

Original

Relationship between non-standard work arrangements and work-related accident absence in Belgium

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Abstract: Objectives: The main objective of this study is to examine the relationship between indicators of non-standard work arrangements, including precarious contract, long working hours, multiple jobs, shift work, and work-related accident absence, using a representative Belgian sample and considering several socio-demographic and work characteristics. **Methods:** This study was based on the data of the fifth European Working Conditions Survey (EWCS). For the analysis, the sample was restricted to 3343 respondents from Belgium who were all employed workers. The associations between non-standard work arrangements and work-related accident absence were studied with multivariate logistic regression modeling techniques while adjusting for several confounders. **Results:** During the last 12 months, about 11.7% of workers were absent from work because of work-related accident. A multivariate regression model showed an increased injury risk for those performing shift work (OR 1.546, 95% CI 1.074-2.224). The relationship between contract type and occupational injuries was not significant (OR 1.163, 95% CI 0.739-1.831). Furthermore, no statistically significant differences were observed for those performing long working hours (OR 1.217, 95% CI 0.638-2.321) and those performing multiple jobs (OR 1.361, 95% CI 0.827-2.240) in relation to work-related accident absence. Those who rated their

health as bad, low educated workers, workers from the construction sector, and those exposed to biomechanical exposure (BM) were more frequent victims of work-related accident absence. No significant gender difference was observed. **Conclusion:** Indicators of non-standard work arrangements under this study, except shift work, were not significantly associated with work-related accident absence. To reduce the burden of occupational injuries, not only risk reduction strategies and interventions are needed but also policy efforts are to be undertaken to limit shift work. In general, preventive measures and more training on the job are needed to ensure the safety and well-being of all workers.

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Key words: Long hours, Multiple jobs, Occupational injuries, Precarious contract, Shift work, Work-related accident absence

Introduction

Work accidents and injuries are a significant public health issue because of associated human, social, and economic losses¹. A work injury is defined as a bodily harm, irrespective of its intensity, resulting from an accident at work, usually followed by absence from work and for which the victim deserves compensation. Work accidents and injuries are known to be multifactorial: Both individual and work-related factors play an important role in their occurrence. With regard to individual factors, previous studies generally showed that accidents and work in-

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jury absence occur more often in males as well as in younger, less experienced, and less educated workers²⁻⁶. Accidents and injuries are more prominent in construction, agriculture, and manufacturing sectors^{7,8} as well as in small enterprises⁹.

Work-related factors that have been considered include a variety of physical and psychosocial working conditions. Several studies confirmed that dangerous work conditions, job stress, and high physical and mental workload were associated with work accidents and absence¹⁰⁻¹⁴.

In the last decade, legislators and employers in Europe became increasingly aware of the fact that not only improving the working conditions will have beneficial effects on workers' health and safety, but also that employment quality is important to increase well-being and productivity¹⁵. Employment quality refers to the wage, working hours, and other aspects of a mutual agreement with associated social protection systems and security. However, globalization of the labor market and the recent financial crisis have led to a shift from the traditional standard employment relationship to an increasing number of jobs with insecure contract type or non-standard working time arrangements¹⁶⁻¹⁸.

In this study, non-standard work arrangements refer to occupations that fall outside the field of standard work arrangements, including precarious work, long working hours, multiple jobs, and shift work.

In consequence, the fast growth of non-standard work arrangements in advanced countries highlights the importance of studying the influence of non-standard work arrangements indicators on employee's health and safety as well as on firms and labor market performance.

Therefore, the associations between several measures of non-standard work arrangements, such as precarious contracts, long working hours, multiple jobs, shift work, and several health and safety outcomes have become the subject of more recent studies. The adverse effects of precarious employment on health are already well documented. A majority of studies is showing a positive relationship between non-standard work arrangements and health problems, such as backache, muscular pains, high blood pressure, coronary heart disease, stroke, unhealthy behaviors, and even mortality¹⁹⁻²¹. In contrast, studies investigating the associations between measures of non-standard work and occupational accidents and injuries have revealed more inconsistent results.

