CLAS-HÅKAN NYGÅRD, MINNA SAVINAINEN,
TAPIO KIRSI & KIRSI LUMME-SANDT (eds.)

Age Management during the Life Course

Proceedings of the 4th Symposium on Work Ability

TAMPERE
UNIVERSITY
PRESS

The Effect of Job Control and Quantitative Workload on the different Dimensions of the Work Ability Index

Prümper J[1], Thewes K[2], Becker M[2]

1. Business and Organizational Psychology, University for Applied Sciences, HTW Berlin, 2. Büro für Arbeits- und Organisationspsychologie GmbH, Berlin

Abstract

Based on Karasek's Job Demand-Control model, we analyzed whether job control moderates the impact of quantitative workload on work ability and its dimensions. Furthermore, we investigated whether there is a difference in the occurrence of the interaction effect between self-reported dimensions and dimensions reporting diagnosed diseases or sick leave. Using WAI and SQUAW, 3,345 employees were questioned. The moderating effect of job control was found for the WAI Total score, self-reported work ability in relation to demands of the job, work impairment due to diseases, prognosis of work ability 2 years from now and mental resources.

Key terms: work ability, job control, quantitative workload.

Introduction

Karasek's (1) Job Demand-Control Model (JDC) has been a leading and frequently discussed work stress model in health psychology since the 1980s. According to the model an employees work environment can be characterized by a combination of job demands and job control, whereas the combination of high job demands and low job control is assumed to result in a psychological strain reaction, such as high blood pressure and low job satisfaction. Conversely, low job demands in combination with high job control lead to a lower than average number of health complaints (1, 2).

Figure 1 illustrates Karasek's hypotheses. The figure contains four types of jobs that might result from different combinations of job demands and job control. The diagonals actually represent two interactions: situations where job demands and job control match (B) and situations where they diverge (A) (2). Thus, relative to decreasing job control, strain increases if job demands increase. When job demands and job control are simultaneously high, the job is defined as "active". The other way around, when job demands and job control are low, the job is defined as "passive".

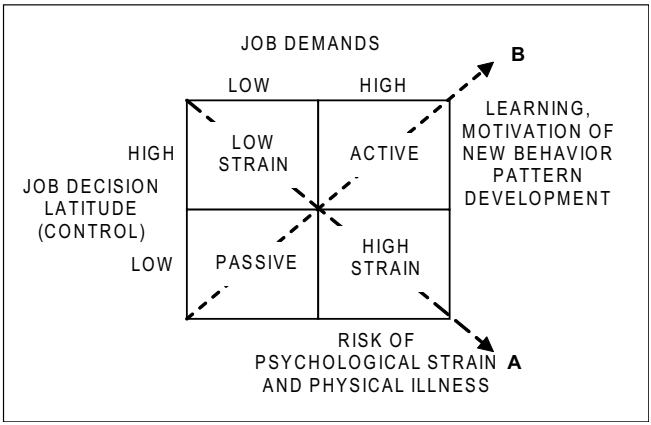

Figure 1. The demand-control model: according to Karasek (2)

Karasek's model assumes a positive relationship between job demands and psychological strain and a negative relationship between job control and psychological strain. An earlier study showed that a low individual control at the workplace was an important risk factor for increased sickness absence (3). A lack of freedom at work was also associated with impaired work ability (4). Additionally, research revealed that high job demands and psychosocial work stress are considered to be contributory factors to adverse health effects and work related disability (5, 6). For Karasek's (1) interaction hypothesis less support has been revealed in existing research. A meta-analysis by de Lange, Taris, Kompier, Houtman and Bongers (7) which was focussed on methodological issues of 45 longitudinal studies investigating the DC(S)-model found only modest support for the hypothesis that the combination of high demands and low control especially results in high job strain. Depending on the several outcome variables investigated, the results yielded a heterogeneous picture for the interaction hypothesis. However, they found good evidence for the effect of job characteristics on self-reported health or well-being.

Taking previous research into account, it seemed interesting to analyze Karasek's JDC model with work ability and its several dimensions as outcome variables. According to Ilmarinen and Tuomi (8), work ability may be understood as how able employees are to do their work with respect to work demands, health and mental resources. In design, the concept of work ability is heterogeneous, consisting of several self-reported measures, but also of fairly objective measures like "number of diseases diagnosed by a physician" and "sickness absence".

