

How different stressors affect quality of life: An application of multilevel latent class analysis on a large sample of industrial employees

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Abstract

Background and objectives: Quality of Life (QoL) indicates individual's perception of the physical, psychological and social aspects of health. The association between QoL and all stressful life events 'dimensions has not been investigated among industrial employees. The present study aimed at investigating the association between stressful life events and QoL in a large sample of Iranian industrial employees.

Methods: In a cross-sectional study, 3063 manufacturing employees in Isfahan, Iran were recruited. QoL was measured by Euro-QoL five dimensions questionnaire (EQ-5D). Stressful life events were assessed by an Iranian validated stressful life event questionnaire (SLE). Multilevel latent class regression was employed for classifying participants based on QoL and for determining its association with stressful life events.

Results: Two classes of employees i.e. low (comprised 20% of participants) and high QoL (80%) were identified. Also, from 11 eleven dimensions of stressful life events two major domains i.e. socioeconomic and personal stressor profiles were identified. Multilevel latent class regression's results showed that the higher scores of social (OR:1.14, 95% CI: 1.12, 1.16) and personal (OR:2.36, 95% CI: 1.87, 2.98) stressor domains were significantly associated with increased risk of being in poor QoL class. Among personal and socioeconomic stressors, health concerns and daily life dimensions had higher significant association with poor QoL.

Conclusions: Results of our study indicated that life stressors have negative impacts on QoL of employees. Personal stressors showed higher negative impacts than socioeconomic on QoL. Managing the stressors has an effective role on improving the QoL of employees, their physical and mental health and indirectly enhances the organizational performance and job productivity.

Introduction

Quality of life (QoL) is one of the important outcome measures in health care programs (1,2). QoL is an individual, multidimensional and latent concept that involves both objective and subjective factors, reflecting the physical, mental and social health of a person(3-6). The World Health Organization also defines quality of life (QoL) as : "individuals' perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns" (7).

QoL influences the quality of work life and work characteristics such as productivity (8-12). QoL has been found to be negatively associated with stress (13,14). Increased stress levels are related to decreased job performance, higher medical costs and impaired QoL(15). A number of studies have reported significant association between psychological stressors and poor physical and mental health (16,17). Furthermore, stressful life events inversely related to QoL and well-being (18-20). Stressful life events were defined by the occurrence of both positive and negative situations in individual's life that lead to significant changes in usual activities(18).

The body's response to stress is attributed to the activity of several axes, such as the hypothalamic-pituitary-adrenal (HPA) axis and sympathetic adrenomedullary circuits. Stressful life events through HPA axis can affect the function of neuroendocrine and immune systems, physical and psychological well-being (21-23). Long-term stress by changing many physiological systems, such as metabolic and inflammatory pathways and immunological defense systems in the body leads to functions and cell senescence impairment (24).

Stressful life events have been identified as a risk factor for variety of physical and mental illnesses such as cardiovascular disease, cancer, metabolic syndrome and depression(23,25-27)

Stressful life events can also lead to change in job-related behaviors such as reduced job involvement, impaired performance effectiveness, and reduced job satisfaction and eventually absenteeism, tardiness and turnover(28).

Numerous studies are available on the relation between quality of life and stressful life events across different populations such as patients with chronic obstructive pulmonary disease (29), coronary artery disease patients (30), breast cancer patients (31) and older adults (20,32) and less attention has been paid to evaluate it among workforce or general population. Furthermore, in many studies among workforce population, the association between QoL and job stress has been widely studied but other stressors have been neglected.

