ERJ Express. Published on May 30, 2007 as doi: 10.1183/09031936.00149206

First months of employment and new onset of rhinitis in adolescents

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Funding sources:

The study has been supported by the German Ministry for Economy and Labor, Elena Riu has been supported by a grant of the European Respiratory Society. None of the authors is involved in any organization with a direct financial interest in the subject of the manuscript.

[+]Stefan Weiland died since preparation of the paper.

Parts of this paper have been used for the medical thesis of Elena Riu.

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Running title: Rhinitis in new occupational exposure

Key words: Cohort; Rhinitis; Adolescence; Occupational Epidemiology; Europe

Word count abstract: 206 Word count main text: 2544

Abstract:

Aim: To investigate the incidence of rhinitis in adolescents taking into account duration and kind of employment in holiday and vocational jobs, and to study latency until development of symptoms.

Methods: Participants of the ISAAC-II study in Munich and Dresden enrolled in 1995 were re-contacted by a postal questionnaire in 2002 (age 16 to 18 years). This focused on allergic rhinitis (AR), kind and duration of all jobs, and potential confounders. All jobs hold for at least 8 hours/week and at least 1 month were coded and occupational exposure was assigned by a job-exposure matrix.

Results: Of the 3785 participants, 964 reported an employment history. The median duration of employment was 10 months (25^{th}; 75^{th} percentile: 1; 16 months). After adjusting for potential confounders, those working in high-risk occupations (OR 1.4; CI 1.0-2.1) had an increased risk for new onset of rhinitis, especially those exposed to low molecular weight agents (OR 1.78; 95% CI 1.1, 2.8). The incidence of rhinitis was the highest among those currently employed in a high-risk job for less than 10 months.

Conclusion:

Teenagers who start working in high-risk occupations have a higher incidence of rhinitis as compared to those not working. This increased risk might occur early on during employment.

Introduction

Work-related rhinitis and asthma are a leading cause of occupational diseases in industrialized countries. In the past years, international studies assessed the prevalence of atopic diseases in childhood (ISAAC phases I and II) (1) and in adults (ERCHS) (2). They showed high prevalences of allergic diseases worldwide, and they are the basis for current studies on aetiology and frequency of asthma and allergies. Most epidemiological studies on occupational allergies are cross-sectional (3). However, cross-sectional studies about occupational diseases in adult populations are thought to be highly affected by the healthy worker effect (4) and thus provide underestimates of the problem. There are only few longitudinal studies reporting incidence of AR, occupational asthma and other allergies. Up to date, results from general population studies were based on surveillance schemes and national disease registers. High risk workforce cohort studies comprise a few lately published studies among apprentices (5) (6) (7) (8) and newly hired workers (9), designed to reduce the selection biases in those cohorts. Both showed high incidences of work-related rhinitis and asthma, with very short latency periods, especially for rhinitis. Hellgren (10), for example, described an incidence rate of non-infectious-rhinitis related to occupational exposure of 13.5/1000 person-years in a random population. Rodier and Gautrin (5) studied 387 animal health apprentices starting exposure, and they found incident occupational rhinoconjunctivitis in 24% of them, with a tendency of early development of these symptoms.

To our knowledge, there are no prospective studies from the general population starting in childhood and studying adolescents who are at the start of their working life, and who are thus newly exposed to substances that might be responsible for the disease. This population of teenagers does still not suffer from “healthy worker survivor effect”, and allows a much better estimate of latency, incidence and natural history of work-related rhinitis.

The aim of our study was to investigate the incidence of rhinitis in German adolescents attributable to their occupational exposure, as well as to determine latency from the first

contact to an allergen/irritant to the development of symptoms in this group of teenagers at the beginning of their working life. This way, the role of a life-time history of holiday and other pre-vocational occupations and professional training jobs on respiratory health should be assessed.

Methods

Study population and follow-up questionnaire

The study population consisted of the participants of the second Phase of the International study of Asthma and Allergies in Childhood (ISAAC II) in Munich and Dresden, enrolled in 1995 and 1996 (age 9-11 years). Details of the study have been described elsewhere (11). Briefly, information on atopy and respiratory symptoms as well as potential risk factors were assessed by parental questionnaire, and clinical measurements were performed in parts of the population (skin prick test, specific and total IgE, spirometry, and BHR to NaCl).

