

Relationship between Eczema and Self-reported Difficulties Keeping up with School Education: A Cross-sectional Study

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Eczema is a common chronic disease that affects both children and adults, and may have an adverse impact on school performance, as it is characteristically pruritic, and hence may lead to poor concentration and inadequate sleep. The aim of this study was to elucidate the relationship between eczema and self-reported difficulties keeping up with school education. The study was based on cross-sectional questionnaire data collected in schools among all 9th graders (15–16 years old) within a Swedish county. Logistic regression analyses were used to assess the association between having eczema and self-reported difficulties keeping up with school education. A total of 2,620 pupils participated (50.1% female). An increased odds ratio (OR) of self-reported difficulties keeping up with school education was found in adolescents with eczema compared with those without eczema after adjustment for sex and family residence (OR 2.13, 95% confidence interval (95% CI) 1.32–3.44), and with additional adjustment for sleeping problems, attention-deficit hyperactivity disorder, allergy, rhinitis, asthma, and alcohol consumption (adjusted OR 1.78, CI 1.05–3.00). Eczema may be a relevant risk factor for difficulty keeping up with school education in adolescents. However, studies that can assess temporality, based in different settings with objective reports of both eczema and self-reported difficulties at school, are needed to confirm these findings.

Key words: achievement; adolescents; questionnaire.

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Eczema (also known as atopic dermatitis or atopic eczema) is a common chronic disease that affects both adults and children, and is the most frequent inflammatory childhood disease (1). Eczema is estimated to contribute the largest global burden of disability from skin disease; it affects up to 20% of children (2) and is associated with impaired quality of life (3, 4).

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SIGNIFICANCE

Eczema negatively influences quality of life, but there are conflicting results about its relationship with school performance. Results from this study revealed that eczema was a relevant independent risk factor for having difficulty keeping-up with school education in adolescents. Understanding whether people with eczema are at risk of impaired educational attainment is highly relevant to enable targeted preventive measures.

hence may lead to poor concentration and inadequate sleep (5, 6), in addition to absenteeism from school due to illness (7). We previously highlighted a lack of evidence on the association between eczema and educational outcomes (8) with only 1 population-based cohort study assessing if eczema was associated with impaired educational outcomes (9). This cohort study (9) reported no association between eczema and reduced educational attainment. The search also identified 1 cross-sectional study, a Swedish general population-based study (10) ($n=9,538$) which reported no association between current eczema and the final-year grade attained during compulsory schooling. However, more recently there have been 2 cohort studies focusing on this topic, including a study of Swedish military conscripts (11) and a further study using Danish registry data (12). In the study by Smirnova et al. (11) which included more than 230,000 men, eczema was associated with higher educational level (relative risk ratio 1.29, 95% confidence interval (95% CI) 1.13–1.47). The study by Schmidt et al. (12), which included more than 61,000 children, had the possibility to study cohort data. They found that children who were diagnosed with eczema were at increased risk of not attaining lower secondary education (adjusted risk ratio [RR] 1.50; 95% CI 1.26–1.78) and upper secondary education (RR 1.16; 95% CI 1.09–1.24), but not higher education (RR 0.95; 95% CI 0.91–1.00) in adulthood. However, due to small absolute differences and possible confounding by familial factors in this study, the authors emphasize the uncertainty of the clinical importance of the results.

Increasing evidence supports a relationship between eczema and attention-deficit hyperactivity disorder (ADHD) (13–16). ADHD is characterized by persistent

symptoms of inattention, hyperactivity and impulsiveness (17), which may interfere with social relations and lead to lower school performance (18, 19).

Understanding the consequences of eczema in children, including how pupils perceive their own success in keeping up with school education is imperative for holistic care.

The objective of this study was to assess the relationship between eczema and self-reported difficulties keeping up with school education in 9th grade adolescents (15–16 years old), including assessing possible mediation effects of ADHD, sleeping problems and drinking alcohol.

