Manual Handling of Heavy Loads and Low Back Pain: Results of the 2018 BIBB/BAuA Employment Survey

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Title

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Abstract

Background:

In Germany and other European countries, many occupations still involve manual handling of loads (MHL), an activity that puts the musculoskeletal system at risk of low back pain (LBP). This study aims to describe the frequency of MHL as well as the association between MHL and LBP.

Methods:

Data was collected in telephone interviews conducted as part of the 2018 BIBB/BAuA Employment Survey.The analyses have been limited to full-time workers (>35 h/week) aged between 15 and 67. The frequency of MHL has been analysed descriptively. The analysis of the association between MHL and the prevalence of LBP over the last 12 months is based on robust log-linear Poisson regression that results in prevalence ratios (PR). The main regression model has been adjusted for gender, age, working hours, and working conditions. Adjusted estimates for the prevalence of LBP were calculated based on regression analysis.

Results:

The sample consists of n = 14,249 subjects (61.5% men, 38.5% women, median age 49 years). Of these, 52.9 % say they are exposed to MHL at work. In the regression model, subjects who said they were “often” exposed to MHL reported more frequently LBP than those subjects who said they were “never” exposed to MHL (PR = 1.41 CI [1.32; 1.50]). Postestimation of the prevalence of LBP began with 47.1 % for subjects who said they were “never” exposed to MHL and rose to 66.4 % for subjects who indicated they were “often” exposed to MHL.

Conclusions:

The 2018 BIBB/BAuA Employment Survey emphasizes that MHL is still common in the German workforce and shows a significant association to LBP. Prevention policies for avoiding MHL remain vital.

Key words:

Manual handling of loads, low back pain, working conditions, BIBB/BAuA Employment Survey

Background

Manual handling of loads (MHL) is still a common physical workload at workplaces in Germany. According to the 2012 BIBB/BAuA Employment Survey, one fourth of employees said they “often” manually handled loads. Half of these respondents also said they suffered under this working condition. Strain occurs during the packing and unloading of containers as well as when transporting furniture or persons who are not able to walk [1]. The European Agency of Safety and Health at Work (EU-OSHA) reported a proportion of 32 % to 35 % of workers who carried or moved heavy loads for at least a quarter of their working time across the EU28 states between 2005 and 2015 [2]. To protect employees from its adverse health consequences, MHL should be avoided as far as possible [3].

MHL is well known to be a risk factor for back pain [4, 5], which causes a major share of health costs in Germany and is one of the main reasons for incapacity for work [6, 7]; it also negatively affects the quality of life and everyday activities [8-10]. In 2015, 3.2 % of total health-care- costs were caused by dorsopathies (ICD-10: M45 –M54) [6]. In 2017, back pain (ICD-10: M54) was the cause of 5.8 % of days of temporary incapacity for work [7]. There is evidence that further work-related, physical and climatic factors such as heavy physical work, awkward postures, slipping and falling or working in cold environments contribute to the multifactorial causes of back pain [5, 8, 11]. Furthermore, sitting and standing are thought to be associated with low back pain (LBP) [12-14]. Apart from these physical working exposures, psychosocial factors and working hours also affect the genesis of musculoskeletal disorders [5, 15-17]. Gender, age, anthropometric characteristics, socioeconomic status, and smoking are known other factors that influence back pain [4, 5, 8, 18].

Conducting risk assessments at the workplace is considered a basic step to derive and implement effective measures of primary prevention to reduce physical workload as a work-related risk factor of low back pain [19]. In a work-specific context, this strategy has also been embedded in German and European legislation [20, 21]. Even though digitalization and technologization are changing working environments, resulting in a decrease in physical workload, there are still professions in which physical strains are high [22].

It is important to use existing data to keep MHL under surveillance in Germany and to contribute by this to the surveillance in Europe. By determining the current prevalence of MHL in different professions, target-oriented primary prevention programs can be implemented. Reducing the prevalence of MHL – as a risk factor for low back pain- can help to reduce the prevalence of low back pain – one of the most expensive disorders - in workers with high physical demands.

