observed among boys with atopic conditions may as well be a regression toward the mean rather than a factual decrease.

Another aspect of the same problem is that a considerable part of the associations that we found in the multivariate logistic regression model between exposure to atopic conditions at baseline (age 15/16 years) and

subsequent mental health problems 3 years later already exist at baseline. This means that we are not able to really say anything about the direction of effects here. It is still interesting, however, to observe that exposures measured at the age of 15–16 years are also associated with the outcome 3 years later.

The third limitation of this study is that 30% of the participants at baseline were lost to follow-up, resulting in a risk for a selection bias; i.e., the non-responders would differ as a group from the responders. An indication of such selection bias was that our effect estimates in the age group 15/16 years were generally lower than that reported by Lien [20], in which the total data set was used, while the present study only used data of those who also participated in the year 2004. Adolescents with severe physical or mental diseases might fail to meet normal school progression and therefore be a part of the postal survey group where the attrition rate was highest.

Finally, there might be bias in the way the students filled in the questionnaire. Without objective data on either the mental health or the atopic conditions, we face problems both in the calculation of prevalence and of the association measures for the cross-sectional part of study. In the latter case, differential misclassification might lead to both higher and lower estimates of effect sizes.

Acknowledgments The data collection for both the baseline and follow-up study was carried out and funded by the Norwegian Institute of Public Health and the University of Oslo. In addition, the Center for Child and Adolescent Mental Health, Eastern and Southern Norway, contributed to the funding of the follow-up study, and the Municipality of Oslo to the baseline study.