On the other hand, most of the previous studies on the determinants of QoL have applied simple statistical analysis and the subscale scores were combined to obtain an overall, or total QoL score as a single measure. However, QoL is a multidimensional concept with distinct domains. In current study considering QoL as latent structure as well as multilevel structure of study population which employees are nested in different job categories ,as higher level units, multilevel latent class regression (MLCR) analysis was used to classify the participants as well as the job categories based on QoL, and to evaluate the association of stressful life event with QoL. This method provides a comprehensive feature about QoL through classifying employees, objectively based on all domains of QoL and simultaneously enable us to evaluate the association of stressful life events with QoL classes in the presence of various confounders including demographic, life style and job-related variables. The current study provides useful data about the impacts of different stressors on QoL levels in a large sample of employees in a developing country.

Methods And Materials

Study Design and Participants

This cross-sectional study was conducted among full employees and contractual workers of the Esfahan Steel Company (workforce of 16,000). The sample size was determined based on an epidemiological survey of chronic diseases in manufacturing employees by Roohafza et al. (ESCOME) (33) carried out to estimate the prevalence of psychological disorders (depression and anxiety) among the workforce. The sample size was estimated to be 3500 by considering 0.1 (19, 20), 0.05, and 0.01 as prevalence of psychological disorders, type one error rate, and sampling error rate, respectively.

Three thousand and sixty-three volunteers returned complete questionnaires (response rate: 0.87) and were included in statistical analysis. The inclusion criterion was work experience for at least one year and willing and agreeing to participate in the study. Volunteers who did not answer more than 10 % of the questionnaire were excluded from analysis.

We applied multi-stage cluster sampling, in which clusters were the main seven departments and their sections, stratified by job categories. Sample sizes in the clusters and strata were proportional to the size of respective departments. Due to a low number of women workers (n=800), we relied on convenience sampling to recruit women volunteers (n=260).

Demographic data were gathered through self-administered questionnaires at the company premises with the help of study coordinators, who also monitored questionnaire administration over the six months of data gathering. The data were quality checked for inclusion and exclusion criteria as they were entered in the computer for statistical analysis. The study design and its implementation has been presented elsewhere in more detail (33,34).

All participants were informed about the study protocol and signed informed consent. Medical research ethics committee of the Isfahan University of Medical Sciences approved the study protocol (projects numbers #87115 and #395482).

Study instruments and assessment of variables

Quality of life

A standardized and generic form of Euro QoL-five dimensions (EQ-5D-3L) (35,36) was used for assessing QoL. This self-report instrument comprises the two parts of self-classifier (descriptive system) and the visual analog scale (VAS).

The EQ-VAS was considered as a single value for assessing of overall health status. This is a visual analog scale (VAS), ranging from 0 (worst imaginable health) to 100 (best imaginable health). Respondents by marking the scale with a single vertical mark, rate their current health status. EQ-5D self-classifier describes health state of subjects in five domains: mobility, self-care care, normal activities, pain/discomfort, anxiety and depression. Each domain consists of three levels: no problem (1), some problem (2), severe problem (3). We combined the last two categories into a single category in latent class analysis (LCA) due to poor response rate in last category. Higher EQ-5D scores represent worse health status. EQ-5D has shown a good reliability and validity (37,38). Internal reliability of the questionnaire was assessed in a pilot sample of 300 participants in current study and Cronbach alpha was obtained to be 0.51.

Stressful Life Events

The number and intensity of experienced life stressors were measured by Stressful Life Events questionnaire (SLE) (39). Participants were asked about the occurrence of stressors

within the past 6 months. The SLE is a 46-item self-administered scale which consists of eleven dimensions, including home life (measured with 7 items), financial problems (5 items), social relations (4 items), personal conflicts (5 items), job conflicts (4 items), educational concerns (4 items), job security (5 items), loss and separation (4 items), sexual life (4 items), daily life (2 items), and health concerns (2 items). The items are rated on a 6-point Likert scale (0: never, 1: very mild, 2: mild, 3: moderate, 4: severe, 5: very severe) and the higher score indicates higher stress level. Internal consistency of the SLE questionnaire was 0.92(39).

