CHAPTER 4

FINDINGS AND DISCUSSIONS

This chapter, comprising two sections, presents the results and discussion of the data analyses. The finding section presents the characteristics of the sample and the study variables, correlation among study variables, model testing and modification results, as well as hypotheses testing results. In the discussion section, the results of the research questions, including level of fatigue and a final model for predicting fatigue are explained and discussed.

Findings

Descriptive analysis was used to delineate the demographic characteristics of the sample and characteristics of twelve study variables. The LISREL 8.7 software program was used to test and modify the study model. The model fit was also analyzed under six selected goodness-of -fit indices, and the final modified model was verified to have a good fit with the data. The following sections present the findings of the study.

Demographic Data of the Participants

Six hundred and twelve questionnaires were returned from 668 delivered questionnaires with a response rate of 91.62%, and of these 581 questionnaires were completed. The demographic characteristics of 581 samples are presented in Table 2.

Age of the sample ranged from 20 to 50 years, with a mean of 29.49

(SD=6.73). The majority of participants were married (59.7%), 37.5% were single and 2.8% were widowed, divorced or separated. Most participants had an associate degree in nursing (69.5%), followed by a bachelor's degree (18.1%), a secondary technical certificate (12.2%), and master degree's degree or higher (0.2%). With regard to professional title, about half of participants (50.1%) were junior nurse, 32.2% were senior nurses, 16.2% were assistant advanced nurses, and only 1.5% were associate advanced nurses or advanced nurses. The position titles of the participans were mainly staff nurse (93.3%), followed by head nurse and general head nurse and above (see Table 2).

Years of working in the nursing profession for the participants ranged from 1 to 31 years, with a mean of 9.76 years (SD=7.11). The majority of participants (63.3%) had 1-10 years of working experience in the nursing profession. With regard to working units, 29.6% of the participants were in a medical department, 28.7% in a surgical department, 10.8% in a obstetrics & gynecology department, 10% in a pediatric department, 7.7% in ICU or CCU, 3.8% in a psychiatric department, and 9.4% in other departments, including oncology department, geriatric department, and department of traditional Chinese and western medicine (see Table 2).

In terms of shift work, more than half of the participants (50.4%) had eight or more night and evening shifts per month; 18.6% of the participants had 1 to 4 night and evening shifts per month; 16.7% of the participants had 5 to 7 night and evening shifts per month; and 14.3% of participants worked only day shift (see Table 2).

Table 2

Demographic Characteristics of the Participants (N=581)

Characteristics	Number	Percentage
Age (Years)		
(Mean=29.49, SD=6.73, Range=20-50)		
20-30	364	62.7
31-40	171	29.3
41-50	46	8.0
Marital Status		
Never married	218	37.5
Married	347	59.7
Divorced	15	2.6
Widowed or Separated	1	.20
Educations		
Secondary technical certificate	71	12.2
Associate degree	404	69.5
Bachelor degree	105	18.1
Master degree and above	1	.20
Professional title		
Junior nurse	291	50.1
Senior nurse	187	32.2
Assist.advanced nurse	94	16.2
Assoc.advanced nurses or Advanced nurses	9	1.5
Present title of position		
Staff nurse	542	93.3
Head nurse	34	5.9
General head nurse	4	0.7
Director of nursing	1	0.2
Work Unit		
Medical	167	28.7
Surgical	172	29.6
Pediatric	58	10.0
Obstetrics & Gynecology	63	10.8
ICU or CCU	45	7.7
Psychiatric	22	3.8
Others (oncology department, geriatric department, and department of traditional Chinese and western medicine)	54	9.4

Table 2 (Continued)

Demographic Characteristics of the Participants (N=581)

Characteristics	Number	Percentage
Year of working experience in nursing profession (Mean=9.76, SD=7.11, Range=1-31)		
1-10	368	63.3
11-20	167	28.7
21-31		
Shift work (number of night and evening shift per month)		
0	83	14.3
1-4	108	18.6
5-7	97	16.7
≥8	293	50.4

Characteristics of the Study Variables

Characteristics of the study variables, including job demand, job control, support at work, exposure to the hazards in hospital work environments, sleep quality, job dissatisfaction, intershift recovery, anxiety, depression, acute fatigue and chronic fatigue are displayed. Mean, standard deviation, range, skewness, and kurtosis are shown in Table 3 to describe the study variables.

Job demand scores ranged from 21 to 55 with a mean of 39.88 (SD=5.20). The skewness coefficient of job demand was moderately positive (.45), indicating that most participants had scores of job demand below the mean.

Job control scores ranged from 12 to 32 with a mean of 22.27 (SD=2.60). The skewness coefficient of job control was slightly negative (-.26), indicating that most participants had scores of job control above the mean.

Support at work scores ranged from 19 to 44 with a mean of 32.56

(SD=3.36). The skewness coefficient of support at work was slightly positive (.06), indicating that more participants had scores of support at work below the mean.

Exposure to hazards in work environments scores ranged from 24 to 91 with a mean of 59.38 (SD=11.35). The skewness coefficient of exposure to hazards in hospital work environments was slightly positive (.02), indicating that more participants had scores of exposure to hazards in hospital work environments below the mean.

Sleep quality scores ranged from 0 to 19 with a mean of 7.84 (SD=3.86). The skewness coefficient of sleep quality was moderately positive (.52), indicating that most participants had scores of sleep quality below the mean.

Job dissatisfaction scores ranged from 0 to 100 with a mean of 56.81 (SD=20.18). The skewness coefficient of job dissatisfaction was slightly negatively (-.01), indicating that more participants had scores of job dissatisfaction above the mean.

Anxiety scores ranged from 0 to 63 with a mean 10.67 (SD=8.94). The skewness coefficient of anxiety was highly positive (1.81), indicating that most participants had scores of anxiety below the mean.

Depression scores ranged from 0 to 57 with a mean of 11.24 (SD=8.94). The skewness coefficient of depression was highly positive (1.43), indicating that most participants had scores of depression below the mean.

Intershift recovery scores ranged from 0 to 100 with a mean of 45.62 (SD=22.44). The skewness coefficient of intershift recovery was slightly negative (-.08), indicating that more participants had scores of intershift recovery above the mean.

Acute fatigue scores ranged from 3.33 to 100 with a mean of 63.40

(SD=21.69). The skewness coefficient of acute fatigue was moderately negative (-.34), indicating that most participants had scores of acute fatigue above the mean.

Chronic fatigue scores ranged from 0 to 100 with a mean of 47.14 (SD=23.38). The skewness coefficient of chronic fatigue was moderately positive (.32), indicating that most participants had scores of chronic fatigue below the mean.

Table 3

Mean, Standard Deviation, Range, Skewness and Kurtosis of Study Variables (N=581)

Variable	Mean	SD	Actual Range	Possible Range	Skewness (SE=.10)	Kurtosis (SE=.20)	$Z_{Kurtosis}$
Job demand	39.88	5.20	21-55	14-56	.43	.46	2.30
Job control	22.71	2.60	12-32	9-36	-.26	.68	3.40
Support at work	32.56	3.36	19-44	11-44	.06	1.94	9.70
EpHWE	59.38	11.35	24-91	20-100	.02	-.25	-1.25
Sleep quality	7.84	3.86	0-19	0-21	.52	-.24	-1.20
Job dissatisfaction	56.81	20.19	0-100	0-100	-.01	-.42	2.10
Anxiety	10.67	8.94	0-63	0-63	1.81	3.62	18.10
Depression	11.24	9.40	0-57	0-63	1.43	2.64	13.20
Intershift recovery	45.62	22.44	0-100	0-100	-.08	-.70	-3.50
Acute fatigue	63.40	21.69	3.33-100	0-100	-.34	-.47	-2.35
Chronic fatigue	47.14	23.38	0-100	0-100	.32	-.48	-2.40

Note: EpHWE = Exposure to Hazards in Work Environments

According to the level of sleep quality proposed by Buysse and colleagues (1989), a global sum of "5" or more indicated a poor sleep quality. The results showed that majority of (80.8%) participants had the poor sleep quality (see Table 4).

According to anxiety levels proposed by Creamer, Foran, and Bell (1995) and depression level proposed by Beck and colleagues (1961), the results found that more than half of the participants (62.5%) had a minimal level of anxiety, while 7.2% had a severe level of anxiety. Moreover, 44.1% of participants had a mild level of depression, while 13.9% had severe level of depression (see Table 4). Further, based on the levels of intershift recovery, acute fatigue and chronic fatigue proposed by Winwood, Lushington, and Winefield (2006), the results demonstrated that 41.5% of participants had intershift recovery level ranging from moderate to high, while 58.5% had an acute fatigue level from low to moderate. Additionally, 70.9% of participants had an acute fatigue level from moderate to high, while 29.1% had an acute fatigue level from low to moderate. Moreover, 39.4% of participants had a chronic fatigue level ranging from moderate to high, while 60.6% had a chronic fatigue level from low to moderate (see Table 4).