Several research workers have conducted studies on the relationship between contract type, which is considered as one of the indicators of non-standard work arrangements, and occupational accidents or injuries. These studies generally result in conflicting results: Some research workers demonstrated a higher risk of accidents and injuries among precarious contract workers^{20,22}, while others showed a higher risk for permanent contract employees^{23,24}. These conflicting results may reflect differences

in the definition of precarious work because some authors consider only casual and temporary contracts²⁴, while others include fixed-term contract, home-based work, and self-employment^{23,25}.

Several studies addressing long working hours, which may be considered as another measure of non-standard work, demonstrate a positive association with occupational injuries^{8,26-28}. This finding was explained by the higher time pressure that those working long hours may perceive. Employees also experience more sleeping disorders and subsequent fatigue, which may lead to a higher rate of accidents and injuries²⁹.

Working in multiple jobs, a third indicator of non-standard work arrangements, implies working arrangements in which an employee is performing seasonal work concurrent or alternating with a primary job, working two consecutive shifts in separate jobs, possibly full or part time, working on an additional job on weekends, etc.³⁰. Studies investigating the effects of multiple jobs revealed that working in these types of arrangements is associated with an increased risk of occupational injuries^{8,30}. Lack of sleep, fatigue due to extra working hours, and additional physical and mental stress from alternating between different types of exposures, are some reasons that have been provided as an explanation for the higher risk of work injury^{26,27}.

At last, the associations between shift work and occupational injury have also been explored. Shift work is defined as a type of work schedule in which groups of workers are employed in schedules outside regular daytime hours but performing the same type of work³¹. Several studies demonstrated that shift work was positively and significantly related to work-related injuries as compared to regular daytime schedules³¹⁻³³.

In conclusion, some studies suggest that non-standard work arrangements are associated with a higher rate of occupational accidents and injuries. However, this relationship has rarely been explored in a large harmonized sample of the Belgian working population. Therefore, this study is the first that aims to examine the associations between contract type, long working hours, multiple jobs, shift work, and work-related accident absence, considering several demographic and work-related confounding factors, in a large dataset of Belgian employees.

Methods

Study population

This study was based on the data of the fifth European Working Conditions Survey (EWCS) conducted by Eurofound from January to June 2010 among 34 countries: EU27, Kosovo, Turkey, Croatia, Albania, Former Yugoslav Republic of Macedonia, Montenegro, and Norway. This periodical survey is considered as the main source of comparable data and uses face-to-face questionnaires at

participants' homes to gather information on working and employment conditions. A total of 43816 workers from 34 European countries was interviewed giving an overall response rate of 44%. Among these responders, 4001 Belgian workers were selected.

The data are freely accessible from the United Kingdom Data Archive (UKDA): Study number 6971 for research purposes. The EWCS follows the guidance provided in the European statistics code of practice. The external data quality assessment report documents how the EWCS subscribes to the principle of the American Association for Public Opinion Research (AAPOR) code of ethics. "In Belgium, the consent of an additional ethical commission for the secondary analysis that we conducted is not necessary as there is no respondents' confidentiality risk and neither a risk for abuse or misinterpretation of the original data."

Details on sampling design, methods, and questionnaire are available elsewhere³⁴. For this analysis, persons who were not employed, or were self-employed or with an apprenticeship were excluded, and the analytical sample was restricted to a subgroup of 3343 employees from Belgium.

Study questionnaire

Dependent variable: Occurrence of work-related accident absence

In Belgium, only accidents with at least one day of absence are included in the official statistics.

The outcome variable was evaluated by the following question in the EWCS: "Over the past 12 months, of the days of absence, can you indicate how many days were attributable to an accident or accidents at work?" Those responding zero days were considered as having no work accident, and those responding more than one day of absence were considered as having a work accident that resulted in an injury.

Independent variable: Indicators of non-standard work arrangements

Four independent variables were first separately and then simultaneously examined with regard to work-related accident absence.

The variable "contract type" was based on the answer to the following question: "What type of employment contract do you have?" Workers with a fixed term contract or temporary employment agency contract were defined as having a precarious contract as compared to those with a permanent contract.

Long working hours were defined as working 48 hours/week and more³⁵.

The variable "multiple jobs" was assessed by one question: "Besides your main paid job, do you have any other paid job(s)?" There were four possible response categories: "No other paid job," "regular," "occasional," and "other." Those who reported that they have regular, occa-

sional, and other paid jobs were categorized in the "yes" category and those with no other paid jobs in the "no" category.