For the follow-up study all subjects were traced 7 years after baseline, and 4.893 could be relocated (76.5%) using population registries of each community (figure 1). In 2002 a questionnaire was mailed to these participants (age 16 to 18 years), and 3.785 took part in the study (77% of the contacted teenagers) (figure 1).

The questionnaire included validated items on respiratory symptoms, work-related respiratory symptoms, socio-demographic characteristics and family history of asthma and allergies. Subjects were also asked about their occupational history, including jobs held during holidays and the professions that they were being trained for, as well as duration of employment in these jobs. In order to only include potentially relevant exposures, only jobs held for at least 1 month and at least 8 hours a week were included (12).

The questions of the follow-up questionnaire were mainly obtained from the International study of Asthma and Allergies in Childhood (ISAAC) (1) and the European Community Respiratory Health Survey (ECRHS) (2).

The data were entered into a MS ACCESS database, using double entry to minimise errors.

Job exposure matrix

The jobs given by the participants were double-coded by 2 trained coders according to the ISCO-88 code (13), and an individual expert re-evaluation step was done. Exposure to agents with potential asthma risk was evaluated using an asthma-specific job exposure matrix (JEM) (14), which allowed classifying the jobs into 3 main groups: ***non-exposed jobs***, ***low risk jobs*** (low level of exposure or low risk agents (chemicals, irritants, fumes and/or environmental tobacco smoke), and ***high risk jobs***. The latter were as well classified into 4 categories: *high molecular weight agents* (HMW: agents derived from animals, plants, arthropods or mites, biological enzymes, bio-aerosols, latex, flour), *low molecular weight agents* (LMW: sensitising chemicals, isocyanates, drugs, cleaning products, sensitising wood dusts and metals), *mixed environments* (agricultural environments, textile industry, metalworking fluids) and *very high level of irritants* (peak exposures).

Definition of variables considered in the analyses

The following job categories were considered as predictors:

1) Never worked at least 8 hours per week for at minimum one month (reference)
2) Always worked in non-risk jobs
3) Ever worked in low-risk jobs
4) Ever worked in high-risk jobs (exposed to HMW, LMW, mixed environments or peak exposures)

Subjects who indicated that they ever worked but did not specify any job they hold for at least 8 hours per week and a minimum of one month (n=1137) were excluded from the analyses (figure 1). Further analyses restricted only to subjects who "ever had a job for >8h/week and ≥ 1 month duration" had as reference group "no risk" when studying "risk of occupation" (Low risk/High risk) and "never worked with that exposure group" when studying exposure groups (HMW, LMW, mixed environments).

Finally, single professions at potentially higher risk for the development of respiratory symptoms were analysed. As subjects might have hold different jobs, the most recent job was considered relevant for these analyses.

The outcome was new onset of rhinitis during follow-up. The following definitions were used:

- **Rhinitis symptoms**: sneezing and runny or blocked nose without a cold or the flu in the last 12 months.

- **Doctors' diagnosed rhinitis**: Nasal allergies ever diagnosed by a doctor and sneezing and runny or blocked nose without a cold or the flu in the last 12 months.

These questions were extracted from the ISAAC questionnaire (questions 2 and 7 respectively).

Statistical methods

The data were analysed using multiple logistic regression models. The considered confounders were sex, place of living (Munich/Dresden), socio-economic status (defined as higher school degree of the parents: <12 years of schooling vs. >11 years of schooling), smoking (active smoking for at least one year) and regular exposure to environmental tobacco smoke (ETS). In addition, asthma and wheeze were considered as potential confounders. However, adjustment did not change the results. Age was not considered as a potential confounder as all subjects were within a limited age range (16-18 years). The participants without German nationality (n= 279) differed significantly in job choices and course of allergic diseases from the rest of the sample. Due to the fact that the group was too small for stratified analyses, and only four of them lived in Dresden, they had to be excluded from the analyses (15).

To investigate the potential influence of the duration of exposure by exposure group on the incidence of symptoms, both the duration of employment (in months employed) and the weekly working hours in the current job, were divided in quartiles. The first quartile was

considered as the reference group.

Results

Descriptive data

Overall, 58% of the participants reported that they ever had a job. Of them, 964 subjects (28%) specified at least one job that was hold for at least 8 hours per week and a minimum of one month duration (figure 1). Table 1 compares these teenagers to the 1391 subjects who never had any kind of job.

