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Original Article

Reliability and Validity of the Greek Version of the Job Content Questionnaire in Greek Health Care Workers

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ABSTRACT

Background: The Job Content Questionnaire (JCQ), which is based on the Demand–Control–Support model, is designed to measure the psychosocial characteristics of the respondent's work, and has been identified to predict health and psychological outcomes. The purpose of this study was to investigate the psychometric properties of this instrument and the subsequent adaptation of its scales to the population of Greek health workers.

Methods: The Greek version of the JCQ was developed by using forward- and back-translation in accordance with the JCQ policy. The reliability and validity of the measure were investigated in a sample of health workers working in a hospital in Athens, Greece. The internal consistency of the scales was examined based on Cronbach α coefficients, and the validity was evaluated subjecting the items of the three main scales of the JCQ (decision latitude, psychological job demands, and social support) to exploratory and confirmatory factor analysis.

Results: The reliability of the scales was found to be acceptable for all the scales, except for the skill discretion subscale. Confirmatory factor analysis confirmed a slightly modified version of the original construct including several items to more than one factor.

Conclusion: Our findings suggest that the Greek JCQ is reliable and valid for investigating psychosocial job characteristics among Greek health workers.

1. Introduction

Work-related stress has been identified in the literature as a risk factor for the presence of health and psychological problems [1]. A number of epidemiological studies have found that work-related psychosocial factors are linked to the incidence of cardiovascular disease [2], disrupted immune responses [3], blood pressure elevation [4], depression [5], and subjective well-being [6].

One of the most well-known models in the field of occupational stress is the Job Strain model proposed by Karasek et al [1]. According to this model, the two central elements of the job stressors that are assumed to impact psychological and physical well-being are self-perceived psychological job demands (PJDs) and job control [or decision latitude (DL)]. People who are confronted with high psychological demands and lack control in their work environment (high strain) are expected to be more susceptible to the development of physical and psychological problems [7,8]. Later research on the field has pointed out the contribution of one more dimension of the workplace in the experience of stress—the social support (SS) [9]. The Job Demand–Control–Support model hypothesizes that employees experiencing high strain along with low SS are the most vulnerable to the negative effects of occupational stress [9]. Given its impact on workers' physical and psychological health, stress related to work constitutes a public health issue and, thus, renders the use of a valid measure for the investigation of its determinants (demand, control, and support in the workplace) compelling.

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The Job Content Questionnaire (JCQ) is an instrument based on the Job Demand–Control–Support model, and it is designed to measure the social and psychological characteristics of the respondent's job [1]. JCQ has been developed to serve the areas of social epidemiology, behavioral medicine, and psychosocial job analysis that require a multidisciplinary theoretical model to study work characteristics that are related to stress responses [1]. It consists of three main scales—psychological demands, DL, and SS—and several additional scales, such as physical demands and job insecurity. The instrument has been translated into several languages, and a large number of studies have been conducted in order to investigate its psychometric properties across different cultures and populations [10–21]. These studies—while showing that some modifications of individual items may be required in order for the instrument to have better validity across different groups and cultures [11,21]—indicate that the JCQ has a good global performance. We have measured job demands, control, and support dimensions derived from the Karasek model, in the past under various settings in musculoskeletal research [22–25]. We have used a large set of questions: 11 for decision authority, six for skill discretion, 11 for job demands, nine for supervisor support, and nine for coworker support, whereas minor problems in construct validity have been identified.

In order to be able to validly measure the psychosocial characteristics of the workplace in Greek health care employees, in this study we focused on evaluating the reliability and validity of a Greek version of the JCQ based on a sample of Greek health workers.

2. Materials and methods

2.1. JCQ linguistic validation

After signing the agreement for the use of JCQ (E.C. Alexopoulos with R. Karasek), in order to translate to Greek the questionnaire items, we used the cross-cultural translation guidelines recommended by the International Quality of Life Assessment Project [26]. Forward translation was done independently by two bilingual translators, and then the version was back-translated by two other bilingual translators. Minor differences in both phases were solved by the research team. The final first Greek version was given to five employees, who were encouraged to make comments and suggestions concerning the clarity of the wording and possible difficulties during completion. The Greek version of the JCQ (GJCQ) contained 22 items and consisted of a full set of questions for the assessment of three scales, DL (9 items), psychological demands (5 items), and SS (8 items). Responses ranged from 1 for "strongly disagree" to 4 for "strongly agree" (4-point Likert scale). Aside from the JCQ items, the self-administered questionnaires also covered demographics, job title and its details, work shift, working hours, family situation, health condition, and income.