Shift work was measured using the question, "Do you have shifts?," with the response options as "yes" and "no."

Covariates

Based on previous studies, several covariates were considered in the multivariate analysis to control potential confounding between precarious work, long working hours, multiple jobs, shift work, and the dependent variable. Considered covariates are gender, age in years, self-rated health, educational background, work experience, company size, economic activity, overall fatigue, sleep difficulties, risk information, and physical (PH), chemical (CH), biological (BL), and biomechanical (BM) exposures.

Self-rated health was assessed with the question, "How is your health in general?," with the response options as "very good," "good," "fair," "bad," and "very bad."

Furthermore, participants were asked about the highest level of education or training that they have successfully completed. Work experience included the number of working years evaluated by the following question: "How many years have you been in your company or organization?" The data included a question with regard to company size: "How many people in total work at your workplace?" The responses were categorized as "small": work alone, 2-4, 5-9; "medium": 10-49, 50-99; "large": 100-249, 250-499, and "very large": 500 and over. Economic activity of the company is coded according to the Statistical Classification of Economic Activities in the European Community, abbreviated as NACE. Overall fatigue was measured using the following question, "Over the past 12 months, did you suffer from overall fatigue?," with the response options as "yes" and "no." Sleep difficulties were assessed with the question, "Over the past 12 months, did you suffer from insomnia or general sleep difficulties?" Risk information variable was evaluated by the question, "With regard to health and safety risks related to the performance of your job, how well informed would you say you are?"

At last, job exposure variable included four types of exposures: (1) PH exposure, (2) BM exposure, (3) BL exposure, and (4) CH exposure. This is done in accordance with the categories defined by Niedhammer et al.³⁵.

We introduced binary variables expressing PH, CH, BL, and BM exposures. The answers are dichotomized at the median of PH, CH, BL, and BM. The Cronbach's alpha (internal consistency estimate of reliability of test scores) is 0.636 for PH, CH, and BM exposure measures (This is an acceptable result.).

Statistical analysis

First, descriptive statistics were computed for all variables and Chi-square tests were conducted to explore whether potential risk factors were univariately associated with the dependent variable, that is, work-related accident absence. At last, to investigate the relationship between non-standard work arrangements and work-related accident absence, multiple logistic regression modeling techniques were applied. A series of multivariate binary regression models were computed in two steps. First, four separate models (one for each work arrangement indicator) were fitted: (1) crude models were computed, (2) socio-demographic items (age (continuous), gender, self-rated health, and education) were entered. (3) work-related factors, such as work experience (continuous), company size, economic activity, overall fatigue, sleep difficulties, risk information, and PH, CH, BL, and BM exposures were entered in a third model. Second, all irregular work arrangements indicators were included simultaneously into a multivariate regression model. In all the analyses, adjustments were made for confounding variables irrespective of their univariate associations with the outcome. This was done to prevent the rejection of potentially important variables. Models were screened for multicollinearity between the independent variables according to the calculation of Variance of Inflation Factors, which revealed no problems. The data were processed and analyzed using SPSS version 21. All models were evaluated at the 0.05 significance level.

Results

Descriptives of the studied sample are presented in Table 1. A total of 3343 workers was included in the analyses. The study population consisted of 1769 males (52.9%) and 1574 females (47.1%). The average age was 39.42 years (± 10.91 SD) and 43.4% of the participants were highly educated. The majority of respondents (81.9%) rated their health as good. Workers who reported work-related accident absence during the past 12 months represented 11.7% of the sample. About 13.1% of the sample had a precarious contract, while 6.1% of the sample was working long hours. Almost 9.1% of the sample had multiple jobs and 15.6% of the workers reported shift work. A third (35.4%) of the workers suffered from overall fatigue and 21.4% from sleep difficulties.

The associations between the separate non-standard work indicator and work-related accident absence are presented in Table 2 (Step 1, with adjustment for covariates). An increased work-related accident absence was observed for those working shift works in the crude and adjusted models (OR 1.546, 95% CI 1.074-2.224). However, the relationship between contract type, those working long hours, and those having multiple jobs, and work-related accident was not significant in all three models (OR

1.163, 95% CI 0.739-1.831), (OR 1.217, 95% CI 0.638-2.321), and (OR 1.361, 95% CI 0.827-2.240), respectively.

