Original Article

Factorial Structure for the Brief Job Stress Questionnaire in Japanese Health Care Workers

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ABSTRACT

Background: Health care workers have high levels of distress, which might lessen their ability to provide safe services. The Brief Job Stress Questionnaire (BJSQ) was developed in Japan and has been used as an instrument to identify job stress among workers in a variety of industries. We used exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) of BJSQ results to clarify the structure of job stress in health care workers.

Methods: This cross-sectional survey assessed 8700 health care workers in 13 acute care general hospitals in Japan between January and November 2009. The overall response rate was 89.0%. We clarified the structure of job stress in health care workers using EFA and CFA of BJSQ results.

Results: EFA showed that the Stress Response and Social Support scales had factor structures similar to the original model, while the Job Stressor scale had a 5-factor model that differed from the original factor structure. CFA indicated that the factor structure identified by EFA might perform better than the original model.

Conclusions: Health care workers may have different factor structures on the BJSQ than do workers in other industries.

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KEYWORDS: job stress, health care worker, Brief Job Stress Questionnaire, confirmatory factor analysis, exploratory factor analysis

Health care workers are reported to have higher distress levels than do workers in other industries. A systematic literature review[1)] found that increased psychological distress was associated with organizational climate, long work hours, work overload and pressure, lack of control over work, lack of participation in decision making, poor social support, and unclear management and work roles. Job-related stress leads to anxiety and depression, burnout, and psychosomatic diseases and a consequent deterioration in quality of life and service provision.[1–4)] Reducing work stress is important in preventing stress-related diseases and improving worker health.

Several self-report rating scales have been developed to measure job stress, including The National Institute for

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Occupational Safety and Health (NIOSH)[5] Generic Job Stress Questionnaire, the Job Content Questionnaire (JCQ) of Karasek et al.,[6] the Job Stress Scale Revised Version (JSS-R) by Kosugi et al.,[7] and the Brief Job Stress Questionnaire (BJSQ) by the Japan Ministry of Labour.[8] The BJSQ was designed by Shimomitsu et al.[8] to measure worker job stress using the minimum number of items. It is a 57-item multidimensional job stress questionnaire and uses 4-point Likert response options (from strongly agree = 4 to strongly disagree = 1) to measure Job Stressor, Stress Response, and Social Support. The BJSQ can be answered with ease and has been widely used as an assessment instrument to identify worker job stress in a variety of studies, including among workers in manufacturing industries,[9] sales and service workers,[10] engineers,[11, 12] teachers,[13] doctors,[14] and nurses.[15]

A few studies have conducted exploratory factor analysis (EFA) of the factor structure of the BJSQ. Shimomitsu et al.[8] examined the BJSQ in 12274 manufacturing workers (2185 women, 10089 men) in Japan. The Job Stressor score was assessed using 17 items from the BJSQ and had 5 subscales. The Stress Response scale was assessed using 29 items, and had 6 subscales. The Social Support scale was assessed using 11 items, and had 4 subscales. To date, there has been no research on factor validity in health care workers. Furthermore, little information is available on confirmatory factor analysis (CFA) of the BJSQ.

The purpose of this study was to structure identify the factor structure of the BJSQ in health care workers. First, to identify a more suitable factor structure in health care workers, we conducted EFA. Second, a CFA was conducted to assess the goodness of fit of the model of Shimomitsu et al.[8] and the factor model identified by EFA. Third, we calculated Cronbach's α coefficients to measure internal consistency.

Methods

1. Participants

This cross-sectional survey of health care workers in 13 acute care general hospitals in Japan was conducted from January through November 2009. The 13 hospitals voluntarily joined this study and included 8 urban hospitals and 5 rural hospitals. One of the hospitals was a university hospital, and 12 were teaching hospitals. Bed size varied from 78 to 1021 beds (3 hospitals < 300, 6 hospitals 300-500, and 4 hospitals > 500 beds). The questionnaires were distributed to health care workers with a sealed reply envelope and were collected anonymously at a collection box in each hospital.