2.2. Participants and study design

This cross-sectional survey took place in a hospital (Onassis Cardiac Surgery Centre) in Athens, Greece, between May 2013 and June 2013, during an occupational health campaign. During this period, all employees who were informed about the study were asked to participate. Overall, 231 employees (35% response rate) agreed to participate and completed the questionnaire. However, 22 respondents were excluded from further analysis because of incomplete data. Additional questions on basic demographics, specifically age, sex, family, and occupational and employment status, were also included. The research was approved by the Hospital Committee and supported by the Health Inspectorate Ministry of Employment. The reference population comprised medical personnel, nursing staff, other health professionals, technicians and paramedics, and administrative employees. An occupational health nurse distributed the questionnaires, which included a cover letter guaranteeing confidentiality and informed consent for the research, during working hours. The questionnaires were collected within 7 days of the distribution date.

2.3. Statistical analysis

Internal consistency for each scale of the JCQ was assessed with the Cronbach α coefficient. The construct validity of the scales was initially evaluated through exploratory factor analysis. For this analysis, polychoric correlations were estimated to take into account the ordinal (Likert-type) nature of the items. Factor extraction was based on principal components, whereas oblique oblimin rotation was applied to enhance the interpretability and to allow for correlation between the different factors. In order to assess the original JCQ's construct validity more explicitly, we performed confirmatory factor analysis using the R package lavaan, version 0.5-16 [27,28]. We assumed the existence of three underlying factors—DL, PJDs, and SS—and the within-factor structures (e.g., coworker support related items within SS) were defined by allowing for the correlation between the residuals of the corresponding items. Again, polychoric correlations were used for the items, and the estimation of the model parameters was based on unweighted least squares. The latter estimation method was chosen owing to the ordinal nature of the items. Additionally, the finite sample properties of this method have been found to be superior to those of other similar estimation methods, such as weighted least squares and diagonally weighted least squares [29]. Good fit of the model was defined as a value of both Tucker–Lewis fit Index (TLI) and Comparative Fit Index (CFI) indices > 0.95 and a value of root-mean-square error of approximation (RMSEA) < 0.06 [30]. In order to address a potential lack of model fit, we evaluated the modification indices to consider reasonable generalizations (some initially null model parameters were permitted to be nonzero) of the JCQ for the study population. Moreover, a formal Wald-type statistical test, based on the additional parameter estimates and a robust estimate of the corresponding variance–covariance matrix, was performed to directly evaluate the fit of the extended model compared to the fit of the original JCQ structure. Finally, we estimated the adjusted effects of job strain as measured by the original and the revised JCQ scales on Perceived Stress Scale (PSS-14) score and self-reported general health score. These estimates could serve as a measure of criterion validity. For the PSS-14 scores (approximately normally distributed) we performed multivariable linear regression, whereas for the general health score we applied multivariable nonparametric median regression. Standard errors in the latter case were estimated through the nonparametric bootstrap method with 1,000 replications.

3. Results

3.1. Demographic characteristics

The total sample size was 209 health workers. The demographic characteristics of the study participants are presented in Table 1. Among the participants, 69.6% were females. The majority were married (59.6%), 32.5% were unmarried, and 7.9% were divorced. Concerning their education, 51 (25.1%) had finished secondary or technical education, 91 (44.8%) had a bachelor's degree, and 61 (30%) had a medical, master's, or doctoral degree. Fifty-eight (27.8%) held administrative positions, 34 (16.3%) were medical and paramedical staff, 106 (50.7%) were nursing staff, and 11 (5.3%) were working at the technical department. Finally, 32.7% of the participants had a constant work shift (mainly daily), 20% had circular shifts not including night, and 47.3% had circular shifts

Table 1
Demographic characteristics of study sample both by sex and overall

	N (%)
Sex	
Female	135 (69.6)
Male	59 (30.4)
Marital status	
Unmarried	66 (32.5)
Married	121 (59.6)
Divorced	16 (7.9)
Education	
Up to secondary or technical	51 (25.1)
Bachelor's degree	91 (44.8)
Medical, masteral, or doctoral degree	61 (30.0)
Job category	
Administration	58 (27.8)
Medical/paramedical staff	34 (16.3)
Nursing staff	106 (50.7)
Technical department	11 (5.3)
Work shift	
Constant (mainly day)	67 (32.7)
Circular not including night	41 (20.0)
Circular including night	97 (47.3)
	Median (IQR)
Age (y)	41.0 (33.0, 46.0)
BMI	23.9 (21.5, 27.3)
Years of employment	15.5 (10.0, 20.0)