Objectives

The study objective was to ascertain the influence of job control and quantitative workload on work ability, and whether the combination of high quantitative workload and low job control results in lower work

ability than the combination of low quantitative workload and high job control. First of all, it was hypothesized that employees with high job control report higher work ability than employees with low work ability. It has also been stated that employees with high quantitative workload report lower work ability than employees with low quantitative workload. Besides these main effects, we expect an interaction effect. Taking the JDC model into account, our hypothesis is that high job control buffers the impact of workload on work ability. This would imply, that redesigning work processes to allow greater job control for employees, could increase or maintain their work ability.

Furthermore, following the recommendations of de Lange et al. (7) to focus on more specific outcome variables, several dimensions of work ability were investigated. The aim was to analyze, whether there is a difference in the occurrence of the interaction effect between self-reported work ability dimensions (dimensions 1, 2, 4, 6 and 7) and the fairly objective dimensions of the number of diseases diagnosed by a physician and sickness absence (dimensions 3 and 5).

Because Karasek (1) defines high work demands mainly as time pressure and work intensity, quantitative workload was taken as an independent variable and job control as a moderating variable.

Methods

Subjects

In this study, a heterogeneous sample of 3,345 employees from different industries (private services, public services, manufacturing and healthcare) was investigated. Of those surveyed, 59.1% were female, 23.6% were aged less than 31 years, 51.5% between 31 and 50 years and 24.9% were 50 years or over.

Measures and procedures

Work ability as the dependant variable was assessed by the German version of the Work Ability Index (WAI) (11). The WAI combines

subjective experiences of one's ability to cope with physical and psychological requirements at work with information on diseases, sick leave and mental resources. The seven dimensions of the Work Ability Index (WAI) can be found in Table 1. Recent studies have approved the predictive value of WAI for receiving work-related disability pensions and early retirement (12). The analyzed internal consistency of the scale was satisfactory for the sample of the study (Cronbach's alpha = .728).

The WAI consists of ten questions and a list of diseases. The questions and the disease list comprise seven distinct dimensions as listed in Table 1. For each dimension, a score can be obtained. The final WAI score is calculated by summing up all single item scores. The index can range from 7 to 49 points. Higher scores on the WAI indicate better work ability. Based on the WAI score, the individual's work ability can be classified into four categories: poor (7-27 points); moderate (28-36 points); good (37-43 points); and excellent (44-49 points).

One example for a WAI question is: "Do you believe, according to your present state of health, that you will be able to do your current job two years from now?" (dimension 6, Table 1).

Table 1. The seven dimensions of the Work Ability Index, WAI

Dimension	Range in questionnaire	Range observed
1. Current work ability compared with lifetime best	0 - 10	0 - 10
2. Work ability in relation to demands of a job	2 - 10	2 - 10
physical demands	1 - 5	1 - 5
mental demands	1 - 5	1 - 5
3. Number of current diseases diagnosed by a physician	0 - 14*	0 - 10*
4. Estimated work impairment due to diseases	1 - 6	1 - 6
5. Sick leave during the past year (12 months)	1 - 5	1 - 5
6. Own prognosis of work ability 2 years from now	1 - 3	1 - 3
7. Mental resources	0 - 12	0 - 12
WAI-Total score	7 - 49	9 - 49

* In contrast to all other dimensions, in dimension 3 high values indicate low work ability. This dimension is recoded for the calculation of WAI-Total score

Quantitative workload as the independent variable was measured with the corresponding scale of the German version (9) of the SQUAW – Short Questionnaire for Work Analysis by Prümper (10). SQUAW items measuring quantitative workload are: "I often work under time pressure" and "I have too much work". The items were measured on a 5-point scale. The internal consistency of the scale was good (Cronbach's alpha = .816).

Job control as a moderating variable was also measured with another scale of the SQUAW. The following items measured job control: "If you look at your overall operations, to what extent can you determine the order of individual operations yourself?" "How much influence do you have on the work that will be allocated to you?" and "During your work in general, do you have the opportunity to make your own decisions and arrangements?". The internal consistency of the scale was good (Cronbach's alpha = .815)

Statistical analysis

In this paper, as dependent variables, the WAI-Total score and its seven dimensions were investigated by stepwise moderated linear regression to analyze the moderating effect of job control.

