

Occupational Health Promotion Using Online Visual Representation on Internet for Consultation

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Abstract

Objective: To show an on-line visual representation to a mental health related Doctor for consultation and to compute the prevalence rate of work strain for a workplace.

Methods: Exploration factor analysis and parallel analysis were used to validate the items retained in the Chinese-version of the Job-Content Questionnaire (C-JCQ). The setting was a 900-bed hospital in southern Taiwan. A total of 1,800 full-time workers in this hospital were asked to participate in a job perception survey in May 2009. One way analysis of variance (ANOVA) was applied to analyze the differences in work strain among work sections. A visual representation of the C-JCQ findings was then prepared to provide practitioners with a tool for use in clinical settings.

Results: The prevalence rate of hospital workers' strain in the study workplace was 13.26%. There were significant differences among work sections on most C-JCQ subscales.

Conclusions: Periodical surveys of the quality of work life with the C-JCQ are urgently needed. A visual representation of C-JCQ findings could be made available to highlight the need for mental health consultation in clinical settings.

Keywords: Visual representation; Mental health; ANOVA

Abbreviations: ANOVA: One Way Analysis of Variance; C-JCQ: The Chinese-version of the Job-Content Questionnaire; CS: Coworker Support; CTT: Classic Test Theory; DA: Decision Authority; DL: Decision Latitude; EFA: Exploratory Factor Analysis; IRT: Item Response Theory; JCQ: Job Content Questionnaire; KMO: Kaiser-Meyer-Olkin; PA: Parallel Analysis; PD: Psychological Job Demand; QWL: Quality of Work Life; SD: Skill Discretion; SS: Supervisor Support; VBA: Visual Basic for Application; WPS: Workplace Support

Introduction

The evolution of the quality of work life (QWL) began in the late 1960s, emphasizing the human dimensions of work by focusing on the quality of the relationship between the workers and working environment [1]. With the increasing concern about job stress on workers, many researchers [2-4] have addressed psychosocial job stress and its adverse effects on health. The topic of occupational stress currently thus receives considerable research attention and is an important issue of occupational health from a QWL perspective.

Many studies that adopt different scales report the prevalence of work-related stress among workers in various workplaces [5-9]. However, it is difficult to compare these rates of job strain prevalence each other because using different job stress scales and definitions. Among many job stress scales, the Job Content Questionnaire (shortened for JCQ) developed by Karasek [10,11] is ultimately famous in the world. The JCQ is one of the leading theoretical work-related stress models, which is applicable to all jobs and all workers for predicting job related stress and coronary heart disease [9,10,12] and for studying work motivation, job satisfaction, absenteeism, and labour turnover [10,13,14] besides adopted by many epidemiological studies to measure general work content [5]. There are so many language translation versions of JCQ shown at <http://www.jcqcenter.org/Translations.html>, including the Chinese C-JCQ [15] that was used in this study.

In the demand-control model, workplace stress is a function of job demand and decision latitude. Job demands represent the psychological stressors in the work environment, and decision latitude refers to employees' control over their tasks and how those tasks are wholly executed by their own willingness. Four types of jobs are classified: (a) passive (low latitude and low demand), (b) active (high latitude and high demand), (c) high strain (low latitude and high demand), and (d) low strain (high latitude and low demand) [9,10]. High strain jobs are the most likely to cause adverse psychological reactions and directly associated with the computation of the prevalence rate of work strain in a workplace [9,10,12].

Primary care providers have high expectations for how online programs or instructions should deliver services to patients and fit into the clinical workflow [15]. It is interesting to depict a diagram incorporated with the above mentioned four quadrants to provide clinical practitioners for employee's job stress consultation.

Objectives

This study aimed (1) to present an on-line visual representation to a mental health related Doctor for consultation, (2) to show the prevalence rate of work strain in a workplace, and (3) to analyze the

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difference of employee's job stress among work sections using C-JCQ assessment.

Materials and Methods

Study sample

The setting was a 900-bed hospital in southern Taiwan. A total of 1,823 full-time workers in the studied hospital participated in a job perception survey with the 3-point 22-item C-JCQ in May of 2009. Several demographic features including age, work tenure, job type, marital status, employment status, and education level were required to respond. There are 4 items with a reverse scoring response according to respondent's perception from 0 (strongly disagree) to 3 (strongly agree).