BMI, body mass index; IQR, interquartile range.

including night. The median [interquartile range (IQR)] age of the participants was 41 (33–46) years, whereas the median (IQR) body mass index was 23.9 (21.5–27.3). The median (IQR) length of employment was 15.5 (10–20) years. The median scores of the JCQ scales are shown in Table 2.

3.2. Reliability

The internal consistency of the core scales was good, with the exception of the PJD scale, the internal consistency of which was acceptable. Specifically, the Cronbach α coefficient was 0.74, 0.63, and 0.83 for the DL scale, PJD scale, and SS scale, respectively. The Cronbach α coefficient for the skill discretion subscale, decision authority subscale, supervisor support subscale, and coworker support subscale was 0.69, 0.45, 0.86, and 0.81, respectively.

3.3. Exploratory factor analysis

The results of the exploratory factor analysis are presented in Table 3. Items of the three scales of DL, PJD, and SS were included in this analysis. The analysis suggested a six-factor solution instead of the original three factors. The first factor reflected accurately the supervisor support subscale of SS with the greatest loadings ranging from 0.792 to 0.906. Factor 2 was strongly associated with all items of the coworker support subscale of SS. The loadings of the items for this factor were quite high, between 0.807 and 0.902. Factor 3 was associated with the majority of the items of DL. The Factor 3 loadings ranged from 0.543 to 0.842. Factor 4 was associated with the majority of PJD items and one item of DL, i.e., repetitive work. The range of the loadings for this factor was between 0.561 and 0.877 in absolute terms. The remaining two items of the original PJD were loaded by Factor 5 (loadings: 0.773 and 0.864). Finally, Factor 6 was associated with the two remaining items of DL and specifically two of the three items of the decision authority subscale of the JCQ.

Table 2
Median scores of the JCQ scales

	Original	Revised
	Median (IQR)	Median (IQR)
Decision latitude	68.0 (62.0, 74.0)	69.0 (62.5, 73.5)
Skill discretion	34.0 (30.0, 36.0)	34.5 (31.5, 37.5)
Decision authority	36.0 (28.0, 36.0)	36.0 (28.0, 36.0)
Psychological job demands	36.0 (32.0, 40.0)	36.0 (32.5, 39.5)
Social support	24.0 (21.0, 25.0)	24.0 (21.2, 25.0)
Supervisor support	12.0 (10.0, 12.0)	12.0 (10.0, 12.0)
Coworker support	12.0 (11.0, 12.0)	12.0 (11.0, 12.0)

IQR, interquartile range; JCQ, Job Content Questionnaire.

Table 3
Exploratory factor analysis of the items comprising the three dimensions of the Job Content Questionnaire (decision latitude, psychological job demands, social support)*

		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Decision latitude							
Q3	Learn new things			0.783			
Q4	Repetitive work				−0.561		
Q5	Requires creativity			0.813			
Q6	Allows own decisions			0.843			
Q7	High skill level			0.701			
Q8	Little decision freedom						0.911
Q9	Variety			0.578			
Q10	Lots of say			0.312	0.331		−0.528
Q11	Develop own abilities			0.543			
Psychological job demands							
Q19	Work fast					0.864	
Q20	Work hard					0.773	
Q22	No excessive work				0.877		
Q23	Enough time				0.765		
Q26	Conflicting demands				0.591		
Social support							
Q48	Supervisor is concerned	0.838					
Q49	Supervisor pays attention	0.792					
Q51	Helpful supervisor	0.906					
Q52	Supervisor good organizer	0.857					
Q53	Coworkers competent		0.808				
Q54	Coworkers interest in me		0.807				
Q56	Coworkers friendly		0.889				
Q58	Helpful coworkers		0.902				

* Only items with factor loadings > 0.3 are shown.

