

Do young adults with atopic dermatitis avoid harmful workplace exposure at their first job? A prospective cohort study

Junxiang Wei¹ · Jessica Gerlich¹ · Christian Vogelberg² · Erika von Mutius³ · Doris Windstetter^{1,3} · Jon Genuneit⁴ · Gudrun Weinmayr⁴ · Dennis Nowak¹ · Katja Radon¹

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Abstract

Purpose Patients with atopic dermatitis (AD) are at high risk of chronic hand eczema. In this prospective cohort study, we assessed the influence of pre-hire-onset AD on the first job choice. We also analysed the potential association between AD and usage of preventive measures in high-risk occupations.

Methods Subjects (aged 19–24 years) who were followed from childhood until the second Study on Occupational Allergy Risks and indicated a job were included ($n = 1566$). We defined AD as doctor-diagnosed AD and symptoms of an itchy rash during the past 12 months before the study. Pre-hire-onset AD was having AD prior to the first job. Preventive measure usage was self-reported gloves use or use of ointment or moisturizer. We performed multiple imputations to deal with missing values and analysed

associations using logistic regression models adjusted for several potential confounders.

Results Risk categories of the first job did not differ between participants with pre-hire-onset AD and those without (odds ratio 1.05, 95 % confidence interval 0.59–1.87). AD status was not statistically significantly associated with usage of preventive measures (1.22, 0.56–2.64). Conversely, having received job counselling (2.76, 1.15–6.63) and a family history of AD (2.09, 1.01–4.31) were associated with a higher use of such measures.

Conclusion We could not confirm a healthy hire effect in this cohort of young adults. Although subjects with AD in high-risk occupations do not seem to use more preventive measures than their non-affected peers, job counselling seems to be an effective approach to encourage secondary prevention.

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✉ Jessica Gerlich
Jessica.Gerlich@med.lmu.de

Junxiang Wei
carolyn.wei@gmx.net

¹ Occupational and Environmental Epidemiology and Net Teaching Unit, Institute and Outpatient Clinic for Occupational, Social and Environmental Medicine, University Hospital of Munich (LMU), Munich, Germany

² Pediatric Department, University Hospital Carl Gustav Carus Dresden, TU Dresden, Dresden, Germany

³ Dr. v. Haunersches Kinderspital, University Hospital of Munich (LMU), Munich, Germany

⁴ Institute of Epidemiology and Medical Biometry, Ulm University, Ulm, Germany

Keywords Atopic dermatitis · Healthy hire effect · Longitudinal study · Preventive measure

Abbreviations

ISAAC	International Study of Asthma and Allergies in Childhood
SOLAR	Study on Occupational Allergy Risks
OR	Odds ratio
SES	Socio-economic status
AD	Atopic dermatitis
SPT	Skin prick test
AR	Allergic rhinitis

Background

Atopic dermatitis (AD) is a chronic dermatologic condition which generally presents in infancy and early childhood but

also occurs later in life with different clinical manifestations (Buggiani et al. 2008). It is one of the most common skin diseases in Western industrial countries and the estimated prevalence is 10–20 % for children and 1–3 % for adults (Wolter and Price 2014; Wüthrich et al. 2007). The investigation of the aetiology and pathogenesis of AD is ongoing, but the interplay between genetic, environmental, and social factors has been well recognized.

Compelling evidence has shown that subjects with a history of AD are at increased risk of chronic hand eczema (Bryld et al. 2003; Meding and Swanbeck 1990a; Mortz et al. 2001, 2014). Occupational exposures such as wet work might aggravate this risk. This frequently results in job changes or dropping out from the workforce in those affected (Meding and Swanbeck 1990b). Therefore, young adults with AD might avoid jobs with relevant workplace exposures resulting in the well-known healthy hire effect (Bregnhøj et al. 2011; Holm et al. 2006). However, one case–control study did not confirm such risk-avoiding behaviour (Nyren et al. 2005). To our knowledge, there is so far no such evidence from longitudinal studies either.

