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The clustering of health-related occupational stressors among contemporary wage-earners

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In this study, it is investigated whether a typology can be imposed upon a sample of wage-earners, based on their exposure to a broad number of occupational stressors: quantitative, emotional, and physical demands, repetitive movements, atypical schedules, low job control, relationships with superiors, job insecurity, and bullying behaviour. Also associations between this typology and measures of emotional problems (EP) and musculoskeletal complaints (MC) are tested. Logistic regression and a latent class cluster analysis are performed on a representative sample of 10,074 Flemish (Belgian) employees. Five clusters are revealed: ''low stress'', ''high stress'', ''manual-passive'', ''human contact'', and ''high demand''. These clusters are showing a clear socioeconomic distribution and distinct associations with EP and MC—with the ''high stress cluster'' being the most problematic. Health-damaging occupational stress clusters are prevalent at both higher and lower socioeconomic positions. This is suggesting a complex relationship between occupational stressors and socioeconomic health variations.

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In the past 40 years the content of work in Western societies has shifted from the "ideal type" of predominantly routine manual labour and its organization in a bureaucratic industrial labour process, towards the flexible combination of skills in problem-identifying and problem-solving processes for the production of material and immaterial goods and services (Ackerman, Goodwin, Dougherty, & Gallagher, 1998). This has resulted in the emergence of new health-related *nonmaterial occupational stressors* (Siegrist & Theorell, 2006). Another important aspect of change is situated in the *employment relationship*: The postwar *psychological contract* of "standard and relatively permanent employment for work well done" has become increasingly blurred (Cooper, 2002). Instead, nowadays employment relations are increasingly characterized by uncertainty, as a consequence of short-term contracts and threatened job security, flexible work hours, limited social protection, etc. (Benach & Muntaner, 2007; Cooper, 2002). For most of these *new* occupational stressors, the effects on health and well-being are well documented, but their structuring within the population often remains unclear. The principal aim of this article is to present a typology of wage-earners according to their exposure to a broad set of health-related occupational stressors and, subsequently, to test associations of this typology with outcomes of emotional problems and musculoskeletal complaints.

In reacting to the developments described, occupational health research has expanded its scope beyond the traditional physical exposures towards these new nonmaterial work characteristics (Janssen, de Jonge, & Bakker, 1999). Probably the most important contribution comes from occupational stress models, such as the Demand–Control Model (DC Model; Karasek, 1979), which are catching the psychosocial work environment in a number of "stress dimensions". In the DC Model it is assumed that high demands of work and low control over the work environment have negative consequences for job performance, mental well-being, and various physical health outcomes (Rydstedt, Devereux, & Sverke, 2007). Later on, studies inspired by the DC framework have introduced additional stressors. Social relationships with co-workers and supervisors are the best-established addition (Johnson & Hall, 1994). In addition, other (contemporary) stressors have been added to the models: physical and emotional demands, atypical work schedules, job insecurity, etc. For most of these stressors associations with the considered outcomes have been found previously. Low social support is associated with higher frequencies of mental health problems and musculoskeletal complaints

(Vanroelen, Levecque, & Louckx, 2009a), and exposure to bullying behaviour and emotional demands are related to indicators of mental health problems (Rydstedt et al., 2007). General physical demands show clear associations with musculoskeletal complaints (Leroux, Dionne, Bourbonnais, & Brisson, 2005) and mixed results for mental health complaints (de Croon, Blonk, de Zwart, Frings-Dresen, & Broersen, 2002; Laaksonen, Rahkonen, Martikainen, & Lahelma, 2006). Stressors related to flexible and atypical employment relationships, such as excessive hours of work (Sekine, Chandola, Martikainen, Marmot, & Kagamimor, 2006), nonstandard schedules (Bildt & Michelsen, 2002), and job insecurity (Mauno, Kinnunen, Makikangas, & Natti, 2005) are also related with mental health complaints. Musculoskeletal complaints are higher in workers engaged in nonstandard schedules (Trinkoff, Le, Geiger-Brown, Lipscomb, & Lang, 2006) or experiencing job insecurity (Cole, Ibrahim, Shannon, Scott, & Eyles, 2001).