2. Measures

All subjects were assessed with the BJSQ,[8] which comprises 57 items that cover Job Stressor, Stress Response, and Social Support. The Job Stressor scale includes 5 factors: quantitative overload, mental demand, interpersonal relations, job control, and job fitness. The Job Stressor scores for all factors are summed to yield a total score ranging from 17 to 68. The scale has acceptable internal consistency for the 5 subscales ($\alpha = 0.64$-0.79) and for total score ($\alpha = 0.74$).[8] The Stress Response scale comprises lack of vigor, irritability, fatigue, anxiety, depressed mood, and somatic symptoms. The Stress Response scale yields a total score ranging from 29 to 116 and has acceptable internal consistency for the 6 subscales ($\alpha = 0.71$-0.89) and for total score ($\alpha = 0.84$).[8] The Social Support scale includes supervisor support, coworker support, and family support. The Social Support scale yields a total score ranging from 9 to 36 and has acceptable internal consistency for the 3 subscales ($\alpha = 0.76$-0.83) and for total score ($\alpha = 0.83$).[8] We excluded 2 items related to satisfaction from Social Support. Although the subjects of "Social Support" were decided, such as supervisor, coworker, and family, the subjects of the 2 excluded items differed from those of the other 9 items (*e.g.*, "I have a sense of job satisfaction" and "I have a sense of home life"). In addition, 1 factor could not be composed of 2 question items.

3. Statistical analysis

A 3-step analysis was conducted. For the first step, we conducted an EFA with promax rotation to identify the factor structure of the BJSQ among the health care workers. The maximum likelihood method was used for estimation. The criteria for retention of factors were the scree plot test and interpretability of the factors. For each of the identified dimensions, BJSQ items with loadings greater than 0.35 were retained and used to construct a quantitative scale.[16, 17]

For the second step, to assess the goodness of fit of the model of Shimomitsu et al.[8] and the factor model identified by EFA, a series of CFAs were carried out. The maximum likelihood procedure was used for estimation. Nine fit statistics were used to assess the best model fit: χ^2, comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA) and its 90% confidence intreval (CI), standardized root mean square residual (SRMR), Akaike information criterion (AIC), consistent

Akaike information criterion (CAIC), and Bayesian information criterion (BIC).

The χ^2 test assesses the magnitude of the discrepancy between the sample and the fitted covariance matrix. A non-statistically significant χ^2 value indicates good model fit. The CFI is a measure of proportional increase in fit over a null model. The CFI varies from 0 to 1, and a CFI value greater than 0.95 indicates a good model fit. The TLI, also known as the non-normed fit index (NNFI), combines a measure of parsimony into a comparative index between the proposed and null models, resulting in values ranging from 0 to 1. RMSEA values of 0.05 or less indicate a reasonable error of approximation in the population. The SRMR is the average discrepancy between the correlations observed in the input matrix and the correlations predicted by the model. The SRMR ranges between 0 and 1, with 0 indicating a perfect fit. The AIC permits comparison of non-nested models. Generally, models with the lowest AIC are judged to fit the data better than alternative solutions. The CAIC is a measure of the global fit of a cluster model to the input data, and the smallest CAIC value indicates the best fit. The BIC is a criterion for model selection among a class of parametric models with different numbers of parameters. The model with the lowest BIC is preferred.

For the third step, to measure internal consistency, we calculated Cronbach's α coefficients. The software package Mplus (Mplus version 3.0) was used for CFA. An EFA was also conducted, and Cronbach's α coefficients were calculated using SPSS 17.0.

Results

We surveyed all health care workers in the participating hospitals and received responses for 8777 of the 10395 questionnaires sent. We excluded 77 questionnaires collected from participants who had not answered more than 1 entire section of the survey. Missing values were replaced by the mean scores of all respondents. A total of 8700 respondents were analyzed, and the overall response rate was 89.0% (ranging from 58.2-93.9%). Nurses were the largest group of respondents (55.6%), administrative workers were the second largest group (12.9%), and physicians were the third largest group (6.99%). The remaining respondents included pharmacists, dieticians, physical/occupational/speech/orthoptics therapists, technicians, janitors, and others. The characteristics of respondents are presented in Table 1.

Descriptive statistics of the Job Stressor scale are summarized in Table 2. We conducted EFA to identify a more suitable factor structure for the Job Stressor scale in the health care workers. A scree plot indicated a 5-factor solution. Factor loadings and factor intercorrelation matrices are presented in Table 3. Factor 1 reflects mental demand, factor 2 reflects job fitness, factor 3 reflects job control, factor 4 reflects discordance (although this factor has an item with a loading >0.35), and factor 5 reflects quantitative overload.