Assessment of other variables

Variables that were considered as potential confounders included demographics [age (years), gender (male/female), marital status (married/single), education (0-5 years / 6-12 years / over 12 years)], lifestyle variables [sleep duration (hours) and physical activity (hours per week) ,BMI (weight (kg)/ height (m²)]], job-related variables [job stress (effort-reward imbalance), and second job (yes/no)]. Physical activity was evaluated with the International Physical Activity Questionnaire (IPAQ), which included 11 questions (40). The internal reliability of this questionnaire was reported good by Moghaddam et al. (41), based on Cronbach's alpha of 0.7 and Spearman Brown correlation coefficient of 0.9.

Statistical analysis

Two level latent class analysis (42-44) (employees as level 1 and job categories level 2 units) was employed to identify homogeneous latent classes of employee according to their responses to 5 indicators of QoL. Multilevel latent class analysis is an extension of traditional latent class analysis (LCA) that handles situations where there is a multilevel construct (in our study, employees (level 1) are nested within job categories (level 2)).

The two-level latent class model not only classifies the employees but also the job categories based on the distribution of QoL of employees nested in job categories. The modeling process consists of the following steps: In the first step, with ignoring the nesting structure of data, LCA was used to classify individuals based on their response to the 5 items of the EQ-5D. To determine the appropriate number of classes at the employee-level, we started

by fitting a one-class model and sequentially increased the number of classes until to yield the best fit. Bayesian Information Criterion (BIC) (45) was used to select the best-fitting model. Additionally, interpretability of the identified classes was also considered.

In the next step, two-level latent class model was estimated to take (the clustered nature of the data) into account the multilevel structure of our data. A two-level model with two classes at level one and two classes at the second level was selected as the best fitted model.

Finally, we used multilevel latent class regression (MLLCR) for evaluating the predictors of QoL. The proposed predictors of QoL in current study were stressors. For evaluating their association with QoL, at first, we used exploratory factor analysis on eleven domains of life stressors and two factors were extracted and labeled as “personal stressors” and “socioeconomic stressors” and these domains were used as latent predictors of QoL of employees.

We adjusted for the effects of potential confounding variables that were statistically *significant at $\alpha=0.1$* in univariate analyses.

Continuous and categorical variables were represented as mean (SD) and number (percentage) respectively. Independent samples t-test / Mann-Whitney U test and Chi-square test were used for comparing continuous and categorical variables between studied groups, respectively. MLLCR was fitted in Mplus 8 statistical software.

Results

The current study consists of 3063 participants aged 21-64 (*mean (SD):36.73 (7.30)*) years.

Most of the participants were male (91.5%), 90% married and 29.4% of the employees had university educational attainment.

Table 1 presents the two classes at the employees' level based on five dimensions of QoL identified by LCA. The first class is characterized by higher probabilities of expressing “*no problem*” for all items of QoL. Accordingly, this class was labeled as *high QoL* (consisted of 80% participants). The second class is characterized by higher probabilities of expressing

“some/severe problems” for items of mobility, pain/discomfort and anxiety/depression. Accordingly, we named this class as low QoL (consisted of 20% participants).

Using exploratory factor analysis, two factors were identified from eleven life stressors (table 2). Financial problems, social relations, personal conflicts, job conflicts, educational concerns, job security and daily life were loaded more on first factor. Accordingly, this factor was labeled as "socioeconomic stressors". Home life, loss and separation, sexual life and health concerns stressors were highly loaded on second factor. Therefore, this factor was labeled as "personal stressors" (33,34).

Differences in demographic, life style and job-related variables between two extracted classes of QoL are shown in table 3. These results indicated that the subjects who were classified as high QoL, were more likely to be younger, men, and have lower BMI and higher sleep duration than those in low QoL class.

Differences between two classes in terms of the scores of stressful life events domains and two extracted socioeconomic and personal stressors dimensions are reported in table 4. Compared with those people in high QOL class, individuals in low QOL class had higher mean stress scores in all eleven stressors domains as well as socioeconomic and personal stressors (Table 4).