In reality, however, mental and physical distress is determined by complex patterns of exposure to various stressors (Benach, Muntaner, Benavides, Amable, & Jodar, 2002). Nevertheless, occupational stressors extending the traditional accounts of demand and control are often analysed as ''single risk factors'', without considering their structuring in the population. Indeed, some occupational stress research has adopted a more ''structural approach'' by rearranging a broader number of job stressors into *dimensions*. For instance, the Job Demands–Resources Model can be conceived as an expansion of the DC Model, incorporating different types of work demands (physical, environmental, and flexibility-related demands) and buffering resources (job control, rewards, support) (Demerouti, Bakker, Nachreiner, & Schaufeli, 2001). The Effort–Reward-Imbalance–Model (ERI; Siegrist, 2002) and the recent concept of employment strain (Clarke, Lewchuk, de Wolff, & King, 2007) have introduced notions of uncertainty and unfairness as distinct dimensions. However, also these extended or complimentary dimensional stress models remain *variable-oriented* (Bergman & Magnusson, 1997). This dominant approach in occupational stress research is very suitable for identifying risk factors, but it is less preoccupied with the general distribution and structuring of different types of stressors (Harenstam, Karlqvist, Bodin, Nise, & Scheele, 2003). Exactly these issues are linking the psychosocial experience of stress to wider causes of social inequality, as well as to social differences in health and well-being. Therefore, in this article, a *typological* or *person-oriented* approach (Bergman & Magnusson, 1997) is adopted. We are describing an empirical typology of wage-earners according to their specific patterns of exposure to a broad number of occupational stressors. This *holistic* approach (de Fruyt, 2002), is furthering insights into the complexity of the psychosocial work

environment as a "node" that combines different types of potentially stressful experiences. For the analyses, data from a representative sample of wage-earners in the Flemish region of Belgium is used.

In the first section of the article, the effects on emotional problems and musculoskeletal complaints, of a broad number of separate types of occupational stressors are tested. These stressors are a mix of single items (e.g., overtime work or bullying) and dimensions based on different summed items (e.g., quantitative demands or control). Subsequently, a latent class cluster analysis (McCutcheon, 1987) is performed on these stressors. Different from the structural covariance approach, which is used to *identify latent dimensions*, the principal aim of this approach is to *identify an empirical typology* of workers according to specific characteristics. Hence, in this article the mutual relationship between the stressors is researched from the perspective of categorizing wage-earners based on similar patterns of exposure. Initially this approach is exploratory, since no theoretical expectations regarding the number or type of clusters are defined beforehand. However, the clusters discovered are given substantial interpretation according to their characteristics and with reference to current theoretical frameworks on the organization of work and employment relations. In the final section of the article associations between the typology and the health outcomes are analysed.

METHOD

Participants

The study is based on data from the Flemish Quality of Labour Monitor (QLM), a survey conducted by the Socio-Economic Council of Flanders in 2004. It concerns a random sample extracted out of the official personnel registry of all wage-earners living in the Flemish region of Belgium. This region encompasses about 60% of the Belgian inhabitants and has a population of some 2,400,000 wage-earners. Because the official personnel registry is used as the source for recruitment, the sample obtained provides a good reflection of the Flemish labour market. From the initial sample of 20,000 wage-earners who received a postal questionnaire, 12,095 returned a usable copy (60.6% response rate). Subsequently, 996 individuals were excluded because they had stopped working as wage-earners between the time of sampling and the completion of their questionnaires. After respondents with missing values on one or more of the occupational stressors were excluded, a final number of 10,074 individuals was obtained, upon which the analyses for this article are based. The listwise deletion, however, did not bias the distribution of the sample according to some central characteristics, such as gender, age, skill levels, or occupational categories.

Measures

Psychosocial scales. The questionnaire contains 44 individual items, each coded into four answering categories: ''always'', ''often'', ''sometimes'', or ''never'' (Bourdeaud'hui, Janssens, & Vanderhaeghe, 2004). Theoretically they represent four dimensions: job control (job autonomy—11 items, and task variation—6 items), quantitative demands (11 items), emotional demands (7 items), and the relationship with direct superiors (9 items). These scales are all taken from the Dutch ''VBBA quality of labour questionnaire'' (van Veldhoven, Meijman, Broersen, & Fortuin, 2002). The VBBA quality of labour questionnaire has been tested frequently and the measurement scales are found to be one-dimensional, reliable, and valid (Evers, van Vliet-Mulder, & Groot, 2000; Vanroelen, Levecque, & Louckx, 2009b). In the current dataset the scales are showing Cronbach's alpha values ranging from .80 to .91. The psychosocial scales are constructed by summing the individual item scores, using a coding from 0 to 3. If missing values on a scale were randomly distributed and were not reaching over a third of all items in a scale, mean substitution is used. If these conditions were not satisfied, the scale score of a respondent is coded as missing. All total scale scores are standardized to a 0–100 range, from favourable (0) to unfavourable or problematic (100). For the analyses in this article, the psychosocial scales are categorized into tertiles.

Physical working conditions. The physical workload is measured with eight items: vibrations, noise, extreme temperatures, dangerous substances, dangerous situations, heavy tasks, inconvenient working postures, and repetitive movements of hands and arms. Based on an unrotated principal components analysis, these items—except repetitive movements—are recoded into one dimension representing the general physical workload (Cronbach's alpha = .85). For the construction of this indicator, the same procedure as described previously is applied. The indicator for repetitive movements of hands and arms is used as a single item dichotomy, indicating the frequency of repetitive movements as ''never or sometimes'' and ''often or always''. The latter category has a prevalence of 35% (Table 1).