Few individuals with AD manage to work under untoward exposure without developing hand eczema (Coenraads and Diepgen 1998). One explanation could be that patients with AD are not subjected to skin problems if they use secondary preventive measures such as wearing gloves or applying certain hand moisturizers during work (Lee et al. 2013; Lysdal et al. 2012). Usually, pre-employment occupational counselling carried out by physicians or professional consultants is expected to be a proper way of offering suggestions when making a job selection. It would also be a good opportunity to encourage the implementation of preventive strategies (Bremberg and Andersson 1992; Saunders et al. 2003). Such job counselling is so far not regularly offered in Germany.

Childhood atopic eczema has been regarded as a well-established risk factor for hand eczema (Johannisson et al. 2013; Thyssen et al. 2010), but the influence of history of AD prior to entering the workforce on the first job is unknown. One of our preceding analyses based on the Study on Occupational Allergy Risks (SOLAR) indicated that AD was not associated with adolescents' job choices (Radon et al. 2006a). The present study (SOLAR II) followed this teenager cohort to early adulthood (aged 19–24 years), thus allowing us to assess the impact of AD on the choice of the first actual job they were holding. Therefore, the present study hypothesized that (1) there is an association between pre-hire-onset and the subsequent first job choice, taking into consideration respiratory symptoms at childhood, sensitization, and parental history of asthma and allergy as potential confounders and (2) subjects with AD working under hazardous workplace exposures are more likely to adopt preventive measures than those without AD,

taking into consideration sensitization and parental history of AD and allergic rhinitis as potential confounders.

Methods

Study population

The first and second Study on Occupational Allergy Risks (SOLAR I in 2002–2003, age 16–18 years and SOLAR II in 2007–2009, age 19–24 years) were two follow-up studies of the International Study of Asthma and Allergies in Childhood Phase II (ISAAC Phase II in 1995–1996, age 8–12 years) (Heinrich et al. 2011; Weiland et al. 1999, 2004). These follow-ups were designed to investigate the course of respiratory diseases and atopy from childhood over puberty to young adulthood, together with identifying environmental and occupational risk factors for the diseases under study. In summary, a total of 2051 young adults from Munich and Dresden (Germany) were followed until second follow-up (SOLAR II) and completed questionnaires comprising complete occupational history, pre-employment career counselling, working habits, educational level, and AD status (AD status at ISAAC Phase II was reported by their parents). Subjects also consented to the access to their data about history of AD, parental history of atopic diseases, and skin prick test (SPT) results. For the present analysis, data were restricted to participants who reported holding a job at either of the two follow-up studies. In a subset of participants who at the time of the study were vocational students and therefore were likely exposed for longer time periods, we conducted a sensitivity analysis to assess whether subjects with AD in high-risk jobs used preventive measures more frequently compared with participants not affected by AD.

Variable definitions

Exposure definitions

We defined AD as doctor diagnosis of AD and symptoms of an itchy rash that occurred for at least 6 months at any time during the last 12 months prior to each of the studies.

We considered any job as relevant for these analyses if the participant reported that it was held for at least 8 h per week for 1 month. Among all reported jobs, the chronologically first one meeting this criterion was considered the first job in the analyses. Pre-hire-onset AD was determined by AD status at baseline (ISAAC Phase II) if the subjects reported a relevant first job at the first follow-up (SOLAR I, AD presented in childhood) or by AD status at the first follow-up if the first job was reported at the second follow-up (SOLAR II, new onset AD in adolescence).

Job counselling was determined based on the question “Have you been advised before your career choice in terms of potential health risks for asthma and allergies?” (yes/no).

Potential confounders

The selection of the potential confounders was based on the previous literature and empirical knowledge. Parental history of asthma, allergic rhinitis, and atopic dermatitis, own asthma and allergic rhinitis, and sensitization in childhood indicate an atopic predisposition. These may have an influence on the subjects’ first job choice, so we considered them as potential confounders. Parental history of asthma, allergic rhinitis, and AD (yes/no) were obtained from participants’ parents when they filled out the questionnaire at baseline by the following questions: “Did the biological mother or father ever have asthma, hay fever, or atopic dermatitis?” Asthma and rhinitis symptoms of the participants in childhood (nasal symptoms such as sneezing or having a runny or blocked nose in the absence of infectious disease) were collected from parental-administered questionnaire by the questions: “Has your child had wheezing or whistling in the chest in the last 12 months?” and “Has your child had a problem with sneezing or a runny or blocked nose, or itchy-watery eyes but did not have a cold in the past 12 months?” Positive SPT response to either outdoor or indoor allergens at baseline was defined as presence of sensitization.