Table 4

Number, Percentage and Level of the Participants by Sleep Quality, Anxiety, Depression, Intershift Recovery, Acute Fatigue and Chronic Fatigue Score (N=581)

Variable Score	Number	Percentage	Level
Sleep quality			
0-4	111	19.2	Normal
≥5	470	80.8	Poor
Anxiety			
0-9	363	62.5	Minimal
10-18	115	19.8	Mild
19-29	61	10.5	Moderate
30-63	42	7.2	Severe

Table 4 (Continued)

Number, Percentage and Level of the Participants by Sleep Quality, Anxiety, Depression, Intershift Recovery, Acute Fatigue and Chronic Fatigue Score (N=581)

Variable Score	Number	Percentage	Level
Depression			
0-4	148	25.5	Minimal
5-13	256	44.1	Mild
14-20	96	16.5	Moderate
21-63	81	13.9	Severe
Intershift recovery			
0-25	117	20.1	Low
26-50	223	38.4	Low/Moderate
51-75	159	27.4	Moderate/High
76-100	72	14.1	High
Acute fatigue			
0-25	29	5.0	Low
26-50	140	24.1	Low/Moderate
51-75	220	37.9	Moderate/High
76-100	192	33.0	High
Chronic fatigue			
0-25	107	18.4	Low
26-50	245	42.2	Low/Moderate
51-75	152	26.2	Moderate/High
76-100	77	13.2	High

In addition, none of participants had an acute fatigue score with zero, indicating all the participants had experienced acute fatigue but in different degrees. Further, eight participants (1.37%) had a chronic fatigue score of zero, indicating that they had no experience of chronic fatigue. However, 573 participants (98.63%) had chronic fatigue scores varying from 3.33 to 100, indicating that they had experienced chronic fatigue but in different degrees.

Correlations among Study Variables

Pearson correlation was conducted to examine the correlation among study

variables. The results demonstrated that acute fatigue was significantly correlated with all the independent variables with an absolute value ranging from .13 to .68. Chronic fatigue was also significantly correlated with all the independent variables with absolute value ranging from .17 to .63. Additionally, acute fatigue was positively correlated with chronic fatigue (r=.71, p<.01) (see Table 5)

Table 5

Correlation Matrix of Study Variables (N=581)

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1.ShiftW	1.00											
2. JobDem	.08	1.00										
3.JobCon	-.10*	-.17**	1.00									
4.SuppW	-.06	-.04	.25**	1.00								
5.ExpH	-.01	.46**	-.16**	-.11*	1.00							
6. JobDis	.14**	.47**	-.34**	-.30**	.39**	1.00						
7.SleQ	.17**	.41**	-.18**	-.09*	.34**	.39**	1.00					
8.Depr	.13**	.39**	-.22**	-.17**	.39**	.46**	.61**	1.00				
9. Anxi	.12**	.44**	-.17**	-.06	.43**	.39**	.62**	.71**	1.00			
10.IntR	-.19**	-.49**	.41**	.26**	-.40**	-.56**	-.49**	-.51**	-.45**	1.00		
11. AcuF	.13**	.57**	-.32**	-.16**	.43**	.48**	.48**	.47**	.46**	-.68**	1.00	
12. ChrF	.17**	.53**	-.29**	-.17**	.41**	.57**	.51**	.54**	.53**	-.63**	.71**	1.00

*p<.05, **p<.01

Note: ShiW=Shift Work, JobDe=Job Demand, JobCo=Job Control, SupW=Support at Work, ExpH=Exposure to Hazards in work environments, JobDis=Job Dissatisfaction, SleQ=Sleep Quality, Depr=Depression, Anxi=Anxiety, IntR=Intershift Recovery, AcuF=Acute fatigue; ChrF=Chronic Fatigue

Model Testing and Modification

As stated in chapter 1, this study aimed to determine which variables in the model (shift work, job demand, job control, support at work, exposure to hazards in hospital work environments, job dissatisfaction, sleep quality, anxiety, depression, and intershift recovery) would predict acute and chronic fatigue in Chinese nurses. It was hypothesized that shift work, job demand, exposure to hazards in work environments, job dissatisfaction, sleep quality, anxiety, depression, acute fatigue would directly and positively influence chronic fatigue, while job control, support at work, and intershift recovery would directly and negatively influence chronic fatigue. Shift work, job demand, and exposure to hazards in work environments would directly and positively influence acute fatigue, while job control, support at work would directly and negatively influence acute fatigue. In addition, shift work and job demand would directly and positively influence sleep quality, job dissatisfaction, anxiety, and depression, while support at work and job control would have direct and negative effects on sleep quality, job dissatisfaction, anxiety, and depression. Further, sleep quality and job dissatisfaction would directly and positively influence anxiety and depression. Finally, sleep quality would directly and negatively influence intershift recovery, and exposure to hazards in work environments would directly and positively influence job dissatisfaction (see Figure 1).

In the analysis, the Maximum Likelihood (ML) method was used to estimate the parameters. A non-significant chi-square (χ^2) was expected as it indicated consistency of covariation among variables (Stevens, 2002). Moreover, other fit indices, including normed fit index (NFI), nonnormed fit index (NNIF), comparative fit index (CFI), root mean square error of approximation (RMSEA), and goodness of

fit index (GFI) are also considered. The CFI, NFI, NNFI and GFI greater than .90 are expected, indicating a good fit model. Lastly, the RMSEA value less than .05 is expected, indicating a good fit. The steps of analysis are presented as follows:

Step One: Testing Hypothesized Model

The variables were entered into the structural equation modeling based on the initial hypothesized model. The output showed that χ^2 (df, 25) =659.39, p=0.00, NFI = .89, NNFI= .71, CFI = .89, GFI = .87, and RMSEA=.19. All of these fit indices were not in the acceptable level, which indicated that the initial model did not fit the data. Thus, the magnitude of the modification indices was examined to improve it.

Step Two: Model Modification

Since the initial hypothesized model (M0) did not fit the data, it was modified based on the modification indices, together with theoretical reasoning. Nine paths were suggested to be added including: the path from acute fatigue to intershift recovery, the paths from depression to anxiety, the path from intershift recovery to job dissatisfaction, the path from sleep quality to acute fatigue, the path from job control to intershift recovery, the path from exposure to hazards in hospital work environments to sleep quality, the path from exposure to hazards in hospital work environments to anxiety, the path from intershift recovery to sleep quality, and the path from the path from intershift recovery to depression.

After adding each path, the results showed the gradually improvement of the fit indices (see Table 6). Then, the model was run again, and the output showed χ^2 (df, 16) =17.92, p=0.33, NFI =1.00, NNFI= 1.00, CFI =1.00, GFI =.99, and RMSEA=.014,

which indicated that this model fitted the data well. Then, the next step for model trimming was initiated.

Table 6

Results of Fit Indices for Model Modification

	χ^2	df	p value	RMSEA	NFI	NNFI	CFI	GFI
M0	659.39	25.00	0.000	0.190	0.89	0.71	0.89	0.87
M1	424.33	24.00	0.000	0.160	0.93	0.81	0.93	0.90
M2	247.79	23.00	0.000	0.120	0.96	0.89	0.96	0.94
M3	191.72	22.00	0.000	0.110	0.97	0.91	0.97	0.95
M4	147.15	21.00	0.000	0.098	0.98	0.93	0.98	0.96
M5	100.17	20.00	0.000	0.081	0.98	0.95	0.99	0.97
M6	80.09	19.00	0.000	0.074	0.99	0.96	0.99	0.98
M7	56.29	18.00	0.000	0.059	0.99	0.98	0.99	0.98
M8	28.41	17.00	0.040	0.034	1.00	0.99	1.00	0.99
M9	17.92	16.00	0.330	0.014	1.00	1.00	1.00	0.99
M10	34.85	32.00	0.330	0.011	0.99	1.00	1.00	0.99

Note: M0= Initial Hypothesized Model, M1-M9= Modified Model
M10= Final Model

Step Three: Model Trimming and Testing

In this step, all the paths with levels of significance greater than .05 were dropped from the model. These sixteen paths included paths from shift work to chronic fatigue, acute fatigue, job dissatisfaction, anxiety and depression; path from exposure to hazards in work environments to chronic fatigue; path from job demand to depression; paths from support at work to chronic fatigue, sleep quality, anxiety and depression; paths from job control to chronic fatigue, anxiety and depression; path from sleep quality to chronic fatigue; and path from job dissatisfaction to anxiety. Furthermore, six significant correlations among exogenous variables were added in

the model, including shift work with job control, exposure to hazards with job demand, exposure to hazards with job control, exposure to hazards with support at work, and job demand with job control, as well as support at work with job control.