Other working conditions. The type of work schedule is a dichotomous variable with as categories: ''fixed day work'' and ''atypical work schedules'' (e.g., night work, rotating shift systems, and nonstandard daytime shifts). The majority of the respondents (75%) is engaged in daytime work schedules. Overtime work is represented as a dichotomous variable, consisting of the categories ''never or sometimes'' and ''always or often'' (33%). In addition, subjective job insecurity is included as the chance of becoming unemployed being ''inexistent to low'' versus ''very high to

TABLE 1
General distribution of the categorical variables

	N	%
Gender		
Women	4429	47
Men	4926	53
Age		
16–29 years	1963	21
30–49 years	5825	62
50 years +	1593	17
Repetitive movements		
Always–often	3556	35
Never–sometimes	6518	65
Type of work schedule		
Atypical schedule	2509	25
Fixed day	7565	75
Bullying behaviour		
Sometimes–always	1444	14
No	8630	86
Overtime work		
Always–often	3301	33
Never–sometimes	6773	67
Job insecurity		
High	2245	22
Low	7829	78
Emotional problems		
Moderate–severe	2354	32
No–a little	6999	68
Musculoskeletal complaints		
Three or more	1967	22
No/some	7187	78

medium high'' (22%). Finally, a variable for bullying behaviour is included. In total 14% of the respondents is confronted—at least sometimes—with bullying behaviour within a reference period of 1 year.

Covariates. The respondent's age at the moment of the survey is categorized corresponding to three main periods in a working career: lift-off (16–29 years), a mid-career period (3–49 years), and the end-of-career period (50 years or older). Table 1 shows these three age groups to represent 20% for the lift-off category, 62% for the mid-career period, and 18% for the end-of-career period. As Table 1 shows, female wage-earners make up 47% of the sample. Finally, also indicators of skill levels and occupational categories are included in order to describe the socioeconomic distribution of the clusters. These variables are also included as controls in the models predicting the association between the clusters and the outcome measures.

Outcome measures. Two outcomes are considered: emotional problems and musculoskeletal complaints. For each of these outcomes a reference period of 2 weeks is applied. Emotional problems is assessed with a single question: "To what extent were you bothered with emotional problems, such as anxiety, depressive feelings, feelings of irritation, or dejection during the last 2 weeks?" The original five answering categories are dichotomized into "not at all or a little" versus "moderately, rather, or very much" (32%). The indicator for musculoskeletal complaints is based on a combination of four self-reported health complaints: backache, pain in the neck and shoulders, muscular pains in the limbs, and a tingling or numb feeling in the limbs. These four indicators are summed together and then dichotomized into "less than three" versus "three or more" complaints. In this sample 22% of the respondents has reported three or more musculoskeletal complaints.

Procedure

As a consequence of the mixed measurement levels of the independent variables and the dichotomous outcomes measures, a categorical approach is appropriate. In a first phase, associations of gender, age, and the occupational stressors with emotional problems and musculoskeletal complaints are assessed, making use of a standard logistic regression procedure. Two models are tested. In Model 1, each occupational stressor is assessed separately, controlled for gender and age. In Model 2 all occupational stressors are included at the same time, together with gender and age. The effects are interpreted in terms of odds ratios (ORs) with 95% confidence intervals (CIs). In addition, the predictive strength of the individual variables and the complete Model 2 is reported using Nagelkerke pseudo R^2-measures.

In the second phase, a latent class cluster analysis (LCA cluster) is conducted on the occupational stressors. The best-fitting latent class model is obtained by stepwise extending the number of clusters, until a parsimonious well-fitting model is obtained. For model selection formal indicators of model fit—the log likelihood-statistic (L^2) and the Bayesian Information Criterion (BIC)—are used. In addition, also the more heuristic method of substantial interpretation of the relations between the clusters and the original stressors is used.

For the best-fitting cluster solution, probability scores for each respondent to belong to one particular cluster are calculated. In a traditional cluster approach respondents are exclusively assigned to a particular cluster (modal assignment). Modal assignment, however, has the disadvantage of not taking into account the probability of misclassification, e.g., the amount of dissimilarity between a cluster profile and the profile of an actual

respondent with regard to the exposure to the stressors. Misclassification may seriously distort the composition of the latent categories (Yamaguchi, 2000). For that reason it is preferred to use the latent class probability scores, which take into account measurement error (Moors, 2003).

In the final section, the probability scores, representing the extend of similarity between the respondents and the particular clusters, are related to the health outcomes in a logistic regression analysis. Here too, the explanatory strength of the models is reported in the form of pseudo R^2-measures. Parameter effects are reported again as ORs (and CIs). The original probability scores of the clusters are transformed into percentages. As a result, the ORs of the clusters are to be interpreted as the effect of a 1% increase in the probability of a respondent to correspond with the response pattern of that cluster. All analyses are performed using SPSS 16.0, except for the latent class cluster analyses, where the software program lEM is used (Vermunt, 1997).