Without further follow-up prompts to respondents, a total of 1,257 employees completed the C-JCQ (return rate=68.95%). One hundred fifteen participants were excluded because they did not provide information on age, gender, had not worked for more than three months, were part time workers, or did not answer all of the C-JCQ 22 items (i.e., missed any one of the 22 items). As a result, the responses of 1,124 workers (62.64% of 1,823) were analyzed (Table 1). This study was approved by Taiwan Chi-Mei Hospital Review Board.

22-item C-JCQ scale

The C-JCQ was used with permission from the author [16]. It consists of 22 three-point Likert items (0 = strongly disagree, 1 = disagree, 2 = agree, 3 = strongly agree) on five subscales: skill job discretion (six items), decision authority (three items), psychological job demand (five items), supervisor support (four items), and coworker support (four items) [16]. The latter two subscales are referred to workplace support (WPS). Firstly, we converted the reverse scoring responses into monotonically increasing sequence. Secondly, the summation score (X) ratio (p) to the totally maximum score for each subscale was created by the formula of $p = X / (3 \times L)$, where L stands for item length of the subscale. Lastly, to represent job strain exposure in a graphical plot (i.e., the above mentioned four quadrants), we transformed the summation score ratio (p) to a coordinate position with the formula of $p' = (p - 0.5) \times 8$, where 0.5 (=1.5/3) is yielded by computing the ratio of scoring median in the range between 0 and 3 (=1.5) to the upper scale score (=3). The value of p' is in a range between -4 and 4 on the respective horizontal (Y) or vertical (X) axes. For instance, the subscale of 5-item psychological job demand can produce a coordinate score of -1.36 (i.e., $p' = (0.33 - 0.5) \times 8 = -1.36$) when $p = 5 / (3 \times 5) = 0.33$ in case the summation score equals to 5.

Data analysis

6.3.1 Scale dimension and reliability: When a set of items is designed to measure the same construct (e.g., quality of work life), item scores are often summed to represent the level of the construct. This summation method assumes that all items contribute equally to the construct and that all items are substantially related to the common construct. Otherwise, the summation score is meaningless and the assumptions are problematic [17].

The exploratory factor analysis is often used to examine whether items measure a common construct in social science. In tradition, we adopt Kaiser [18] eigenvalue greater than one or Cattell [19] scree plot to determine the number of factors (domains or dimensions). From empirical research results, parallel analysis (PA) [20] is one of the

most accurate ways to determine the number of factors [21,22]. KMO (Kaiser-Meyer-Olkin) and Bartlett Sphericity test are used to examine whether the scale is appropriate for conducting the exploratory factor analysis. The reliability of a scale (i.e., Cronbach's α) is then to report whether it is greater than 0.7.

Calculating the prevalence rate of work strain in a workplace: The ratio of the explosion number in quadrant IV (high strain, low latitude and high demand) to the surveyed sample size in the diagram of four quadrants constructed by Karasek et al. [10,11] demand-control model is applied to calculate the prevalence rate of work strain in a workplace [9]. It is worth noting that the high-rank employees in quadrant I (active, high latitude and high demand) are excluded from the computation of the work strain prevalence rate.

Analyzing the difference of employee's job stress among work sections: One way analysis of variance (ANOVA) was applied to analyze the differences in work strain among work sections. We considered differences to be significant at the $p < .05$ level.

Programming an on-line visual representation to Doctors for consultation: ASP (Application Service Provider) language was used to programming an on-line visual representation of C-JCQ diagnosis designed to provide practitioners for use in clinical settings. The scatter plot that constructs the diagram of four quadrants according Karasek et al. [10,11] demand-control model is shown to readers. In which, an asterisk representing the job stress coordinate position of a specific examinee is labeled on the diagram. A # signal to stand for WPS [supervisor support in the vertical (X) axle and coworker support in the horizontal (Y) axle] in the plot. The number of examinees is shown for each spot (e.g., 1 for 1, A for 10, and F for 15, etc.). The diagram is expected to provide mental health-related Doctors with on-focus information for worker consultation in job stress.

Statistical analysis: We used SPSS version 15 (IBM Corporation, Somers, NY, USA) for analysis and plotting. MS-Excel-VBA (visual basic for application) module was programmed to plot the PA [20] approach for determining the number of factors.

Results

Demographics

Full data sets were available for 1,124 employees in four job types of Doctor, nurse, technician, and administrator. Among them, non-managerial workers account for 84.07%. Nurses account for 64.50 %. A 2-sample t test in gender was performed to determine that there was a significant difference between groups with respect to the mean of age and work tenure. Chi-square tests showed that significant differences were found in association between groups of gender and variables instead of employment status in Table 1.