High socio-economic status (SES) was defined as at least one parent having ≥ 12 years of schooling. High educational level was defined as having qualified for university entrance. Smoking status at time of hire was defined as follows: never/irregular smoker was considered as smoking < 20 packs of cigarettes in a lifetime, or less than one cigarette per day or one cigar per week for a year; non-current smoker was considered as smoking at least 20 packs of cigarettes in a lifetime, or at least one cigarette per day or one cigar per week for a year but not having smoked within the last month; current smoker was defined equivalent to non-current smoker with the exception of having smoked in the last month.

Outcome definitions

Two previously trained coders coded all relevant jobs according to the International Standard Classification of Occupations (ISCO-88) (ILO 1988). In case of discrepancy between first and second coding, one of the authors (KR) re-evaluated the codes.

We classified job codes into high- or low-risk jobs. High-risk jobs were jobs considered to be of increased risk of hand eczema (i.e. nursing, healthcare assistance, bakery, cleaning, hairdresser, and gastronomy) based on the

preceding analysis on the same data set by Radon et al. (2006b). We defined all other jobs as low-risk jobs.

In order to define the use of secondary preventive measures, we considered the use of gloves (“Do you wear gloves when you are working?”) and the use of skin-protective products (“Do you use skin protection or skin care products (e.g., ointment, moisturizer)?”).

Data analysis and statistics

We used complete cases for descriptive analyses. Participants with no missing data on exposures, outcomes, and above-mentioned potential confounders were included in this descriptive sample. All predictors comprising the potential confounders and socio-demographic variables were tested for associations with high-risk job choice and secondary preventive measure usage either by Chi-square or by Mann–Whitney *U* test. We assumed missing values to be missing at random and the variables marked in Table 1 were multiply imputed using the Amelia II (version 1.7.2) package in R software (version 3.1.0; www.r-project.org) (Blankers et al. 2010). According to Little and Rubin (1987), relative efficiency of multiple imputation relies on the fraction of missing information and the number of imputation. Therefore, we multiply imputed 20 data sets based on the percentage of missing information of our data (25 %), taking recent recommendations into consideration (Graham et al. 2007). A comparison of complete cases and multiply-imputed data is provided in the supplementary material.

The statistical analysis was conducted within these imputations using the Zelig (version 4.2-1) package in R software (www.gking.harvard.edu/zelig). All predictors including variables of interest, asthma and allergy symptoms at baseline, sensitization, parental history of allergy, and socio-demographic variables were analysed in the univariate logistic regression models. Adjusted odds ratio and 95 % confidence intervals for associations between pre-hire-onset AD (predictor) and being exposed in high-risk jobs (outcome) were evaluated in the final multiple logistic regression model. Based on the hypotheses stated in this study, the final multivariate logistic regression model included the potential confounders as well as those socio-demographic variables that were statistically significant in the univariate regression analyses. An association between current AD status (yes/no) and secondary preventive measures usage among individuals who ever worked in a high-risk job was also assessed by multiple logistic regression analysis. Job counselling (yes/no) was included in all models to test its influence on the first job choice or the secondary preventive measures usage. The statistical significance level was set at $P < 0.05$ for the final multiple logistic regression models.

Table 1 Variables, categories, and percentage of missing

Variable	Category	% Missing ^b
Age at baseline (ISAAC Phase II) ^a	Range 9–11 years	0.4
Age at second follow-up (SOLAR II) ^a	Range 19–24 years	0
Sex	Male/female	0
Study location	Munich/Dresden	0
SES	High ^c /low	1.5
Educational level	High ^d /low	0.4
Smoking status at the time of hire	Never/irregular smoker/non-current smoker/current smoker ^e	1.1
Parental history of		
AD	Yes/no	10.0
Asthma	Yes/no	8.1
AR	Yes/no	8.7
AD at baseline (ISAAC Phase II)	Yes/no	3.2
AD at first follow-up (SOLAR I)	Yes/no	2.1
AD at second follow-up (SOLAR II)	Yes/no	1.4
Asthma symptoms at baseline (ISAAC Phase II)	Yes/no	0.6
Rhinitis symptoms at baseline (ISAAC Phase II)	Yes/no	1.4
SPT	Positive/negative	13.8
Received job counselling	Yes/no	0.2
Occupational exposure ^f	Yes/no	1.4
Glove usage	Yes/no	1.7
Moisturizer usage	Yes/no	0.1