For the statistical analyses, some methodical problems associated with the WAI have to be taken into account. Following the instructions of the instrument, the transformations of the raw values into the seven dimensions contain certain weightings of the raw values, which might lead to biased and cropped data (i. e. dimension 3). Therefore, in this paper, the raw values of the seven dimensions were analyzed[1]. However, WAI Total score was calculated as described in the WAI instructions including the weightings.

Furthermore, most of the so called WAI dimensions are in fact single items (except items 2 and 7). The term dimension may therefore be misleading. Due to the widespread use of this term in the WAI

1. For dimension 3, the number of all diseases diagnosed by a physician was investigated as dependent variable. Most of the surveyed do not suffer from more than 4 diseases, therefore persons with four or more diseases were grouped.

literature, we will follow this convention. However, this limitation should be kept in mind.

Another aspect is the assumption of linearity of the dependent variables. For the WAI Total score and dimensions one to four and six to seven, linearity can be assumed. However, dimension five (sick leave) is clearly scaled exponentially (1: 0 days, 2: 1 to 9 days, 3: 10 to 24 days, 4: 25 to 99 days, 5: 100 to 365 days). In order to come up to the linearity assumption of regression analysis, the numeric relation from 1 to 5 can be considered a log-transformation of the exponential scale into a linear scale. Therefore, statistical procedures with assumptions of linearity can be performed. However, this has to be taken into account when regression coefficients (Bs) are examined. Bs may only be interpreted after retransformation. Yet, as the present paper specifically asks whether there is an interaction (or not), the interpretation of particular effects (especially dimension 5) is less important.

For all dependent variables, the tests were conducted identically. In the first regression step, the age was introduced as ordinal-scaled control variable (three groups).

The continuous SQUAW dimensions "quantitative workload" and "job control" were used as predictor and moderator in steps two and three. In the fourth step, according to Aiken and West (13), the interaction between predictor Quantitative Workload (QW) and moderator Job Control (JC) was tested by introducing the multiplicative term of both centered variables. A significant increase in the explained variance of the regression model R^2 may be considered as evidence for an interaction. Finally, post-hoc residual analyses were conducted to ensure validity of the regression models.

Results

The results of the analyses performed are presented in Table 2. At first, the regression models for all the seven dimensions and the WAI Total

score showed overall-significance of $p \leq .000$. The corrected explained variances by the different models vary between 4.2% (dimension 1) and 13.2% (WAI Total score). These values may seem to be relatively low but they are not unusual for multiple linear regression models in field studies. Tolerance as an indicator for collinearity of the predictors never undercut .926. Therefore, collinearity can be safely ruled out. Finally, the post-hoc residual analyses approved the validity of the regression models.

With regard to the covariate age (regression step 1), the results for WAI-Total score and all WAI-dimensions except dimension 7 showed that age is a significant predictor of work ability. With ascending age, the observed employees reported lower current work ability compared with lifetime best (dimension 1), lower work ability in relation to demands of a job (dimension 2a/b), more diagnosed diseases (dimension 3), greater work impairment due to diseases (dimension 4), longer sick leave during the past year (dimension 5) and poorer prognosis of work ability 2 years from now. Only the rating of the mental resources (dimension 7) is not influenced by age.