The exploratory factor analysis

There are 5 factors extracted from the 22-item C-JCQ by the PA approach shown in Figure 1. KMO (=0.876) and Bartlett Sphericity test ($p = 0.000$) verified that the C-JCQ is appropriate for conducting the exploratory factor analysis. The explained variance accounts for 58% in these 5 factors. The least reliability (0.57) is decision authority (DA). The highest (0.88) is supervisor support (SS). The reliability less than the criterion of 0.70 in DA is ascribed to the reason of short item length with 3 items. However, all of item factor loading in DA are above 0.70, indicating that DA is acceptable for measurement.

Variable	Male		Female		Total	Statistical
	Mean	SD	Mean	SD		
Age (years)	33.23	5.79	29.1	4.32		t=9.65***
Work tenure (years)	5	4	3.9	3.3		t=3.45**
	N	%	N	%		
Proportion for gender	120	10.68	1004	89.32	1124	$\chi^2=909.62^{***}$
Age (Average years)						$\chi^2=52.98^{***}$
1.21~30	33	5.5	567	94.5	600	
2.31~45	80	15.69	430	84.31	510	
3.46~60	7	50	7	50	14	
Work tenure						$\chi^2=12.07^{**}$
1. Within 1 year	6	10.71	50	89.29	56	
2.1-39	33	7.48	408	92.52	441	
3.3.1-10	65	11.95	479	88.05	544	
4.>10	16	19.28	67	80.72	83	
Job type						$\chi^2=26511^{***}$
1.Administration staff	65	26	185	74	250	
2.Technician	24	19.67	98	80.33	122	
3.Nurse	10	1.38	715	98.62	725	
4.Physician	21	77.78	6	22.22	27	
Marital status						$\chi^2=22.79^{***}$
1.Single	60	7.91	699	92.09	759	
2.Married	60	17.29	287	82.71	347	
3.Widowed/Separated/ Divorced		0	8	100	8	
Employment status						$\chi^2=1.11$
1.Managers/administrators	19	13.77	119	86.23	138	
2.Low-skilled staff	98	10.37	848	89.63	946	
Education level						$\chi^2=36.83^{***}$
1.Senior high school	4	18.18	18	81.82	22	
2.College	22	6.43	320	93.57	342	
3.University	76	10.76	630	89.24	706	
4.Graduate school	18	33.33	36	66.67	54	
*p<0.05; **p<0.01; ***p<0.001						

Table 1: Demographic characteristics and work conditions of the study population (n = 1,124).

Calculating the prevalence rate of work strain in a workplace

According Karasek et al. [9,10] classification that combines skill job discretion (SD) and decision authority (DA) together and forms a Decision Latitude (DL), Through which, DL with psychological job demand (PD) that can be plotted in a diagram of the four quadrants [9,10]. Accordingly, we performed the exploratory factor analysis once again using these 14 items with eigenvalues of 3.12 (= 1.74+1.38) and 2.90 in Table 2 in 9-item DL and 5-item PD, respectively, to examine whether SD and DA can be combined as an acceptable DL domain. After conducting the factor analysis, we found that the factor loadings of DL and PD are in a range of 0.35-0.65 and 0.72-0.78, respectively, indicating that SD and DA can be combined as DL domain shown in Figure 2.

The examinee summation score ratio (p) to a coordinate position

with the formula of $p^* = (p - 0.5) \times 8$ can be transformed and scattered in a plot (Figure 3). The prevalence rate of work strain in a workplace is 13.26% (=149/1,124).

Analyzing the difference of employee's job stress among work sections

It can be seen in Table 3 that there are significant differences in SD, PD, and CS among job types. Post hoc Scheffé test shows that administrators earn higher satisfaction in CS but lower in SD and PD than other job types. In contrast, nurses gain higher satisfaction in SD and PD and lower in CS than others.