Figure 1 shows the two-level latent class model with two classes at level one (employees) and two classes in the second level (job categories) and the distribution of employee's classes in terms of QoL at the classes of job categories. "Job categories with low QoL" consist of a higher percentage of employees with low QoL (27.2%) whereas a larger percentage of "job categories with high QoL" contains employees with high QoL (84.5%).

The Crude and adjusted odds ratios (ORs) (95% confidence interval for OR) for the association of socioeconomic and personal stressors and all domains of stressful life events with QoL in the presence of demographic, life style and job-related confounding variables are presented in table 5. Higher scores of socioeconomic (OR: 1.15, 95% CI: 1.13, 1.17) and

personal stressors (OR: 2.56, 95% CI: 2.02, 3.24) are associated with increase risk of being in poor QoL class in crude model. The association of socioeconomic (OR: 1.12, 95% CI: 1.12, 1.16) and personal stressors scores (OR: 2.48, 95% CI: 1.96, 3.14) with low QoL was remained statistically significant after adjustment for demographic variables including age, sex and household size. These associations, remained significant even after adjustment for the effects of other confounders including BMI, sleep duration and shift work. In the fully adjusted model, it was observed that one unit increase in socioeconomic stressors' score significantly associated with 14% increased risk for being in poor QoL class (OR:1.14, 95% CI: 1.12, 1.16) and one-unit increase in personal stressors score, enhances the risk of being in poor QoL class by 2.36 times (OR:2.36, 95% CI: 1.87, 2.98).

All dimensions of stressful life events were found to be significantly associated with increased risk of belonging to low QoL class in both crude and adjusted models. Health concerns, daily life and home life had the strongest association with low QoL which resulted in odds ratios of 1.40, 1.23 and 1.17, respectively.

Table1 Latent classes of QoL identified by latent class analysis

Class-specific response patterns of participants to EQ-5D items			
High	Low	Levels of Quality of life	
2442(0.80)	621(0.20)	Class size	Items of EQ-5D questionnaire
		Mobility	
0.99	0.69	I have no problems in walking about	
0.01	0.31	I have some problems in walking about / I am confined to bed	
		Self-Care	
1.00	0.99	I have no problems with self-care	
0.00	0.01	I have some problems washing or dressing myself / I am unable to wash or dress myself	
		Usual Activities (e.g. work, study, housework, family or leisure activities)	
1.00	0.94	I have no problems with performing my usual activities	
0.00	0.06	I have some problems with performing my usual activities / I am unable to perform my usual activities	
		Pain/Discomfort	
0.94	0.13	I have no pain or discomfort	
0.06	0.87	I have moderate pain or discomfort / I have extreme pain or discomfort	
		Anxiety/Depression	
0.89	0.48	I am not anxious or depressed	
0.11	0.52	I am moderately anxious or depressed / I am extremely anxious or depressed	

Data are presented as percentage

Table 2 Factor loadings of two extracted factors from stressful life events

	socioeconomic stressors	Personal stressors
Financial problems	0.80	
Social relation	0.74	
Personal conflicts	0.67	
Job conflict	0.70	
Educational concerns	0.40	
Job security	0.81	
Daily life	0.58	
Home life		0.51
Loss and separation		0.62
Sexual life		0.53
Health concerns		0.61

For each life stressor the highest factor loading has been reported.