CFA showed evidence of Heywood cases with correlations between the emerging latent constructs of greater than 1, suggesting that the model reported by Shimomitsu et al.[8] did not fit the present survey results. Heywood cases can be caused by specification errors, nonidentification of the model, the presence of outlier cases that distort the solution, and other discrepancies.[18] The factor analysis model identified here showed acceptable measurement properties [$\chi^2 = 5436$, degrees of freedom (df) = 109, CFI = 0.86, TLI = 0.83, RMSEA = 0.075, RMSEA 90% CI = 0.073-0.077, SRMR = 0.065, AIC = 5217.6, CAIC = 4514.1, and BIC = 4623.1]. The Cronbach's α for the Job Stressor scale total score was 0.75. Cronbach's α for the subscale scores ranged from 0.58 to 0.75 (Table 2).

The scree plot of the Stress Response scale indicated a 6-factor solution. Factor loadings and factor intercorrelation matrices are presented in Table 4. Factor 1 reflects anxiety and depressed mood, factor 2 reflects somatic symptoms, factor 3 reflects fatigue, factor 4 reflects lack of vigor, factor 5 reflects irritability, and factor 6 reflects pain. The CFA showed that the Stress Response scale data were adequately fitted by the 6-factor model of Shimomitsu et al. ($\chi^2 = 18876$, df = 362, CFI = 0.88, TLI = 0.87, RMSEA = 0.077, RMSEA 90% CI = 0.076-0.078, SRMR = 0.062, AIC = 18151.7, CAIC = 15815.5, and BIC = 16177.5)[8] and the factor model identified here ($\chi^2 = 14851$, df = 362, CFI = 0.91, TLI = 0.90, RMSEA = 0.068, RMSEA 90% CI = 0.067-0.069, SRMR = 0.055, AIC = 14127.0, CAIC = 11790.8, and BIC = 12152.8). Cronbach's α for the Stress Response total score was 0.90. Cronbach's α for the subscale scores ranged from 0.80 to 0.92 (Table 2).

The scree plot of the Social Support scale indicated a 3-factor solution, similar to the model of Shimomitsu et al.[8] Factor loadings and factor intercorrelation matrices are presented in Table 5. CFA showed that the model of Shimomitsu et al.[8] fitted the Social Support scale data adequately ($\chi^2 = 4760$, df = 24, CFI = 0.89, TLI = 0.83, RMSEA =

Table 1 Characteristics of respondents (N＝8700)

Worker characteristics	n (%)	Hospital characteristics	n (%)
Job title		Bed size	
Nurse	4840 (55.6)	0-299 beds	3 (23.1)
Administrative worker	1126 (12.9)	300-500 beds	6 (46.2)
Physician	608 (7.0)	＞500 beds	4 (30.8)
Technician	542 (6.2)	Teaching status	
Dietician	372 (4.3)	Teaching hospital	12 (92.3)
Pharmacist	177 (2.0)	University hospital	1 (7.7)
Therapist*	302 (3.5)	Location	
Janitor	176 (2.0)	Urban	8 (61.5)
Other	485 (5.6)	Rural	5 (38.5)
No answer	72 (0.8)		
Age			
＜20	31 (0.4)		
20-29	2601 (29.9)		
30-39	2185 (25.1)		
40-49	1450 (16.7)		
50-59	1189 (13.7)		
＞59	562 (6.5)		
No answer	682 (7.8)		
Sex			
Female	1931 (22.2)		
Male	6240 (71.7)		
No answer	529 (6.1)		

*Therapist is physical/occupational/speech/orthoptics therapist.