Table 3 summarizes the Odds Ratios (ORs) and 95% Confidence Interval (95% CI) from the multivariate logistic regression analysis for those performing shift work. Shift work was significantly associated with work-related accident in the crude model (OR 1.811, 95% CI 1.331-2.463). In the second model, which adjusted for socio-demographic variables, shift work, gender, self-rated health, and education were significantly associated with work-related accident: (OR 1.611, 95% CI 1.167-2.225), (OR 0.756, 95% CI 0.577-0.991), (OR 2.226, 95% CI 1.656-2.992), and (OR 2.367, 95% CI 1.103-5.080), respectively. In the third model, which included work-related variables, shift work, self-rated health, and education remained positively associated with work-related accident ((OR 1.546, 95% CI 1.074-2.224, (OR 2.153, 95% CI 1.531-3.028), (OR 2.420, 95% CI 1.044-5.607), respectively). Furthermore, economic activity was significantly associated with work-related accident (OR 1.866, 95% CI 1.119-3.111). Among the exposure variables, work-related accident absence was associated only with BM exposure (OR 1.670, 95% CI 1.225-2.277).

Including all non-standard work factors simultaneously in a model with adjustments for covariates did not change the overall results.

Discussion

This study provides an overview of the associations between non-standard work arrangements and work-related accident absence in Belgian workers. In general, the results show that shift work was significantly associated with work-related accidents, which is in line with previous studies in this field²⁸.

A plausible methodological explanation for our finding that shift work may contribute to the high risk of work-related accidents is that shift work may disrupt the body's regular schedule and normal sleep styles, thereby leading to increased fatigue due to sleep disturbance. Sleepiness and fatigue at workplace can lead to work accidents, injuries, errors, fatalities, poor concentration, and absenteeism. For example, about one in three shift workers is affected by insomnia and up to 90% of shift workers report regular fatigue and sleepiness at workplace. Furthermore, shift work may cause lower levels of co-worker support and supervision during non-daytime work schedules. Another possibility to explain our results is that shift work can be more stressful mentally, physically, and emotionally and cause stress and lack of concentration^{36,37}.

In this study, we further investigated the reasons behind the susceptibility of shift workers toward work-related accidents. A positively significant correlation was found between shift work, job stress, work-life balance, and self-rated health. The correlation coefficients between

Table 1. Characteristics of the study population (n=3343)

Individual and work-related factors	Total study sample
Socio-demographic factors	
Gender: <i>n (%)</i> ^a	
Male	1769 (52.9)
Female	1574 (47.1)
Mean age/yr (SD)	39.42 (10.91)
Self-rated health: <i>n (%)</i> ^a	
Bad	606 (18.1)
Good	2735 (81.9)
Education level: <i>n (%)</i> ^a	
Primary level	80 (2.4)
Low secondary	446 (13.4)
High secondary	1361 (40.9)
Tertiary level	1444 (43.3)
Work-related factors	
Work-related accident absence: <i>n (%)</i> ^a	
No	1973 (88.3)
Yes	262 (11.7)
Yes: Mean/day (Min/Max)	24.69 (1/365)
Contract type: <i>n (%)</i> ^a	
Precarious contract	428 (13.1)
Permanent contract	2847 (86.9)
Long hours: <i>n (%)</i> ^a	
Long hours	202 (6.1)
Normal hours	3087 (93.9)
Multiple jobs: <i>n (%)</i> ^a	
No	3026 (90.9)
Yes	303 (9.1)
Shift work: <i>n (%)</i> ^a	
No	2815 (84.4)
Yes	520 (15.6)
Mean work experience/yr (SD)	9.69 (9.85)
Company size: <i>n (%)</i> ^a	
Small	813 (25.9)
Medium	1397 (44.5)
Large	556 (17.7)
Very large	370 (11.8)
Economic activity: <i>n (%)</i> ^a	
Construction	190 (5.9)
Mining, quarrying, manufacturing, electricity, gas and water	432 (13.3)
Agriculture, hunting, forestry and fishing	38 (1.2)
Services	2587 (79.6)
Overall fatigue: <i>n (%)</i> ^a	
No	2150 (64.6)
Yes	1179 (35.4)
Sleep difficulties: <i>n (%)</i> ^a	
No	2616 (78.6)
Yes	713 (21.4)