RESULTS

Effects of the individual stressors

From Table 2 it can be seen that gender is significantly associated with emotional problems: women have a higher prevalence than men. The differences according to the age categories are not significant. In association with musculoskeletal complaints, a small but significantly higher prevalence of women, compared to men exists. The association with age categories shows a higher prevalence of musculoskeletal complaints in older respondents.

In relation with emotional problems, all job stressors included in this study, except the type of work schedule, show significant gender and age-controlled effects. The strongest associations are seen for a problematic relationship with superiors ($R^2 = .085$), being exposed to bullying ($R^2 = .068$), high emotional ($R^2 = .054$), and quantitative demands ($R^2 = .073$). Each time the most adverse tertile has the highest prevalence of emotional problems. In the mutually controlled Model 2, the categorical differences become reduced. The associations with physical demands, the type of work schedule, and overtime work are no longer significant.

Associations with musculoskeletal complaints are reported for each of the gender and age-controlled job stressors, except for overtime work. The strongest effects are seen for high physical demands ($R^2 = .050$), low control over the work environment ($R^2 = .044$), a high number of repetitive movements ($R^2 = .060$), a problematic relationship with superiors ($R^2 = .033$), and exposure to bullying ($R^2 = .026$). Again, the most adverse categories of the stressors are showing the highest prevalence of

TABLE 2
Main effects of the individual working conditions in relation with emotional problems and musculoskeletal complaints (ORs – 95% CIs)

	Emotional problems			*Musculoskeletal complaints*		
	R^2	*Model 1*	*Model 2*	R^2	*Model 1*	*Model 2*
Gender						
Man	.007	1.00***	1.00***	.002	1.00***	1.00***
Woman		1.40 (1.27–1.54)	1.48 (1.33–1.65)		1.24 (1.21–1.37)	1.48 (1.32–1.66)
Age						
16–29 years	.001	1.00	1.00	.015	1.00***	1.00***
30–49 years		1.08 (0.96–1.22)	0.95 (0.84–1.08)		1.40 (1.22–1.60)	1.37 (1.19–1.59)
50 years +		1.14 (0.98–1.33)	1.06 (0.89–1.25)		2.20 (1.87–2.60)	2.53 (2.12–3.02)
Quantitative demands						
Low demands	.073	1.00***	1.00***	.043	1.00***	1.00***
Middle demands		1.53 (1.35–1.75)	1.12 (0.97–1.28)		1.71 (1.49–1.96)	1.33 (1.15–1.54)
High demands		3.66 (3.22–4.15)	1.95 (1.68–2.26)		2.91 (2.54–3.33)	1.79 (1.53–2.10)
Emotional demands						
Low demands	.054	1.00***	1.00***	.009	1.00***	1.00***
Middle demands		1.67 (1.48–1.89)	1.44 (1.26–1.65)		1.30 (1.15–1.47)	1.31 (1.14–1.50)
High demands		3.11 (2.74–3.52)	2.22 (1.91–2.58)		1.57 (1.38–1.79)	1.41 (1.20–1.65)
Physical demands						
Low demands	.007	1.00***	1.00	.050	1.00***	1.00***
Middle demands		1.40 (1.25–1.58)	1.07 (0.94–1.22)		2.08 (1.80–2.40)	1.64 (1.41–1.91)
High demands		1.71 (1.51–1.93)	1.03 (0.89–1.19)		3.97 (3.44–4.59)	2.49 (2.12–2.91)
Repetitive movements						
Low	.013	1.00***	1.00**	.060	1.00***	1.00***
High		1.57 (1.43–1.73)	1.19 (1.07–1.34)		2.71 (2.44–3.00)	1.87 (1.67–2.10)
Type of work schedule						
Fixed daytime work	.001	1.00	1.00	.004	1.00***	1.00
Atypical schedule		1.10 (0.99–1.23)	0.90 (0.79–1.02)		1.39 (1.24–1.55)	0.93 (0.82–1.06)

(*continued overleaf*)

TABLE 2
(*Continued*)