Working adolescents were less likely to have a higher SES compared to those without a job (46% vs. 57% respectively), were more likely to be from Dresden than from Munich (54% vs. 47%), to be smokers (47% vs. 26%) and to have regular ETS exposure (74% vs. 58%). They were more likely to be in vocational training than visiting high school compared to those who did not have a job (40% vs. 26%).

The incidence of symptoms of rhinitis (sneezing and runny or blocked nose without a cold or the flu in the last 12 months) was higher among those who already had a job as compared to non-working adolescents (37% vs. 32%) while the baseline prevalence of symptoms of rhinitis differed only slightly between the two groups (23 vs. 26%).

Subjects reporting symptoms or allergic rhinitis diagnosed by a doctor at baseline were excluded from the following analyses (fig 1).

New onset of rhinitis according to occupational exposure

Table 2 shows the results of the adjusted model for new onset of rhinitis during follow-up.

Teenagers working in high-risk occupations had significantly elevated incidence (OR 1.49; 95% CI 1.07, 2.07) of symptoms of rhinitis (Model 1).

Additionally, the incidence of symptoms in relation to each exposure group (low risk, HMW, LMW, mixed exposure) was analysed (Model 3). Those with exposure to LMW antigens had a significantly higher odds ratio for new onset of rhinitis (OR 1.78; 95% CI 1.14, 2.79). In

contrast, no increased odds ratios were seen for any occupational exposure and doctors' diagnosed rhinitis.

Effect of intensity and length of exposure:

The effect of hours worked per week and latency period (in months of exposure) for new onset of rhinitis symptoms was investigated stratified for subjects employed in **high risk jobs** (HMW, LMW mixed exposures or peak exposures), low risk jobs and jobs not considered exposed based on the job exposure matrix. No association between weekly working hours and new onset of symptoms was seen for none of the exposure groups. For those whose last job included exposure to high-risk agents the incidence was elevated during the first 16 months of employment with the highest incidence between the second to the ninth working month (OR 3.5; 95% CI 1.3, 9.8).

Repeating analyses with subgroups of participants exposed either to HMW agents, LMW agents or mixed exposures (Fig 3), we could confirm the results obtained in the high-risk exposure group, for those who worked with HMW agents. However, confidence intervals were wide due to low numbers.

Professions at risk for respiratory symptoms

In addition, single professions were analysed in comparison to adolescents working in office jobs, which were considered unexposed (Table 3). No significant associations were observed. Science technicians had a slightly higher risk for rhinitis symptoms (OR 2.1; 95% CI 0.9, 5.25) and doctor diagnosed rhinitis (OR 2.8; 95% CI 0.9, 8.8). In addition, there was a tendency for an increased odds ratio for symptoms of rhinitis among those involved in nursing, metal workers as well as construction workers.

Discussion

Rhinitis is a very common disease worldwide, with an increasing prevalence, nowadays especially in developing countries. Rhinitis is not usually a severe disease, but it can strongly affect social and working life of many patients (16). There is no standardized definition of occupational rhinitis in the literature, and multiple definitions are currently used (17) (18) (19, 20). Different estimates of the prevalence of the disease have been published, possibly due to the use of different diagnostic criteria, a high rate of underdiagnosis, and geographical and occupational variations.

Our results indicate that teenagers at the start of their working life who are involved in high risk jobs already have a higher risk for new onset of rhinitis (OR 1.49; 95% CI 1.07, 2.07), especially during the first months of employment (OR 3.5; 95% CI 1.3, 9.8 between the second to the ninth working month) as compared to teenagers not occupationally exposed in holiday jobs or vocational training.

Our study was done prospectively in a general population sample, and data on childhood exposure and respiratory diseases, including rhinitis, as well as data of a life-time job exposure, could be thoroughly investigated. It was possible to trace most of the subjects after 7 years, and we obtained a high response rate. Questionnaire instruments used at baseline and follow up have been validated against clinical measurements (1) (2).

The exposure to agents with potential risk for rhinitis was evaluated using an asthma-specific JEM. It has not yet been validated for rhinitis. This matrix is currently used in analyses of the European Community Respiratory Health Survey and was used in a recently published work by our group (21). Causative agents of rhinitis and asthma are very similar (22) and it was repeatedly reported than rhinitis often precedes the development of asthma symptoms in allergic patients (23). Therefore, we believe the JEM as an acceptable instrument to evaluate risk exposure for rhinitis.