Programming an on-line visual representation to Doctors for consultation

An on-line visual representation was plotted in Figure 3 with two

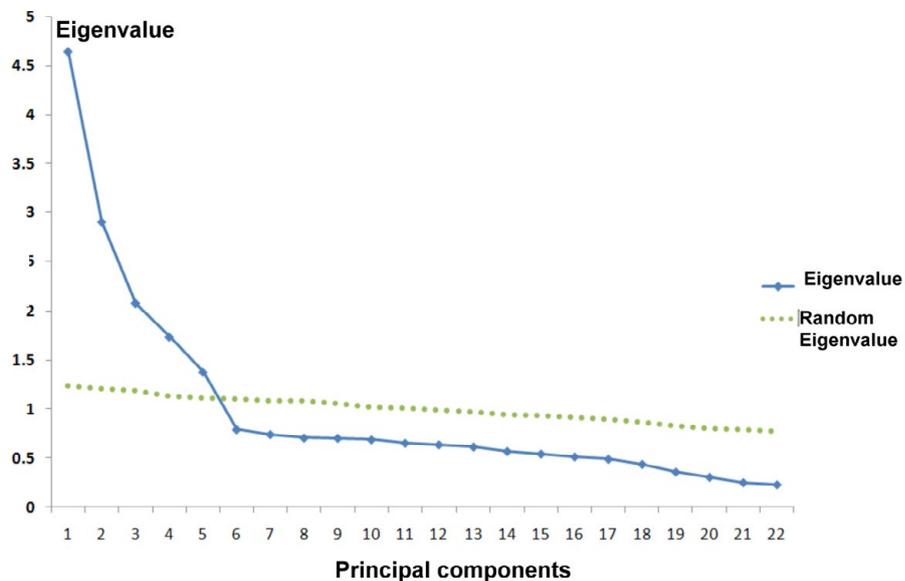


Figure 1: Determining the number of factors in C-JCQ by parallel analysis.

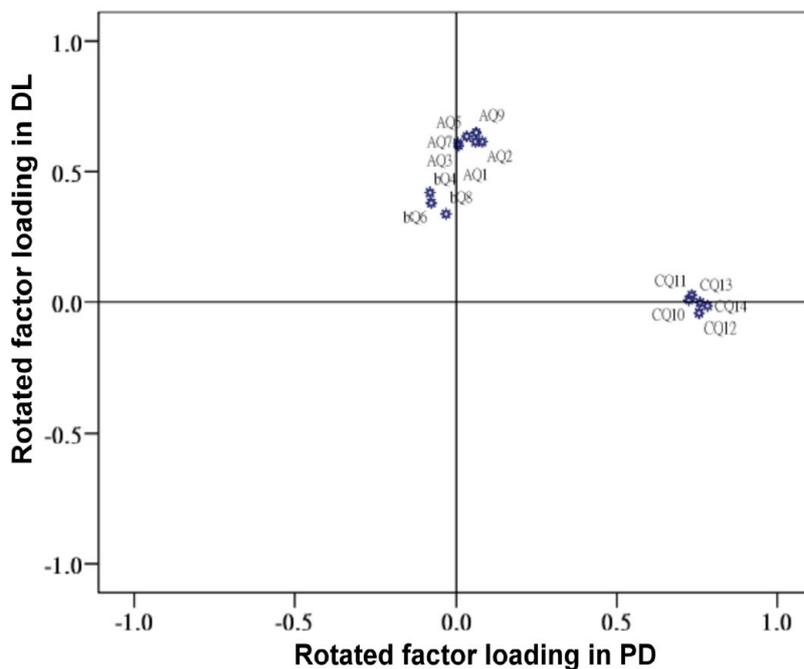


Figure 2: Rotated factor loadings in DL and PD.

axes of PD and DL (at http://www.healthup.org.tw/scater/output_scater.asp) to show the examinee job stress with asterisk signal. In addition, SS and CS to coordinate WPS were jointly positioned with the # signal. We can see that the examinee job content is located in quadrant IV on the right-side bottom (high strain, low latitude and high demand). However, the WPS is at the upper-left-side quadrant II that indicates supervisor support is substantially insufficient. The diagram can provide mental health-related Doctors focusing on a small area for worker consultation in job stress.