	Emotional problems			*Musculoskeletal complaints*		
	R^2	*Model 1*	*Model 2*	R^2	*Model 1*	*Model 2*
Overtime work						
Never–sometimes	.003	1.00***	1.00	.001	1.00	1.00
Often–always		1.30 (1.18–1.43)	0.99 (0.88–1.11)		1.03 (0.92–1.14)	1.03 (0.91–1.16)
Control						
High control	.024	1.00***	1.00***	.044	1.00***	1.00***
Middle control		1.45 (1.28–1.63)	1.31 (1.15–1.50)		1.55 (1.35–1.77)	1.34 (1.16–1.55)
Low control		2.05 (1.82–2.31)	1.62 (1.40–1.87)		2.82 (2.48–3.21)	1.83 (1.57–2.13)
Job insecurity						
Low	.025	1.00***	1.00***	.013	1.00***	1.00***
High		2.06 (1.86–2.29)	1.56 (1.38–1.75)		1.77 (1.58–1.99)	1.26 (1.11–1.43)
Problematic relationship with superior						
Not problematic	.085	1.00***	1.00***	.033	1.00***	1.00**
Average		1.73 (1.52–1.97)	1.32 (1.15–1.51)		1.45 (1.27–1.65)	1.10 (0.96–1.27)
Problematic		4.31 (3.79–4.90)	2.14 (1.85–2.47)		2.52 (2.21–2.87)	1.28 (1.10–1.49)
Bullying behaviour						
Never	.068	1.00***	1.00***	.026	1.00***	1.00***
Sometimes or more		3.71 (3.29–4.19)	2.15 (1.88–2.46)		2.20 (1.95–2.52)	1.33 (1.16–1.54)
Total variance explained for Model 2 (R^2)			.191			.165

ORs = odds ratios; CIs = confidence intervals. The column "R^2" represents the explained variance of the separate variables; Model 1 = controlled for gender and age; Model 2 = controlled for all independent variables reported in the table. The p-values apply to overall significance levels of the main effects: *$p < .05$, **$p < .01$, ***$p < .001$.

musculoskeletal complaints. In Model 2, all categorical differences diminish. The effects of the type of work schedule and the middle tertile of a problematic relationship with superiors become insignificant in Model 2.

Identification of a typology of wage-earners

Table 3 shows seven subsequent models at each step being extended with one additional cluster. In assessing the formal fit of the subsequent models, the L^2 and BIC-values are used. BIC is a parsimony index that belongs to the family of Bayesian estimation procedures, making a correction to the L^2-statistic for the number of model parameters and the sample size. The lower the values of BIC, the better a model fits the data. The indications of model fit are improving with each additional latent class being added.

However, there is a clear break in the dropping rate of the BIC-values (ΔBIC) around the four-category solution. This is an indication for an optimal number of latent classes around that point. As a consequence, the latent class probabilities from the models with three to six latent classes are investigated in more detail. The latent class probabilities can be used to attach a substantive meaning to the clusters. They are an expression of the proportion of the categories of the manifest variables represented in the categories of the latent variable(s). As such, they are comparable with factor loadings in ordinary factor analysis. As a general rule, clusters with only a small prevalence or with little substantial meaning or contrast with other clusters are indications that the number of appropriate clusters in a model is exceeded (see Table 4 for the final solution).

In comparing the different models (the comparison results are not shown), starting from the three-clusters solution, it becomes clear that some clusters consistently emerge in each model: a cluster of respondents

TABLE 3
Comparison of the model fit of the latent class cluster solutions

Latent class models	L^2	*DF*	*p-value*	*BIC*	ΔBIC
Model 1 (respondents in 1 cluster)	16,665.04	7760	.001	−54,864.41	
Model 2 (respondents in 2 clusters)	12,361.15	7744	.001	−59,020.82	4303.89
Model 3 (respondents in 3 clusters)	8,787.29	7728	.001	−62,447.20	3426.38
Model 4 (respondents in 4 clusters)	8,039.03	7712	.005	−63,047.97	600.77
Model 5 (respondents in 5 clusters)	7,595.40	7696	.791	−63,344.12	296.15
Model 6 (respondents in 6 clusters)	7,245.50	7680	.999	−63,546.54	202.42
Model 7 (respondents in 7 clusters)	6,886.48	7664	1.000	−63,758.08	211.54

The clusters are incorporating the following manifest variables: quantitative demands, emotional demands, overtime work, physical demands, repetitive movements of hands and arms, type of work schedule, problematic control, subjective job insecurity, relationship with superiors, bullying behaviour.

TABLE 4
Probabilities of the manifest variables in the clusters of the final model

	Clusters				
	Low stress	*Passive-manual*	*Human contact*	*High demand*	*High stress*
Overall proportion of the cluster	.261	.242	.208	.180	.109
Quantitative demands					
Low demands	.688	.386	.134	.035	.025
Middle demands	.296	.465	.384	.429	.258
High demands	.016	.150	.482	.536	.717
Emotional demands					
Low demands	.477	.657	.000	.090	.189
Middle demands	.415	.331	.359	.459	.427
High demands	.108	.011	.641	.452	.384
Overtime work					
Never–sometimes	.864	.874	.516	.279	.714
Often–always	.136	.126	.484	.721	.286
Physical demands					
Low demands	.485	.193	.139	.553	.066
Middle demands	.320	.333	.462	.348	.221
High demands	.195	.475	.399	.100	.713
Repetitive movements					
Low	.807	.483	.711	.820	.221
High	.193	.517	.289	.180	.779
Type of work schedule					
Fixed daytime work	.835	.651	.644	.996	.570
Atypical schedule	.165	.349	.356	.005	.430
Problematic job control					
High control	.507	.071	.335	.648	.012
Middle control	.375	.279	.439	.316	.150
Low control	.119	.651	.226	.036	.838
Job insecurity					
Low	.874	.725	.810	.847	.483
High	.126	.275	.190	.153	.517
Problematic relationship with superior					
Not problematic	.637	.246	.161	.312	.032
Average	.296	.487	.378	.464	.141
Problematic	.068	.267	.461	.224	.827
Bullying behaviour					
No	.976	.915	.702	.957	.573
Sometimes–always	.024	.085	.298	.043	.427