After the non-significant paths were dropped and six significant correlations were added, the modified model was tested again. The results showed that this model (M10) fit the data well at χ^2 (df, 32) =34.85, p=.33, NFI = .99, NNFI= 1.00, CFI = 1.00, GFI = .99, and RMSEA=.01 (see Table 6). In the final model, 44.8% of total variance in acute fatigue was accounted for by job demand (γ=.43, p<.001), sleep quality (β=.28, p<.001), job control (γ=-.20, p<.001), exposure to hazards in work environments (γ=.19, p<.001), intershift recovery (β=-.20, p<.001), shift work (γ=.07, p<.001) and support at work (γ=-.08, p<.001). Moreover, 61.5% of total variance in chronic fatigue was accounted for by acute fatigue (β=.40, p<.001), job demand (γ=.32, p<.001), sleep quality (β=.27, p<.001), job dissatisfaction (β=.20, p<.001), exposure to hazards in work environments (γ=.18, p<.001), anxiety (β=.17, p<.001), job control (β=-.17, p<.001), depression (β=.10, p<.001), shift work (γ=.06, p<.001), support at work (γ=-.05, p<.001), as well as intershift recovery (β=-.01, p<.05). In addition, 40.2% of total variance in job dissatisfaction and 45.5% of total variance in anxiety were accounted for by the shift work, exposure to hazards in work environments, job demand, job control, support at work, sleep quality, intershift recovery and acute fatigue. Further, 58.8% of total variance in depression was accounted for by the shift work, exposure to hazards in work environments, job demand, job control, support at work, sleep quality, acute fatigue and anxiety. While, 53.4% of total variance in intershift recovery was accounted for by the shift work, exposure to hazards in work environments, job demand, job control, support at work,

sleep quality and acute fatigue. Lastly, 29.9% of total variance in sleep quality were accounted for by the shift work, exposure to hazards in work environments, job demand, job control, support at work, intershift recovery, and acute fatigue. The summary of standardized path coefficients and square multiple correlations (R^2) of the final model were illustrated in Table 7. The final model, which is the best-fit model, is shown in Figure 3.

Table 7

Direct, Indirect, and Total Effect of Causal Variables on Affected Variables (N=581)

Causal Variables	Affected Variables														
	Intershift recovery			Sleep quality			Job dissatisfaction			Anxiety			Depression		
	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE
ShiW	--	-.11***	-.11***	.23***	-.07**	.16***	--	.04**	.04**	--	.08***	.08***	--	.09***	.09***
ExpH	--	-.18***	-.18***	.32***	.-13***	.19***	.12***	.06***	.18***	.19***	.09***	.28***	--	.22***	.22***
JobDe	--	-.36***	-.36***	.54***	-.25**	.29***	.23***	.12***	.35***	.15***	.15***	.30***	--	.29***	.29***
JobCo	.16***	.14***	.30***	-.30***	.21***	-.09*	-.12***	-.10***	-.22***	--	-.04*	-.04*	--	-.10***	-.10***
SupW	--	.03*	.03*	--	-.02*	-.02*	-.11***	-.01*	-.12***	--	-.01*	-.01*	--	-.01	-.01
SleQ	-.47***	.01	-.46***	--	--	--	--	.15***	.15***	.50***	-.16***	.34***	.19***	.18***	.37***
JobDi	--	--	--	--	--	--	--	--	--	--	--	--	.13***	--	.13***
Anxi	--	--	--	--	--	--	--	--	--	--	--	--	.49***	--	.49***
Depr	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
IntR	--	--	--	-.69***	.22***	-.47***	-.33***	.11***	-.22***	--	-.24***	-.24***	-.21***	.12***	-.09
AcuF	-.50***	.16**	-.34***	--	.24***	.24***	--	.11***	.11***	--	.12***	.12***	--	.04	.04

Note: ShiW=Shift Work, ExpH=Exposure to Hazards in work environments, JobDe=Job Demand, JobCo=Job Control, SupW=Support at Work, SleQ=Sleep Quality, JobDis=Job Dissatisfaction, Anxi=Anxiety, Depr=Depression, IntR=Intershift Recovery, AcuF=Acute fatigue; DE=direct effect; IE=indirect effect; TE=total effect
*p<.05, ** p<.01, ***p<.001

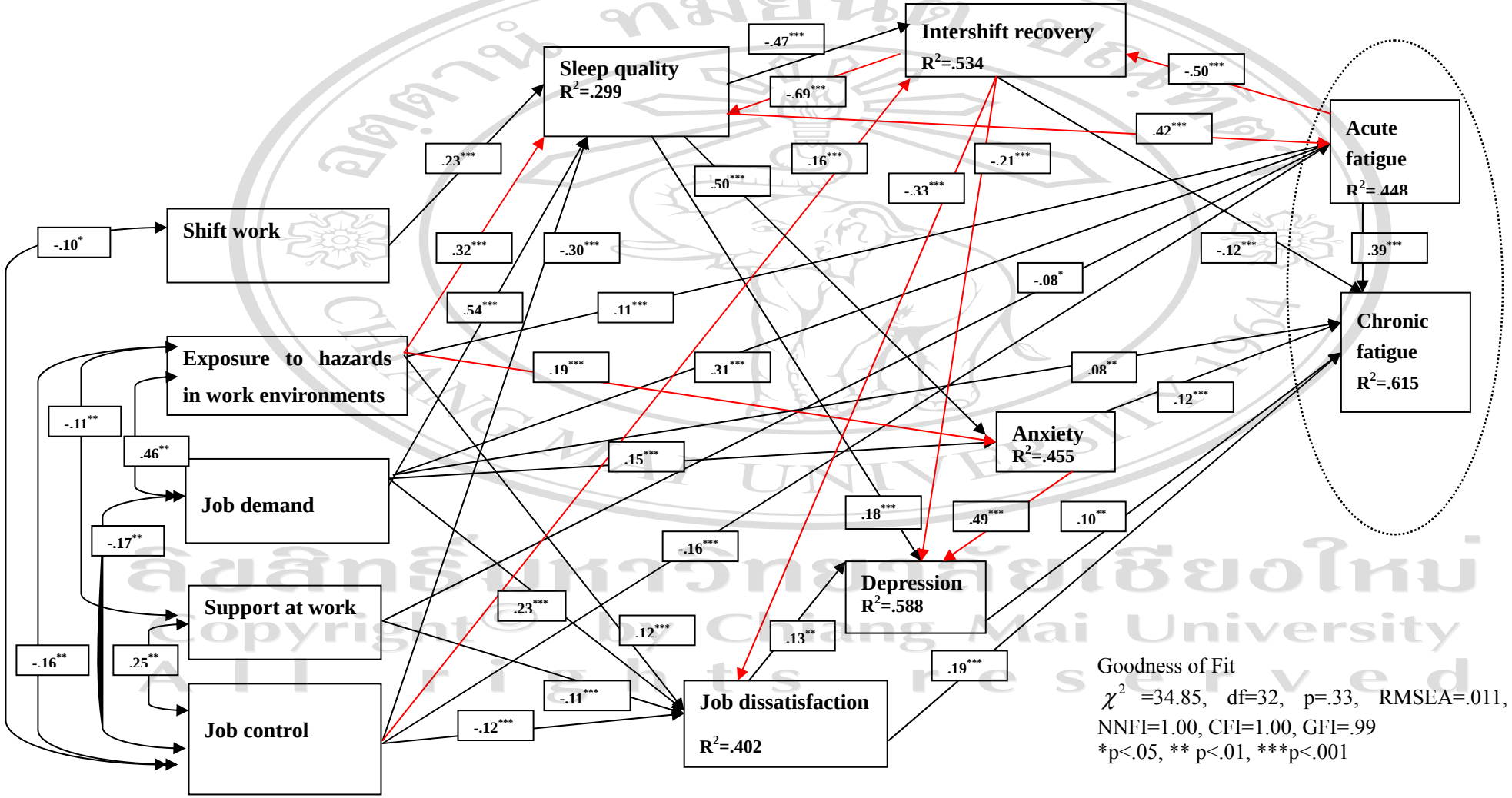
Table 7 (Continued)

