CHAPTER 3

METHODOLOGY

In this chapter, the methodological aspects of this study are presented, including the research design, population and sample. Instruments for measuring the variables are also included, as well as the research setting, the protection of human rights, and data collection. Finally, data analysis is presented.

Research Design

A cross-sectional, descriptive correlational design was used in this study to examine the theoretical linkage among the variables of interest and fatigue in Chinese nurses. The variables of interest selected for this study were primarily derived from the Job Demand Control Model, a conceptual framework for a project titled "Fatigue at Work", and empirical findings and knowledge of the relevant literatures.

Population and Sample

Population

The target population of this study is Chinese registered nurses (RNs) who work in the general hospitals in P.R.China. The accessible population is Chinese RNs who work in the general hospitals in Chengdu city, Sichuan Province, P.R.China. In Chengdu city, there are 18 general hospitals. The total numbers of RNs in those hospitals was 7,521, accounting for 73.1% of RNs in Chengdu City. These 18 general hospitals cover 5 districts of Chengdu City, and included four general hospitals in

WuHou District (2,042 RNs), four in QingYang District (2,038 RNs), three in JinNiu District (1,071 RNs), four in JinJiang District (1,381RNs), and three in ChengHua District (989 RNs).

Sample

Sample size is a crucial consideration in any research aimed at enhancing the reliability of population estimates. According to Cohen and Cohen (1983), sample size was calculated from the following formula:

$n^* = L/f^2 + k + 1$. ($f^2 = R^2 / 1 - R^2$)

When n=number of sample, L=the noncentrality parameter, f^2=effect size for regression statistics can be calculated from the squared multiple regression correlation coefficient (R^2) value. $f^2 = R^2/1-R^2$, k=the number of predictors for multiple correlation testing.

In previous studies, there was a significant correlation between fatigue and job demand (r=.17-.44) (de Croon, et al, 2002; Janssen & Nijhuis, 2004); fatigue and job control (r=-.17- -.33) (Bültmann, Kant, Schroer, & Kasl, 2002; de Croon et al., 2002); fatigue and support at work (r=-.24- -.18) (Bültmann, Kant, Schroer, & Kasl, 2002; Janssen & Nijhuis, 2004); fatigue and job dissatisfaction (r=.27-.49) (de Croon et al., 2002; MacDonald et al., 2003); fatigue and poor sleep quality (r=.26-.65) (Belza, 1995; Pilcher et al., 2000); and fatigue and anxiety and depression (r=.35-.68) (Dalopakarn, 2002; Zheng et al., 2006). Thus, in order to maximize statistical power based on previous studies the effect size is determined as:

$f^2 = 0.17^2 / 1 - 0.17^2 = .0298$

Cohen and Cohen (1983) also proposed a power of .80 as reasonable for a

study. From a table used to compute the noncentrality parameter with significance level of .05, power .80, and 11 predictor variables, the L value is found to be 16.24 (Cohen & Cohen, 1983).

n=16.24/0.0298+10+1=557

Given this criterion, a minimum of 557 subjects was necessary for this study. Considering a 20% non-response rate (Xu et al., 2006), the total of 668 subjects was the sample size identified for this study.

The inclusion criteria were (1) female; (2) working in in-patient departments; and (3) providing direct patient care. Nurses current on maternity or disability leaves during data collection were excluded.

Multi-stage sampling employed to recruit subjects is presented as follows:

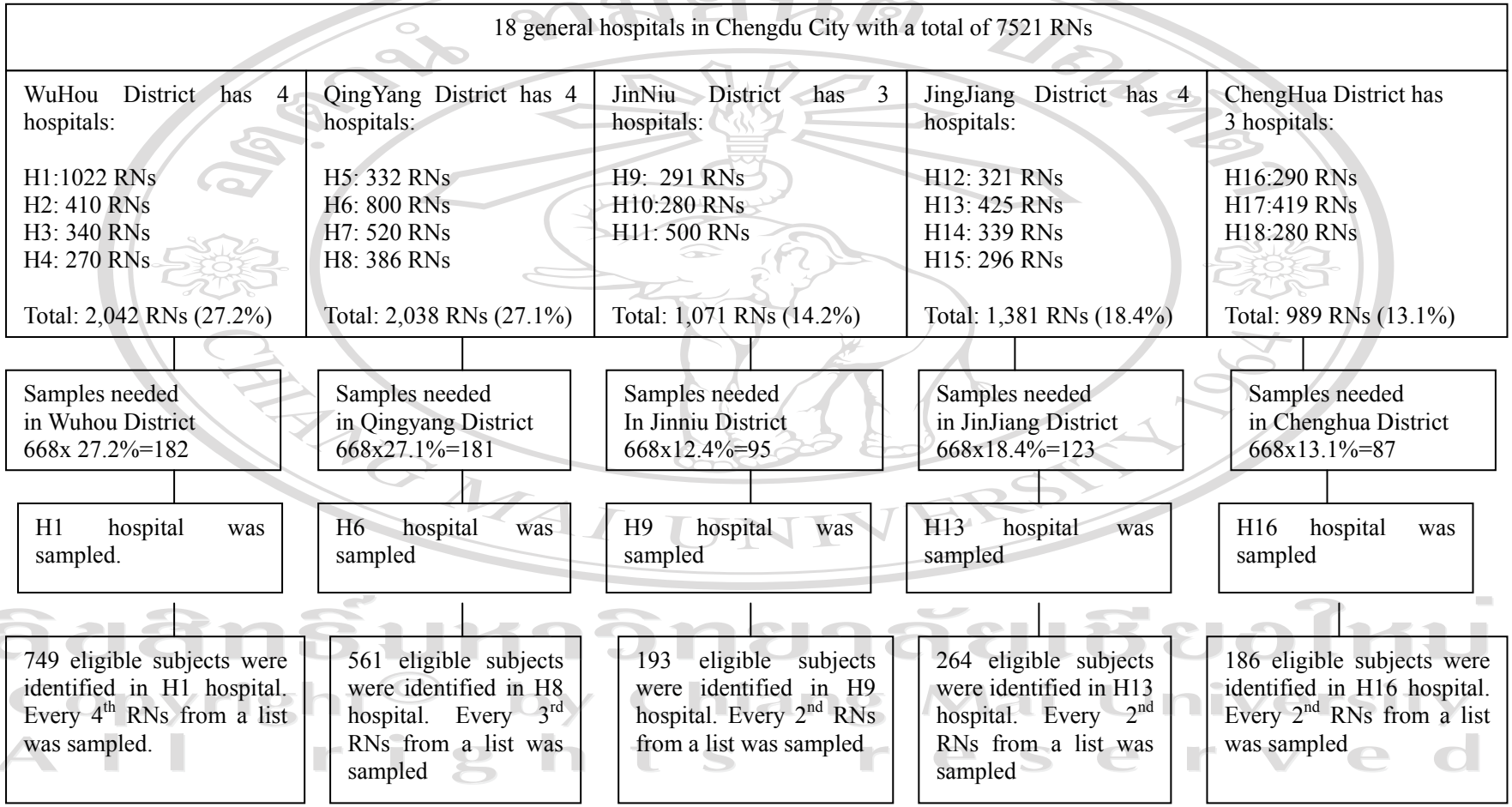
1. Stage One: A proportionate sampling method is used in this stage. The number of nurses needed from each district was calculated based on the number of nurses employed in the district. In the five districts selected for this study, 27.2% of RNs were employed in WuHou District. Thus, 182 RNs (27.2%*668=182) were recruited from WuHou District. By parity of reasoning, 181 RNs (27.1%*668=181) from QingYang District, 95 RNs (668*12.4%=95) from JinNiu District, 123 RNs (668*18.4%=123) from JinJiang District, and 87 RNs (668*13.1%=87) from ChengHua District were identified.

2. Stage Two: In this stage, simple random sampling was used to select one hospital among the hospitals in each district. Finally, H1 hospital in WuHou District, H6 hospital in QingYang District, H9 hospital in JinNiu District, H13 in JinJinag District, and H16 hospital in ChengHua District were sampled.

3. Stage Three: In this stage, a list of all eligible nurses at the selected

hospitals was obtained from nursing service departments. The nurses chosen for participation were selected from these lists using a systematic random sampling approach. There were 749 eligible subjects in H1 hospital from WuHou District, and taking every four persons from the list was identified. Similarly, taking every three persons from 561 eligible subjects in H6 hospital from QingYang District was also identified. By parity reasoning, taking every two persons from 193 and 264 eligible subjects in H9 and H13 Hospital from JinNiu District and JinJiang District were confirmed too. Finally, there were 186 eligible subjects in H16 hospital from the ChengHua District, and taking every two persons from the list was identified. Multi-stage sampling process is shown in Figure 2.