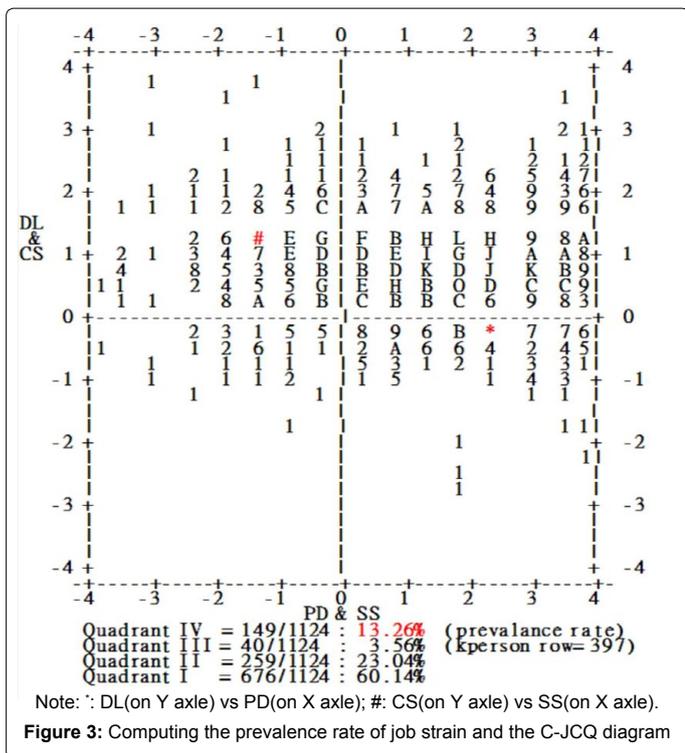
Discussion

We found that (1) the prevalence rate of hospital workers' strain in the study workplace was 13.26%; (2) there were significant differences among work sections on most C-JCQ subscales. Administrators earn higher satisfaction in CS but lower in SD and PD than other job types. In contrast, nurses gain higher satisfaction in SD and PD and lower in CS than others; (3) a visual representation of C-JCQ findings could be made available to highlight the need for mental health consultation in clinical settings.

	Items (3-point subscale) (From strongly disagree to strongly agree)	Factor loading					Cronbach's Alpha
		1	2	3	4	5	
DL	SD: Skill job discretion						
	1. My job requires that I learn new things				0.64		0.73
	2. My job involves a lot of repetitive work				0.6		
	3. My job requires me to be creative				0.62		
	5. My job requires a high level of skill				0.68		
	7. I get to do a variety of different things in my job				0.63		
	9. I have an opportunity to develop my own				0.67		
	DA: Decision authority						
	4. My job allows me to make a lot of decisions					0.7	0.57
	6. On my job, I have very little freedom to ...					0.71	
8. My job allows me to make a lot of decisions.					0.76		
PD	PD: Psychological job demand						
	10. My job requires working very quickly		0.72				0.81
	11. My job requires working very hard		0.73				
	12. I am not asked to do an excessive amount of work		0.76				
	13. I have enough time to get the job done		0.75				
	14. I am free of conflicting demands that others make		0.78				
WS ¹	SS: Supervisor support						
	15. My boss is concerned about the welfare of us	0.81					0.88
	16. My boss pays attention to what I am saying	0.82					
	17. My supervisor is helpful in getting the job done	0.88					
	18. My boss gets people to work together well	0.79					
	CS: Coworker support						
	19. People I work with take a personal interest in me			0.63			0.84
	20. People I work with take a personal interest in me			0.86			
	21. People I work with are friendly			0.88			
	22. When needed, my colleagues will help me			0.81			
Pre-rotated eigenvalue	4.65	2.9	2.08	1.74	1.38		
Cumulative variance (%)	21.1	34	43.8	51.7	58		
Post- rotated eigenvalue	2.92	2.9	2.74	2.6	1.63		
Cumulative variance (%)	13.3	26	38.8	50.6	58		

Note. ¹ reverse scoring response; ¹ Workplace support = supervisor support + coworker support

Table 2: Domain checking for Decision Latitude L(C-JCQ) by EFA.



There are 5 factors that can be extracted in the 22-item C-JCQ questionnaire. However, the SD and DA can be combined as a DL domain shown in Figure 2, indicating that SD and DA have a higher correlation in contrast to PD. Accordingly; DL can be incorporated with PD plotted in a diagram of the four quadrants shown in Figure 3. It is congruent with the two subscale analysis of Karasek et al. [9,10] to highlight the coordination of the job stress and stain for a workplace, and meant that the visual representation of C-JCQ findings could be made available for mental health consultation in clinical settings.

For instance illustrated for an examinee in Figure 3, the # signal was located at quadrant IV in the area of high strain (low latitude and high demand) accounting for 13.26% to the study sample size, which means that the examinee suffers from somewhat high strain but not substantial due to closing to the central. We further refer to the # signal located at quadrant II with a low supervisor support and high coworker support. The mental health consultant should focus more suggestions and efforts to the examinee on upgrading supervisor support in the workplace.