Direct, Indirect, and Total Effect of Causal Variables on Affected Variables (N=581)

Causal Variables	Affected Variables					
	Acute fatigue			Chronic fatigue		
	DE	IE	TE	DE	IE	TE
ShiW	--	.07***	.07***	--	.06***	.06***
ExpH	.11***	.08***	.19***	--	.18***.	.18***
JobDe	.31***	.12***	.43***	.08**	.24***	.32***
JobCo	-.16***	-.04*	-.20***	--	-.17***	-.17***
SupW	-.08*	.01	-.07*	--	-.05**	-.05**
SleQ	.42***	-.13***	.28***	--	.27***	.27***
JobDi	--	--	--	.19***	.01*	.20***
Anxi	--	--	--	.12***	.05*	.17***
Depr	--	--	--	.10**	--	.10**
IntR	--	-.20***	-.20***	-.12***	.11***	-.01*
AcuF	--	--	--	.39***	.01	.40***

Note: ShiW=Shift Work, ExpH=Exposure to Hazards in work environments, JobDe=Job Demand, JobCo=Job Control, SupW=Support at Work, SleQ=Sleep Quality, JobDis=Job Dissatisfaction, Anxi=Anxiety, Depr=Depression, IntR=Intershift Recovery, AcuF=Acute fatigue; DE=direct effect; IE=indirect effect; TE=total effect
*p<.05, ** p<.01, ***p<.001

Figure 3: Final model for predicting fatigue in Chinese nurses



Goodness of Fit

χ^2 =34.85, df=32, p=.33, RMSEA=.011, NFI=.99, NNFI=1.00, CFI=1.00, GFI=.99

*p<.05, ** p<.01, ***p<.001

Note: ⟶ Structural effect (Standardized Weight) ⟷ Correlation

Hypothesis Testing Results

By analyzing the influence effects of all variables in the proposed model, the research hypotheses in this study were answered. The structural effects of all variables in the final model comprised three parts, including direct, indirect and total effect. Results of all structural effects on each variable have been presented in the Table 7.

Hypothesis 1: Shift work has a direct positive effect on sleep quality, job dissatisfaction, anxiety, depression, acute fatigue and chronic fatigue.

The statistical analysis showed that shift work had a significant direct positive effect on sleep quality (r=.23, p<.001). Unexpectedly, shift work had no direct positive effects on job dissatisfaction, anxiety, depression, acute fatigue, and chronic fatigue. Therefore, hypothesis one was partially supported. In addition, shift work had a significant indirect positive effect on job dissatisfaction (r=.04, p<.01), on anxiety (r=.08, p<.001) and on depression (r=.09, p<.001) probably through sleep quality and intershift recovery. Shift work also had an indirect positive effect on acute fatigue (r=.07, p<.001) and on chronic fatigue (r=.06, p<.001) probably both through sleep quality and intershift recovery. Further, shift work was also found to have a significant indirect negative effect on sleep quality (r=-.07, p<.01) and intershift recovery (r=-.11, p<.001) probably through sleep quality and intershift recovery (see Figure 3 and Table 7).

Hypothesis 2: Exposure to hazards in work environments has a direct positive effect on job dissatisfaction, acute fatigue and chronic fatigue.

Findings revealed that exposure to hazards in work environments had a significant direct positive effect on job dissatisfaction (r=.12, p<.001), and on acute fatigue (r=.11, p<.001), but had no direct effect on chronic fatigue. Thus, hypothesis 2

was partially supported. Moreover, it had a significant indirect positive effects on job dissatisfaction (r=.06, p<.01) and on acute fatigue (r=.08, p<.001) probably through intershift recovery and sleep quality, as well as on chronic fatigue (r=.18, p<.001) through job dissatisfaction, anxiety, acute fatigue, also probably through intershift recovery and sleep quality (see Figure 3 and Table 7). Unexpectedly, exposure to hazards in work environments had a significant direct positive effect on sleep quality (r=.32, p<.001), and on anxiety (r=.19, p<.001). Additionally, it also had significant indirect negative effects on sleep quality (r=-.13, p<.001) probably through intershift recovery and acute fatigue, as well as on intershift recovery (r=-.18, p<.001) through sleep quality and acute fatigue. Exposure to hazards also had indirect positive effects on anxiety (r=.09, p<.001) and depression (r=.22, p<.01) probably through sleep quality, intershift recovery and job dissatisfaction (see Figure 3 and Table 7).

Hypothesis 3: Job demand has a direct positive effect on sleep quality, job dissatisfaction, anxiety, depression, acute fatigue and chronic fatigue.

The results demonstrated that job demand had a direct positive effect on sleep quality (r=.54, p<.001), on job dissatisfaction (r=.23, p<.001), on anxiety (r=.15, p<.001), on acute fatigue (r=.31, p<.001) and on chronic fatigue (r=.08, p<.01). However, it had no direct effect on depression. The third hypothesis therefore, was partially supported. Additionally, job demand had a significant indirect positive effect on job dissatisfaction (r=.12, p<.001) probably through sleep quality and intershift recovery, on anxiety (r=.15, p<.001) through sleep quality, on depression (r=.29, p<.001) probably through job dissatisfaction, anxiety, sleep quality and intershift recovery. It also had an indirect effect on acute fatigue (r=.12, p<.001) probably through sleep quality, and intershift recovery, and on chronic fatigue (r=.24, p<.001)

through job dissatisfaction, anxiety and acute fatigue, also probably through sleep quality and intershift recovery. Further, job demand had a significant indirect negative effect on intershift recovery (r=-.36, p<.001) through sleep quality and acute fatigue, and on sleep quality (r=-.25, p<.01) probably through intershift recovery and acute fatigue (see Figure 3 and Table 7).

Hypothesis 4: Job control has a negative direct effect on sleep quality, job dissatisfaction, anxiety, depression, acute fatigue and chronic fatigue.

The findings revealed that job control had a direct negative effect on sleep quality (r=-.30, p<.001), on job dissatisfaction (r=-.12, p<.001), and on acute fatigue (r=-.16, p<.001). However, no direct negative effect was found on anxiety, depression and chronic fatigue. The fourth hypothesis was partially supported. In addition, job control had an indirect effect on sleep quality (r=.21, p<.001) probably through acute fatigue and intershift recovery, on acute fatigue (r=-.04, p<.05) probably through sleep quality and intershift recovery, on chronic fatigue (r=-.17, P<.001) probably through intershift recovery, sleep quality, job dissatisfaction and acute fatigue, on anxiety (r=-.04, p<.05) probably through sleep quality and intershift recovery, on depression (r=-.10, p<.001) probably through job dissatisfaction, sleep quality and intershift recovery, and on job dissatisfaction (r=-.10, p<.001) probably through intershift recovery and sleep quality. An unexpected significant direct positive effect was found on intershift recovery (r=.16, p<.001). A significant indirect positive effect was also found on intershift recovery (r=.14, p<.001) through sleep quality and acute fatigue (see Figure 3 and Table 7).

Hypothesis 5: Support at work has a direct negative effect on sleep quality, job dissatisfaction, anxiety, depression, acute fatigue and chronic fatigue.

The results showed that support at work had a direct negative effect on job dissatisfaction (r=-.11, p<.001) and on acute fatigue (r=-.08, p<.05). No direct negative effect was found on sleep quality, anxiety, depression and chronic fatigue. The fifth hypothesis therefore, was partially supported. In addition, support at work had a significant indirect negative effect on sleep quality (r=-.02, p<.05) probably through acute fatigue and intershift recovery, on job dissatisfaction (r=-.01, p<.05), on anxiety (r=-.01, p<.05) probably through sleep quality and intershift recovery, and on chronic fatigue (r=-.05, p<.01) through job dissatisfaction and acute fatigue. Further, support at work was found having a non-significant indirect positive effect on acute fatigue (r=.01, p>.05) and had a non-significant indirect negative effect on depression (r=-.01, p>.05) (see Figure 3 and Table 7).

Hypothesis 6: Sleep quality has a direct positive effect on anxiety, depression and chronic fatigue, but a direct negative effect on intershift recovery.