This study aims to investigate the current prevalence of manual handling of heavy loads in in different occupational groups in Germany, the association between MHL and self-reported LBP, and adjusted prevalence of low back pain in the different respond categories of MHL, using the 2018 BIBB/BAuA Employment Survey conducted by the Federal Institute of Occupational Training (BIBB) and the Federal Institute for Occupational Safety and Health (BAuA) [24]

Subjects and Method

Subjects and Setting

The 2018 BIBB/BAuA Employment Survey [24] is an interview-based, cross-sectional study. The survey is conducted periodically every six years and aims at gathering information about the working conditions of the German workforce. The BAuA ethics committee approved the

study (EK007_2017 date d January 9, 2017). From August 2017 to April 2018, 20,012 employees were interviewed using a computer-assisted telephone questionnaire. To minimize selection bias a dual frame approach was implemented to enable interviewers to also contact persons who are only available via cell phone. This led to a sample that consists of 70% landline and 30% mobile network users. Subjects were included if they were 15 years of age and over, were gainfully employed for 10 hours per week or more and had an adequate command of the German language. Inclusion and exclusion criteria have been described in detail earlier [24]. Interviewers needed 40 minutes on average to complete the questionnaire in full. The main fields of the survey, which were assessed are information on the respondent's current occupation, working conditions, education, health status and job satisfaction. For study project no. F2456[1], conducted by the Federal Institute for Occupational Safety and Health (BAuA), the sample was restricted to full-time workers (>35 h/week) under the age of 67, resulting in a sample size of 14,414 subjects. The study employed complete case analysis; therefore, a total of 14,331 persons were included in the study to examine the prevalence of MHL and its association to LBP.

Operationalization

During the telephone interview, subjects were asked in German if they had experienced pain in their lower back in the last 12 months ("*Please tell me if you have had any of the following health problems during work or on working days in the past 12 months. We are interested in complaints that occurred frequently: Low back pain*" / author's translation from German).

[1] www.baua.de/DE/Aufgaben/Forschung/Forschungsprojekte/f2456.html

Possible answers were “yes” or “no”. The question had been designed specifically for and applied similarily in all previous BIBB/BAuA employment surveys.

To assess manual handling of heavy loads, subjects were asked how often they had to lift heavy loads (> 20 kg for men and > 10 kg for women). Subjects could answer “often”, “sometimes”, “rarely” or “never” to categorize how often they manually handled heavy loads. During the telephone interview, respondents were asked to answer questions on their gender (“male”, “female”), age (in years), actual weekly working hours, how often they stood, sat or worked in awkward postures (bending, kneeling, working overhead), climatic factors and psychosocial workload. The psychosocial index was operationalized as index (WL_{PSY}) from 0 to 100. The selection of items used in the index is comparable to the selection made by Kroll (2011) [25]. Three subcategories (psychological stress, social burden, temporal involvement) were calculated by adding up points assigned to the items according to the answers. The achieved score was divided by the maximum possible points for valid answers. For WL_{PSY} the sum of these scores was standardized based on the total amount of validly answered subcategories.

With the exception of awkward postures, working conditions were assessed in the same way as the manual handling of loads, using the categories “often”, “sometimes”, “rarely” and “never”. In the regression model, dummy variables were used to adjust for awkward postures. These were based on the questions regarding how often respondents worked in awkward postures (“often”, “sometimes”, “rarely” and “never”). Interviewers only asked for details on the specific type of posture (kneeling, working overhead, and working in bended postures) if subjects responded “often”. Futher information about the construction of the dummy variables is provided in Figure 1 in the additional material. A German system for classifying occupations, published by BLOSSFELD, was used to assess occupational groups. This

system divides occupations into 12 groups (agricultural occupations, unskilled manual occupations, skilled manual occupations, technicians, engineers, unskilled services, skilled services, semiprofessions, professions, unskilled commercial and administratorial occupations, skilled commercial and administratorial occupations, managers) [26].

Missing data

The dataset of the 2018 BIBB/BAuA Employment Survey is only missing a small proportion of data. For the relevant exposure variable, only 0.1% of information is missing, and only 0.4% of information on outcome variable LBP. A complete case analysis was therefore performed, on the assumption that the data was missing completely at random.

Data analysis

The statistical analysis was performed using SPSS 25 statistical software. Unadjusted prevalences of MHL were estimated based on the description of the data of 14,331 subjects. For gender-specific prevalences of MHL in different occupational groups, data was stratified separately for men and women based on the BLOSSFELD occupation code. Blockwise multivariate Poisson regression was performed with robust variance estimates. The main regression model was adjusted for gender, age, working hours, standing, sitting, awkward postures (bending, kneeling, working overhead), and climatic factors. Confounders of the further models are depicted in Table 1 in the additional material. Confounders considered in the regression models were selected based on an a priori review of the available evidence of relevant cause-effect relationships. The dependent variable was LBP. Prevalence ratios (PR) with 95% confidence intervals were estimated and rounded to two decimal places. Postestimations were done on the basis of the main regression model to derive adjusted

estimates of the prevalence of LBP, assuming that the cofactors are equally distributed. This leads to the assumption that the population exhibits an equally distributed proportion of men and women. Working hours were centered to 40 h/week and the index for WL_{PSY} to 38.9 points. The resulting prevalence was rounded to one decimal place.