reporting *high demands* (high quantitative and emotional demands, overtime work); a *low stress* cluster (low probabilities of each of the stressors), and a "high stress" cluster (high probabilities on each of the stressors, except for emotional demands and overtime work). Model 4 provides an additional

TABLE 5
Descriptive distribution of the cluster probabilities over gender, age, and occupational categories

	N	*Low stress*	*Passive-manual*	*Human contact*	*High demand*	*High stress*
Mean/overall proportion		.261	.242	.208	.180	.109
Gender (Eta)		.081***	.064***	.016	.015	.030**
Woman	4429	.290	.222	.212	.176	.101
Man	4926	.235	.262	.203	.184	.115
Age (Eta)		.050***	.053***	.036**	.027*	.028*
16–29 years	1963	.271	.274	.190	.165	.100
30–49 years	5825	.248	.237	.215	.185	.114
50 years +	1593	.292	.223	.202	.182	.100
Skill levels (Eta)		.081***	.297***	.134***	.470***	.179***
Unskilled	4125	.281	.327	.166	.077	.149
Semiskilled	3300	.268	.227	.247	.163	.095
Experts	1855	.208	.074	.233	.448	.037
Occupational categories (Eta)		.144***	.456***	.322***	.550***	.257***
Nonmanual, routine	2874	.305	.247	.196	.148	.103
Un/semischooled manual	1371	.214	.465	.087	.018	.216
Schooled manual	2003	.260	.374	.153	.056	.157
Educational professionals	819	.305	.060	.271	.338	.026
Healthcare professionals	760	.257	.112	.452	.082	.097
Other professionals	754	.280	.089	.207	.385	.040
Middle management	720	.177	.066	.304	.416	.036
Higher management	451	.132	.019	.216	.618	.016

F-tests and their corresponding *p*-values, indicating the significance of the difference between the categories of a variable: *$p < .05$, **$p < .01$, ***$p < .001$.

manual-passive cluster, showing high associations with low control over the work environment, physical demands, repetitive movements, job insecurity, and atypical work schedules. The extra cluster in Model 5 is labelled as *human contact*, with high probabilities of emotional demands, overtime work, and moderately high probabilities of a problematic relationship with superiors, bullying behaviour, quantitative demands, physical demands, and atypical work schedules. The associations between the clusters of Model 5 and the stressors are reported in Table 4. When a sixth cluster is added, the human contact cluster of the five-category solution becomes divided into a cluster with more or less the same characteristics as the human contact cluster from Model 5—and a smaller cluster, being only substantially different from that human contact cluster regarding the proportion of atypical work schedules. In sum, the solution with five clusters, labelled as ''passive'', ''human contact'', ''high demand'', ''high stress'', and ''low stress'' is selected as the most appropriate compromise between sensitivity and parsimony. From a substantial point of view, this solution presents a

clear and stable typology with a distinct profile according to the stressors included in the model (Table 4).

The final solution shows also a distinct pattern of association with gender, age, skill levels, and occupational categories (Table 5). The low stress cluster (26.1% of the total sample) is somewhat more prevalent in women, lower skilled and nonmanual routine workers, and educational and other professionals. The passive-manual cluster (24.2%) is more prevalent among male and younger workers, as well as among unskilled and manual wage-earners. The human contact cluster (20.8%) shows clearly higher proportions at the semiskilled and expert levels and in healthcare and middle management occupations. The high demand cluster (18%) is more prevalent among experts and in professional and managerial occupations. Finally, 10.9% of the sample belongs to the high stress cluster, showing higher proportions in unskilled workers and workers in manual occupations.