3.4. Confirmatory factor analysis

We subjected the three-factor solution of the original JCQ to confirmatory factor analysis, while taking into account the within-factor structures (e.g., coworker support related items within SS) by allowing for the correlation between the residuals of the corresponding items, in order to test its validity in our study population. The model did not fit the data well as it was indicated by the poor fit indices. Specifically, the model resulted in a CFI of 0.888 and a TLI of 0.853, values considerably lower than the acceptable level of 0.95. The RMSEA was 0.101, exceeding the suggested bound of 0.06.

In order to improve the fit of the model, we examined the modification indices. The fit of the model was significantly improved when we assumed that the items *repetitive work* and *develop own abilities* are additionally loaded by PJD, the item *allows own decisions* is additionally loaded by SS, and the items *work hard* and *work fast* are additionally loaded by the DL. That is, although we retained the initial three factors, we allowed some items to be

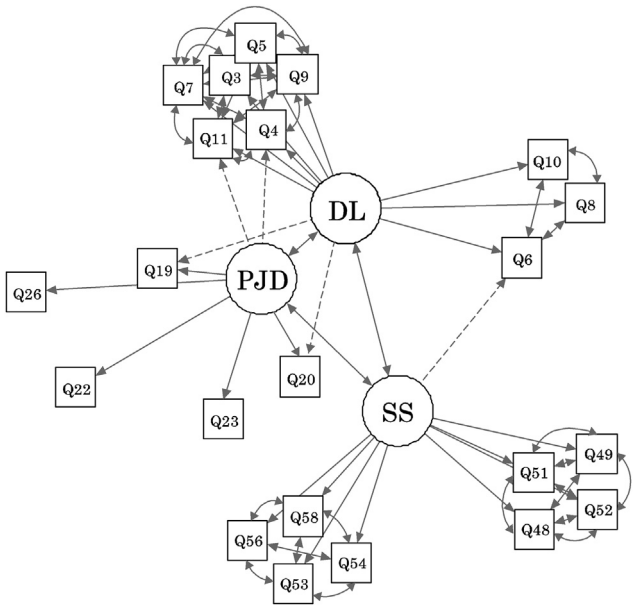

Fig. 1. Confirmatory Factor Analysis (CFA): Modified model for the Job Content Questionnaire (JCQ). Circles correspond to the underlying factors, squares to the items, unidirectional arrows to factor loadings, and bidirectional arrows to either correlations between the underlying factors or correlations among the residuals of the items belonging to the same subcategory. Broken unidirectional arrows correspond to the additional loadings of the extended model.

loaded by two instead of one factor. Consequently, PJD was negatively associated with the item *repetitive work*, whereas it was positively correlated with the item *develop own abilities*. SS was negatively associated with *allows own decisions*. DL was positively associated with both *work hard* and *work fast*. DL and PJD were negatively correlated ($r = -0.137$, $p < 0.001$), DL and SS were positively correlated ($r = 0.489$, $p < 0.001$), whereas PJD and SS were negatively correlated ($r = -0.383$, $p < 0.001$).

The fit indices of the modified model satisfied their respective criteria with CFI = 0.973, TLI = 0.963, and RMSEA = 0.051. The extended model had a statistically significant better fit ($p < 0.001$) to the data of the study population compared to the supposed structure of the original JCQ. Consequently, we revised the scoring formulae, while keeping the ranges and the relative weights of the items within each scale the same as those in the initial version. The revised scoring is included in Appendix 1. The new Cronbach α coefficient for DL, PJD, and SS was 0.73, 0.65, and 0.80, respectively. For the scales skill discretion, decision authority, supervisor support, and coworker support, the Cronbach α coefficient was 0.69, 0.45, 0.86, and 0.81, respectively.

The modified model is depicted in Fig. 1. The circles in the figure correspond to the three underlying factors, and the squares to the items. Furthermore, unidirectional arrows correspond to factor loadings, whereas bidirectional arrows correspond to either correlations between the underlying factors or correlations among the residuals of the items belonging to the same subcategory (i.e., skill discretion, decision authority, coworker support, and supervisor support). Finally, broken unidirectional arrows correspond to the additional loadings of the extended model.