The results demonstrated that sleep quality had significant direct positive effects on anxiety (β=.28, p<.001), and depression (β=.18, p<.001). It also had a significant direct negative effect on intershift recovery (β=-.45, p<.001). However, no direct effect was found on chronic fatigue. Therefore, the seventh hypothesis was partially supported. Unexpectedly, sleep quality had a direct positive effect on acute fatigue (β=.42, p<.001). It also had an indirect negative effect on acute fatigue (β=-.13, p<.001) probably through intershift recovery, and an indirect positive effect on chronic fatigue (β=.27, p<.001) through intetshift recovery, anxiety, depression and acute fatigue. In addition, sleep quality had a significant indirect positive effect on depression (β=.18, p<.001) through intershift recovery and anxiety, on job dissatisfaction (β=.15, p<.001) through intershift recovery, and on intershift recovery

(β=.01, p>.05) through acute fatigue. Further, sleep quality had a significant indirect negative effect on anxiety (β=-.16, p<.001) probably through a non-recursive path between intershift recovery and sleep quality (see Figure 3 and Table 7).

Hypothesis 7: Job dissatisfaction has a direct positive effect on anxiety, depression and chronic fatigue.

The outcomes illustrated that job dissatisfaction had a significant direct positive effect on depression (β=.13, p<.001) and chronic fatigue (β=.19, p<.001), but no direct positive effect on anxiety. Therefore, the sixth hypothesis was partially supported. Additionally, job dissatisfaction had a significant indirect positive effect on chronic fatigue (β=.01, p<.05) through depression (see Figure 3 and Table 7).

Hypothesis 8: Anxiety has a direct positive effect on chronic fatigue.

The findings suggested that anxiety had a positive direct effect on chronic fatigue (β=.12, p<.001). The eighth hypothesis was supported. In addition, it also had a indirect positive effect on chronic fatigue (β=.05, p<.05) through depression. Unexpectedly, anxiety had a direct positive effect on depression (β=.49, p<.001) (see Figure 3 and Table 7).

Hypothesis 9: Depression has a direct positive effect on chronic fatigue.

The result illustrated that depression had a direct positive effect on chronic fatigue (β=.10, p<.01). The hypothesis ninth was supported (see Figure 3 and Table 7).

Hypothesis 10: Intershift recovery has a direct negative effect on chronic fatigue.

The findings demonstrated that intershift recovery had a significant direct negative effect on chronic fatigue (β=-.12, p<.001). The eleventh hypothesis was supported. Additionally, intershift recovery also had a significant indirect positive

effect on chronic fatigue (β=.11, p<.001) probably through job dissatisfaction, depression, and acute fatigue. Unexpected results were that intershift recovery had a significant direct negative effect on sleep quality (β=-.69, p<.001), on depression (β=-.21, p<.001) and on job dissatisfaction (β=-.33, p<.001). Additionally, it also had a significant indirect positive effect on sleep quality (β=.22, p<.001), on job dissatisfaction (β=.11, p<.001) both probably through a non-recursive path between sleep quality and intershift recovery, and on depression (β=.11, p<.001) probably through sleep quality and a non-recursive path between sleep quality and intershift recovery. Further, intershift recovery also had a significant indirect negative effect on acute fatigue (β=-.20, p<.001) and on anxiety (β=-.24, p<.001) both through sleep quality (see Figure 3 and Table 7).

Hypothesis 11: Acute fatigue has a direct positive effect on chronic fatigue.

Results of the analysis indicated that acute fatigue had a significant direct positive effect on chronic fatigue (β=.39, p<.001). The tenth hypothesis was supported. Additionally, acute fatigue had a non-significant indirect effect on chronic fatigue (β=.01, p>.05) through intershift recovery. Unexpectedly, acute fatigue was found to have a significant direct negative effect on intershift recovery (r=-.50, p<.001) and had a significant indirect positive effect on intershift recovery (r=.16, p<.001) probably through sleep quality. In addition, acute fatigue had a significant indirect positive effect (β=.24, p<.001) on sleep quality and job dissatisfaction (β=.11, p<.001) both through intershift recovery. Acute fatigue also had a significant indirect positive effect on anxiety (β=.12, p<.001) probably through sleep quality and intershift recovery. However, it had a non-significant indirect effect on depression (β=.04, p>.05) (see Figure 3 and Table 7).

Summary of Results in the Study

In summary, the results of this study showed that majority of participates had moderate-to-high and high levels of acute fatigue (70.9%), and 39.4% of participants had chronic fatigue at the same level. The final modified model was verified to have a good fit with the data. Nine paths were suggested to be added in the model including: the path from acute fatigue to intershift recovery, the paths from depression to anxiety, the path from intershift recovery to job dissatisfaction, the path from sleep quality to acute fatigue, the path from job control to intershift recovery, the path from exposure to hazards in hospital work environments to sleep quality, the path from exposure to hazards in hospital work environments to anxiety, the path from intershift recovery to sleep quality, and the path from the path from intershift recovery to depression. Among the predictors in the proposed model, job dissatisfaction, anxiety and depression did not affect acute fatigue. Seven predictors had direct and/or indirect effects on acute fatigue including: shift work, job demand, job control, support at work, exposure to hazards in work environments, intershift recovery and sleep quality. All the eleven predictors proposed had direct and /or indirect effects on chronic fatigue including shift work, job demand, job control, support at work, exposure to hazards in hospital work environments, sleep quality, intershift recovery, anxiety, depression, job dissatisfaction and acute fatigue. Shift work, job demand, exposure to hazards in work environments and sleep quality had total positive effects on both acute fatigue and chronic fatigue, while job control, support at work and intershift recovery had total negative effects on both acute fatigue and chronic fatigue. Further, job dissatisfaction, depression, anxiety and acute fatigue had total positive effects on chronic fatigue.

In this final model, 44.8% of total variance in acute fatigue was accounted for by the shift work, job demand, job control, support at work, exposure to hazards in work environments, sleep quality and intershift recovery. Job dissatisfaction, anxiety, and depression had no effect on acute fatigue. Moreover, 61.5% of total variance in chronic fatigue was accounted for by shift work, job demand, job control, support at work, exposure to hazards in work environments, job dissatisfaction, sleep quality, anxiety, depression, intershift recovery and acute fatigue.

Discussions

Discussions of the results include two sections. The first section discusses the level of fatigue. The second section discusses the final model predicting fatigue, including effects of exogenous variables on fatigue and the effect of endogenous variables on fatigue.

Level of Fatigue

The results revealed that 70.9% of participants had moderate-to-high and high levels of acute fatigue, and a mean of acute fatigue was 63.40. Furthermore, 39.4% of participants had moderate-to-high and high levels of chronic fatigue, and the mean of chronic fatigue was 47.14. The findings in this study were consistent with results from Winwood et al (2006), which demonstrated that scores of acute fatigue were higher than that of chronic fatigue. A possible explanation is based on knowledge about acute fatigue and chronic fatigue. Acute fatigue is characterized by an energy lost status and is task specific. After work, certain levels of acute fatigue are anticipated. Regarding chronic fatigue, it may not exist if a person recovers from acute fatigue or the causes

are removed. Therefore, this knowledge explains why acute and chronic fatigue had such levels or scores in the study. Another plausible reason for this phenomenon is that, most recovery from acute fatigue occurs in the non-work period between work shifts (intershift recovery), therefore, intershift recovery can reduce acute fatigue and prevent acute fatigue from progressing into chronic fatigue (Winwood et al., 2005). In this study, 41.5% of participants had moderate-to-high and high levels of intershift recovery. Thus, although the majority of participants (70.9%) had moderate-to-high and high levels of acute fatigue, 39.4% of participants had moderate-to-high and high levels of chronic fatigue through the effect of intershift recovery.

Additionally, the findings indicated that all the participants (100%) had experiences of acute fatigue, but in differing degrees. Furthermore, eight participants (1.37%) had no experience of chronic fatigue whatsoever. In this study, 573 participants (98.63%) had experience of chronic fatigue, but in different degrees. Although direct comparison of fatigue levels is difficult because of different definitions and measurement of fatigue, the findings in the present study are consistent with fatigue the situation reported by other Chinese scholars. For example, Zhang and colleagues (1993) reported 98.87% nurses had fatigue experience in an investigation of 354 nurses; Meng and colleagues (1998) investigated 481 female nurses, and discovered that 92.03% nurses reported fatigue. A recent study, carried out by Xu and colleagues (2005), showed that 91.27% of Chinese nurses experienced fatigue. The nature of nursing work, holistic care carried out in China, and problems in the Chinese nursing profession, including nursing shortage and turnover, as well as underlying beliefs and values regarding the relative value of nursing to Chinese society may explain why a high prevalence of fatigue was found in Chinese nurses (Li, C.L., 2002;

Li & Zhang, 2002; Lv & Lin, 2003; Shi et al., 2001; Zhao & Luo, 1998). Another plausible reason for high fatigue prevalence in nurses is that, majority participants (67.1%) had 5 or more night and evening night shifts per month in this study, and this suggested that they worked in a rapid rotating shift system which may have less intershift recovery. Shen and colleagues (2006) also reported that nurses working in a rotating shift system, especially in a rapidly rotating shift system, were prone to fatigue due to lacking enough time for recovery.