Figure 2: Multi-stage sampling process in the present study



Research Setting

This study was conducted among nurses at five general hospitals in Chengdu City, Sichuan Province, P.R.China. These hospitals included Huaxi Hospital, the Third Hospital of Chengdu City, ChengTie Central Hospital, the Second Hospital of Sichuan Province, and the Second Hospital of Chengdu City.

Instruments

The instruments used in this study consist of eight parts, including the Demographic Information Form, the Occupational Fatigue Exhaustion Recovery (OFER) scale, the Job Content Questionnaire (JCQ), the Job Dissatisfaction Scale, the Exposure to Hazards in Hospital Work Environments (EHHWE) scale, the Pittsburgh Sleep Quality Index (PSQI), the Beck Anxiety Inventory (BAI), and the Beck Depression Inventory (BDI).

Part I Demographic Information Form

The demographic information form was developed by the investigator. It comprised questions which covered age, marital status, educational level, professional title, position title, working unit, years of working in nursing profession, and work schedule (see Appendix A).

Part II Occupational Fatigue Exhaustion Recovery (OFER)

The OFER scale was originally developed by Winwood, Lushington, and Winfiled (2006) based on nursing populations. This scale contains 15 items that assess

the subjective feeling of fatigue and intershift recovery. The Chronic Fatigue Subscale (5 items) and the Acute Fatigue Subscale (5 items) measure employees' subjective feeling of fatigue, and the Intershift Recovery Subscale (5 items) measures the feeling of recovery from acute fatigue by the time the next work shift is commenced (see Appendix B). The items of OFER were scored on 7-point likert scales (0= "strongly disagree" to 6="strongly agree"). The Cronbach's alphas for the subscales were .89 for Chronic Fatigue Subscale, .84 for Acute Fatigue Subscale, and .84 for Intershift Recovery. The test-retest correlations were .62 for Chronic Fatigue Subscale, .61 for Acute Fatigue Subscale, and .62 for Intershift Recovery Subscale. Subscale correlations range from .53-.61. Exploratory factor analysis indicated a three-factor solution. Confirmatory factor analysis demonstrated that X^2 was 210.9, Goodness of Fit Index was .95, Cumulative Fit Index was .97, Tucker-Lewis Index was .96, and root mean square error of approximation was .05, which further tested the results from exploratory factor analysis and demonstrated a good construct validity (Winwood, Lushington, & Winfiled, 2006).

The investigator received the permission from original author to use this scale (see Appendix L). The researcher translated the English version into Chinese. The accuracy of the translation was verified by the back-translation procedure by the two bilingual experts to maintain the content of the original items (see Appendix I). Two language versions were reconsidered and modified until the translator and back translator agreed to its correct translation.

The reliability of the Chinese version of this scale was tested among 15 Chinese nurses at HuaXi Hospital, Sichuan University. The Cronbach's alpha obtained was .82 for Acute Fatigue Subscale, .81 for Chronic Fatigue Subscale,

and .86 for Intershift Recovery Subscale.

The scoring method of each subscale is based on the following formula: sum (subscale items scores)/30x100, which produce comparable values between 0-100 for each subscale. The interpretation of the result value is based on Winwood and colleagues (2006), who suggest that a global sum of "1-25" indicates a low level of each subscale's construct; "26-50" indicates low to moderate level; "51-75" suggests moderate to high level; and "76-100" indicates a high level of each subscale construct.

Part III Job Content Questionnaire (JCQ)

The Job Content Questionnaire is a self-report instrument originally developed by Karasek (1985) to measure the demand, control and support of job strain. The Job Control Subscale, Job Demand Subscale, and Support at Work Subscale were best-known scales included in the JCQ. The Job Control Subscale includes 9 items; the Job Demand Subscale includes 14 items; and the Support at Work Subscale includes 11 items. Three subscales in the JCQ were designed in Likert scale with 4 levels from 1 (strongly disagree) to 4 (strongly agree). The Cronbach's alpha for the subscales was .78 (men) and .80 (women) for the Support at Work Subscale; .68 (men) and .67 (women) for the Job Demand Subscale; .81 (men) and .82 (women) for the Job Control Subscale (Karasek et al., 1998). The construct validity of the JCQ subscales was established by using factor analysis. The factors extracted by the principal axis factoring method corresponded very closely to the theoretical constructs (Cheng et al., 2003). In addition, predictive validity was established by using the Job Demand, Job Control and Support at Work subscales to predict illness in dozens of studies. These three scales were significantly associated with cardiovascular

disease and blood pressure by using a wide range of methodologies (Karasek et al., 1998).