Subsequently, we compared the original and revised JCQ scales in terms of their effect on the Perceived Stress Scale (PSS-14) score and the self-reported general health score, while adjusting for potential confounders (Table 4). Original and revised JCQ scales were found to be significant predictors of the perceived stress (overall $p = 0.001$ for both the original and revised JCQs). Specifically, social support was negatively associated with perceived stress in both versions of the GJCQ ($p = 0.003$ and $p = 0.004$ for the original and revised JCQ, respectively). However, PJD was a marginally significant predictor of higher perceived stress only for the revised JCQ scale ($p = 0.106$ and $p = 0.061$ for the original and revised JCQ, respectively). Overall, there was no evidence for an effect of JCQ on self-reported general health score ($p = 0.126$ and $p = 0.127$ for the original and revised JCQ, respectively), with the effect estimates being similar for both JCQ versions. This lack of significance may be partly attributable to the relatively low power of the nonparametric regression along with the moderate sample size. These results indicate an approximately equal overall criterion validity of the original and the revised JCQ scales, with a mild superiority of the revised JCQ regarding the PJD scale. Finally, the between-scale associations (i.e., original and revised) exhibited very high correlation levels (Spearman's rho = 0.94–0.99). These results indicate that our modifications were slight.

Table 5 presents the associations of demographic characteristics with the three main scales of the GJCQ. The job category was statistically significantly related to the mean score levels of DL and PJD, with nursing staff having the lowest mean scores in DL and PJD, 70.5 (65.0–74.5) and 36.5 (34.5–40.0), respectively. We also found that education was associated with PJD, and those who have completed secondary or technical education had the lowest mean score in PJD, i.e., 33.5 (31.5–37.5). Furthermore, the type of the work shift was related to the mean score levels in the three main scales of GJCQ. Specifically, the employees with circular work shifts including night had the highest mean score in DL and the highest PJD, 70.5 (65.5–75.0) and 36.5 (34.0–40.5), respectively, whereas those with circular work shifts not including night had the lowest mean score in PJD. Age, years of employment, and body mass index were also statistically significantly associated with PJD and SS.

Table 4
Adjusted effects of job strain as measured by original and revised JCQ scales on Perceived Stress Scale (PSS-14) score and self-reported general health score*

	PSS-14			General health score		
	Mean difference†	95% CI	*p*	Median difference†	95% CI	*p*
Original scales			0.001			0.126
Decision latitude	−0.293	(−0.903, 0.317)	0.344	0.026	(−0.106, 0.158)	0.697
Psychological job demands	0.940	(−0.201, 2.080)	0.106	−0.004	(−0.293, 0.285)	0.979
Social support	−2.409	(−3.993, −0.826)	0.003	0.368	(0.015, 0.721)	0.041
Revised scales			0.001			0.127
Decision latitude	−0.211	(−0.862, 0.441)	0.524	0.028	(−0.112, 0.169)	0.695
Psychological job demands	1.256	(−0.058, 2.571)	0.061	−0.068	(−0.408, 0.272)	0.695
Social support	−2.402	(−4.020, −0.783)	0.004	0.338	(−0.009, 0.686)	0.057

BMI, body mass index; CI, confidence interval; JCQ, Job Content Questionnaire.
* Results from multivariable linear regression (PSS-14) and multivariable median regression (general health score).
† Per 5 unit increase in JCQ scales and adjusted for age, sex, BMI, job category and work shift.