MATERIALS AND METHODS

Setting and participants

A cross-sectional survey, "Young in Värmland", was undertaken by the local University in 2011 in the county of Värmland, located in central-west Sweden. The study objective was to gain knowledge about the relationship between social and environmental exposures and adolescents' health. All 9th graders in public and private mainstream schools in Värmland were invited to participate. 2,620 pupils participated (response rate 83.4%). The majority of the participants (95%) were born in 1996 and were aged 15–16 years old at the time of the survey. Survey participation was voluntary, and the paper questionnaire was completed anonymously during a lesson during the spring of 2011. Informed consent was inferred by completing the questionnaire. Parental consent was not considered necessary due to participants' age. The questionnaire asked for individual details, including demographic, social and anthropometric characteristics, school environment, subjective health, including previous or existing medical conditions, and recreational drug use (see Appendix S1 for full questionnaire).

Ethics. The questionnaire and the principles guiding the data collection in 2011 were approved by the ethics committee at Karlstad University (registration number C 2011/135).

Variables

Outcome. The study outcome was self-reported difficulties keeping up with school education, based on the response to the question: "Do you have difficulties keeping up with school education?" The 4 possible response categories were dichotomized to "yes in every subject/yes in most subjects" and "yes in one or two subjects/no".

Exposure. The exposure of interest was self-reported ever having eczema, identified by the question "Do you have any of these disability/physical illnesses?" "Eczema" (with 2 response alternatives; yes, no).

Selection of co-variables. A directed acyclic graph (DAG) was used to identify potential confounders, mediators and colliders of the relationship between eczema and keeping up at school; Fig. S1). Possible co-variables were determined through a literature search assessing common associated factors for eczema and educational outcomes. A DAG is assumed to achieve a model selection accounting for a hypothesized causal relationship (20). The green lines in the DAG (Fig. S1) indicate causal paths and red lines indicate biasing paths. Fig. S1 shows us that covariables that were considered *a priori* as confounders included sex, family structure, and maternal and paternal employment. Sleeping problems, reported ADHD, and alcohol consumption were considered as possible confounders or possible intermediate on the pathway; alcohol was measured using questions from The Swedish Council for Information on Alcohol and Other Drugs (21). Self-reported

diseases, including allergy, rhinitis and asthma, were considered possible effect modifiers. See Table SI for more details of variable categorization.

The proportions with missing data for each study variable and patterns of missingness were explored. Complete case analyses were undertaken, on the basis that data are likely to be missing not at random (and might depend on actual values); analyses including and excluding the variable were also undertaken.

Statistical analysis

The characteristics of those with and without eczema were described. Logistic regression was used to determine odds ratios (OR) and their 95% CI comparing the odds of reporting difficulties keeping up at school between those with eczema and those without.

Subsequent multivariable logistic regression analyses adjusted initially for *a priori* confounders (sex, socio-economic status (based on family structure), the adjusted model) and subsequently for possible confounders or intermediates on the pathway between eczema and difficulties keeping up at school, including ADHD, sleeping problems and drinking alcohol at least once per week. Three models were constructed, all starting with adjusting for family structure (socioeconomic status; SES). Model 1 adjusted for SES and sex, model 2 additionally adjusted for ADHD and sleeplessness. Model 3 adjusted for the variables included in models 1 and 2 and additionally adjusted for drinking alcohol at least once a week. All models' observations were based on the observations in model 3 ($n=1,783$). Missing values from model 3 were excluded in models 1 and 2 in order to have equal observations. However, excluding missing variables did not change the relationships in model 1 and 2.

Secondary analyses. It was tested whether self-reported diseases allergy, rhinitis and asthma, and sex had a modifying effect on the relationship between eczema and not keeping up with school.

Sensitivity analyses. Additional analyses were run using parental occupation instead of family residence as a proxy for SES.

STATA ver14 (StataCorp LP, Texas, USA) was used for statistical analyses and an online program "dagitty" to develop the DAG for the current study (www.dagitty.net version 2.3, 2017).