Table 3 Demographic *characteristics*, life style, job related variables *of participants* in two classes of QoL

variables	Levels of QoL (QoL class)		
	low	high	P*
sex			
Male	547(88.1)	2256(92.4)	0.001
Female	74(11.9)	186(7.6)	
Marital status			
Married	568(91.5)	2190(89.7)	0.185
Single	53(8.5)	252(10.3)	
Education level			
0-5 years	41(6.6)	214(8.8)	0.193
6-12	389(62.6)	1519(62.2)	
>12	191(30.8)	709(29)	
shift work			
Daily (daily shift)	316(50.9)	1064(43.6)	0.001
Shift (rotational shift work)	305(49.1)	1378(56.4)	
second job			
yes	54(8.7)	231(9.5)	0.559
Household size	3.74±1.12	3.58±1.10	0.001
Age (years)	38.48±7.22	36.26±7.26	<0.001
BMI (kg/m ²)	26.09±4.11	25.46±3.70	<0.001
physical activity(h/week)	9.20±14.51	9.97±15.55	0.26
sleep duration(h)	6.91±1.22	7.16±1.15	<0.001

*P-values resulted from two independent samples t-test or Mann-Whitney U test and χ^2 test for continues and categorical variables, respectively. Values are mean(SD) and frequency (percentage) for continuous and categorical variables, respectively.

Table 4 Mean scores of stressful life events across two classes of QoL

P*	Levels of QoL		
	high	low	
<0.001	3.28±2.58	5.15±3.04	Socioeconomic stressors
<0.001	7.09±6.17	9.87±6.80	financial problems
<0.001	3.58±4.28	6.07±5.04	social relations
<0.001	3.13±1.73	3.89±4.87	personal conflicts
<0.001	3.73±3.48	4.18±5.42	job conflicts
<0.001	2.20±1.02	2.95±1.81	Educational concerns
<0.001	3.79±3.99	3.94±5.56	job security
<0.001	2.07±2.01	2.58±3.42	daily life
<0.001	0.73±1.01	1.67±1.51	Personal stressors
<0.001	0.86±2.09	2.27±3.39	home life
<0.001	2.17±1.27	2.81±2.11	loss and separation
0.008	1.23±0.32	1.56±0.50	sexual life
<0.001	1.27±0.46	2.16±1.80	health concerns

*P-values resulted from two independent sample t-test or Mann-Whitney U test

Table5 Crude and multivariable adjusted odds ratio (OR) and 95% confidence interval (95% CI for OR) of the association of stressful life events scores and QoL

Model 2**		Model 1*		Crude model		Stressful life events
p-value	Odds ratio(OR) (95% CI OR)	p-value	Odds ratio(OR) (95% CI OR)	p-value	Odds ratio(OR) (95% CI OR)	
□	1.14 (1.12, 1.16)	□	1.14 (1.12, 1.16)	< 0.001	,1.13) 1.15 (1.17	Socioeconomic stressors
0.001		0.001				
□	1.05 (1.03, 1.07)	□	1.05 (1.03, 1.07)	□ 0.001	,1.04) 1.05 (1.06	financial problems
0.001		0.001				
□	1.12 (1.09, 1.14)	□	1.12 (1.09, 1.14)	□ 0.001	,1.09) 1.12 (1.14	social relations
0.001		0.001				
□	1.12 (1.09, 1.14)	□	1.12 (1.09, 1.14)	□ 0.001	,1.11) 1.13 (1.15	personal conflicts
0.001		0.001				
□	1.11 (1.08, 1.13)	□	1.11 (1.08, 1.13)	□ 0.001	,1.08) 1.10 (1.13	job conflicts
0.001		0.001				
□	1.07 (1.05, 1.09)	□	1.07 (1.05, 1.09)	□ 0.001	,1.06) 1.08 (1.10	Educational concerns
0.001		0.001				
□	1.08 (1.06, 1.10)	□	1.08 (1.06, 1.10)	□ 0.001	,1.05) 1.07 (1.09	job security
0.001		0.001				
□	1.23 (1.19, 1.28)	□	1.23 (1.19, 1.28)	□ 0.001	,1.19) 1.23 (1.28	daily life
0.001		0.001				
□	2.36 (1.87, 2.98)	□	2.48 (1.96, 3.14)	□ 0.001	,2.02) 2.56 (3.24	Personal stressors
0.001		0.001				
□	1.17 (1.13, 1.22)	□	1.22 (1.13, 1.23)	□ 0.001	,1.14) 1.19 (1.23	home life
0.001		0.001				
□	1.07 (1.05, 1.09)	□	1.07 (1.05, 1.09)	□ 0.001	,1.07) 1.09 (1.12	loss and separation
0.001		0.001				
□	1.07 (1.03, 1.12)	□	1.07 (1.03, 1.12)	□ 0.001	,1.03) 1.07 (1.12	sexual life
0.001		0.001				
□	1.40 (1.32, 1.49)	□	1.42 (1.34, 1.51)	□ 0.001	1.43 (1.35, 1.52)	health concerns
0.001		0.001				