Results

Study population

For the analysis of low back pain, 14,331 subjects were included from the total dataset of the 2018 BIBB/BAuA Employment Survey, of which 61.6% were male and 38.4% female, with a median age of 49. On average respondents worked 43.81 hours a week and indicated a psychosocial workload of 38.9 points. Of this population, 52.8% of subjects said they were exposed to manual handling of heavy loads at work and 17.5% said that they “often” manually handled loads during working hours. As to low back pain, 43.9% stated that they had experienced pain in their lower back in the last 12 months. Further characteristica are provided in Table 1.

(Insert Table 1 here)

Prevalence of manual handling of heavy loads in different occupational groups

Regarding the prevalence of manual handling of heavy loads in different occupational groups (as defined by BLOSSFELD (1985)), the analysis shows that 56.1% of men and 54.8% of women in the agricultural sector answered “often”. For men, this is followed by persons working in skilled manual occupations (44.6%), unskilled manual occupations (37.4%) and unskilled services (31.2%).

For women, the ranking continues with skilled manual occupations (39.9%), unskilled manual occupations (34.4%), semiprofessions (30.5%) and unskilled services (30.2%).

Women in semiprofessions answered “often” more frequently than men, with a total of 17.1 percentage points compared to 13.1% for men. Table 2 shows the prevalences of exposure in the categories “never”, “rarely” and “sometimes” gender, stratified by gender.

(Insert Table 2)

Association between manual handling of loads and low back pain

Table 3 shows the crude prevalence of low back pain as the outcome of interest, stratified by the self-reported frequency of manual handling of loads. The prevalence of low back pain increases from 36.0% in subjects who answered “never” to 65.9% in subjects who answered “often”. Furthermore, Table 3 shows the distribution of other confounders that had been considered, such as age, gender, working hours, current weekly working time and the psychosocial index, stratified by the MHL categories.

(Insert Table 3)

Unadjusted model

In the unadjusted model, the prevalence ratio for LBP is estimated at 1.83 (CI [1.76; 1.91]) for subjects who frequently handle heavy loads manually compared to subjects who never handle heavy loads (“never”). In the categories “rare” (1.38 CI [1.31; 1.46]) and “sometimes”

(1.12 CI [1.06; 1.18]) also reveal an association to manual handling of heavy loads compared to subjects indicating no manual handling of heavy loads (“never”).

Main Model

After adjusting for gender, age, actual weekly working hours, and further working conditions, including psychosocial workload, this relationship decreases, as can be seen in Table 4. Full results of the blockwise regression have been provided as additional material. Nevertheless, the positive association between the manual handling of heavy loads and LBP is revealed after adjusting for all selected confounders. The model-based, estimated prevalence of LBP increased with the frequency at which heavy loads were handled manually. Subjects who said that they “often” handled heavy loads manually reported 40.7% more disorders in the lower back (PR 1.41 CI [1.32; 1.50]) compared to subjects who said that they never handled loads manually (“never” MHL). Subjects who said they “sometimes” (PR 1.19 CI [1.12; 1.27]) or “rarely” (1.07 CI [1.01; 1.13]) handled loads manually also showed an increased prevalence of LBP compared to the reference group (“never” exposed to MHL). The frequency of working in awkward postures (bending (PR 1.19 CI [1.11; 1.27]), kneeling (PR 1.11 CI [1.04; 1.19]), sometimes working in awkward postures (PR 1.10 CI [1.03; 1.16]), being exposed to hard climatic factors (PR: 1.22 CI [1.15; 1.28]), and increased psychosocial workload (PR: 1.11 CI [1.08; 1.13]) are also positively associated with LBP in the main model. Furthermore, the results indicate that women (PR 1.21 CI [1.17; 1.26]) are at higher risk of low back pain. Sitting (PR 0.90 CI [0.85; 0.95]) during working hours and actual weekly working hours (PR 0.92 CI [0.90; 0.95]) show a negative association with LBP. Table 4 shows the adjusted prevalence ratios of the main model.

(Insert Figure 1 here)

(Insert Table 4 here)

Estimated prevalences of low back pain in the main model

The estimates of the prevalence of LBP based on the adjusted model (main model) increase with the frequency at which heavy loads are handled manually. 47.1% (CI [43.6%; 50.9%]) of subjects who said they never handle heavy loads manually ("never") indicated complaints in the low back. In the "rarely" category, this value increases to 50.3% (CI [46.7%; 54.1%]), and for subjects who answered that they "sometimes" handle loads manually it is estimated to be 56.1% (CI [52.2%; 60.4%]). For those who answered that they "often" lift heavy loads manually, the estimated percentage of persons who reported pain in their lower back rises to 66.4% (CI [62.2%; 70.8%]).