Table 2. Results of stepwise moderated linear regression analyses

WAI-Dim.	step	Variable	R^2	Corr. R^2	ΔR^2	p(ΔR^2)	B	SE	β	p
WAI-Total		Const.					42.14**	.33		.000
	1	Age	.053	.053	.053**	.000	-1.76**	.16	**-.20****	.000
	2	QW	.108	.108	.055**	.000	-1.37**	.10	**-.24****	.000
	3	JC	.132	.131	.023**	.000	.99**	.11	**.16****	.000
	4	QW x JC	.133	.132	.002*	.013	.25*	.10	**.04***	.013
WA compared to lifetime best		Const.					8.23**	.16		.000
	1	Age	.009	.009	.009**	.000	-.21**	.05	**-.08****	.000
	2	QW	.030	.030	.021**	.000	-.25**	.03	**-.15****	.000
	3	JC	.043	.043	.013*	.000	.22**	.03	**.12****	.000
	4	QW x JC	.043	.042	.000	.722	.01	.03	.01	.722
WA in relation to physical job demands		Const.					4.41**	.07		.000
	1	Age	.036	.036	.036**	.000	-.21**	.02	**-.18****	.000
	2	QW	.054	.054	.018**	.000	-.11**	.01	**-.13****	.000
	3	JC	.067	.066	.013**	.000	.10**	.01	**.12****	.000
	4	QW x JC	.069	.067	.002*	.017	.03*	.01	**.04***	.017
WA in relation to mental job demands		Const.					4.30**	.07		.000
	1	Age	.015	.015	.015**	.000	-.11**	.02	**-.08****	.000
	2	QW	.099	.098	.084**	.000	-.25**	.01	**-.29****	.000
	3	JC	.127	.126	.028**	.000	.16**	.02	**.17****	.000
	4	QW x JC	.128	.127	.001*	.033	.03*	.01	**.03***	.033
Number of diseases diagnosed by a physician		Const.					.41**	.12		.001
	1	Age	.057	.057	.057**	.000	.44**	.03	**.22****	.000
	2	QW	.070	.070	.013**	.000	.15**	.02	**.11****	.000
	3	JC	.073	.072	.003**	.002	-.08**	.03	-.05**	.002
	4	QW x JC	.073	.072	.000	.566	-.01	.02	-.01	.566
Work impairment due to diseases		Const.					6.01**	.09		.000
	1	Age	.033	.033	.033**	.000	-.23**	.03	**-.15****	.000
	2	QW	.052	.052	.019**	.000	-.14**	.02	**-.14****	.000
	3	JC	.053	.053	.001*	.038	.04*	.02	**.04***	.032
	4	QW x JC	.055	.054	.002*	.012	.04*	.02	**.04***	.012
Sickness absence		Const.					4.18**	.08		.000
	1	Age	.009	.009	.009**	.000	-.12**	.02	**-.09****	.000
	2	QW	.013	.012	.004**	.000	-.06**	.02	**-.06****	.000
	3	JC	.018	.017	.006**	.000	.07**	.02	**.08****	.000
	4	QW x JC	.018	.017	.000	.855	.00	.02	.00	.855
Prognosis of work ability 2 years from now		Const.					2.99**	.03		.000
	1	Age	.014	.014	.014**	.000	-.06**	.01	**-.11****	.000
	2	QW	.032	.031	.017**	.000	-.05**	.01	**-.13****	.000
	3	JC	.043	.043	.012**	.000	.05**	.01	**.11****	.000
	4	QW x JC	.045	.043	.001*	.047	.01*	.01	**.03***	.047
Mental resources		Const.					6.956**	.22		.000
	1	Age	.000	.000	.000	.841	.000	.06	.00	1.000
	2	QW	.028	.027	.028**	.000	-.407**	.04	**-.17****	.000
	3	JC	.096	.095	.068**	.000	.712**	.05	**.27****	.000
	4	QW x JC	.097	.096	.002*	.011	.104*	.04	**.04***	.011

QW: Quantitative Workload, JC: Job Control, ** p≤.01, * p ≤.05

The results for the main effects of the predictor quantitative workload and the moderator job control are easily reported (steps 2 and 3). For all dimensions and WAI-Total score, all main effects for QW and JC were significant and followed the expected directions. With increasing QW, the employees reported lower current work ability compared with lifetime best (dimension 1), lower work ability in relation to physical and psychological demands of the job (dimension 2a/b), more diagnosed diseases (dimension 3), greater work impairment due to diseases (dimension 4), longer sick leave during the past year (dimension 5), poorer prognosis of work ability 2 years from now and lower mental resources (dimension 7). With increasing job control, these effects can be observed exactly in the inverse way.

Finally, the interaction of quantitative workload and job control is considered. For WAI Total and the dimensions 2a/b, 4, 6 and 7, the increases in R^2 obtained by the inclusion of the interaction term (regression step 4) were significant and associated with better work ability. Employees experiencing high quantitative workload and high job control at the same time, reported higher WAI Total score, better work ability in relation to physical and psychological demands of the job (dimension 2a/b), lower work impairment due to diseases (dimension 4), better prognosis of work ability 2 years from now (dimension 6) and better mental resources (dimension 7) than employees facing high quantitative workload and low job control coincidentally. By contrast, when QW was rated low, no differences were revealed between employees experiencing high and low JC.

For dimensions 1, 3 and 5, the change in R^2 on introduction of the interaction term was not significant. When QW is high, employees facing high JC do not differ from employees experiencing low JC in relation to their current work ability compared with lifetime best (dimension 1), their diagnosed diseases (dimension 3) and their sick leave during the past year (dimension 5). All regression parameters can be retained from Table 2.