According to our results, the first 9 months of employment seem to be crucial for the development of work-related rhinitis. The decreasing OR for new onset of rhinitis with longer duration of exposure might already indicate a healthy worker survivor bias (4). Thus, estimates of prevalence and incidence of rhinitis from cross-sectional studies or from longitudinal studies not taking lifetime job history into account may be strongly affected by selection bias and thus underestimate the problem. Repeating our analyses with subgroups of participants exposed to each of the high-risk groups (HMW agents, LMW agents or mixed environments), we could partly confirm the results, with the highest new onset of rhinitis in the first 9 months of employment in the HMW agents group.

Unfortunately, with our questionnaire it was not possible to assure the chronological order between occupational exposure and incidence of symptoms. Also for this reason, we had to use duration of exposure in the most recent job as proxy of duration of exposure.

We used a symptom-based definition of rhinitis as well as definition based on doctors' diagnosis. One might argue that it would also be worthwhile looking at nose and eye symptoms as symptoms-based definition of rhinoconjunctivitis. Forty eight percent of incident cases nasal symptoms of rhinitis also reported new onset of eye symptoms. All of the 156 new cases of doctors' diagnosed rhinitis reported nose and eye symptoms. Therefore, the following analyses were restricted to the least (rhinitis symptoms) and most (doctors' diagnosed rhinitis) specific definition of rhinitis.

We found that teenagers working in high-risk occupations had an increased risk for rhinitis symptoms but we did not find the same result when looking at doctors' diagnosed rhinitis. This could be due to the small number of cases in this group and thus a lack of statistical power. Little is known about use of health services in this population of working teenagers. It is possible that adolescents, who were already working and who were mostly from families with lower socio-economic status, were not visiting their general doctor for the diagnosis of rhinitis.

It would have been interesting to stratify our analyses according to asthma. However, only 18 of the participants with new onset of doctors' diagnosed rhinitis reported asthma. Therefore, the number was too low to perform stratified analyses.

In conclusion, this study indicates a higher risk for rhinitis in occupationally active adolescents compared to those not working. Even exposure in holiday jobs might thus be relevant for the development of rhinitis. Studies including a larger number of subjects are needed to better determine the incidence and course of work-related rhinitis.

Table 1: Characteristics of the subjects based on job history

		Never hold any job		Ever employed	
				>8 h/w and ≥1 month	
	N	n	%	n	%
N	2355	1391		964	28
Area Dresden	2355	648	47	519	54
Munich		743	53	445	46
Male	2355	666	48	453	47
High SES	2310	787	57	426	46
ETS	2337	799	58	708	74
Active smoking	2338	365	26	451	47
Actual activity	2347				
School		997	72	532	55
Vocational training		362	26	386	40
Other*		27	2	43	5
Occupational exposure**	2355				
Always worked in no risk jobs		-	-	465	48
Ever worked in low risk jobs but never worked in high jobs		-	-	214	22
Ever worked in high risk jobs		-	-	285	30
Baseline symptoms (1995/96)***					
Rhinitis symptoms	2283	308	23	243	26
Rhinitis symptoms and dr. diagnosed rhinitis	1862[#]	141	13	117	16
Wheezing	2281	132	10	121	13

Dr. diagnosed asthma	1830[#]	87	8	82	11
Incidence of symptoms (excluding those with baseline symptoms)					
Rhinitis symptoms	1732	330	32	253	37
Rhinitis symptoms and dr. diagnosed rhinitis	1604[#]	91	10	65	10
Wheezing	2028	139	11	151	19
Dr. diagnosed asthma	1661[#]	19	2	25	4

* Unemployed, family manager, looking for a job

** Low risk jobs: Low level of exposure or low risk agents (chemicals, irritants, fumes and/or environmental tobacco smoke); High risk jobs.: Exposure to high molecular weight agents, low molecular weight agents, mixed environments or very high level of irritants.

*** excluding those with missing information

[#] ،excluding subjects without diagnosis but with symptoms at baseline or follow-up

Table 2: Occupational exposure and new onset of rhinitis according to risk of occupation (Model 1 and 2) and to exposure group (Model 3). Odds Ratios with 95% confidence interval adjusted for centre, gender, SES, active and passive smoking and mutually adjusted for the other variables in the model.