Discussion

The aim of the study was to determine the current prevalence of MHL in different occupational groups in Germany, the association between this physical strain and low back pain and to estimate adjusted prevalence of LPB in the respond categories of MHL.

The analysis of the German Employment Survey of the Working Population on Qualification and Working Conditions reveals that employees in the agricultural sector frequently handle loads manually ("often"), with a prevalence of over 50% for both men and women. Persons employed in skilled and unskilled manual occupations or unskilled services also indicate a high prevalence of manual handling of heavy loads. Women who work in semiprofessions are also often exposed to the manual handling of heavy loads at work, with 30.5% responding that they "often" manually handle heavy loads. Only 13.1% of men working in

these professions said they were “often” exposed to these activities at work. These results correspond to other studies on Germany’s working population [27, 28]. Furthermore, it is a well-known fact that manual handling of loads is a risk factor for musculoskeletal diseases in persons who work in the agricultural sector [29, 30].

The analysis of this survey underlines the well-known relationship between manual lifting or carrying of heavy loads and LBP [4, 5]. After adjusting for gender, age, actual weekly working hours and physical, climatic and psychosocial working conditions, the prevalence of LBP in employees who frequently handle heavy loads manually is 1.41 times higher than in employees who are not exposed to such activities. According to other studies, effect estimates vary between 1.5 and 3.1, depending on selected confounders [5]. Due to the subjective measurement of the exposition in this study, it is possible that the estimated effect is too low [5]. This may be a reason for the lower effect found in this analysis.

When the adjusted prevalence of LBP for workers who frequently handle heavy loads manually is compared to workers who don’t handle heavy loads, it is shown that 19.4 percentage points of LBP can be avoided by reducing manual handling of heavy loads. This underlines the hugh potential for primary prevention of MHL to reduce the prevalence of LBP in workers.

Compared to the unadjusted model the effect decreases with the adjustment for the selected covariables. According to the results of the blockwise regression, the main reason for the reduction seems to be the adjustment for physical and climatic working conditions (sitting, standing, awkward postures and climatic factors). The difference between the results of the unadjusted and adjusted model emphasizes the importance of adjustment, when analysing physical strains.

With the increasing frequency of MHL, the estimated prevalences of LBP rise from 47.1% for employees who responded that they do not handle heavy loads manually to 66.4 % for those who answered that they “often” handle heavy loads manually. It is already known that the frequency of MHL has an impact on the mechanical strain of the spine [5]. The results support this knowledge.

There are some limitations which should be considered. The data originated from a cross-sectional study and was collected via telephone. For this reason, there may be selection bias due to the respondents’ availability by phone and their willingness to participate (“self-selection bias”). Efforts were made to obtain the basic data of the non-responders by means of a short questionnaire, however, response rates were too low to allow a comparison of the groups. Interviews were conducted in German; this is why persons without an adequate command of the language have been excluded. Therefore, important data of a potentially vulnerable group of employees is missing.

All variables are based on self-reports of the subjects, which leads to an information bias due to memory failure and recall bias. With regard to the latter, it is known that persons with complaints tend to overestimate exposure; in other words, persons without complaints underreport exposure [31]. The resulting differential misclassification of the exposure status can lead to an overestimation of the effect [31]. Memory failure may also result in respondents underestimating the effect [31]. However, objective measurements cannot be obtained for the high number of subjects (n = 14,414) analysed in this study.

LBP was only assessed by asking if it occurred; how often the pain occurred and how intense it was remains unclear. In addition, the question on the assessment of climatic factors in particular is imprecise (see Operationalization). The index used for the operationalization of psychosocial workload is based on the calculation of a validated index. Secondary data was

used to investigate the research questions. The 2018 German Employment Survey of the Working Population on Qualification and Working Conditions does not provide all confounders that are considered important for the investigated research question. However, there may be overadjustment bias, as a high number of cofactors that were included as models were built based on knowledge obtained from the literature [32, 33].

When interpreting the results, it should be kept in mind that the data exclusively originated from employed persons, who tend to be healthier in comparison to the total population. This can lead to bias due to the healthy worker effect. Therefore, the results cannot be applied in full to the general situation in Germany.

Although this cross-sectional study has not revealed a causal relationship, the dataset represents the largest survey that considers the working conditions of the German working population with an absolute number of 20,012. Furthermore, the aim of the study was to derive prevalence of MHL in the work force in Germany.