ISAAC International Study of Asthma and Allergies in Childhood, SOLAR Study on Occupational Allergy Risks, AD atopic dermatitis, AR allergic rhinitis, SES socio-economic status, SPT skin prick test

^a Age was handled as a continuous variable

^b Variables with >0 % missing were imputed

^c High SES was defined as at least one parent having ≥ 12 years of schooling

^d High educational level was defined as having qualified for university entrance

^e Never/irregular smoker was deemed as having smoked <20 packs of cigarettes in a lifetime, or <1 cigarette per day or one cigar per week for a year; non-current smoker was deemed as having smoked ≥ 20 packs of cigarettes in a lifetime, or ≥ 1 cigarettes per day or one cigar per week for a year but not having smoked within the last month; current smoker was equivalent to non-current smoker but smoked in the last month

^f Just missing working hours per week were imputed to determine relevance of job; jobs lasting ≥ 4 weeks with ≥ 8 working hours a week were considered as relevant

Results

Among 1027 participants who had no missing information and indicated at least one relevant job, 128 (13 %) reported having pre-hire-onset AD and 25 % had a high-risk first job. Subjects with pre-hire-onset AD were statistically significantly more often from Dresden, were older at first follow-up, and had a higher SES than those without pre-hire-onset AD. Asthma and rhinitis symptoms at baseline were more common among subjects whose AD developed before their first job. There were also marked differences according to pre-existing AD before first job for parental history of allergic rhinitis and AD (Table 2). Among subjects with pre-hire-onset AD, 22 (20 %) reported having received job counselling related to asthma and allergies and this was statistically higher compared with those not affected by AD ($P_{\chi^2}^2 = 0.01$).

Results from the logistic regression analyses on the imputed data showed that among 1566 participants who had a relevant job, there was no statistically significant association between pre-hire-onset AD and high-risk exposure in the first job (OR 1.05, 95 % CI 0.59–1.87). Job counselling concerning atopic conditions was not associated with high-risk job choice either (0.88, 0.55–1.43). No difference in the first job choice was observed among participants in the presence or absence of childhood asthma or allergic symptoms or parental history of atopic diseases (Table 3).

Of subjects who reported ever having had a job, 621 (56 %) had ever worked in a high-risk job. Among those, 85 % reported using preventive measures. Those using such measures more often reported parental history of AD (19 vs. 10 %, $P_{\chi^2}^2 = 0.07$), but had a lower prevalence of a

Table 2 Description of demographic and health characteristics of the participants with complete data by atopic dermatitis (AD) status before first job ($n = 1027$)

	Total	Pre-hire-onset AD		P^2_{χ} value
		No	Yes	
Subjects (n)	1027	899	128	
	Mean (SD)			
Age at baseline (ISAAC Phase II) (years) ^a	9.6 $\pm$ 0.53	9.6 $\pm$ 0.53	9.6 $\pm$ 0.53	0.63*
Age at second follow-up (SOLAR II) (years) ^a	21.7 $\pm$ 0.74	21.7 $\pm$ 0.73	21.7 $\pm$ 0.77	0.77*
	N (%)			
Sex (female)	601 (58.5)	521 (58.0)	80 (62.5)	0.44
Study location (Munich)	491 (47.8)	441 (49.1)	50 (39.1)	0.03
SES (high) ^b	617 (60.1)	531 (59.1)	86 (67.2)	0.08
Educational level (high) ^c	680 (66.2)	592 (65.9)	88 (68.8)	0.58
Smoking status ^d at the time of hire				0.75
Never/irregular	615 (59.9)	541 (60.2)	74 (12.0)	
Non-current smoker	72 (7.0)	64 (7.1)	8 (11.1)	
Current smoker	340 (33.1)	294 (32.7)	46 (13.5)	
Parental history of				
AD	192 (18.7)	137 (15.2)	55 (43.0)	<0.001
Asthma	115 (11.2)	96 (10.7)	19 (14.8)	0.21
AR	372 (36.2)	302 (33.6)	70 (54.7)	<0.001
AD at baseline (ISAAC Phase II)	100			
AD at SOLAR I	118 (11.5)	20 (2.2)	98 (76.6)	
Asthma symptoms at baseline (ISAAC Phase II)	110 (10.7)	89 (9.9)	21 (16.4)	0.04
Rhinitis symptoms at baseline (ISAAC Phase II)	148 (14.4)	114 (12.7)	34 (26.6)	0.001
Positive SPT	252 (24.5)	194 (21.6)	55 (43.0)	<0.001
Received job counselling	108 (10.5)	86 (9.6)	22 (20.1)	0.01