Limitations and directions

Chi-square tests showed that significant differences were found in association between groups of gender and variables instead of employment status in Table 1. It can be seen in Table 3 that there are significant differences in SD, PD, and CS among job types. Administrators earn higher satisfaction in CS but lower in SD and PD than other job types. In contrast, nurses gain higher satisfaction in SD and PD and lower in CS than others. Nevertheless, those findings cannot be generalized to other kinds of workplaces in Taiwan or around the world because it is difficult to compare these rates of job strain prevalence each other because using different job stress scales and definitions [5-9]. The C-JCQ diagram can be applied to other workplaces and availablely made in comparison with the job strain prevalence rate (e.g., 13.26% in this study) to each other (e.g., 21% in Malaysian office workers [9]) when the JCQ is adopted in any other languages (referred to websites at <http://www.jcqcenter.org/Translations.html>).

Implication and further studies

The reliabilities of Cronbach's α are 0.73, 0.57, 0.81, 0.88 and 0.84, respectively for each subscales in Table 3, somewhat different from the previous study ($\alpha = 0.71, 0.69, 0.55, 0.86$ and 0.86) [16] using the C-JCQ in Taiwan. The least reliability of subscales in this study is the DA (0.57), different from that the PD (0.55) in the study of Cheng et al. [16]. The reasons can be ascribed to (1) different workplaces(hospital versus telecommunication company) with different sample variances leading to different Cronbach's α ; (2) less item length(e.g., the DA with 3 items); and (3) different semantic meaning and understanding of words to specific items in the translated C-JCQ. When referring to the factor loadings of items beyond 0.70 in the DA subscale in Table 2, we make sure that each item earns a high correlation with the construct of latent train entity. The reliability can be increased to 0.70 when the item length reaches to 4 (similar to the subscales of SS and CS) according to the Spearman-Brown prediction formula, new item length= original 3 items $\times 1.228 = 0.7 \times (1-0.57)/(0.57 \times (1-0.57))$.

Another issue is regarding to the summation scores for each subscale that all items should be assumed measuring a common construct and all endorsed responses are interval instead of ordinal scores. Even if 5 factors were extracted from the C-JCQ in Table 2 and Figure 1 and

Subscale	n	Mean	Difference (p<0.05)	F-ratio Prob.
SD:				11.098
(1) Adm. staff	250	6.60	(2)(3)	p< 0.001
(2) Technician	122	7.16	(1)	
(3) Nurse	725	7.21	(1)	
(4) Physician	27	7.38		
DA:				0.0602
(1) Adm. staff	250	5.92		p = 0.981
(2) Technician	122	5.96		
(3) Nurse	725	5.97		
(4) Physician	27	6.02		
PD:				11.318
(1) Adm. staff	250	6.60	(3)	p< 0.001
(2) Technician	122	6.79	(3)	
(3) Nurse	725	7.62	(1)(2)	
(4) Physician	27	6.82		
SS:				0.818
(1) Adm. staff	250	7.34		p = 0.484
(2) Technician	122	7.17		
(3) Nurse	725	7.38		
(4) Physician	27	7.69		
CS:				2.862
(1) Adm. staff	250	8.01	(3)	p = 0.036
(2) Technician	122	7.82		
(3) Nurse	725	7.70	(1)	
(4) Physician	27	7.91		

Table 3: ANOVA in the comparison of groups on subscales.

the SD and DA can be combined together to form a common entity (DL) shown in Figure 2, the C-JCQ is constructed with 3-point ordinal scores. Stevens [23] addressed that "In fact, psychologists often use scales that are ordinal. Strictly speaking, each statistics related to the mean or standard deviation of data cannot be assumed to be interval because the requirement for a scale using ordinal scores is not sufficient in measurement". Unfortunately, the alert claimed by Stevens seems not to be noted. In practice, many researches still commonly consider the ordinal as the interval in response scores for a scale to perform the computation of the mean and standard deviation of data [17].

As item response theory (IRT) is increasingly popular in the fields of social science and psychometrics, especially applying Rasch [24,25] model's transformed interval scores to a target of the post hoc statistical analyses and tests that might be making different inferences to the results yielded by the summation scores [26] in Table 3. However, the prevalence rate of job strain must be same to each other because specific objectivity [17,24] is one of Rasch model's features that lead Rasch scores to match up the summation scores in order and to distribute the counts in quadrants equivalently. Furthermore, any subscale score of an examinee transformed by the formula of $p' = (p - 0.5) \times 8$ is independent to others, indicating that any new examinee is easily enrolled into the C-JCQ diagram (Figure 3) in comparison for clinical consultation.

Conclusions

Periodical surveys of labor quality of work life with C-JCQ are urgently in need. The graphical representation system to report the individual work stain in workplace can be applied to clinical settings in use and to the prevalence rate of work strain in computation.

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