Conclusion

It is still a common occurrence for the German work force to be exposed to the manual handling of heavy loads at work, even though this is already known to be a risk factor, particularly for the lower back [4, 5, 8]. The surveillance of physical strains remains important. According to the results of this study, avoiding this physical workload has huge potential to prevent pain in the lower back – especially in professions in the agricultural sector (i.e. farmers), unskilled manual occupations (i.e. construction helpers), skilled manual occupations (i.e. locksmiths) and in unskilled services (i.e. waiters) –and should furthermore be sustained.

List of abbreviations

EU-OSHA: European Agency of Safety and Health at Work

LPB: low back pain

MHL: manual handling of heavy loads

PR: prevalence ratio

WL_{PSY}: Index for psychosocial workload

Declarations

Ethics approval and consent to participate

The BAuA ethics committee approved the study (EK007_2017 date d January 9, 2017).

Consent for publication

Not applicable

Availability of data and materials

The dataset (number ZA7574) supporting the conclusions of this article is available as scientific-Use-File and can be requested at „BIBB – Bundesinstitut für BerufsbildungForschungsdatenzentrum“ (Postfach 201264; 53142 Bonn; Germany; fax number: +49 – (0)228 – 107 – 2020)). The dataset will be available as ftp-download after approved application.

Competing interests

The authors declare that they have no competing interests.

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The study is part of the F2456 project conducted by the Federal Institute for Occupational Safety and Health (BAuA) and focuses on physical occupational exposures and complaints of

the musculoskeletal system. Further information can be found online (www.baua.de/DE/Aufgaben/Forschung/Forschungsprojekte/f2456.html).

Authors' contributions

FL and MS did the conception of the work, FL and MS prepared the data for analysis, MS analysed the data, all authors worked on the interpretation of data, MS prepared the manuscript; JB, CM, FL reviewed the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1: Individual characteristics of the study population (N = 14,331, missings n = 0).

	Gender					
	Male		**Female**		**Total**	
	61.6% (n = 8828)		38.4% (n = 5503)		100% (n = 14331)	
Age in years						
• *Mean*	46.2		47.5		46.7	
• *SD*	11.3		10.9		11.2	
• *Median*	48		50		49	
Actual weekly working hours in h/week						
• *Mean*	44.8		42.3		43.8	
• *SD*	7.8		7.0		7.6	
• *Median*	42		40		40	
WL_{PSY}						
• *Mean*	39.1		38.5		38.9	
• *SD*	11.9		11.7		11.8	
• *Median*	37.7		37.2		37.4	
Manual lifting of heavy loads	**n**	**col%**	**n**	**col%**	**n**	**col%**
• *Never*	3884	44.0	2877	52.3	6761	47.2
• *Rarely*	2227	25.2	1033	18.8	3260	22.7
• *Sometimes*	1133	12.8	672	12.2	1805	12.6
• *Often*	1584	17.9	921	16.7	2505	17.5
Low back pain in the last 12 months						
• *Yes*	3613	40.9	2681	48.7	6294	43.9
• *No*	5215	59.1	2822	51.3	8037	56.1
Standing						
• *Never*	1081	12.2	885	16.1	1966	13.7
• *Rarely*	1983	22.5	1167	21.2	3150	22.0
• *Sometimes*	1782	20.2	1047	19.0	2829	19.7
• *Often*	3982	45.1	2404	43.7	6386	44.6
Sitting						
• *Never*	1168	13.2	821	14.9	1989	13.9
• *Rarely*	1037	11.7	536	9.7	1573	11.0
• *Sometimes*	999	11.3	598	10.9	1597	11.1
• *Often*	5624	63.7	3548	64.5	9172	64.0
Bending						
• *Yes*	781	8.8	468	8.5	1,249	8,7
• *No*	8047	91.2	5035	91.5	13082	91,3
Kneeing						
• *Yes*	7996	90.6	5063	92.0	13059	91.1
• *No*	832	9.4	440	8.0	1272	8.9
Working overhead						

• *Yes*	8274	93.7	5338	97.0	13612	95.0
• *No*	554	6.3	165	3.0	719	5.0
Sometimes working in awkward postures						
• *Yes*	1567	17.8	657	11.9	2224	15.5
• *No*	7261	82.2	4846	88.1	12107	84.5
Rarely working in awkward postures						
• *Yes*	1293	14.6	590	10.7	1883	13.1
• *No*	7535	85.4	4913	89.3	12448	86.9
Climatic factors						
• *Never*	4286	48.6	3611	65.6	7897	55.1
• *Rarely*	1301	14.7	594	10.8	1895	13.2
• *Sometimes*	1481	16.8	707	12.8	2188	15.3
• *Often*	1760	19.9	591	10.7	2351	16.4

Legend: SD: standard deviation, n: absolute number of subjects, col%: column percentage

Table 2: Manual handling of heavy loads in occupational groups (n = 14,331; missings n = 62)