References

1. Absolon CM, Cottrell D, Eldridge SM, Glover MT (1997) Psychological disturbance in atopic eczema: the extent of the problem in school-aged children. *Br J Dermatol* 137(2):241–245
2. Angold A, Erkanli A, Silberg J, Eaves L, Costello EJ (2002) Depression scale scores in 8–17-year-olds: effects of age and gender. *J Child Psychol Psychiatry* 43(8):1052–1063
3. Asher MI, Montefort S, Björkstén B, Lai CK, Strachan DP, Weiland SK, Williams H, ISAAC Phase Three Study Group (2006) Worldwide time trends in the prevalence of symptoms of asthma, hay fever, and eczema in childhood: ISAAC Phases One and Three repeat multicountry cross-sectional surveys. *Lancet* 368(9537):733–743
4. Beasley R (1998) Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC. The International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee. *Lancet* 351(9111):1225–1232
5. Bell IR, Jasnosi ML, Kagan J, King DS (1991) Depression and allergies: survey of a nonclinical population. *Psychother Psychosom* 55(1):24–31
6. Baiardini I, Braidò F, Brandi S, Canonica GW (2006) Allergic diseases and their impact on quality of life. *Ann Allergy Asthma Immunol* 97(4):419–428
7. Bland JM, Altman DG (1994) *Statistic notes: regression towards the mean*. *BMJ* 308:1499
8. Bland JM, Altman DG (1994) *Statistics notes: some examples of regression towards the mean*. *BMJ* 309:780
9. Cadman D, Boyle M, Szatmari P, Offord DR (1987) Chronic illness, disability, and mental and social well-being: findings of the Ontario Child Health Study. *Pediatrics* 79(5):805–813
10. Chen E, Bloomberg GR, Fisher EB Jr, Strunk RC (2003) Predictors of repeat hospitalizations in children with asthma: the role of psychosocial and socioenvironmental factors. *Health Psychol* 22(1):12–18
11. Chida Y, Hamer M, Steptoe A (2008) A bidirectional relationship between psychosocial factors and atopic disorders: a systematic review and meta-analysis. *Psychosom Med* 70(1):102–116
12. Essau CA, Conradt J, Petermann F, Phil (2000) Frequency, comorbidity, and psychosocial impairment of anxiety disorders in German adolescents. *J Anxiety Dis* 14:263–279
13. Gaitens T, Kaplan BJ, Freigang B (1998) Absence of an association between IgE-mediated atopic responsiveness and ADHD symptomatology. *J Child Psychol Psychiatry* 39(3):427–431
14. Goodman R (2001) Psychometric properties of the Strengths and Difficulties Questionnaire. *J Am Acad Child Adolesc Psychiatry* 40(11):1337–1345
15. Goodman R, Meltzer H, Bailey V (2003) The Strengths and Difficulties Questionnaire: a pilot study on the validity of the self-report version. *Int Rev Psychiatry* 15:173–177
16. Goodwin RD, Messineo K, Bregante F, Hoven CW, Kairam R (2005) Prevalence of probable mental disorders among pediatric asthma patients in an inner-city clinic. *J Asthma* 42(8):643–647
17. Gortmaker SL, Walker DK, Weitzman M, Sobol AM (1990) Chronic conditions, socioeconomic risks, and behavioral problems in children and adolescents. *Pediatrics* 85(3):267–276
18. Grant KE, Compas BE, Stuhlmacher AF, Thurm AE, McMahon SD, Halpert JA (2003) Stressors and child and adolescent psychopathology: moving from markers to mechanisms of risk. *Psychol Bull* 129(3):447–466 (Review)
19. Hurwitz EL, Morgenstern H (1999) Cross-sectional associations of asthma, hay fever, and other allergies with major depression and low-back pain among adults aged 20–39 years in the United States. *Am J Epidemiol* 150(10):1107–1116
20. Lien L (2008) Mental health, asthma, allergy, and eczema; prevalence and associations across gender and immigrant status. A population-based cross-sectional study among 10th grade students. *Scand J Public Health* 36(4):353–360
21. Lien L, Dalgard F, Heyerdahl S, Thoresen M, Bjertness E (2006) The relationship between age of menarche and mental distress in Norwegian adolescent girls and girls from different immigrant groups in Norway: results from an urban city cross-sectional survey. *Soc Sci Med* 63(2):285–295
22. Nesdale D, Mak A (2003) Ethnic identification, self-esteem and immigrant psychological health. *Int J Intercultural Rel* 27:23–40
23. Nystad W, Magnus P, Roksund O, Svidal B, Hetlevik O (1997) The prevalence of respiratory symptoms and asthma among school children in three different areas of Norway. *Pediatr Allergy Immunol* 8(1):35–40
24. Oppedal B, Røysamb E, Heyerdahl S (2005) Ethnic group, acculturation, and psychiatric problems in young immigrants. *J Child Psychol Psychiatry* 46:646–660
25. Randolph C, Fraser B (1999) Stressors and concerns in teen asthma. *Curr Probl Pediatr* 29(3):82–93 (Review)
26. Rich M, Schneider L (1996) Managing asthma with the adolescent. *Curr Opin Pediatr* 8(4):301–309 (Review)
27. Roberts RE, Attkisson CC, Rosenblatt A (1998) Prevalence of psychopathology among children and adolescents. (Review) (86 refs). *Am J Psychiatry* 155(6):715–725

28. Roth N, Beyreiss J, Schlenzka K, Beyer H (1991) Coincidence of attention deficit disorder and atopic disorders in children: empirical findings and hypothetical background. *J Abnormal Child Psychol* 19:1–13
29. Ryan ND (2005) Treatment of depression in children and adolescents. *Lancet* 366:933–940
30. Selnes A, Nystad W, Bolle R, Lund E (2005) Diverging prevalence trends of atopic disorders in Norwegian children. Results from three cross-sectional studies. *Allergy* 60(7):894–899
31. Stevenson J, ETAC Study Group (2003) Relationship between behavior and asthma in children with atopic dermatitis. *Psychosom Med* 65(6):971–975
32. Strand BH, Dalgard OS, Tambs K, Rognerud M (2003) Measuring the mental health status of the Norwegian population: a comparison of the instruments SCL-25, SCL-10, SCL-5 and MHI-5 (SF-36). *Nordic J Psychiatry* 57:113–118
33. Verhaak PFM, Heijmans MJWM, Peters L, Rijke M (2005) Chronic disease and mental disorder. *Soc Sci Med* 60:789–797
34. Vila G, Nolle-Clemencon C, de BJ, Mouren-Simeoni MC, Scheinmann P (2000) Prevalence of DSM IV anxiety and affective disorders in a pediatric population of asthmatic children and adolescents. *J Affect Disord* 58(3):223–231