RESULTS

A total of 2,620 participants completed the survey, of whom 50.1% were female. The total proportion reporting eczema in the sample was 10.1% ($n=250$). Of those reporting eczema, 64% were girls and 42.6% lived with both parents. Of these, 34.2% with eczema reported asthma and 15.3% reported having allergies, 11.6% reported ADHD, 24.9% reported sleeping problem, and 14.1% consumed alcohol at least once a week. The corresponding percentages for those without eczema were: 48.9% were girls and 62.4% were living with both parents, 11.7% had asthma, 5.5% reported any allergies, 3.0% reported ADHD, 20.9% reported sleeping problems, and 9.6% consumed alcohol at least once per week (**Table I**).

Missing values

Missing values for each variable are shown in Table I. The variable consumption of alcohol included the highest missing values ($n=661$, 25.2%). A higher proportion of children who did not answer the ques-

Table I. Baseline demographic table comparing pupils with eczema with pupils without eczema

	Without eczema <i>n</i> = 2,218 (%)	With eczema <i>n</i> = 250 (%)
Participants' characteristics		
Sex ¹		
Girls	1,082 (48.8)	160 (64.0)
Boys	1,131 (51.0)	90 (36.0)
Living with both parents (family structure) ²		
No	828 (37.3)	143 (57.2)
Yes	1,376 (62.0)	106 (42.4)
Father's occupation ³		
Employed	1,976 (89.1)	217 (86.8)
Not employed	166 (7.5)	19 (7.6)
Mother's occupation ⁴		
Employed	1,968 (88.7)	206 (82.4)
Not employed	190 (8.6)	36 (14.4)
Sleeping problem ⁵		
No	1,742 (78.5)	189 (75.6)
Yes	460 (20.8)	60 (24.0)
ADHD ⁶		
No	2,125 (95.8)	214 (85.6)
Yes	66 (3.0)	28 (11.2)
Alcohol consumption at least once a week ⁷		
No	1,502 (67.7)	165 (66.0)
Yes	160 (7.2)	27 (10.8)
Asthma ⁸		
No	1,949 (88.4)	161 (66.0)
Yes	257 (11.7)	83 (34.0)
Allergies ⁹		
No	2,086 (94.0)	210 (84.0)
Yes	122 (5.5)	38 (15.2)
Rhinitis ¹⁰		
No	1,858 (83.8)	149 (59.6)
Yes	342 (15.4)	92 (36.8)

Missing: ¹*n* = 4 (0.15%), ²*n* = 17 (0.7%), ³*n* = 104 (4.0%), ⁴*n* = 75 (2.9%), ⁵*n* = 37 (1.4%), ⁶*n* = 161 (6.2%), ⁷*n* = 661 (25.2%), ⁸*n* = 143 (5.5%), ⁹*n* = 39 (1.5%), ¹⁰*n* = 132 (5.8%).

ADHD: attention-deficit hyperactivity disorder.

tion regarding alcohol were living with 2 parents (70.2%, *n* = 423) compared with those who answered the question about alcohol (59.5%, *n* = 1,060). A lower proportion of those not answering the alcohol question reported difficulties keeping up with school education (2.0%, *n* = 12), compared with those who answered the alcohol question, (7.1%, *n* = 126). A lower proportion of those not answering the alcohol question reported having ADHD (1.2%, *n* = 7 compared with those who answered the alcohol question (4.7%, *n* = 83.). There was no difference in self-reported eczema prevalence between children who did not answer (9.1%, *n* = 55) and those who reported their alcohol consumption (10.3%, *n* = 184) (Table SV).