	Rhinitis symptoms			**Dr. diagnosed rhinitis**		
Model 1	**N**	**OR**	**95% CI**	**N**	**OR**	**95% CI**
Never worked	1021	1		941	1	
No risk ever	326	1.14	0.87; 1.49	304	1.11	0.72; 1.74
Low risk ever*	152	1.01	0.69; 1.46	147	1.02	0.56; 1.88
High risk ever**	183	1.49	1.07; 2.07	167	1.18	0.68; 2.04
Model 2 (Restricted to subjects who ever had a job for >8h/week and ≥ 1 month duration)						
No risk ever	326	1		304	1	
Low risk ever*	152	1.02	0.66; 1.57	147	0.94	0.47; 1.90
High risk ever**	183	1.41	0.97; 2.07	167	1.08	0.70; 2.03
Model 3 (Restricted to subjects who ever had a job for >8h/week and ≥ 1 month duration)						
Never	326	1		304	1	
Low risk ever*	152	1.04	0.68; 1.60	147	1.02	0.51; 2.05
High risk ever:**						
HMW ever	86	1.13	0.68; 1.88	80	2.08	0.98; 4.41
LMW ever	103	1.78	1.14; 2.79	98	0.91	0.43; 1.97
Mixed ever	43	0.98	0.50; 1.95	38	0.69	0.22; 2.20

* Low risk jobs: Low level of exposure or low risk agents (chemicals, irritants, fumes and/or environmental tobacco smoke)

** High risk jobs: Exposure to high molecular weight agents (HMW), low molecular weight agents (LMW), mixed environments (mixed) or very high level of irritants

Table 3: Association between current job category and new onset of rhinitis. Odds Ratio with 95% confidence interval. Adjusted for center, gender, SES, smoking and ETS

Jobs	**N**	**Rhinitis symptoms**	**N**	**Dr. diagnosed Rhinitis**
Clerks, shop assistants, child care workers	283	1	253	1
Nurses	22	1.90 (0.78; 4.61)	23	1.27 (0.34; 4.70)
Science technicians	21	2.13 (0.86; 5.25)	22	2.84 (0.92; 8.75)
Health care assistants	38	1.15 (0.57; 2.33)	35	0.72 (0.20; 2.55)
Waiters, gastronomy	88	0.91 (0.53; 1.55)	80	0.65 (0.25; 1.68)
Farmers, florists, animal care	34	0.90 (0.42; 1.94)	30	0.54 (0.12; 2.41)
Hairdressers	5	-	4	-
Construction workers	29	2.22 (0.98; 5.06)	30	1.10 (0.28; 4.28)
Metal workers	29	1.76 (0.79; 3.93)	35	0.61 (0.13; 2.85)
Carpenters	8	-	10	-
Electricians	17	0.92 (0.31; 2.76)	16	1.23 (0.25; 6.07)
Bakers	11	1.16 (0.33; 4.13)	9	-
Cleaners	20	1.27 (0.50; 3.25)	15	0.52 (0.07; 4.24)
Others	56	1.11 (0.60; 2.05)	56	0.79 (0.28; 2.22)

Figure 1: Study population and subjects included in the analyses presented in Table 1-3

Target population (n)			**Participants of ISAAC II in Munich and Dresden N=6,399**	
Of these:	**No (Excluded)**		**Yes (Included)**	
Relocated	1,506		**4,893 (100%)**	
Questionnaire response	2,360		3,785 (77%)	
		No (Excluded)	**Yes (Included)**	
Of these:		**(Excluded)**	**(Included)**	
No German nationality		279 (7.4%)	3506 (92.7)	
Missing information on nationality		14 (0.4%)	3492 (92.3)	
			No (Excluded)	**Yes (Included)**
Of these:				
Never hold a job				1391 (39.8%)
Ever hold a job for ≤8 hours a week or < 1 month or missing information on intensity/ job			1137 (32.6%)	
Ever hold a job for >8 hours a week and ≥1 month duration				964 (27.6)
Study population				**2355**
			No (Excluded)	**Yes (Included)**
Of these:				
1) Included in analyses on rhinitis symptoms:				
1a) complete information on rhinitis symptoms, no baseline symptoms of rhinitis			623	1732

	1b)	Complete information on all of the potential confounders	50	**1682**
	1c)	Ever hold a job for >8 hours a week and ≥1 month duration	1021	**661**
	2) Included in analyses on doctor diagnosed allergic rhinitis:			
	2a)	Complete information on doctor diagnosed allergic rhinitis, no rhinitis symptoms and no doctor diagnosis at baseline, no symptoms of rhinitis without doctor diagnosis of allergic rhinitis	751	1604
	2b)	Complete information on all of the potential confounders	45	**1559**
	2c)	Ever hold a job for >8 hours a week and ≥1 month duration	941	**618**