*Model 1 was adjusted for age and sex **Model 2 was adjusted for age, sex, household size, BMI, sleep duration and shift work

Figure 1. Distribution of level-one latent classes (n= 3063 employees) within level-two latent classes (n= 71 job categories).

Discussion

This cross-sectional study examined the association between stressful life events and QoL using MLCR analysis among 3063 Iranian industrial employees. Two classes of employees, as lower-level units, and two classes of job categories, as higher-level units, were identified according to QoL's indicators. These classes were labeled as high and low or poor QoL.

Poor QoL, was significantly associated with higher scores of social and personal stressor profiles extracted from 11 dimensions of stressful life events. However, the strength of the associations was markedly higher for personal stressors than socioeconomic stressors. Higher scores of all dimensions of stressful life events were significantly associated with increased risk of low QoL. Among them health concerns, daily life and home life had the greatest associations with low QoL.

To the best of our knowledge, the current study is the first one that was conducted on employees and classified individuals by considering all aspects of QoL and constructed two parsimonious and comprehensive measures from all dimensions of stressful life events and evaluated their association with QoL using MLLCR analysis. In line with our results, one study among older Texans adults has reported that increased total number events are associated with poor physical and mental health (20). One study among older Australians women showed exposure to stressful events was associated with reduced QoL (46). Similarly, in a study among young black men with high blood pressure in Maryland, cumulative stressful life events were negatively associated with QoL(18). The study of Staniute et al. on 560 coronary artery disease patients in Lithuania indicated negative relationship between stressful life events and QoL (30). In a population-based study of individuals with chronic obstructive pulmonary disease (COPD) in Singapore, higher stressful life events scores was associated with lower physical and mental health scores(29). Our results are also consistent with a study on adults aged 60 years and older in Bhutan, in which stressful life events during childhood and adulthood negatively associated with overall QOL(32).

The possible mechanism that underlies the relationship between stressful life events and physical QoL include neuroendocrine responses. Stressful life events can make people susceptible and vulnerable to chronic and acute diseases through changes in immune competence are mediated by the neuroendocrine system. Stressful life events may be associated with QoL indirectly through impairing the psychological health (47). Some psychological responses to stress include changes in cognitive functions such as limitation

of perceptions, reduced ability to concentrate, change in emotional responses such as anxiety and depression(48).

Potential mediators, including elevated levels of cortisol and neurotoxicity might underlie the impact of stressful life events on physical and mental health (20). Long-term stress can lead to dysregulation of the allostatic system by altering physiological processes within the body, and thus contribute to health morbidities (24,46). Another pathway for explaining the stress effects on health and finally QoL, is directed through behavioral changes such as increased smoking, decreased exercise and sleep duration and quality(25, 49).