There were also missing values (Table I) for questions about the exposure, eczema (5.8%); the outcome,

difficulties keeping up with school work (1.2%); and covariates and effect modifiers, including ADHD (6.2%), asthma (5.5%), rhinitis (5.8), sex (0.15%), or family structure (0.7%),

Eczema was associated with self-reported difficulties with keeping up with school education in crude analyses (crude OR 2.24, 95% CI 1.45–3.45), with some attenuation when adjusting for family structure and sex (OR 2.13, 95% CI 1.32–3.44). When ADHD and sleeplessness were added to the model, the OR for self-reported difficulties keeping up with school education for children with eczema compared with those without eczema reduced to OR 1.90 (95% CI 1.15–3.13), while the association was further attenuated when adjusting for drinking alcohol at least once a week (OR 1.78, 95% CI 1.05–3.00).

Additional analyses

Secondary analyses. Analyses were repeated within strata of sex, and asthma, allergy, rhinitis (hay fever) status (Tables SII and SIII). The results showed that the effect of eczema on difficulties keeping up with school education was more than threefold increased in boys (OR 3.63, 95% CI 1.89–7.01) and approximately 60% increased in girls (OR 1.59, 95% CI 0.88–2.88) (Table SII). However, there is an overlap between confidence intervals.

Sensitivity analyses. The study further assessed whether parental occupation (whether parents were unemployed or employed) influenced eczema and self-assessed school performance by substituting family structure for parental occupation. Parental occupation did not alter the strength of the relationship between eczema and keeping up with school (OR 1.99, 95% CI 1.17–3.28) (Table SIV).

DISCUSSION

This cross-sectional study revealed an associated between self-reported eczema and self-reported difficulties at school in grade 9 adolescents (age 15–16 years) in the county of Värmland, Sweden. This finding remained, even after adjusting for possible confounders including family structure (as a proxy for SES), and sex and possible mediating variables, such as ADHD, asthma, allergy, sleeping problems, and drinking alcohol.

Table II. Logistic regression assessing the association (odds ratio, and 95% confidence intervals (95%CI) within parentheses) between eczema and school education among 15-year-old pupils

Difficulties keeping up at school and eczema	Odds ratio (95% CI) for difficulties keeping up at school and eczema		
	Crude	Adjusted	Adjusted
		Model 1: adjusted for sex and SES*	Model 2: Adjusted for sex and SES and further adjusting for ADHD, Sleeplessness
With eczema	2.01 (1.37–3.54)	2.13 (1.32–3.44)	1.90 (1.15–3.13)
No eczema	1.00 (reference)	1.00 (reference)	1.00 (reference)
			Model 3: Adjusted for sex and SES, ADHD, sleeplessness and alcohol consumption*
With eczema			1.78 (1.05–3.00)
No eczema			1.00 (reference)

*SES: socioeconomic status; alcohol: consuming alcohol at least once/week
Observations *n* = 1,783.

Stratified analyses on sex showed, however, that the association between eczema and self-reported difficulties keeping up with school education was stronger among boys. The study did not find statistically significant evidence for interactions; however, the small numbers in the sub-analysis mean that the study is likely to be underpowered for this analysis.

Prior studies show no evidence of worsened school performance in people with eczema, which might appear to contrast with the current study findings (9–11); however, the current results are consistent with those reported by Schmidt et al. (12). While the outcomes in Ruijbroek et al.'s (9) and Sundberg et al.'s (10) studies were teachers' assessment of school tests performance and school grades in those with eczema, respectively, the exposure data on eczema in Smirnova et al. (11), as well as in Schmidt et al. (12) was collected by a physician. In Ruijbroek et al.'s study (9) the pupils were younger (11 years old), while the children in Sundberg et al.'s study (10) were similar to our population. The population in Smirnova's et al study (11) was older, 17–20 years old at the time of the physical examination. However, Smirnova et al. (11) investigated subsequent educational attainment (compulsory schooling to a maximum of 9 years, post-compulsory secondary education over 2 years, but less than 3 years, and subsequent higher or further education). The lack of an association in their study might depend on, for example: (i) eczema does not have such a great impact on an individual's life choices or school performance and grades, or (ii) eczema decreases with age and does not affect the grades of post-compulsory secondary education, or the choice of higher educational attainment, or (iii) there is no relationship amongst those well enough to be conscripted, i.e. healthy participant bias. However, Schmidt et al. (12) reported an association between childhood eczema and reduced educational attainment in adolescence amongst people with moderate-to-severe eczema. The current study did not use a measure of educational attainment, but focused on pupils' reports of how they think they keep up with school education, which may not relate to future educational attainment.