AD atopic dermatitis, AR allergic rhinitis, SES socio-economic status, SPT skin prick test

* P value from Mann–Whitney U test

^a Age was handled as a continuous variable

^b High SES was defined as at least one parent having ≥ 12 years of schooling

^c High educational level was defined as having qualified for university entrance

^d Never/irregular smoker was deemed as having smoked <20 packs of cigarettes in a lifetime, or <1 cigarette per day or one cigar per week for a year; non-current smoker was deemed as having smoked ≥ 20 packs of cigarettes in a lifetime, or ≥ 1 cigarettes per day or one cigar per week for a year but not having smoked within the last month; current smoker was equivalent to non-current smoker but smoked in the last month

positive SPT than those not using such measures (17.0 vs. 26.0 %; $P^2_{\chi} = 0.06$) (Table 4).

Subjects with AD in high-risk jobs were as likely to use preventive measures as participants without AD (1.22, 0.56–2.64). Participants who received job counselling were more often using preventive measures than those who did not receive such advice (2.76, 1.15–6.63). Likewise, women (2.64, 1.67–4.17) and participants with a parental history of AD (2.09, 1.01–4.31) were more likely to use preventive measures (Table 5). The sensitivity analysis restricted to vocational trainees confirmed these estimates except for job counselling. Receiving job counselling was not statistically significantly associated with preventive

measure usage among vocational trainees (2.07, 0.69–7.79). The results are presented in the online supplementary material.

Discussion

The present study shows that young adults with pre-hire-onset AD did not behave differently from those without AD in terms of choosing their first job. Subjects with AD were not significantly more likely to use secondary preventive measures than healthy subjects when they were under high-risk exposures for hand eczema. Nevertheless,

Table 3 Associations between potential predictors and first job choice in a high-risk occupation from imputed data ($n = 1566$)

	High-risk jobs		
	Total	OR (95 % CI)	Multivariate OR ^a (95 % CI)
	Mean $\pm$ SD		
Age at second follow-up (SOLAR II) (years) ^b	21.8 $\pm$ 0.74	1.02 (0.82–1.26)	
	<i>N</i> (%)		
Sex (female)	921 (58.8)	1.03 (0.74–1.43)	
Study location (Munich)	753 (48.1)	0.92 (0.67–1.27)	0.92 (0.67–1.26)
SES (high) ^c	928 (59.3)	1.07 (0.78–1.46)	
Educational level (high) ^d	165 (24.3)	1.13 (0.84–1.52)	
Smoking status ^e at the time of hire			
Non-current smoker	108 (6.9)	1.01 (0.80–1.26)	
Current smoker	523 (33.4)	1.03 (0.67–1.58)	
Parental history of			
AD	320 (20.4)	0.93 (0.62–1.39)	0.92 (0.60–1.41)
AR	597 (38.1)	0.91 (0.65–1.28)	0.92 (0.63–1.34)
Asthma	182 (11.6)	1.02 (0.65–1.60)	1.08 (0.67–1.74)
Pre-hire-onset AD (yes)	207 (13.2)	1.01 (0.59–1.74)	1.06 (0.59–1.87)
Asthma symptoms at baseline (ISAAC Phase II)	23 (20.9)	1.05 (0.71–1.73)	1.12 (0.73–1.71)
Rhinitis symptoms at baseline (ISAAC Phase II)	177 (11.3)	0.89 (0.58–1.38)	0.90 (0.57–1.43)
Positive SPT	388 (24.8)	0.95 (0.67–1.36)	0.97 (0.67–1.41)
Received job counselling	159 (10.2)	0.89 (0.56–1.41)	0.87 (0.54–1.39)