Model for Predicting Fatigue

A final model is discussed to test the hypothesized relationships among the variables and to predict fatigue. The discussion orders in the final model follow by variables, which are from exogenous variables to endogenous variables. The presentation arrangements are also consistent with the sequence of research hypotheses proposed.

Correlations among Exogenous Variables

Results from analysis, as shown in Figure 3, demonstrated that shift work was significantly and negatively associated with job control. This indicates that nurses with more night and evening shifts usually perceive less job control. A possible reason is that, nurses with more evening and night shifts in this study are relatively young and have less working experience, which indicate they may have less skill and ability to control their own work. Thus, these two variables are negatively associated.

Exposure to hazards had a significant and positive relationship with job demand, as well as significant and negative relationships with job control and support

at work. The findings indicate that nurses with more exposure to hazards may have higher job demand, less support at work and job control perception. On the contrary, nurses perceive higher job demand, less support at work and job control may also perceive more exposure to hazards in work environments. A possible reason is that, exposure to hazards in work environments usually increases energy expenditure, decreases tolerance, and makes a person easily irritated at work (Piper et al., 1987), therefore, hazards may induce perceived less job control and less support at work, as well as high job demand. On the contrary, a high job control means having more power and freedom to decide on the job (Karasek & Theorell, 1990). A person with a high job control usually has the power to avoid exposure to hazards in a manner of her own choosing. In addition, a person with more support at work mean she/he has more opportunity to share risk or hazards with the colleagues, therefore, she/he may perceive less exposure to hazards in work environments. Job demand may also give the perception of more exposure to hazards at work. In these ways, exposure to hazards is positively associated with job demand, as well as negatively with job control and support at work.

Moreover, the findings showed that job control significantly and negatively correlated with job demand, as well as significantly and positively related to support at work. The finding is consistent with result from de Croon and colleagues (2002) that job control was significantly and negatively correlated with job demand. This result is similar to Bültmann and colleagues' finding (2002) that job control was significantly and positively associated with support at work. A possible explanation for the negative association between job control and job demand is that, high job control indicates high competence or skill with more freedom and power to make decisions on the job

(Bültmann, Kant, & Van den Brand et al., 2002; Karasek & Theorell, 1990). Therefore, nurses with high job control may perceive less heavy workloads, contributing to low job demand perception. On the contrary, high job demand may induce less job control perception as well. Regarding the positive relationship between job control and support at work, the explanation of this phenomenon may be that, higher job control indicates more competence or skill, and more freedom and power to make decisions on the job (Bültmann, Kant, & Van den Brand et al., 2002; Karasek & Theorell, 1990). Nurses with more competence and higher power tend to be accepted and respected by their colleagues, therefore, it is relatively easy to get more support at work (Lischinger, Finegan, Shamian, & Almost, 2001; Wang, 2004). On the contrary, nurses getting more support at work may acquire more confidence and feel more powerful on the job, therefore contributing to a perception of higher job control.

Effects of Exogenous Variables on Fatigue

Exogenous variables are measured variables that are not caused by any other variables in the model except other exogenous variables (Cohen & Cohen, 1983, Norris, 1997). In this model, shift work, exposure to hazards in work environments, job demand, job control and support at work served as exogenous variables.

The results from path analysis through the LISREL 8.7 program showed that the direct causal pathway from shift work to both acute and chronic fatigue, and paths from exposure to hazards in work environments, support at work and job control to chronic fatigue were not supported in the final model. Instead, the effect of shift work on acute fatigue was mediated through sleep quality and intershift recovery. Similarly, the effects of exposure to hazards in work environments, job demand, job control and

support at work to acute fatigue were all mediated through sleep quality and intershift recovery. Moreover, the effect of all these five exogenous variables on chronic fatigue were mediated through sleep quality, intershift recovery, job dissatisfaction, anxiety, depression, and acute fatigue, as shown in Figure 3.

Effect of Shift Work on Fatigue

Shift work had no direct effect on acute fatigue and chronic fatigue, but it had a small indirect positive effect on acute fatigue and chronic fatigue probably both through sleep quality and intershift recovery. The findings indicated that nurses with more night and evening shifts had more sleep problems and low levels of intershift recovery, thus contributing to acute fatigue and chronic fatigue.

The findings of this study are consistent with results of Akerstedt and colleagues' study (2002), which demonstrated that shift work with day duty (OR=1.05, 95%CI: 0.99-1.12) and with night duty (OR=1.04, 95%CI: 0.93-1.16) were not predictors for fatigue. Furthermore, Ruggiero's study (2003) also supported that permanent day shift nurses, and nurses rotating with night duty, had no significant differences in fatigue level. However, a qualitative study about night shift work experiences among Chinese nurses demonstrated that nurses who worked during night time shifts were prone to experience fatigue because of disruption to the body's circadian rhythm (Xia et al., 2005).

The possible reason that shift work had no direct effect on acute and chronic fatigue is that, shift work includes not only rotating patterns but also shift lengths (Wilson, 2002). In this study, the participants reported their shift length was fixed at 7-8 hours; therefore, only rotating patterns may not be adequate to determine fatigue, for

extended shift length may induce fatigue as well. Regarding its effect on sleep quality, shift work may affect circadian rhythm, which, similar to delayed sleep phase syndrome and jet-lag, desynchronizes the body's sleep-wake schedule (Brown, 1988; Wilson, 2002). In this study, 86.7% of participants had rotating shift patterns with night and evening shifts, suggesting a higher incidence of nervousness and sleep problems, and fatigue is a manifestation of underlying sleep problems (Shen et al., 2005). Additionally, shift work disrupts a person's previously adjusted circadian rhythm, and he or she must readjust the sleep-awake pattern when going back to work. With constant rotation, it is difficult for the body to rest and restore energy (Fitzpatrick, While, & Roberts, 1999), which may contribute to low intershift recovery, thus affecting fatigue.

Effect of Exposure to Hazards in Work Environments on Fatigue

Analysis results in the final model revealed that exposure to hazards in work environments had a direct positive effect on acute fatigue, but it had no direct effect on chronic fatigue. Additionally, exposure to hazards in work environments had an indirect positive effect on acute fatigue, probably through sleep quality and intershift recovery, and had an indirect positive effect on chronic fatigue through job dissatisfaction, anxiety and acute fatigue, as well as probably through intershift recovery and sleep quality. The findings indicate that nurses who have more exposure to hazards in hospital work environments may perceive higher level of acute fatigue. In addition, they may experience more problems in sleep, and lower levels of intershift recovery that result in acute fatigue and chronic fatigue. Furthermore, exposure to hazards in work environments affected job dissatisfaction, anxiety and acute fatigue,

which contributed to chronic fatigue.

Exposure to hazards in hospital work environments predicted acute fatigue, and a possible explanation is that, working under inappropriate physical working environments may increase oxygen and energy expenditure, make nurses easily irritated, and influence the development of fatigue (Feng, 2002; Triolo, 1989). Furthermore, chemical and biological hazards may cause some symptoms, such as nausea, dizziness, headache, and chronic cough, which can increase energy expenditure and decrease body endurance, thus causing fatigue (Piper et al., 1987; Triolo, 1989). Although physical, chemical and biological hazards can increase energy expenditures causing acute fatigue, they may not be sufficient to determine chronic fatigue.

In addition, exposure to hazards in work environments may cause some uncomfortable symptoms that may result in sleep problems and a low level of intershift recovery, which contributes to acute fatigue. Furthermore, exposure to hazards makes nurses easily irritated and intolerant, and may produce anxiety and job dissatisfaction (Feng et al., 1998; Siu, 2002), contributing to chronic fatigue.

Effect of Job Demand on Fatigue

As hypothesized, job demand had a direct positive effect on acute fatigue and chronic fatigue. It also had a small indirect positive effect on acute fatigue probably through sleep quality and intershift recovery. Additionally, job demand had an indirect positive effect on chronic fatigue through job satisfaction, anxiety, and acute fatigue, as well as probably through sleep quality and intershift recovery, but not through depression. These findings suggest that nurses with high job demand perceptions also

perceive high acute fatigue and chronic fatigue. Additionally, job demand affects sleep quality and intershift recovery contributing to acute and chronic fatigue. Further, nurses perceiving high job demand may experience high levels of job dissatisfaction, anxiety and acute fatigue, which may result in perceiving high chronic fatigue.