Table 5
Scales of the GJCQ presented by demographic characteristics

	Decision latitude	Psychological job demands	Social support
	Median (IQR)	Median (IQR)	Median (IQR)
Sex	$p = 0.861$	$p = 0.308$	$p = 0.164$
Female	69.0 (63.5, 74.5)	36.5 (33.0, 40.0)	24.0 (22.0, 25.1)
Male	69.0 (63.5, 73.5)	35.5 (31.5, 39.0)	23.0 (20.2, 25.0)
Marital status	$p = 0.610$	$p = 0.668$	$p = 0.348$
Unmarried	69.0 (64.0, 72.0)	36.0 (31.5, 39.5)	24.0 (22.2, 25.1)
Married	69.0 (62.5, 74.5)	36.0 (33.0, 39.5)	23.1 (21.2, 25.0)
Divorced	70.8 (61.8, 76.0)	35.3 (31.5, 39.0)	22.6 (20.1, 25.0)
Education	$p = 0.254$	$p = 0.018$	$p = 0.458$
Up to secondary or technical	69.0 (59.5, 73.5)	33.5 (31.5, 37.5)	24.0 (20.1, 26.1)
Bachelor's degree	68.0 (61.5, 73.5)	36.5 (34.0, 39.5)	24.0 (22.0, 25.0)
Masteral or doctoral degree	70.5 (66.0, 75.0)	35.5 (32.5, 40.0)	23.1 (21.0, 24.1)
Job category	$p = 0.007$	$p = 0.003$	$p = 0.302$
Administration	67.5 (58.0, 71.0)	34.0 (31.5, 39.5)	24.0 (20.2, 24.1)
Medical/paramedical staff	69.0 (66.0, 75.0)	34.0 (31.0, 38.0)	23.1 (20.2, 25.1)
Nursing staff	70.5 (65.0, 74.5)	36.5 (34.5, 40.0)	24.0 (22.2, 25.1)
Technical department	65.0 (55.0, 73.5)	35.5 (31.5, 37.5)	24.0 (19.2, 25.1)
Work shift	$p = 0.008$	$p = 0.001$	$p = 0.002$
Constant (mainly day)	69.0 (60.5, 74.5)	34.0 (31.0, 38.0)	24.0 (20.1, 24.1)
Circular not including night	67.5 (59.0, 70.5)	35.5 (33.0, 38.0)	22.2 (20.1, 24.1)
Circular including night	70.5 (65.5, 75.0)	36.5 (34.0, 40.5)	24.0 (23.0, 26.1)
	rho* (p)	rho* (p)	rho* (p)
Age (y)	−0.017 (0.809)	−0.285 (<0.001)	−0.120 (0.082)
BMI	0.062 (0.398)	−0.236 (0.001)	0.035 (0.633)
Years of employment	0.059 (0.408)	−0.213 (0.002)	−0.062 (0.381)

BMI, body mass index; GJCQ, Greek version of the Job Content Questionnaire; IQR, interquartile range.
* Spearman's rank correlation coefficient (rho).

4. Discussion

The main purpose of our study was to investigate the psychometric properties of the JCQ in a sample of Greek health care workers. The internal consistency of the scales was found to be acceptable. Based on the confirmatory factor analysis and the modification indices, we proposed a slightly modified three-factor version of the JCQ. The proposed construct was found to be valid for our study population.

In our study, the internal consistency was good for the core scales except for PJD, a finding consistent with previous Western and Asian studies. In line with the reported internal consistency of other studies [1,13,15,31], DL had an acceptable Cronbach α coefficient. The Chronbach α coefficient was good for the SS scale, demonstrating the adequate internal consistency of the scale. PJD demonstrated the lowest internal consistency of the three scales, although the rate is comparable with that reported by Karasek et al [1] and Eum et al [13]. Concerning the internal consistency of the subscales of DL, the skill discretion subscale was acceptable whereas the decision authority subscale was low. Nonetheless, analogous patterns have been found by Eum et al [13] and Choobineh et al [21]. The internal consistency of the SS subscales was high.

As far as the scale score levels are concerned, the pattern of the mean scores in the three main scales was comparable to that of other studies that focused on health care worker populations, but slightly higher in one of the three scales, i.e., DL [13,15,21]. This might be at least partially explained by cultural differences, as these studies come from Eastern cultures. The mean score of DL was 69 compared to the range of 58–64.2 in the other studies [13,15,21]. The mean score of PJD was 36 compared to the range of 33.5–35 in other studies conducted in health care employees [13,15]. Finally, the mean score of SS was 24, whereas in other studies it ranged from 21.7 to 23.3 [13,15,21].

Additionally, we found that several demographic characteristics were related to the mean score levels of the three main scales of GJCQ. Job category was significantly related to the score levels of DL and PJD, which has been noted by other studies as well [13,15,32]. We have also found that the mean score of PJD is different across education levels, with those having completed lower levels of education reporting lower PJD values on average. This result might be explained by the fact that those employees are required to perform more automated tasks that do not include highly demanding intellectual work. Furthermore, the employees with circular work shift including night had the highest DL and PJD on average. Finally, in our results it was apparent that age and years of employment were negatively related with PJD. It is possible that, with age, and the accompanying experience, the employees are getting more familiar with their job responsibilities and, thus, their psychological workload decreases.

The correlations between the three scales were also explored in our study. Specifically, DL and PJD were found to be negatively correlated, as also shown in other studies [1,15]. Additionally, SS had a strong positive correlation with DL, also in agreement with previous studies [1,15,16], and a strong negative correlation with PJD, in line with existing research [15,32].