Health effects of the final cluster solution

In Table 6, the results of a logistic regression analysis, testing the associations of the final cluster solution with the outcomes are shown. The cluster variables are an expression of the degree of correspondence of actual respondents with each of the specific clusters. For example, a specific respondent may have a 60% overlap with the typical response pattern of the manual-passive cluster, 10% with human contact, 5% with high demand,

TABLE 6
Main effects of the clusters with emotional problems and musculoskeletal complaints (ORs – 95% CIs)

Clusters	*Emotional problems*		*Musculoskeletal complaints*	
	Model 1	*Model 2*	*Model 1*	*Model 2*
Low stress	1.000	1.000	1.000	1.000
Manual-passive	1.007 (1.005–1.010)	1.008 (1.006–1.011)	1.012 (1.010–1.015)	1.010 (1.008–1.013)
Human contact	1.020 (1.017–1.022)	1.021 (1.018–1.023)	1.013 (1.011–1.016)	1.015 (1.012–1.017)
High demand	1.010 (1.008–1.012)	1.009 (1.006–1.011)	1.004 (1.002–1.007)	1.009 (1.006–1.012)
High stress	1.029 (1.027–1.032)	1.030 (1.028–1.032)	1.029 (1.026–1.031)	1.027 (1.024–1.029)
Variance explained (R^2)	.156	.163	.142	.157

Model 1: Effects of the clusters controlled for gender and age; Model 2: All effects controlled for gender, age, skill levels, occupational categories, and mutual effects of the clusters.

5% with high stress, and 20% with low stress. For each individual, the proportions of all clusters sum to 100%. As a result, the association of the cluster variables with the outcomes needs to be conceived as the effect of a 1% increase in the overlap with the response pattern of a specific cluster. In relation with emotional problems, the respondent from our example would have an odds for experiencing emotional problems of 1.815 [1 + ((60*0.7) + (10*2.0) + (5*1.0) + (5*2.9))] times higher than a respondent completely overlapping with the low stress cluster.

In Model 1, the gender and age-controlled effects of the clusters are reported. In Model 2, the effects are additionally controlled for skill levels and occupational categories. With respect to the explained variances, Model 1 of the clusters can be compared with Model 2 of the separate stressors. For both outcomes, the simplification of the model into a typology of clusters implies a certain loss of explanatory strength. The cluster typology explains 15.6% of the variance in emotional problems and 14.2% of the variance in musculoskeletal complaints, compared to respectively 19.1% and 16.5% for the models incorporating the separate stressors.

The individual effects of the clusters have to be interpreted with the low stress cluster as the reference. For both outcomes, all other clusters have significantly higher odds. Furthermore, the effect of additional controlling variables in Model 2 is very limited. The highest odds ratios in association with emotional problems are seen for the high stress cluster (1.030) and the human contact cluster (1.021). In relation with musculoskeletal complaints, the highest odds ratio is also reported for the high stress cluster (1.027), and the deviations from the reference of the other clusters are all more or less situated on the same level.

DISCUSSION

Occupational stress models have been of enormous value for the understanding of the impact of working conditions of a nonmaterial nature on various health outcomes. This study fits into a recent trend towards expanding traditional occupational stress models. The results show that each of the included occupational stressors is associated with at least one of the health outcomes. In addition to these individual stressor–distress associations, our findings suggest that the included stressors are structured into five different clusters of workers: ''low stress'', ''high stress'', ''manual-passive'', ''human contact'', and ''high demand''.

Respondents in the *low stress* cluster have the lowest levels of exposure to each of the stressors, as well as the most advantageous health outcomes. The cluster on the other side of the typology is characterized by high exposure to each of the stressors—except emotional demands and overtime work, as well as a high prevalence of the outcomes. The *high stress* cluster could be a

reflection of a trait effect, such as negative affectivity (Burke, Brief, & George, 1993). The trait-like contamination of associations between self-reported stressors and strains has been the object of much discussion (Spector, Fox, & van Katwyk, 1999). Without entering into that discussion, we would like to point at two elements in our analyses that support the assumption of the cluster being composed of *real* stressful situations. First, some of the stressors are more "objectively assessable"—for example, physical demands or types of work schedule. Second, there are significant associations between the high stress cluster and socioeconomic characteristics. As a result, to consider this cluster as the reflection of a personality trait would have the unlikely implication that respondents with high scores share a social class-distributed, personality deficit (Karasek et al., 1998). The high stress cluster can be related to a *high strain* or *isostrain* job situation in the DC(S) Model (Karasek et al., 1998), although the amount of adverse working conditions is broader. The concept of *precariousness* (Benach & Muntaner, 2007; Clarke et al., 2007), which can be described as a combination of temporality, powerlessness, a lack of rewards, and generally adverse working conditions (Benach & Muntaner, 2007), may therefore provide a better description.