AD atopic dermatitis, AR allergic rhinitis, OR odds ratio, CI confidence interval, SES socio-economic status, SPT skin prick test

^a Adjusted for parental history of AD, AR, and asthma; asthma and rhinitis symptoms at baseline; SPT status; study location; and job counselling

^b Age was handled as a continuous variable

^c High SES was defined as at least one parent having ≥ 12 years of schooling

^d High educational level was defined as having qualified for university entrance

^e Never/irregular smoker was deemed as having smoked <20 packs of cigarettes in a lifetime, or <1 cigarette per day or one cigar per week for a year; non-current smoker was deemed as having smoked ≥ 20 packs of cigarettes in a lifetime, or ≥ 1 cigarettes per day or one cigar per week for a year but not having smoked within the last month; current smoker was equivalent to non-current smoker but smoked in the last month. Never/irregular smoker was regarded as the reference category

pre-employment counselling seems to increase use of secondary preventive measures.

This prospective study followed subjects from childhood to the beginning of working life, thus allowing detection of the influence of AD before employment on the choice of the first job. Our results suggest that subjects with pre-hire-onset AD were not less likely to take high-risk jobs than those without before the first occupation. This is in accordance with a previous study showing that AD in childhood does not seem to influence the choice of job (Nyren et al. 2005), but the case–control design limits its interpretations. In contrast, another case–control study among Danish hairdressing apprentices showed that the reported lifetime and one-year prevalence of hand eczema and AD were lower in hairdressing apprentices than in a matched control group from the general population (Bregnhøj et al. 2011). They then concluded that these results indicate a healthy worker

effect. However, the hairdressing apprentices in this Danish study were already exposed working as hairdressers to some extent at the time of the study, so there was more likely a healthy worker survivor effect rather than a healthy hire effect. Our preceding study, which followed the participants from baseline until first follow-up (SOLAR I), found that vocational trainees with AD did not differ significantly in their preferred job choice from teenagers without AD (Radon et al. 2006a). The present analysis investigated the predictable effect of a history of AD before entering the workforce on the subsequent actual first job by means of extending the follow-up period of this cohort from adolescence to adulthood. The results show that there was no statistically significant association between pre-hire-onset AD and choice of their first job. On the basis of these results, we conclude that a healthy hire effect could not be confirmed in this cohort.

Table 4 Descriptive data on the study population by preventive measures in subjects who ever worked in a high-risk occupation

	Total	Preventive measures usage		P^2_{χ} value
		No	Yes	
Subjects (<i>n</i>)	621	96	525	
	Mean (SD)			
Age at baseline (ISAAC Phase II) (years) ^a	9.6 ± 0.54	9.7 ± 0.52	9.5 ± 0.55	0.05*
Age at second follow-up (SOLAR II) (years) ^a	21.8 ± 0.73	21.9 ± 0.74	21.7 ± 0.72	0.11*
	<i>N</i> (%)			
Sex (female)	424 (68.3)	47 (49.0)	377 (71.8)	<0.001
Study location (Munich)	281 (45.2)	44 (45.8)	237 (45.1)	0.99
SES (high) ^b	366 (58.9)	58 (60.4)	308 (58.7)	0.80
Educational level (high) ^c	385 (62.0)	62 (64.6)	323 (61.5)	0.69
Smoking status ^d at the time of hire				0.15
Never/irregular	287 (46.2)	43 (44.8)	244 (46.5)	
Non-current smoker	70 (11.3)	6 (6.3)	64 (12.2)	
Current smoker	257 (41.4)	46 (47.9)	211 (40.2)	
Parental history of				
AD	108 (17.4)	10 (10.4)	98 (18.7)	0.07
AR	229 (36.9)	30 (31.3)	199 (37.9)	0.22
AD status (yes)	76 (12.2)	8 (8.3)	68 (13.0)	0.29
Positive SPT	114 (18.4)	25 (26.0)	89 (17.0)	0.06
Received job counselling	84 (13.5)	6 (6.3)	78 (14.9)	0.03