Table 2 Descriptive statistics (Mean and SD) for the BJSQ

	M	SD	α	Range	
				Potential	Actual
Job Stressor	45.0	6.0	0.75	17-68	18-66.5
Quantitative overload (2 items)	5.9	1.5	0.72	2-8	2-8
Mental demand (5 items)	16.2	2.7	0.75	5-20	5-20
Job control (3 items)	7.7	1.9	0.70	3-12	3-12
Discordance (4 items)	9.1	2.2	0.58	4-16	4-16
Job fitness (3 items)	6.2	1.8	0.66	3-12	3-12
Stress Response	58.6	14.1	0.90	29-116	29-113
Lack of vigor (3 items)	6.3	2.3	0.92	3-12	3-12
Irritability (3 items)	6.7	2.3	0.88	3-12	3-12
Fatigue (4 items)	10.2	3.2	0.88	4-16	4-16
Anxiety & depressed mood (8 items)	14.9	5.8	0.92	8-32	8-32
Somatic symptoms (8 items)	11.4	4.3	0.83	7-28	7-28
Pain (4 items)	9.2	3.3	0.80	4-16	4-16
Social Support	19.6	4.8	0.84	9-36	9-36
Supervisor support (3 items)	7.8	2.1	0.82	3-12	3-12
Coworker support (3 items)	6.7	2.1	0.83	3-12	3-12
Family (3 items)	5.2	2.1	0.86	3-12	3-12

BJSQ: Brief Job Stress Questionnaire, M: mean, SD: standard deviation

Table 3 Factor loadings for exploratory factor analysis with promax rotation of Job Stressor scale (Maximum Likelihood)

Item (Job Stressor)	Factor					Communality
	Mental demand	Job fitness	Job control	Discordance	Quantitative overload	
4	**0.93**	0.05	−0.03	0.01	−0.24	0.58
3	**0.63**	0.03	0.01	−0.07	0.16	0.58
6	**0.57**	0.04	0.03	−0.03	0.13	0.47
5	**0.57**	−0.17	0.00	0.09	0.03	0.75
7	**0.36**	0.01	0.05	0.03	0.14	0.40
16	−0.04	**0.85**	−0.07	−0.02	0.00	0.39
15	0.10	**0.71**	0.06	−0.05	0.04	0.20
14	−0.13	**0.35**	−0.05	0.13	−0.01	0.52
9	−0.04	−0.07	**0.86**	−0.03	−0.07	0.67
8	0.13	−0.01	**0.68**	−0.05	0.11	0.37
10	−0.07	0.18	**0.44**	0.15	−0.07	0.49
11	0.04	−0.10	−0.01	**0.73**	0.03	0.35
12	−0.02	0.01	−0.05	**0.60**	0.02	0.32
13	−0.01	0.22	0.10	**0.39**	−0.04	0.20
17	0.05	0.11	0.01	**0.26**	0.06	0.51
2	0.29	0.01	0.00	0.03	**0.60**	0.69
1	**0.41**	0.02	−0.03	0.04	**0.51**	0.12
	Factor intercorrelation matrix					
F2	−0.16					
F3	0.18	0.41				
F4	0.11	0.44	0.34			
F5	0.35	0.05	0.10	0.15		

F2: Job fitness, F3: Job control, F4: Discordance, F5: Quantitative overload

0.151, RMSEA 90% CI = 0.147-0.154, SRMR = 0.044, AIC = 4712.4, CAIC = 4557.5, and BIC = 4581.5). The Cronbach's α for the Social Support total score was 0.84. Cronbach's α for the subscales of the Social Support scale ranged from 0.82 to 0.86 (Table 2).

Discussion

To date, no other study has reported a factor structure of the BJSQ using CFA of health care workers or has replicated the factor structure identified by Shimomitsu et al. in non-health care workers. EFA of the BJSQ showed that the Stress Response and Social Support scales on the BJSQ had a factor structure similar to the model of Shimomitsu et al., whereas the Job Stressor scale showed a 5-factor model that differed from the model of Shimomitsu et al.[8] CFA indicated that in health care workers the factor structure identified by EFA might perform better than the model of Shimomitsu and colleagues.[8] In addition, the total score and subscale scores of the BJSQ showed adequate internal reliability. These findings suggest that health care workers have different factor structures on the BJSQ than do workers in other industries.

For health care workers, EFA of the Job Stressor scale showed a 5-factor solution that differed from the factor structure of Shimomitsu et al.[8] The mental demand factor was very pure and comprised items related to concentration on work. Job fitness comprised items on adaptability of work content, work environment, and interpersonal relationships. Job control comprised items of feeling, reflection, and opinions about work. Discordance comprised the items on discrepancy of opinion and disagreement regarding work content and knowledge. Quantitative overload comprised items relating to amount of work. Although interpersonal relationships was a major factor among workers in other industries,[8] it was not identified as a factor in our study; rather professional aptitude was identified as a factor. These differences may be partly due to the fact that most participants in the study of Shimomitsu et al.[8] were manufacturing and engineering workers, whereas the present participants were all health care workers.