Given these two extremes, the other clusters take in-between positions. The *manual-passive* cluster refers to characteristics of low job control and high physical demands, in combination with low quantitative demands. This cluster is more or less in line with the passive job quadrant in Karasek's DC Model, which also shows associations with manual and lower end service work (Kristensen, Borg, & Hannerz, 2002). The *human contact* cluster shows higher loadings on bullying and a problematic relationship with superiors, demands in general and, more specifically, emotional demands. These stressors are all related to personal relation skills and role expectations. Jobs requiring such skills have been described as emotional or affective labour (Hardt, 1999). In our data this cluster is most present in educational and healthcare professionals and managerial occupations. Although emotional and social-relational stressors are often neglected, the curbing of one's emotions at work and negatively perceived social contacts are related to strong distress outcomes (Labianca & Brass, 2006; Thompson & McHugh, 2002). Finally, the *high demand* cluster is predominantly defined by overtime work, high quantitative, and emotional demands. This cluster is overrepresented in (educational) professionals and managerial occupations. New management principles of accountability and *delayering* of power structures may increase pressure on professionals and managerial employees (Vilrokx, 1999). In addition, a pattern of work intensification is seen throughout Europe, predominantly affecting the higher end occupations (Parent-Thirion, Fernandez, Hurley, & Vermeylen, 2007).

In interpreting the results, one should keep in mind that the data originate from a cross-sectional sample. Consequently, inferences on causality can only be made on the basis of prior conceptual assumptions. The same empirical limitations exist with regard to the nature and impact of the occupational stress dimensions. Although they are only measured at a cross-section in time, they are assumed to be *chronic stressors*. In other words, because they are attached to relatively fixed social roles (occupational positions), they are assumed to have a relatively enduring character. This is a common underlying assumption in occupational stress research. In addition, some other possible occupational stressors than those included in our analyses can be thought of, like additional types of job demands or *reward-related* characteristics. Such additional stressors may modify our cluster composition. Therefore, replication studies on data incorporating other stressors are desirable. Another point is the simplicity of the outcome of emotional problems. Previous studies in Belgium have, however, shown that a one-item measure does not necessarily perform worse in indicating general emotional problems, compared to multiitem scales (Levecque, Lodewyckx, & Bracke, 2008).

Apart from limitations, related to the data, a major issue concerns the merits additionally provided by our typological approach, compared to the various dimensionally oriented studies in occupational stress research. The originality of the typological approach predominantly lies in its preoccupation with the structuring and social distribution of the stressors. It is related to the *holistic-interactionist framework* in developmental psychology (Bergman & Magnusson, 1997). Where a dimensional approach finds it difficult to translate its findings into properties characterizing individuals, in the holistic approach, the constituting elements are given meaning from the role they play in the total functioning of the individual—given a specific problem and setting (Bergman & Magnusson, 1997). In addition, the typological approach traces back to the old sociological practice of using ideal types for describing social reality. *Ideal typical sociology* uses exaggeration of certain specific features in order to get a deeper understanding of the complexities of social reality (Hagenaars & Halman, 1989). After all, individuals are not one-dimensional beings. However, it is not the intension to classify each individual into one or another category, but rather to compare their differences and similarities to some ideal-typical references (Prandy, 2002). Precisely at this point lies the advantage of the latent class clustering methodology. LCA clustering is very similar to more traditional methods of cluster analysis (McLachlan & Basford, 1988). However, it provides a probability-based, instead of an ad hoc classification of objects on the basis of distance measures. As a result, the researcher is provided with formal statistical indicators informing the choice for one solution or another. Respondents can be classified into clusters according to the model-based

posterior membership probabilities, using the method of modal assignment. However, from that moment—indeed—respondents become allocated to an ideal type, neglecting their degree of dissimilarity with this ideal type (Yamaguchi, 2000). Therefore, faithful to the initial aims of the ideal-typical approach as a means of reducing the complexity of the social reality by creating a discrete number of references, we have chosen to interpret our results in terms of LCA probability scores. Accordingly, each respondent's degree of similarity with a specific ideal type can be expressed as a probability of belonging to that cluster. We are convinced that this approach is the most realistically possible way of grasping the reality of individual situations, shaped at the intersection of different characteristics, without slipping down from ideal types towards ''stereotypes'' (Prandy, 2002).

A practical advantage provided by this typological approach is that it enables the identification of *risk profiles*. Such profiles, from a policy point of view, are crucial for targeting categories with specific needs—and, consequently, differentiating policy interventions. For example, different nonmaterial demands tend to occur simultaneously, while they collapse with a pattern of relatively high control and low physical demands. That profile, in turn, is more prevalent in ''higher end occupations''. Such a risk profile will have limited benefits from providing more participation and control over work planning, although these may be identified as important *risk dimensions* in the general population. In contrast, the higher end occupations may rather gain from a repartition of work tasks, decreasing the number of (conflicting) demands, or from interventions aimed at harmonizing family and work life. In addition, the results are also enlightening for the links between occupational stress experiences and socioeconomic health inequalities in wage-earners. The idea of a segmented labour market, with ''good-quality jobs'' at the high end of the socio-economic ladder and ''unhealthy jobs'' at the lower end, is challenged. Our finding of high demand cluster points at specific risk points for health and well-being is associated with typical high-end jobs as well. As a result, occupational stress has, at the same time, a reinforcing and moderating effect on health inequalities. Such a picture is usually obscured in the traditional ''single risk factor approach'' of occupation stress research.

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