This finding is consistent with the research outcome of Bystrom, Hanse and Kjellberg (2004), who identified that job demand was a significant predictor of acute fatigue (β=.42, $p<.01$). This is similar to the findings of Hardy and colleagues (1997), de Croon and colleagues (2002), Janssen and Nijhuis (2004), Bültmann, Kant, Schroer and Kasl (2002), as well as Eriksen (2006), all showing that job demand was positively related to chronic fatigue and also a significant predictor of chronic fatigue.

A possible explanation is that job demand is self-perceived workload when a nurse performs his or her job, and workload may directly result in energy expenditure (Varghese, Saha, & Atreya, 1994; Xu et al., 2006) which contributes to acute fatigue. Another explanation is that high job demand may cause the nervous system to remain slightly activated and continue to pump out extra stress hormones over an extended period. These can wear out the body's reserves, and leave a person feeling depleted or overwhelmed, which affects acute fatigue perception (Bystrom et al., 2004). Further, job demand reflects a major characteristic of a job. Nurses with persistently perceiving high job demand may also experience impaired occupational function (Karasek, 1979; Karasek et al., 1998), which in turn induces chronic fatiguen. Moreover, nurses with high job demand perception may experience more work stress which may result in sleep problems and mood changes, such as anxiety, and job dissatisfaction perception, thus contributing to fatigue (Akerstedt et al., 2004; Karasek, 1979; Yeung & So-kum Tang, 2001).

Effect of Job Control on Fatigue

As hypothesized, job control had a direct negative effect on acute fatigue, and had an indirect negative effect on acute fatigue probably through sleep quality and intershift recovery. Contrary to what was hypothesized, job control had no direct effect on chronic fatigue, but had an indirect effect on chronic fatigue probably through intershift recovery, sleep quality, job dissatisfaction and acute fatigue. The findings suggest that high job control contributes to a low level of acute fatigue perception, low job dissatisfaction and less sleep disturbance, as well as a high level of intershift recovery, which influences the perception of chronic fatigue.

Job control did not directly affect chronic fatigue, which was contrasted with the findings of Janssen and Nijhuis (2004), de Croon and colleagues (2002), Bültmann, Kant, van den Brandt, and Kasl (2002), as well as Bültmann, Kant, Schroer, and Kasl (2002), all showing that job control was a significant predictor of chronic fatigue. A possible explanation of this phenomenon is that job control refers to a person's competence or skill, and freedom or power to make decisions on the job (Karasek & Theorell, 1990). This may correlate with chronic fatigue in this study, but is not sufficiently contributing since chronic fatigue is also decided by other factors, such as the nature of the work, attitudes toward the job, and psychological status (de Croon, et al., 2002; de Fatima, et al., 2002; Ruggiero, 2003). Another possible explanation is that chronic fatigue is relatively stable, but job control may be changeable throughout the working year, therefore, job control did not predict chronic fatigue in this study. However, job control influenced acute fatigue. A possible reason is that high job control indicates more ability and freedom to control one's activities and work pace,

which is helpful for energy saving (Laschinger et al., 2001), and therefore, less energy expenditure directly affects perception of acute fatigue. In addition, job control can provide confidence, feelings of achievement and psychological well-being for employees (Yeung & So-kum Tang, 2001), then, may produce good sleep quality and positive attitudes toward the job, which contributes to decreased chronic fatigue.

Effect of Support at Work on Fatigue

The analysis showed that support at work had a direct negative effect on acute fatigue, but had a non-significant indirect positive effect on acute fatigue. Furthermore, support at work had no direct effect on chronic fatigue, but had a significant indirect effect on chronic fatigue through acute fatigue and job dissatisfaction. That is, nurses who perceive more support from supervisors and co-workers tend to have less acute fatigue and job dissatisfaction perception, contributing to a decrease in chronic fatigue.

Support at work did not directly predict chronic fatigue in this study. This finding is contrary to results from previous studies that support at work was a significant predictor of chronic fatigue (Bültmann et al., 2002; de Croon et al., 2002; Poleg and Kleber, 2003). A possible explanation is that support at work refers an overall helpful social interaction available on the job from colleagues and supervisors (Karasek & Theorell, 1990), and it may be necessary, but not sufficient to decide chronic fatigue. However, support at work predicted acute fatigue. A possible explanation for this finding is that, more support at work implies getting more help when an employee undertakes the task, therefore, may expend less energy when performing a job. Less energy loss results in less acute fatigue perception (Beurskens et al., 2000).

Support at work also predicted job dissatisfaction. The finding is consistent with previous studies conducted by Yeung and So-kum Tang (2001), and de Croon and colleagues (2002). A possible reason is that, support at work has an effect on decreasing work-related stress and facilitating task completion (Hamaideh, Mrayyan, Mudallal, Faouri, & Khasawneh, 2008; Wan, 2004), which may reduce job dissatisfaction. Furthermore, nurses with more support at work indicated they can get more approval and respect at work, which also contributes to lower levels of job dissatisfaction (Wan, 2004).

Previous studies demonstrated that social support was a predictor of psychological disturbance, including anxiety and depression (Cohen & Will, 1985; Uphold, Lenz, & Soeken, 2002). However, in this study, support at work was not a predictor of anxiety and depression. An explanation for these findings is that the amount of support at work might be necessary, but not sufficient to decide anxiety and depression. Support from friends and family members may be other valuable sources of emotional support, contributing to prevention of psychological disturbances, such as anxiety and depression (Cohen & Will, 1985; Upholdet et al., 2002).

Effects of Endogenous Variables on Fatigue

The results from path analysis showed that the direct causal pathway from sleep quality to chronic fatigue was not supported in the final model. Instead, direct causal pathway from sleep quality to acute fatigue was found. The effect of intershift recovery on acute fatigue was demonstrated to be mediated through sleep quality, and effect of sleep quality on acute fatigue was demonstrated to be mediated probably through a non-recursive path between intershift recovery and sleep quality. Further, the

effects of sleep quality, job dissatisfaction, anxiety, intershift recovery, and acute fatigue on chronic fatigue were mediated through these endogenous variables themselves (see Figure 3).

Effect of Sleep Quality on Fatigue

Contrary to what was hypothesized, sleep quality had no direct positive effect on chronic fatigue, but had an indirect positive effect on chronic fatigue through intershift recovery anxiety, depression and acute fatigue. Additionally, it had a direct positive effect on acute fatigue and had an indirect negative effect on acute fatigue probably through intershift recovery. The findings indicated that nurses with a high level of problems in sleep might experience a high level of acute fatigue, anxiety, and depression, as well as a low level of intershift recovery, which may affect chronic fatigue perception. In addition, a high level of sleep problems in sleep may contribute to a low level of intershift recovery, contributing to acute fatigue.

The findings that sleep quality did not affect chronic fatigue was contrasted with those of Ruggiero (2003) and Smith and colleagues (1999), both showing that quality of sleep was a predictor of chronic fatigue (β=.22, $p<.01$; β=.29, $p<.01$). A possible reason is that, chronic fatigue in this study resembles to an abnormal occupational trait (Winwood et al., 2006), and poor sleep quality might be necessary, but not adequate to result in such an abnormal occupational state. Another possible reason is that chronic fatigue definition and measurement in the present study were different from those in above-mentioned two studies. Thus, sleep quality did not predict chronic fatigue in the present study. Sleep quality predicted acute fatigue in this study, and a plausible explanation is that sleep makes body organs decrease energy

use, and increase blood supply and energy to the brain, which make a person feel refreshed and not fatigued. Therefore, inadequate sleep makes a person feel lack of energy and enviable fatigue (Gall, 1996; Kunert et al., 2007). In this study, acute fatigue definition is closely associated with energy expenditure (Winwood et al., 2005), therefore, it may explain why sleep quality predicted acute fatigue in the present study.

Additionally, the findings support the studies from Ruggiero (2003), Cao and colleagues (2005), as well as Yang and colleagues (1999), which demonstrated that sleep quality was positively associated with anxiety and depression. A study by Zhang and Diao (2006) also showed that anxiety and depression explained 6.8% variance in sleep quality (R^2=.068, β=.249, p<.01). Sleep is considered to be essential for restoring and recovering tissue and function as well as for recovering energy and maintaining psychological well-being (Spenceley, 1993), thus, poor sleep quality induces psychological disturbance, including anxiety and depression, as well as a low level of recovery (Cao et al., 2005; Ruggiero, 2003; Spenceley, 1993;Yang et al., 1999).

Effect of Job Dissatisfaction on Fatigue

As hypothesized, job dissatisfaction had a small direct positive effect on chronic fatigue. Also, job dissatisfaction was found to have an indirect positive effect on chronic fatigue through depression. However, job dissatisfaction had no effect on acute fatigue. The findings indicated that a high level of job dissatisfaction contributes to a high level of chronic fatigue and depression.