Table 4 Factor loadings for exploratory factor analysis with promax rotation of Stress Response scale (Maximum likelihood)

Item (Stress Response)	Factor						Communality
	Anxiety & depression	Somatic symptoms	Fatigue	Lack of vigor	Irritability	Pain	
12	**0.89**	−0.04	0.01	0.08	−0.03	−0.01	0.74
13	**0.84**	−0.11	0.04	−0.07	0.02	0.05	0.82
11	**0.84**	−0.14	0.09	0.05	−0.05	0.04	0.81
15	**0.75**	0.12	−0.06	0.01	−0.03	0.00	0.82
16	**0.69**	0.04	0.02	−0.13	0.04	0.03	0.83
14	**0.68**	0.02	0.02	−0.05	0.02	0.04	0.58
18	**0.58**	0.31	−0.06	0.02	0.03	−0.08	0.81
17	**0.55**	**0.41**	−0.08	0.05	−0.01	−0.13	0.83
27	0.00	**0.80**	0.02	−0.02	−0.03	−0.18	0.69
25	−0.04	**0.71**	−0.01	0.03	0.01	0.01	0.42
19	0.05	**0.66**	0.02	0.05	−0.01	0.00	0.61
26	−0.06	**0.65**	0.02	−0.05	0.01	0.07	0.68
29	0.10	**0.51**	0.01	−0.04	−0.01	0.03	0.74
28	−0.03	**0.50**	0.03	−0.03	0.01	0.08	0.58
20	−0.04	**0.49**	0.03	0.05	0.00	0.21	0.60
8	−0.02	0.07	**0.96**	0.02	−0.03	−0.08	0.68
7	−0.06	0.00	**0.93**	−0.01	0.01	−0.01	0.57
9	0.09	0.03	**0.68**	−0.08	−0.02	0.08	0.56
10	0.25	−0.07	**0.50**	0.11	0.03	0.04	0.48
2	0.01	−0.02	−0.01	**0.91**	0.03	0.02	0.37
3	−0.01	0.02	0.01	**0.91**	0.01	0.00	0.51
1	0.02	0.00	0.02	**0.87**	−0.02	0.00	0.67
4	−0.04	0.00	−0.03	0.03	**0.95**	0.00	0.48
5	−0.02	0.00	−0.03	0.00	**0.94**	−0.02	0.52
6	0.13	−0.01	0.15	−0.03	**0.57**	0.02	0.47
22	0.03	−0.08	−0.05	0.00	−0.02	**0.88**	0.46
24	0.04	0.01	0.00	0.01	0.00	**0.69**	0.52
23	−0.04	0.10	0.03	0.02	0.00	**0.64**	0.31
21	−0.01	0.35	−0.02	−0.02	0.02	**0.46**	0.38

	Factor intercorrelation matrix				
F2	0.64				
F3	0.62	0.41			
F4	−0.41	−0.26	−0.37		
F5	0.53	0.37	0.52	−0.30	
F6	0.45	0.54	0.57	−0.29	0.39

F2: Somatic symptoms, F3: Fatigue, F4: Lack of vigor, F5: Irritability, F6: Pain

CFA showed evidence of Heywood cases among health care workers. However, the factor model identified by EFA performed better than the model of Shimomitsu et al. This result suggests that the factor structure of the BJSQ differs between health care workers and manufacturing workers.