Discussion and Conclusion

The reported results largely support our hypotheses. The postulated moderating effect of job control as researched by Karasek (1) was found for WAI Total score. Moreover, the analyzed dimensions of work ability differed: for work ability in relation to demands of a job (dimension 2a/b), work impairment due to diseases (dimension 4), prognosis of work ability 2 years from now and mental resources (dimension 7) a moderating effect was revealed, whereas no moderating effect was found for current work ability in relation to lifetime best (dimension 1), number of diagnosed diseases (dimension 3) and sickness absence (dimension 5).

Therefore, the distinction between self-reported strain measures and more objective strain measures like diagnosed diseases or sickness absence seem to be helpful in explaining why the moderating effect of job control is sometimes found and sometimes not.

However, these results differ from the findings of de Lange et al.: Studies examined in this meta-analysis, i. e. Parkes, Mendham and von Rabenau (14) and Bromet, Dew, Parkinson and Schulberg (15) found significant Demand times Control interaction effects in predicting somatic symptoms. A possible explanation might be that the WAI dimension "number of current diseases diagnosed by a physician" is a heterogeneous sum of all kinds of diseases, more or less influenced by job characteristics (i. e. birth defects vs. mental disorders). Therefore, in further research focused on (psycho-)somatic symptoms, should this distinction be considered.

For predicted sickness absence, in de Lange et al.'s meta-analysis, interactions were found when social support was included, i. e. Vahtera, Kivimäki, Pentti and Theorell (16). Studies that disregarded social support, i. e. Parkes (17) found no moderating effect. As in our study social support was not considered, the results are consistent with these earlier findings.

A possible reason why no interaction was found for dimension 1 might be the fact that this item is closer to the more objective measures

like diagnosed diseases or sickness absence than to rather subjective self-reported measures, like dimensions 2, 4, 6 and 7. Perhaps, this global rating of current work ability compared with lifetime best can be considered as an overall rating of the current state that is not as much influenced by subjective appraisals as other dimensions. For example, in contrast to dimension 1, dimension 2 explicitly contains ratings of workplace demands. Likewise dimension 7 implicitly includes the assessment of mental resources which might also be present or absent in the private sector. This leads to the general question of how strongly the different dimensions of the WAI are influenced by subjective appraisals which should be investigated in further research on WAI and its dimensions.

In the following section, the effects of the variables entered in the regression equations will be discussed generally according to the order of their introduction. Although the observed effect sizes should be interpreted with caution due to the mentioned methodical issues, some annotations can be made. First, age is not the only and not always the strongest predictor of work ability. Only for dimensions 2a, 3, 4 and 5 which are associated with physical aspects, has age the greatest influence on work ability. The rating of mental resources (dim 7) is not determined by age at all. Therefore, the conclusion that work ability is just a function of age is over simplified. The results of this study clearly confirm the importance of job characteristics and adequate job redesign on work ability. Quantitative workload especially was proven to be significantly associated with work ability. These findings support previous observations of an impact of psychosocial work stress. It was also demonstrated that the associations are more serious for employees with low job control than for employees with high job control. Admittedly, high job control cannot fully compensate the adverse effects of quantitative workload. Although the assumed interactions were significant, its practical relevance could be very small. This has to be taken into account when job redesign is applied in order to maintain the work ability of employees. The negative effects of high quantitative workload on the work ability cannot only be compensated by increasing job control. Job redesign actions should

therefore focus on the reduction of quantitative workload meanwhile job control should be enhanced conjointly.

For the interpretation of the results, some limitations have to be taken into account. First, due to the cross-sectional design of this study, conclusions concerning causal relations are invalid. Although we assume that high quantitative workload determines a decrease in work ability, it is, for example, possible that people with poor work ability are more frequently exposed to high workload situations because of adverse employment chances. It is also possible that employees due to few mental resources perceive high workload. In this case mental resources would be treated as an independent variable and not, as in our study, as a dependant variable. Consequently, in order to confirm our results, longitudinal analyses are required. Second, the attributes of WAI have to be considered. The already mentioned statistical issues in the data might affect the reliability of the reported findings. On the other hand, the large size of the observed sample with more than 3,300 objectives enforces the statistical power of the applied tests. Nevertheless, the validity and structure of WAI should be investigated in further research. Finally, the big sample-size leads to another implication. Due to the fact that small effects tend to become significant more easily in big samples, the discussion of the practical importance of the findings may not be underestimated.