The findings in this study were consistent with previous studies, which found that job dissatisfaction was associated with (r=.49, p<.01) and contributed to chronic fatigue (OR=3.5, 95% CI: 1.50-7.90) (de Croon et al., 2002; de Fatima et al., 2002). A

possible explanation of the findings is that job dissatisfaction is associated with decreased interest and negative feelings at work (McNeese-Smith, 1999). Chronic fatigue is characterized by declining interest and involvement, reduced concentration and motivation, as well as negative emotion on the job (Winwood et al., 2005). Therefore, job dissatisfaction contributed to chronic fatigue in the present study because both of them are associated with a negative belief about the job. Job dissatisfaction did not predict acute fatigue, and a possible explanation is that job dissatisfaction may be necessary but not sufficient to result in an energy loss status at the end of work, contributing to acute fatigue.

Contrary to what was hypothesized, job dissatisfaction did not predict anxiety, but did affect depression in this study. A possible explanation may be that, more than half of participants (62.5%) had only minimal level of anxiety, but the majority of participants (60.6%) had a mild and moderate level of depression. Additionally, more participants had scores of job dissatisfaction above the mean indicating a relatively high job dissatisfaction level in the samples. Thus, low level of anxiety in the sample may conceal the real effect of job dissatisfaction.

Effect of Anxiety on Fatigue

As hypothesized, anxiety had a small direct positive effect on chronic fatigue. Moreover, anxiety was found to have a direct positive effect on depression, as well as an indirect positive effect on chronic fatigue through depression. The findings indicate that nurses have high levels of anxiety, contributing to the severity of chronic fatigue and depression.

The findings in this study are consistent with a study by Ruggiero (2003),

which found that anxiety was associated with chronic fatigue (r=.46, p<.01). Moreover, anxiety was associated with depression, and could trigger depression (Hanprasitkam, 2006). A possible explanation of this phenomenon is that anxiety impairs one's attention and cognition (Eysenck, Derakshan, Santos, & Calvo, 2007); therefore, contributing to declining interest, involvement and commitment, or reduced concentration, which are related to the characteristics of chronic fatigue. However, anxiety did not contribute to acute fatigue, and a possible explanation may be the measurement issue. The acute fatigue scale used in this study measures the end-of-work fatigue, which focuses on a physical energy loss status. The anxiety inventory used in this study measures the psychological attributes. Thus, in this study, acute fatigue did not sufficiently show an effect on acute fatigue. Additionally, anxiety is a psychological disturbance and its effect may be directly on one's mental and emotional aspects, which may be associated with characteristics of chronic fatigue. Therefore, anxiety affected chronic fatigue in the present study.

Effect of Depression on Fatigue

As hypothesized, depression had a small positive direct effect on chronic fatigue. The findings indicate that nurses with high levels of depression contribute to the severity of chronic fatigue perception.

The contribution of depression to chronic fatigue, in this study, was consistent with a previous study which reported positive relationships between depression and fatigue, and depression was a significant predictor of chronic fatigue (β=.47, p<.01) (Ruggiero, 2003). A possible explanation of this phenomenon is that depression overlaps with anxiety in many ways, and the two variables are linked. Similar to

anxiety, depression is a negative emotion that may impair one's occupational function (Delays et al., 1981 as cited in Hanprasitkam, 2006). Impaired occupational function may be associated with declining interest, involvement and commitment, or reduced concentration on one's job, which are the characteristics of chronic fatigue. Similar to anxiety, depression is a psychological disturbance and its influence may be directly on one's mental and emotional aspects, which also overlaps with chronic fatigue characteristics. Therefore, depression predicted chronic fatigue in this study. However, depression did not contribute to acute fatigue, and a possible explanation is that, depression is a mood disorder and it may be necessary, but not adequate, to result in acute fatigue characterized by an energy expenditure status.

Effect of Intershift Recovery on Fatigue

The analysis showed that intershift recovery had a direct negative on chronic fatigue. It also had an indirect positive effect on chronic fatigue probably through job dissatisfaction, depression and acute fatigue. Additionally, intershift recovery had an indirect negative effect on acute fatigue through sleep quality. The findings could be interpreted as that nurses with a high level of intershift recovery may have a low chronic fatigue perception. Additionally, nurses who perceived high levels of intershift recovery reported fewer problems in sleep, contributing to low acute fatigue perception. Furthermore, nurses with high levels of intershift recovery may experience low levels of job dissatisfaction and depression, which contributes to decreased chronic fatigue.

The finding that intershift recovery direct predicted chronic fatigue is consistent with the results of Winwood and Lushington (2006), showing that intershift

recovery affected chronic fatigue (β=-.38, p<.001). An explanation for these findings is that intershift recovery enables nurses to be free from tension built up at work, to keep normal occupational function, to gain more emotional and mental stability, and to maintain psychological well-being (Li, & Zhang, 2002; Winwood, & Lushington, 2006). Thus, intershift recovery may contribute to decreased chronic fatigue, job dissatisfaction, and depression. In addition, intershift recovery maintains normal brain functions and removes tension. Therefore, nurses with high levels of intershift recovery may have less sleep problems as well.

Intershift recovery did not predict acute fatigue in the present study, which was contrasted with findings from Winwod and Lushington (2006), showing that intershift recovery influenced acute fatigue (β=-.44, p<.001). A plausible explanation is that, intershift recovery refers to the extent to which acute fatigue is perceived to have been recovered, or dissipated, by the time the next work shift is commenced (Winwood et al., 2005). Therefore, it is reasonable to assume that acute fatigue is an antecedent variable to intershift recovery. Thus, it is acute fatigue that predicted intershift recovery, but intershift recovery did not predict acute fatigue in this study.

Effect of Acute fatigue on Chronic Fatigue

Acute fatigue had a direct and indirect positive effect on chronic fatigue in the present study. Contrary to what was anticipated, acute fatigue had a direct negative effect on intershift recovery. These results could be interpreted as 1) the higher severity of acute fatigue was reported, the higher level of chronic fatigue was perceived; 2) severity of acute fatigue could interfere with recovery between shifts and, 3) decreasing intershift recovery level affected nurses' perceptions of chronic fatigue

as at a high level.

The contribution of acute fatigue to chronic fatigue and intershift recovery in this study was consistent with findings from previous studies, in which positive relationships between acute fatigue and chronic fatigue ($r=.61$, $p<.01$), as well as negative relationship between acute fatigue and intershift recovery ($r=-.64$, $p<.01$) were reported (Winwood et al., 2005). A possible explanation is based on mechanism of fatigue mentioned in literature review part. Acute fatigue is a response in the first stage of GAS, and chronic fatigue is a response in second stage of GAS. The GAS goes to from the first stage to the second stage if the cause for the stress is not removed, which indicate that chronic fatigue may evolve from acute fatigue. Therefore, it may explain why acute fatigue had a direct effect on chronic fatigue in the present study. A reason that acute fatigue predicted intershift recovery may be that, a high level of acute fatigue indicates more energy expenditure due to previous working activities (Windood et al., 2005), and recovery from high levels of acute fatigue may be relatively time-consuming and difficult. In this way, higher levels of acute fatigue may induce low levels of intershift recovery. In addition, intershift recovery in this study refers to the extent to which acute fatigue is perceived to have been recovered or dissipated by the time the next work shift is commenced. The definition also indicates acute fatigue has an effect on intershift recovery.

In conclusion, the model for predicting fatigue in Chinese nurses was tested. Acute fatigue was both directly and/or indirectly affected by job demand, job control, support at work, exposure to hazards in work environments, and sleep quality. Intershift recovery only indirectly affected acute fatigue. Regarding job dissatisfaction, anxiety and depression, they did not predict acute fatigue both directly and indirectly.

In addition, chronic fatigue was both directly and/or indirectly influenced by acute fatigue, job dissatisfaction, anxiety, intershift recovery and job demand. Depression only directly affected chronic fatigue. However, job control, support at work, exposure to hazards in hospital work environments, and sleep quality indirectly predicted chronic fatigue. Shift work, as a shift pattern, did not directly but indirectly predict both acute fatigue and chronic fatigue. The unique contribution of this study is that it addresses a gap in the literature about fatigue in Chinese nurse. It was the first study in which the predictors of both acute and chronic fatigue were examined at the same time. The new knowledge generated from this study was the identification of different influencing factors on acute fatigue and chronic fatigue in Chinese nurses. The findings have been discussed based on theoretical and methodological aspects, as well as on a review of previous studies.