	Self-reported frequency of manual handling of heavy loads (men > 20 kg and women > 10 kg)									
	Men (n = 8,828, missings n = 44)									
	Never		**Rarely**		**Sometimes**		**Often**		**Total**	
BLOSSFELD occupational group	*n*	*row%*	*n*	*row%*	*n*	*row%*	*n*	*row%*	*n*	*row%*
Agricultural occupations	8	4.3	20	10.7	54	28.9	105	56.1	187	100.0
Unskilled manual occupations	133	19.7	153	22.6	137	20.3	253	37.4	676	100.0
Skilled manual occupations	148	12.2	248	20.5	274	22.6	540	44.6	1,210	100.0
Technicians	228	36.5	249	39.8	92	14.7	56	9.0	625	100.0
Engineers	483	62.7	224	29.1	46	6.0	17	2.2	770	100.0
Unskilled services	202	23.3	223	25.7	172	19.8	271	31.2	868	100.0
Skilled services	211	38.5	143	26.1	85	15.5	109	19.9	548	100.0
Semiprofessions	280	48.9	164	28.6	54	9.4	75	13.1	573	100.0
Professions	330	61.9	149	28.0	37	6.9	17	3.2	533	100.0
Unskilled commercial and administratorial occupations	81	36.5	62	27.9	29	13.1	50	22.5	222	100.0
Skilled commercial and administratorial occupations	1063	67.6	356	22.6	94	6.0	60	3.8	1573	100.0
Managers	694	69.5	227	22.7	51	5.1	27	2.7	999	100.0

Total	3861	44.0	2218	25.3	1125	12.8	1580	18.0	8784	100.0
	Women (n = 5,503, missings = 18)									
	Never		**Rarely**		**Sometimes**		**Often**		**Total**	
BLOSSFELD's Job Category	*n*	*row%*	*n*	*row%*	*n*	*row%*	*n*	*row%*	*n*	*row%*
Agricultural occupations	7	11.3	5	8.1	16	25.8	34	54.8	62	100.0
Unskilled manual occupations	38	24.7	35	22.7	28	18.2	53	34.4	154	100.0
Skilled manual occupations	38	23.3	23	14.1	38	23.3	64	39.3	163	100.0
Technicians	96	49.7	53	27.5	20	10.4	24	12.4	193	100.0
Engineers	83	60.6	32	23.4	17	12.4	5	3.6	137	100.0
Unskilled services	59	26.6	45	20.3	51	23.0	67	30.2	222	100.0
Skilled services	221	47.7	99	21.4	64	13.8	79	17.1	463	100.0
Semiprofessions	488	34.2	264	18.5	239	16.8	435	30.5	1426	100.0
Professions	324	61.4	127	24.1	54	10.2	23	4.4	528	100.0
Unskilled commercial and administratorial occupations	114	41.6	55	20.1	36	13.1	69	25.2	274	100.0
Skilled commercial and administratorial occupations	989	74.3	211	15.9	76	5.7	55	4.1	1331	100.0
Managers	412	77.4	80	15.0	29	5.5	11	2.1	532	100.0
Total	2869	52.3	1,029	18.8	668	12.2	919	16.8	5485	100.0

Legend: n: absolute number of subjects, row%: row percentage.

Table 3: Manual handling of heavy loads stratified for important variables (n = 14,331; missings n = 0)

	Self-reported frequency of manual handling of loads (men > 20 kg and women > 10 kg)									
	Never		**Rarely**		**Sometimes**		**Often**		**Total**	
	n	*col%*	*n*	*col%*	*n*	*col%*	*n*	*col%*	*n*	*col%*
Low back pain in the last 12 months										
• *Yes*	2435	36.0	1311	40.2	897	49.7	1651	65.9	6294	43.9
• *No*	4326	64.0	1949	59.8	908	50.3	854	34.1	8037	56.1
Gender										
• *Male*	2877	42.6	1033	31.7	672	37.2	921	36.8	5503	38.4
• *Female*	3884	57.4	2227	68.3	1133	62.8	1584	63.2	8828	61.6
Age in years										
• *Mean*	47.24		47.06		45.55		45.33		46.65	
• *SD*	10.88		11.02		11.32		11.72		11.15	
• *Median*	49		49		48		48		49	
• *n*	6761		3260		1805		2505		14331	
Actual weekly working hours in hours per week										
• *Mean*	43.43		43.90		43.93		44.61		43.81	
• *SD*	6.79		7.66		8.57		8.71		7.60	
• *Median*	40		41		40		40		40	
Psychoscial Workload Index WL_{PSY} (0-100)										
• *Mean*	36.59		39.12		40.93		43.41		38.91	
• *SD*	10.83		11.52		12.13		13.02		11.84	
• *Median*	35.06		37.65		40.25		43.25		37.41	