Table 1. Characteristics of the study population (n=3343) (continued)

Individual and work-related factors	Total study sample
Risk information: <i>n (%)</i> ^a	
Well informed	2796 (85.3)
Not well informed	482 (14.7)
Physical exposure (PH): <i>n (%)</i> ^a	
No	1357 (40.7)
Yes	1981 (59.3)
Chemical exposure (CH): <i>n (%)</i> ^a	
No	1872 (56.1)
Yes	1465 (43.9)
Biological exposure (BL): <i>n (%)</i> ^a	
No	2587 (77.9)
Yes	735 (22.1)
Biomechanical exposure (BM): <i>n (%)</i> ^a	
No	1447 (43.3)
Yes	1895 (56.7)

^a Calculated according to the percentage of the valid count.

Table 2. Results from the multivariate binary regression analysis for long hours, multiple jobs, precarious work and shift work separately in relation with work-related accident absence.

Non-standard work arrangement indicators	Model 1	Model 2	Model 3
Step 1	Crude OR [95% CI]	Adjusted OR [95% CI]	Adjusted OR [95% CI]
Contract type <i>Precarious Vs. permanent</i> ^a	1.049 [0.695-1.584]	0.952 [0.617-1.468]	1.163 [0.739-1.831]
Long hours <i>Long Vs. normal</i> ^a	0.924 [0.500-1.708]	1.113 [0.595-2.082]	1.217 [0.638-2.321]
Multiple jobs <i>Yes Vs. no</i> ^a	1.325 [0.861-2.037]	1.222 [0.771-1.937]	1.361 [0.827-2.240]
Shift work <i>Yes Vs. no</i> ^a	1.811 [1.331-2.463]	1.611 [1.167-2.225]	1.546 [1.074-2.224]

OR: Odds ratios, [95% CI]: 95% confidence interval.

Model 2: Adjusted for socio-demographic factors. Model 3: Adjusted, in addition, for all work-related factors.

Significant associations are in bold

^a Reference category

these covariates and shift work differ highly significantly from 0 as $p < 0.01$ in all cases. Therefore, workers with shift work are also workers who struggle more with the work-life balance and have more stress due to their job. Moreover, workers with shift work evaluate their health as poor. All these expressions of not feeling well can lead to work-related accidents and injuries.

However, with regard to contract type, no difference was observed between precarious and permanent workers in terms of work-related accident absence. This is in accordance with some previous studies in this field^{23,24} but contradicts other studies^{20,22}. A possible explanation for the inconsistent results in the study with regard to con-

tract type may be that the group of workers with a precarious contract consists of a rather heterogeneous population. Some authors solely consider casual and temporary employment (including agencies leasing workers) as precarious, whereas²⁴ others include self-employment and home-based work as well^{23,25}. Our sample consisted of only two categories of precarious workers: Fixed-term and temporary employment contract, which may have influenced the results. Another possible explanation is that workers in a precarious work arrangement may be hesitant to report injuries and accidents to increase their chances of obtaining a permanent contract and more job security. An additional reason can be the voluntary aspect

Table 3. Odds ratios OR and 95% confidence intervals [95% CI] for work-related accident absence from multivariate logistic regression model with non shift workers as reference group.

Variables	Work-related accident absence
<i>Model 1</i>	<i>Crude OR [95%CI]</i>
Shift work (Yes vs. no ^c)	1.811 [1.331-2.463]*
<i>Model 2</i>	<i>Adjusted OR [95%CI]</i>
Shift work (Yes vs. no ^c)	1.611 [1.167-2.225]*
Gender (Men Vs. women ^c)	0.756 [0.577-0.991]*
Age (Continuous)	1.005 [0.992-1.017]
Self-rated health (Bad Vs. good ^c)	2.226 [1.656-2.992]*
Education (Low Vs. high ^c)	2.367 [1.103-5.080]*
<i>Model 3</i>	<i>Adjusted OR [95%CI]</i>
Shift work (Yes Vs. no ^c)	1.546 [1.074-2.224]*
Gender (Men Vs. women ^c)	0.752 [0.561-1.007]
Age (Continuous)	1.014 [0.996-1.032]
Self-rated health (Bad Vs. good ^c)	2.153 [1.531-3.028]*
Education (Low Vs. high ^c)	2.420 [1.044-5.607]*
Work experience (Continuous)	0.986 [0.966-1.006]
Company size (Small Vs. large ^c)	0.739 [0.442-1.236]
Economic activity (Construction Vs. services ^c)	1.866 [1.119-3.111]*
Overall fatigue (Yes Vs. no ^c)	1.263 [0.905-1.763]
Sleep difficulties (Yes Vs. no ^c)	0.896 [0.614-1.308]
Risk information (Not well informed Vs. well informed ^c)	1.194 [0.799-1.784]
Physical exposure (PH) (Yes Vs. no ^c)	0.748 [0.535-1.045]
Chemical exposure (CH) (Yes Vs. no ^c)	1.211 [0.857-1.711]
Biological exposure (BL) (Yes Vs. no ^c)	0.693 [0.463-1.037]
Biomechanical exposure (BM) (Yes Vs. no ^c)	1.670 [1.225-2.277]*