Despite these limitations the results of this study contribute to a clarification of the relationship between work-related stressors and work ability. Furthermore, they help to improve the insights of WAI and the concept of work ability.

In conclusion, the results confirmed that work ability has a heterogeneous structure. The results of de Lange et al. (7) were approximately replicated by investigating the concept of work ability and its dimensions as outcome variables. Moderating effects of job control were only found for the WAI Total score and for the fairly subjective WAI dimensions. In further studies, for a deeper understanding of the moderating effect of job control it therefore makes sense to consider each of the dimensions of the Work Ability Index (WAI) on its own.

References

1. Karasek, RA. Job Demands, Job Decision Latitude, and Mental Strain: Implications for Job Redesign. Administrative Science Quarterly. 1979; 24:285–308.
2. Karasek, R. Control in the Workplace and it's Health related Aspects. In: S.L. Sauter, J.J. Hurrel, & C.L. Cooper (Eds.), Job Control and Worker Health. New York: John Wiley and Sons; 1980, p.107–128.
3. Niederhammer I, Bugel I, Goldberg M, Leclerc A, Gueguen A. Psychosocial factors at work and sickness absence in the Gazel cohort: a prospective study. Occupational Environmental Medicine. 1998; 55:735–741.
4. Tuomi K, Eskelinen L, Toikanen J, Jarvinen E, Ilmarinen J, Klockars M. Work load and individual factors affecting work ability among aging municipal employees. Scandinavian Journal of Environmental Health. 1991; 17:128–134.
5. Alavinia SM, Duivenbooden C van, Burdorf, A. Influence of work-related factors and individual characteristics on work ability among Dutch constuction workers. Scandinavian Journal of Work and Environmental health. 2007; 33:351–257.
6. Berg TIJ van den, Elders L A, de Zwart B C, Burdorf A. The effects of work-related and individual factors on the Work Ability Index: a systematic review. Occupational and Environmental Medicine. 2009; 66:211–220.
7. Lange AH de, Taris TW, Kompier MAJ, Houtman ILD, Bongers PM. "The Very Best of the Millennium": Longitudinal Research and the Demand-Control-(Support) Model. Journal of Occupational Health Psychology. 2003; 8:282–305.
8. Ilmarinen J, Tuomi K. Past, Present and Future of Work Ability. In: Ilmarinen, J. & Lehtinen, S. Past, Present and Future of Work Ability. People and Work – Research Reports 65, Finnish Institute of Occupational Health; 2004.
9. Prümper J, Hartmannsgruber K, Frese M. KFZA. Kurz-Fragebogen zur Arbeitsanalyse. Zeitschrift für Arbeits- und Organisationspsychologie. 1995; 39:125–132.
10. Prümper J, SQUAW. Short Questionnaire for Work Analysis. Unpublished paper; University for Applied Sciences; 2010
11. Tuomi K, Ilmarinen J, Jahkola A, Katajarinne L, Tulkki A. Arbeitsbewältigungsindex. Work Ability Index. Schriftenreihe der BAuA; 2006.
12. Zwart BCH de, Frings-Dresen MHW, Duivenbooden JC van. Test-retest reliability of the Work Ability Index questionnaire. Occupational Medicine. 2002; 52:177–181.

13. Aiken LS, West SG. Multiple Regression: Testing and Interpreting Interactions. Thousand Oaks: Sage; 1991.
14. Parkes KR, Mendham, CA, von Rabenau, C. Social support and the demand–discretion model of job stress: Tests of additive and interactive effects in two samples. Journal of Vocational Behavior. 1994; 44: 91–113.
15. Bromet EJ, Dew MA, Parkinson MS, Schulberg HC. Predictive effects of occupational and marital stress on the mental health of a male work force. Journal of Organizational Behavior. 1988; 9: 1–13.
16. Vahtera J, Kivimäki M, Pentti J, Theorell T. Effect of change in the psychosocial work environment on sickness absence: A seven year follow up of initially healthy employees. Journal of Epidemiology and Community and Health. 2000; 54: 484–493.
17. Parkes KR. Occupational stress among student nurses: A natural experiment. Journal of Applied Psychology. 1982; 6: 784–796.