AD atopic dermatitis, AR allergic rhinitis, SD standard deviation, SES socio-economic status, SPT skin prick test

* *P* value is Mann–Whitney *U* test

^a Age was handled as a continuous variable

^b High SES was defined as at least one parent having ≥12 years of schooling

^c High educational level was defined as having qualified for university entrance

^d Never/irregular smoker was deemed as having smoked <20 packs of cigarettes in a lifetime, or <1 cigarette per day or one cigar per week for a year; non-current smoker was deemed as having smoked ≥20 packs of cigarettes in a lifetime, or ≥1 cigarettes per day or one cigar per week for a year but not having smoked within the last month; current smoker was equivalent to non-current smoker but smoked in the last month

Studies have shown that a skin barrier dysfunction might be a key initiator of AD (Agrawal and Woodfolk 2014; Boguniewicz and Leung 2011; Leung 2013). Results from recent randomized controlled trials demonstrated that skin barrier enhancement such as emollient or moisturizer use in early life could be an effective approach for AD prevention (Horimukai et al. 2014; Simpson et al. 2014). In our study, 85 % of the subjects who ever worked in a high-risk occupation used preventive measures for the skin such as ointment or creams, or wearing gloves during work regardless of AD status. Women were more likely to use secondary preventive measures compared with men, which is intuitive as women are more careful with their health and prone to adopt some protection (Lysdal et al. 2012). Our findings also show that subjects with parental history of AD or receiving job counselling concerning their health status were twofold more likely to use preventive measures if they

were exposed to a hazardous working environment. The reason may be that family history of AD is a well-known risk factor for AD in the offspring, so those with AD family history who worked in high-risk occupations may have been more aware of their susceptibility. It might also be that subjects getting job counselling were more severe cases and that they complied very well with the warning from a physician or a counsellor regarding their health conditions.

In this study, subjects with pre-hire-onset of AD were more likely to obtain job counselling compared with those without ($P^2_{\chi} = 0.01$), but we observed no difference in the choice of their first job based on the status of the pre-employment AD. By contrast, studies with regard to respiratory health symptoms and job selection showed that young adults with respiratory symptoms intentionally seek jobs with lower risks of exposure that may be hazardous to respiratory health (Dumas et al. 2011; Olivieri et al.

Table 5 Univariate and multivariate associations between potential predictors and the use of preventive measures among subjects who ever worked in a high-risk occupation from imputed data ($n = 627$)

	Preventive measures usage		
	Mean $\pm$ SD	OR (95 % CI)	Multivariate OR (95 % CI) ^a
Age at baseline (ISAAC Phase II) ^b	9.6 $\pm$ 0.54	0.69 (0.46–1.02)	0.69 (0.46–1.05)
	<i>N</i> (%)		
Sex (female)	427 (68.1)	2.70 (1.73–4.19)	2.63 (1.66–4.15)
Centre (Munich)	284 (45.3)	0.95 (0.61–1.47)	
SES (high) ^c	373 (59.5)	0.94 (0.60–1.46)	
Educational level (high) ^d	389 (62.0)	0.86 (0.55–1.35)	
Smoking status ^e at the time of hire			
Non-current smoker	71 (11.3)	1.77 (0.72–4.35)	
Current smoker	263 (41.9)	0.80 (0.51–1.25)	
Parental history of			
AD	127 (20.3)	1.83 (0.92–3.63)	1.99 (0.96–4.11)
AR	252 (40.2)	1.37 (0.85–2.20)	1.35 (0.82–2.25)
Subjects with AD (yes)	80 (12.8)	1.42 (0.68–2.97)	1.18 (0.54–2.56)
Positive SPT	144 (23.0)	0.66 (0.41–1.09)	0.68 (0.40–1.16)
Received job counselling	84 (13.4)	2.63 (1.11–6.21)	2.78 (1.16–6.68)

AD atopic dermatitis, AR allergic rhinitis, OR odds ratio, CI confidence interval, SES socio-economic status, SPT skin prick test

^a Adjusted for parental history of AD and AR, SPT status, age at baseline, and job counselling