It has been shown that visible impairments (such as eczema) might be more important during adolescence and adulthood, and might thus contribute to an individual's self-assessed school performance (22). Differing results may also relate to using different measures of exposure: in the current study, the question about eczema may relate to having persistent or current eczema, while Ruijbroek et al. (9) and Sundberg et al. (10) assessed current eczema at age 1 year and 11 years by asking about whether an itchy rash had been present at 1 or more of the typical locations (the folds of the elbows or behind the knees, around the ears or eyes, or at the front of the ankles) during the previous 12 months using a combined answer of questions of a validated questionnaire (23).

Strengths and limitations

The strength of this study is the large population-based sample, including most 9th graders in a Swedish county. The questionnaire study was conducted with a high participation rate, which minimizes the potential risk of selection bias. The questionnaire was conducted by schools during the spring, eventually minimizing seasonal effects, although the effects of rhinitis may have been more pronounced.

However, some limitations of this study must be highlighted. First, the data used are quite old, and it is possible that we would not get the same answers if the study was repeated today. Secondly, the data were cross-sectional, meaning that the study cannot assess temporality. It is also possible that doing worse at school could lead to stress that might worsen symptoms of eczema; hence, reverse causality might be an explanation for the current findings. Furthermore, both the exposure and outcome data are self-reported; however, self-reported data on children's health outcomes have been suggested to be valid (24). However, the exposure is still self-reported eczema, and there is a risk that some of the children do not have eczema, which we have considered exposed and vice versa (i.e. misclassification). Self-assessed school performance can differ due to the individuals' background, expectations and goals. There might also be differences between sex and self-assessed school ability, with some studies describing girls underestimating their performance compared with boys (25). Self-assessed performance or achievement has shown to be a predictor of later academic achievement including more objective assessment, including examination grades (26–28). The validity of self-reported difficulties at school might not reflect the grades students attain in examinations (29); i.e. children might report difficulties keeping up at school but still achieve high grades, or vice versa. The outcome, self-reported difficulties keeping up with school education, has been used elsewhere, but has not been validated (30). The measures used in this study may be subject to misclassification (i.e. identifying eczema, self-assessed keeping up with school education, parental occupation). It is possible that some of this misclassification could be differential, in that differing SES may affect how keeping up with school is reported, and as eczema is associated with higher SES, this could mean that people with eczema report the outcome in a different way. The prevalence of ADHD in survey participants (4.1%) was comparable to the national reported prevalence (approximately 5–6% in Sweden (31)). Questions of self-assessed health were used previously in large epidemiological surveys (e.g. Kalander Blomqvist, Janson (32)). The variable alcohol consumption included many missing values. The different groups were compared regarding those who answered and those who did not, and it was identified that those who had answered the question seemed to have a higher socioeconomic position, and were more likely to report ADHD (33).

Future studies should use validated measurements, ideally using standard diagnostic criteria to identify the presence of eczema and validated outcomes to measure eczema severity and study outcomes. The use of longitudinal study designs would also enable future studies to determine temporality and exclude the presence of important reverse causality.

Conclusion

This cross-sectional study showed a possible relationship between eczema and self-reported difficulties keeping up at school; however, other explanations for this association cannot be excluded. Therefore, studies with longitudinal design are needed to confirm the current findings. Educational attainment is a key determinant of occupational choices. Understanding whether people with eczema are at risk of impaired educational attainment and reduced occupational status is highly relevant to enable targeted preventive measures.

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The questionnaire and the principles guiding the data collection in 2011 were approved by the Ethics Committee at Karlstad University (registration number C 2011/135).

The authors have no conflicts of interest to declare.

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