In the present study, it was found also that personal stressors were more strongly related to poor QoL than socioeconomic stressors. This result is in agreement with Holmes and Rahe Stress Scale; in which death of a spouse, divorce, marital separation, death of close family member and personal injury or illness ranked as highest stressors (50). Also, the results of a study conducted among children in three US metropolitan areas, found that the higher number of family-related stressful life events are associated with impaired QoL(47). Damush *et al.* in their study on college students have reported a statistically significant relationship between autonomous life event, distressful life events, family / parental life events, sexual life events and poor QoL. However, they did not find significant relationship between accident/illness, deviance and relocation events with QoL and concluded that the negatively perceived events lead to a greater potential adverse effects on QoL(51). Villalonga-Olives et al. in a study on Spanish adolescents and youths did not find significant association between family and extra family events and desirable events and QoL (52). The study of Gardens on Indian [undergraduate medical and dental students](#) showed that the stress related to academics, self-expectations, relationships and living conditions are associated with decreased QoL including physical, psychological, social, and environmental dimensions and stress related to health and value conflict leads to decrease in physical and social components of QoL(53).

Although in current study, personal stressors had strong association with QoL but sexual life dimension had the lowest strength. This result may be attributed to the fact that some people probably have not correctly answered to the questions in the area of this type of

stressors because of cultural constraints and limitations about declaration of sexual issues in public settings.

Study strengths and limitations

The major strength of the present research is a used an advanced statistical model that provides a comprehensive evaluation of both life stressors and QoL and their association. Other strengths of the current study include large sample of industrial employees and the estimated association between life stressors and QoL have been adjusted for many potential confounding variables. The present study has several limitations that it is necessary to be mentioned. Because of cross sectional design of the study, causality between life stressors and QoL cannot be inferred. All information in the present study was self-reported by participants which may lead to misclassify of study participants.

In conclusion, life stressors have negative impacts on QoL of employees. Personal stressors showed higher negative impact on QoL than social stressors. Managing the stressors and educating stress coping styles can play an effective role in improving of QoL of employees and it could be finally effective on promoting organizational performance and job productivity.

Declarations

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

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Figures

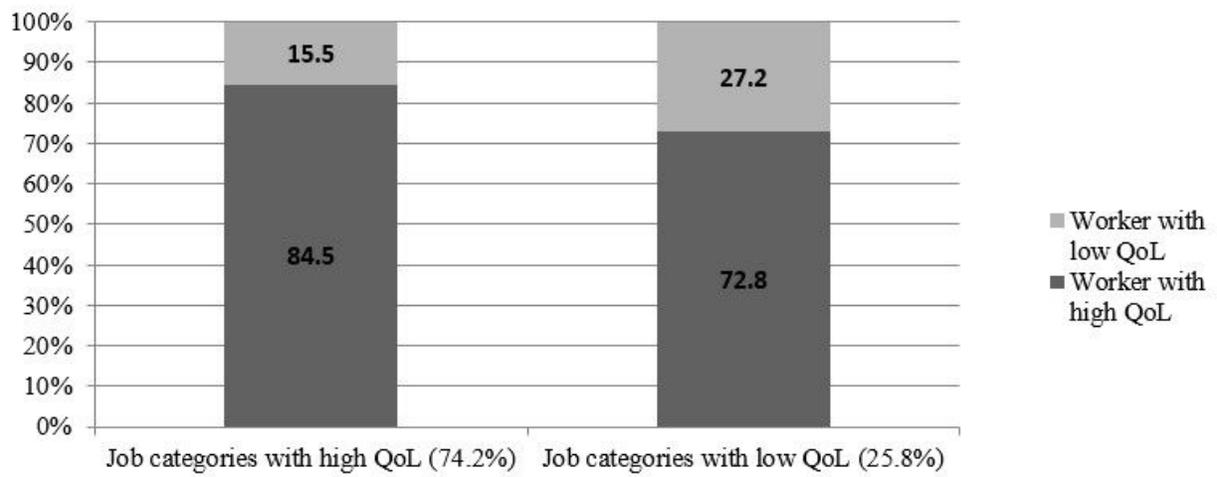


Figure 1. Distribution of level-one latent classes (n= 3063 employees) within level-two latent classes (n= 71 job categories).

Figure 1

. Distribution of level-one latent classes (n= 3063 employees) within level-two latent classes (n= 71 job categories).