^b Age was handled as a continuous variable

^c High SES was defined as at least one parent having ≥ 12 years of schooling

^d High educational level was defined as having qualified for university entrance

^e Never/irregular smoker was deemed as having smoked < 20 packs of cigarettes in a lifetime, or < 1 cigarette per day or one cigar per week for a year; non-current smoker was deemed as having smoked ≥ 20 packs of cigarettes in a lifetime, or ≥ 1 cigarettes per day or one cigar per week for a year but not having smoked within the last month; current smoker was equivalent to non-current smoker but smoked in the last month. Never/irregular smoker was regarded as the reference category

2010). This discrepancy might reflect that the impact of AD on career choice has not gained as much attention by those who are susceptible to skin disease as that of respiratory diseases in the respiratory susceptible group or general population. A plausible reason could be that subjects with AD have not had evident skin symptoms such as hand eczema, and they might not have had the experience or be aware of the risk of harmful occupational exposure exacerbating their skin condition, while those with respiratory symptoms already have signs from the reaction organ and are aware of the hazardous allergens in certain jobs. The percentage of subjects having received job counselling in this analysis was low (10 %) and seems insufficient to guide adults to avoid choosing high-risk jobs, but it could also be due to a lack of adherence to the advice given by a physician or a job counsellor by the subject. Nevertheless, in this study, adults who had received job counselling in high-risk jobs used secondary preventive measures more often than those who did not receive job counselling, so career advice seems to be an effective measure to

encourage secondary prevention. In the analysis of preventive measure use among subjects with current AD who ever worked in high-risk jobs, current smokers seemed to be less likely to apply prevention compared with never/irregular or non-current smokers. This might be attributed to the fact that these subjects who were more aware of their health condition were more likely to not smoke or stop smoking and to adopt preventive measures during work than subjects who continued smoking.

Strengths and limitations

This prospective cohort study enabled us to gather the complete and detailed employment history of the study population, which made it possible to assess a potential healthy hire effect.

One limitation might be the measurement of pre-hire-onset AD. We based the status of pre-hire-onset AD (yes/no) either on AD status at baseline (ISAAC Phase II) if the first job was indicated at first follow-up (SOLAR I)

or on AD status at first follow-up (SOLAR I) if the first job was indicated at second follow-up (SOLAR II) by the participant. This method is a conservative approach since the exact timing of symptoms and the onset of AD were unknown.

With regard to the definition of high-risk jobs, knowledge about occupational hazardous exposures for AD is cumulating and the definition of high-risk jobs which was based on current known risk factors should also be updated over time. In this study, we confined preventive measure adoption to a common approach and defined it as glove use or ointment/moisturizer application at work based on questionnaire items. There might be a variation between the self-reported behaviour and the action in practice in certain types of jobs such as hairdresser. The reliability of this approach has not been evaluated yet, and validated standard questionnaire items need to be developed for the secondary preventive measure assessment in the future.

The first job choice occurs at the very beginning of the subjects' careers and might represent only temporary or short-term part-time jobs. Thus, subjects might not yet have taken into account their health status and the corresponding precautions with respect to health risks. In addition, the questionnaire item related to job counselling that we analysed in this research could be misleading as it is somehow confined to asthma and allergies. However, this question was the only available item concerning job counselling and job counselling was not the primary research question of this study. Further studies that specifically assess the association between job counselling on skin disorders and job choices or preventive measures use are needed.

Multiple imputations were used to deal with the missing values and the uncertainty associated with them. The underlying assumption behind this is that the data are missing at random which could not be tested for. However, this approach is a common practice in epidemiological studies (Blankers et al. 2010; Enders 2011).

Conclusion

In summary, we could not find a statistically significant influence of pre-employment AD on subsequent choice of first job. We did not observe a statistically significant association between current AD status and the adoption of secondary preventive measures while working in high-risk occupations. Occupational counselling seems to increase the use of preventive measures, but the extent of providing such occupational advice is still inadequate. The awareness for the importance of occupational counselling should be raised, and the compliance with this occupational advice should also be encouraged. Further studies from other

nations are warranted to verify the influence of pre-existing skin problems on the first job choice.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics approval Ethical Committees of the Medical Faculty of the University of Dresden and the Bavarian Chamber of Physicians.

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