Figure 2

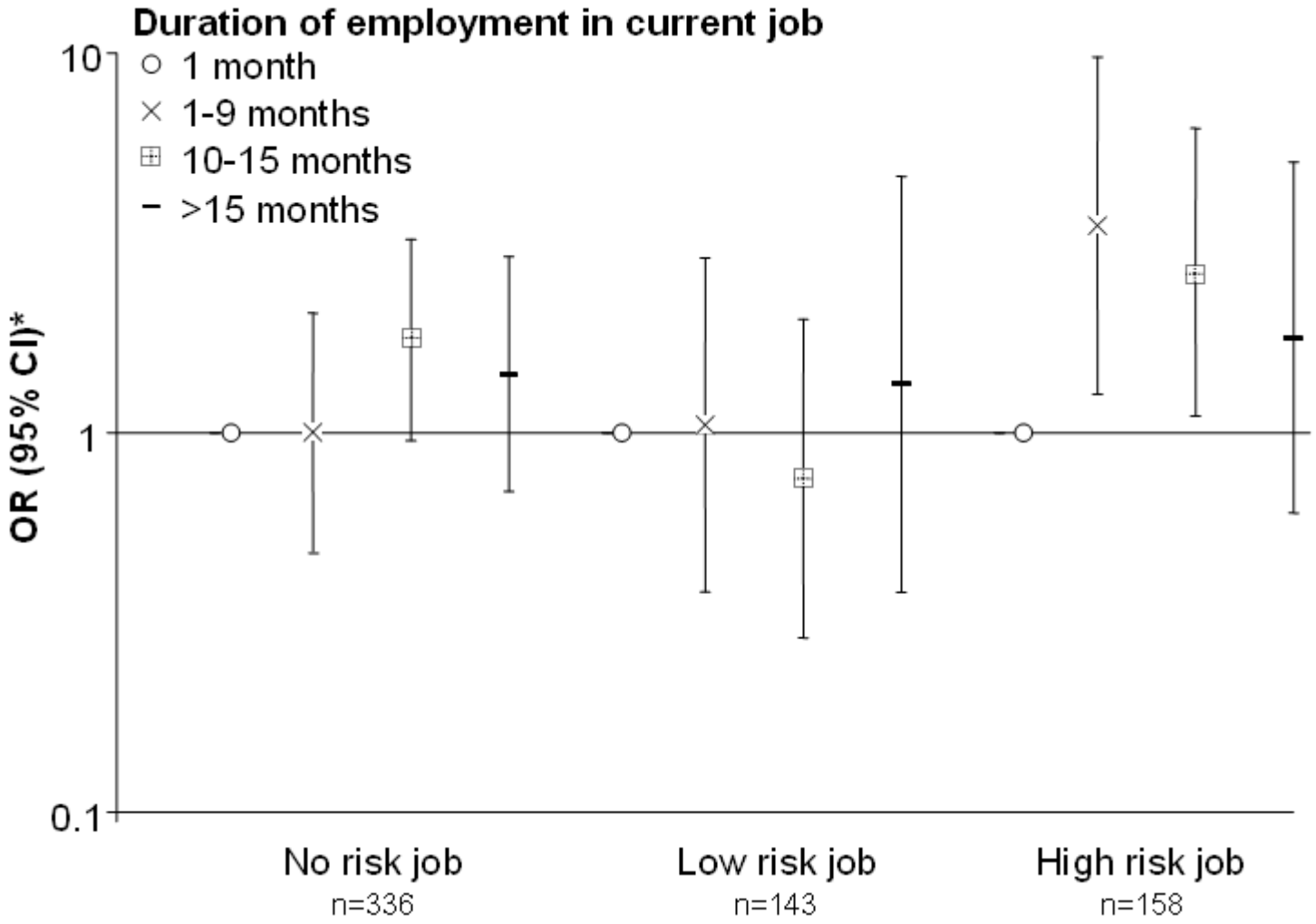
Duration of employment in current job
1 month
1-9 months
10-15 months
>15 months
OR (95% CI)*
10
1
0.1
No risk job
n=336
Low risk job
n=143
High risk job
n=158

Figure 3


Duration of employment in current job
1 month
1-9 months
10-15 months
>15 months
OR (95% CI)*
100
10
1
0.1
176
Mixed
n=34
LMW
n=85
HMW
n=72

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