In the exploratory factor analysis, six factors were formed that reflected to a great degree the subscales of the original JCQ (decision authority, skill discretion, PJDs, supervisor support, and coworker support). In the confirmatory factor analysis, taking into account the correlation between the items of the original subscales, the original structure of the construct had not been confirmed. Further analysis showed that the fit of the model considerably improved when several items were allowed to be loaded by more than one factor. Specifically, in the final fitted model, the items *repetitive work* and *develop own abilities* were allowed to be additionally loaded by PJD, the item *allows own decisions* by SS, and the items *work hard* and *work fast* by DL. The modified model had a good fit to our sample and also had a statistically significantly superior fit compared to the original structure. The original and revised JCQ scores exhibited very high correlation levels and also similar criterion validity, with an exception regarding the subtle superiority of the revised PJD scale. However, there was no statistical evidence for an association between both versions of the JCQ with self-reported general health score. In conclusion, there is evidence that our modification led to a valid measure of work-related psychosocial characteristics in our population, but this modification is not too extensive that could result in a significant departure from the original theory conceived by Karasek et al [1].

In our study population, repetitive work is probably perceived as an indication of low control and a source of psychological demand in the workplace as well. Previous studies have also found that the item *repetitive work* is loaded by the same factor that loads items of the PJD scale [10,11,13,15]. Furthermore, according to Bonde et al [33], repetitive work, such as the task cycle time, might constitute a physical characteristic of a job, but it is also related to psychosocial factors, time pressure, and perceived job demands. Therefore, repetitive work could be perceived as a psychological load for the employees of our population. As far as the item *develop own abilities* is concerned, Edimansyah et al [12] found that it is highly correlated with the items of PJD and loaded by the same factor. It appears that the high opportunities for developing personal skills provided by a job position (high control) are also perceived as psychologically demanding (high demands) in our study population. A possible explanation for this phenomenon is that a work environment that favors skill growth is more competitive and demands stronger mental efforts, and thus, for Greek health care workers, although it is conducive to skill development, it is also regarded as psychologically

pressing to some extent. Moreover, our suggestion that the items *work hard* and *work fast* are additionally loaded by the DL is consistent with the results of Choobineh et al [21], who have noticed that these items are loaded by the same factor that loads the items of PJD. Apparently, for Greek health care workers difficult and fast work tasks indicate not only high demands, but also low control in the workplace, maybe because such types of tasks do not allow flexibility in deciding what skills to use and, consequently, they are not susceptible to control and burden employees with psychological load. Finally, the finding that *allows own decisions* item was additionally loaded by the SS suggests that, when a position requires decision-making by the individual, the workplace is perceived not only as less controlling, but also less socially supportive. This may be common in hierarchical organizational structures such as hospitals and reflects the unwillingness to make decisions.

Our study has certain limitations. First, a major limitation is that the response rate was not very high. Second, the sample size was not very large. Further exploration would be useful in order to take into account the heterogeneity of the study population regarding the job categories, which was not possible to carry out in our study because of the sparseness of the data. Furthermore, given that our sample came from a health care setting, further studies need to be conducted including a larger variety of occupations before the GJCQ can be safely applied to the whole Greek worker population. Finally, future research could be done to evaluate the stability of our results in time using a longitudinal design.

In conclusion, our study has confirmed the existence of three factors consistent with Karasek's Demand–Control–Support model. However, the structure of the GJCQ was slightly different from that of the original. Our findings suggest that the GJCQ has satisfactory reliability and validity in the Greek health worker population and can be safely used as a measure of the psychosocial characteristics in this workplace.

Conflicts of interest

The authors declare no conflicts of interest.

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Appendix 1. Revised formulas for the Greek version of Job Content Questionnaire (JCQ).

The additional items to those of the original JCQ are indicated in red.

Skill Discretion = [Q3 + Q5 + Q7 + Q9 + Q 11 + (5 – Q4) + Q19 + Q20] * (3/2)

Decision Authority = [Q6 + Q10 + (5 – Q8)] *4

Decision Latitude = Skill Discretion + Decision Authority

Psychological Job Demands = [(Q19 + Q20 + Q4) * 2 + (20 – (Q22 + Q23 + Q26 + Q11)) * (3/2)]

Supervisor Support = Q48 + Q49 + Q51 + Q52

Coworker Support = Q53 + Q54 + Q56 + Q58

Social Support = (Coworker Support + Supervisor Support) * (64/65) + Q6 * (8/65)

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