Legend: SD: standard deviation, n: absolute number, col%: column percentage

Table 4: Adjusted prevalence ratios for low back pain in the last 12 months

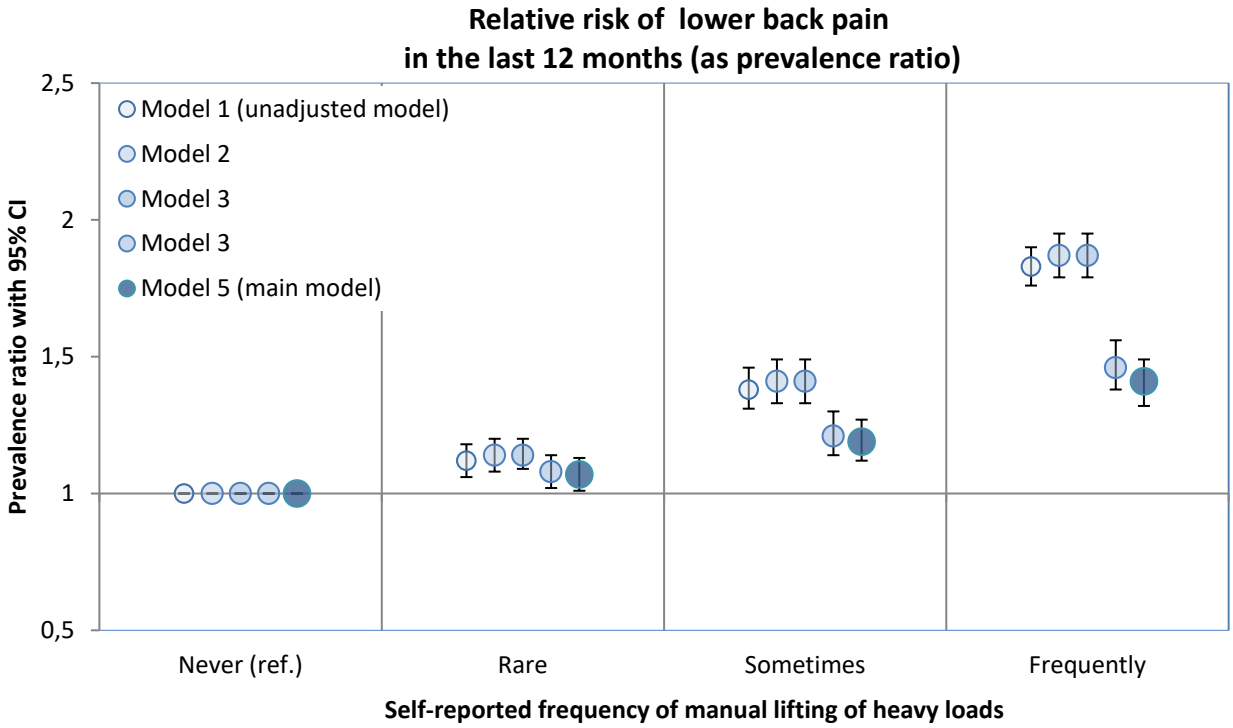
	Adjusted prevalence ratios for reported low back pain (PR (95% CI))
Manual handling of loads (exposure of interest)	
• *Often*	1.41 (1.32; 1.50)
• *Sometimes*	1.19 (1.12;1.27)
• *Rarely*	1.07 (1.01; 1.13)
• *Never (reference)*	1
Considered confounders	
Gender	
• *Women*	1.21 (1.17; 1.26)
• *Men (reference)*	1
Sitting	
• *Often*	0.90 (0.85; 0.95)
• *Sometimes*	0.83 (0.78; 0.89)
• *Rarely*	0.90 (0.85; 0.96)
• *Never (reference)*	1
Standing	
• *Often*	0.98 (0.91; 1.06)
• *Sometimes*	0.97 (0.90; 1.05)
• *Rarely*	1.01 (0.93; 1,08)
• *Never (reference)*	1
Bending	
• *Often*	1.19 (1.11; 1.27)
• *Not often (Reference)*	1
Kneeling	
• *Yes*	1.11 (1.04; 1.19)
• *No (reference)*	1
Working over head	
• *Yes*	0.98 (0.91; 1.05)
• *No (reference)*	1
Sometimes working in awkward postures	
• *Yes*	1.10 (1.03; 1.16)
• *No (reference)*	1
Rarely working in a awkward postures	
• *Yes*	1.01 (0.95; 1.07)
• *No (reference)*	1
Climatic factors	
• *Often*	1.22 (1.15; 1.28)
• *Sometimes*	1.14 (1.08; 1.20)
• *Rarely*	1.03 (0.97; 1.09)
• *Never (reference)*	1
Numeric parmaters	
• *Age (per 10 years)*	1.06 (1.04; 1.07)