Model 2: Adjusted for socio-demographic factors.

Model 3: Adjusted for socio-demographic factors and, in addition, for all work-related factors.

^c Reference category

The proportion of the explained variance of the multivariate model is 10.7% $R^2=0.107$ (Nagelkerke R Square) for work-related accident absence.

of choosing a contract type of which we do not have information in the EWCS. It is possible that for several reasons, some persons (in particular females) have freely chosen this type of contract while others are in an undesirable precarious employment.

Our results with regard to the two other indicators of non-standard work arrangements, “long working hours and multiple jobs” did not confirm the findings of previous studies that determined an excess risk of occupational injuries among workers with these employment conditions^(26,27,29,30,38). Most likely, due to the less number of precarious workers, those performing long hours, and those performing multiple jobs in this study, the results were not significant. Therefore, these data are not shown. For example if n is the size of the total population that is used in the analysis, a factor k that is required to have significant ORs was calculated. This means that at least $k*n$ participants are required to have 95% C.I. where the value 1 is not part of the same proportions and the same value for the estimation of ORs. The calculated values for k were all greater than 1 for the three aforementioned indicators, indicating that the sample size is quite small to have significant results with the current data. Therefore, in case of working long hours as a predictor, a sample of at least $k*n$ with $k > 60.36$ for model 1 ($k > 34.22$ for model 2 and $k > 10.81$ for model 3) is required to have significant ORs with $\alpha=0.05$.

Although this study adds evidence to the existing knowledge about work-related accident, there are several limitations that should be considered when interpreting the results. One possible shortcoming is that due to the cross-sectional nature of this study, an association between two variables can be established, but it is not possible to determine the causality of this relationship. It is necessary to conduct studies on the association of specific job contents of shift work with occupational accidents. However, this information about specific job contents of shift work (Workload, stress-related job contents, accident risks at work, etc.) is lacking in this study. In addition, the results are based on self-reports and the respondents were only asked whether they were absent due to a work-related accident. They were neither questioned about the total number of accidents that they had encountered during the previous year nor about the cause and severity of the accident. A reporting bias may be suspected related to common method variance. However, it should be noted that the questions are formulated in a general manner and are not specifically asking about the relationship between non-standard work arrangements and work-related accident. Therefore, we assume that the common method variance bias may be limited.

Nevertheless, some particular strengths of this study should be mentioned. This study was based on a large harmonized sample size of the Belgian working population. All responses were collected by face-to-face ques-

tionnaires at participants' homes and the response rate was relatively high for such a large survey (44%). Furthermore, the fifth EWCS survey has been used in many published studies and the findings could promote workers' health and safety^(39,40). At last, several confounders (important factors in the context of work accidents) were included in the study.

Conclusion

Despite methodological considerations, the results of this study have important implications for workers, employers, and policy makers. To promote health and safety, more attention should be paid in particular to those performing shift work. At the individual and organizational levels, we recommend the implementation of more safety measures and educational programs that aim at improving awareness about the deleterious effects of shift work. At the policy level, Belgian strategies should continue to emphasize on the importance of the development of more and better jobs.

In conclusion, the increasing number of non-standard work arrangements becomes a serious threat to the safety and health of workers. One indicator investigated in this study, such as shift work, was significantly associated with work-related accident absence. These findings could be used as an important element in creating and implementing health and safety policies at the Belgian and international levels.

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