Among the health care workers, EFA of the Stress Response scale showed a 6-factor solution, which somewhat differs from the factor structure of Shimomitsu et al.[8] The "lack of vigor" and irritability factors had the same factor structure as the model of Shimomitsu et al.,[8] and the fatigue factor had almost the same factor structure. Anxiety and depressed mood was composed of the factors anxiety and depressed mood, as reported by Shimomitsu et al.[8] The somatic symptoms factor was very pure and comprised items related to somatic symptoms. The pain factor comprised items on physical pain. The somatic symptoms and pain factors represent the somatic symptoms reported by Shimomitsu et al.[8]

The results of CFA indicated that the structure under-

Table 5 Factor loadings for exploratory factor analysis with promax rotation of Social Support scale (Maximum likelihood)

Item (Social Support)	Factor			Communality
	Family support	Coworker support	Supervisor support	
6	**0.87**	−0.04	0.02	0.41
9	**0.85**	0.07	−0.04	0.36
3	**0.72**	0.00	0.01	0.52
8	−0.05	**1.08**	−0.13	0.87
5	0.05	**0.59**	0.21	0.57
2	0.08	**0.53**	0.06	0.75
4	0.00	−0.08	**0.97**	0.62
1	0.01	−0.03	**0.65**	0.99
7	−0.04	0.27	**0.62**	0.75
	Factor intercorrelation matrix			
F2	0.39			
F3	0.24	0.55		

F2: Coworker support, F3: Supervisor support

lying the Stress Response in the health care workers fitted both the factor model identified here and the model of Shimomitsu et al. Additionally, the 6-factor model identified here performed slightly better than the model of Shimomitsu et al., which suggests that Stress Response has almost the same factor structure in health care workers and manufacturing workers.

Among the health care workers, EFA of the Social Support scale showed the same 3-factor structure as that of Shimomitsu et al.[8] The results of CFA indicate that the structure underlying the Social Support scale among the health care workers fits the 3-factor model reported by Shimomitsu et al.[8] These results suggest that the Social Support scale has the same factor structure in health care workers and manufacturing workers.

The results of the present study should be considered in the light of several limitations. First, the present study did not verify the influence of sociodemographic factors such as sex, age, job description, work time. All participants in the present study were health care workers, whereas most participants in the study of Shimomitsu et al.[8] were manufacturing workers and engineering workers. The levels of psychological distress between health care workers and non-health care workers might differ, and occupational differences might influence the factor structure of the BJSQ. Furthermore, there were many female participants in our study, whereas most participants in the study of Shimomitsu et al.[8] were males. Job stress may affect men and women differently.

Another limitation of this study is the absence of random sampling. The research was conducted with a convenience sample of 10395 health care workers from 13 general hospitals (response rate: 89.0%). Although the present study has a large sample size and a high response rate, the absence of random sampling may limit the generalizability of our findings to other health care workers in Japan. Future research should seek to include random samples.

Conclusion

In conclusion, this study provides new and important information on the factor structure of the BJSQ in health care workers. As compared with the original model of Shimomitsu et al., EFA showed similar factor structures in the Stress Response and Social Support scales, but a different 5-factor structure for the Job Stressor scale. CFA indicated that the factor structure identified by EFA might perform better than the original model. In addition, Cronbach's α coefficients showed adequate internal reliability in the total and subscale scores of the BJSQ. These findings suggest that health care workers may have different factor structures of the BJSQ as compared with workers in other industries.

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日本人医療従事者における職業性簡易ストレス調査票の因子構造

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要約

目的：医療従事者はストレスが強いことが報告されており，強いストレスを抱えると提供するサービスに悪影響を及ぼすことが知られている．職業性簡易ストレス調査票（Brief Job Stress Questionnaire：BJSQ）は，さまざまな領域の労働者の職業性ストレスを評価するためのツールとして使用されている．本調査では，BJSQ の結果に探索的因子分析と確認的因子分析を行うことで，医療従事者の職業性ストレスの構造を明らかにすることを目的とした．

対象と方法：2009 年 1～11 月に 13 の急性期病院につとめる 8700 名の医療従事者を対象に BJSQ を実施した．われわれは，探索的因子分析と確認的因子分析を用いて医療従事者の職業性ストレスの因子構造を明らかにした．

結果：探索的因子分析を行った結果，“Stress Response”と“Social Supports”はオリジナルモデルと同様の因子構造を示したが，“Job Stressors”はオリジナルモデルとは異なる 5 因子モデルを示した．次に，確認的因子分析を行った結果，探索的因子分析によって作成したモデルの方がオリジナルモデルよりも適合度指標の値が優れていた．

考察：本調査の結果，医療従事者における BJSQ の因子構造は，他産業の労働者とは異なることが示唆された．

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索引用語：職業性ストレス，医療従事者，職業性ストレス簡易調査票，確認的因子分析，探索的因子分析

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