• *Working hours (per 10 hours per week)*	0.92 (0.90; 0.95)
• *Psychosocial working conditions (per 10 points)*	1.11 (1.08; 1.13)

Legend: 95% CI: 95% confidence interval

Figures

Figure 1: Relative risk of low back pain in the respond-categories of manual handling of heavy loads



Additional material

File name	File format	Title of data	Decription of data
Additional table 1	Table (pdf)	Prevalence ratios of further models	Models used in the blockwise regression analyses and main results of the models regarding the relative risk of low back pain in the last 12 months stratified by the self-reported frequency of manual handling of heavy loads
Additional figure 1	Figure (pdf)	Construction of the dummy-variables	Flowchart of the construction of the dummy-variables for working in awkward postures used in the regression analyses

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Figures

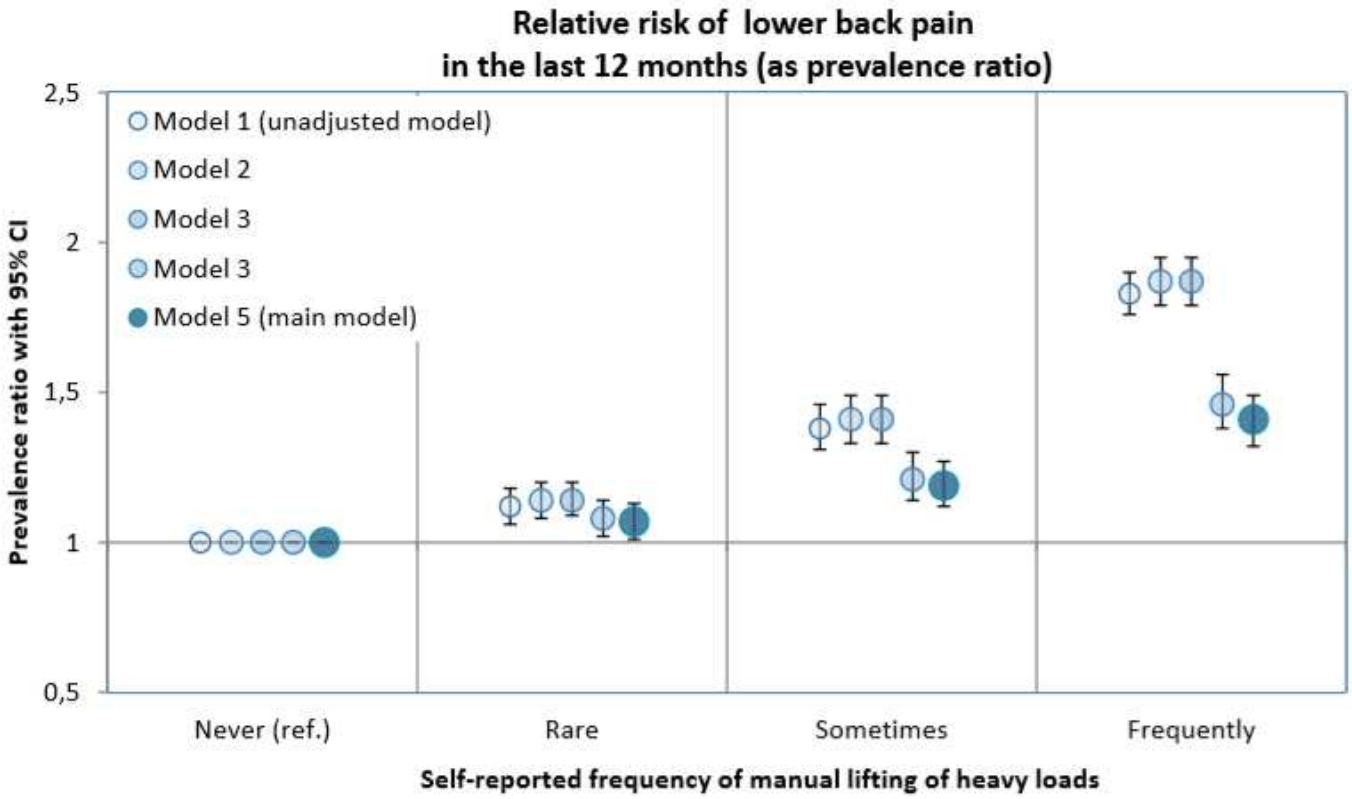

Figure 1

Relative risk of low back pain in the respond-categories of manual handling of heavy loads

Supplementary Files

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