Sa and colleagues (2003) validated the Chinese version of the Job Demand, the Job Control and the Support at Work Subscales in 320 health professionals. The internal consistency reliabilities (Cronbach's alpha) were r=.67 for the Job Control Subscale, .68 for the Job Demand Subscale, and .70 for the Support at Work Subscale. The test-retest reliabilities of these three subscales range from .87-.97 ($p<.01$). Eighty seven percent items correlated with the scale with correlation above .50 ($p<.01$). Principal component analysis showed that factor loading on items was above .40. The factor analysis confirmed the constructed validity for job demand, job control and support at work subscales. Xie (1996) reported Cronbach's alpha coefficients for job demand and job control were .79 and .77 in Chinese employees. Cheng and colleagues (2003) reported that Cronbach's alpha coefficients for job control and support at work were all above .80 in Chinese Taiwanese workers.

The investigator received the permission from original author to use the Job Content Questionnaire (see Appendix L). In this study, the reliability of a Chinese version of the JCQ, including Job Demand, the Job Control, and the Support at Work Subscales (see Appendix C) was tested among 15 Chinese nurses at HuaXi Hospital, Sichuan University. The Cronbach's alphas were .76 for the Job Demand Subscale, .70 for the Job Control Subscale, and .90 for the Support at Work Subscale.

The scoring method of each subscale is based on the sum of items' scores in each of the subscales. The interpretation of the results value is that the higher scores in each subscale, there is a higher level of job demand, job control, and support at work (Karasek, 1985).

Part Ⅳ Job Dissatisfaction Scale

The Job Dissatisfaction Scale is a self-report instrument and consists of 5 items rating about overall negative feeling about one's job. The Job Dissatisfaction Scale established internal consistency reliability (Cronbach's alpha coefficient=.77), split-half coefficient (r=.71) in 3,683 Flemish workers (Storms, Casaer, Wit, van den Bergh, & Moens, 2001); Cronbach's alpha coefficient=.81 in 338 Korea health care workers (Eum et al., 2006), and Cronbach's alpha coefficient=.80 in 1,199 Chinese Taiwanese workers (Cheng et al., 2003). Another study reported the internal consistency reliability (Cronbach's alpha) of the Job Dissatisfaction Scale was .61 among Chinese healthcare workers (Li, Yang, Chen, Siegrist, & Cho, 2005).

Predictive validity of the Job Dissatisfaction Scale was established with the high correlation with general fitness scale (r=.23), negative affectivity (r=.28), and score of general health questionnaire (r=.34) (Storms, et al., 2001). Cheng and colleagues (2003) reported that a lower level of job control, higher level of job demand, and lower level of support at work were associated with a higher level of job dissatisfaction scores, which demonstrated a good criteria-related validity.

In this study, the reliability of a Chinese version of the Job Dissatisfaction Scales (see Appendix D) was tested among 15 Chinese nurses at HuaXi Hospital, Sichuan University. The Cronbach's alpha was .76.

Regarding the interpretation of this scale, a sum of weighted item scores is calculated. Total scores of five items were calculated based on formula: score equals [(Item3+Item5-Item2-Item4)*3–(Item1*4) + 40]/60*100, with values ranging from 0 (completely satisfied) to 100 (completely unsatisfied). The higher scores represent the

higher levels of job dissatisfaction (Karasek, 1985).

Part Ⅴ Exposure to Hazards in Hospital Work Environments Scale (EHHWE)

The EHHWE was modified by investigator based on Gillmore's Hospital Occupational Hazards Scale (1990), and evidence from literature reviews. The original Hospital Occupational Hazards Scale was developed to measure the frequency of hospital nurses' exposure to physical, chemical, biological and psychosocial occupational hazards (Gillmore, 1990). It included four subscales such as Accidents and Injures, Environmental Exposure, Infectious Disease and Job stress. Because the Job Stress Scale mainly referred to psychosocial hazards in Gillmore's study, which overlap with the investigator's psychosocial measurement of job characteristics in the present study, it was not included in Exposure to Hazards in Hospital Work Environments Scale. Accidents and Injures (CVI=.50, Cronbach'α =.54), Environmental Exposure (CVI=.75, Cronbach'α=.49), and Infectious Disease Scales (CVI=1.00, Cronbach'α=.68), which measured the exposure to hazards in physical, chemical, and biological hospital work environments (Gillmore, 1990), were adopted and modified in the present study by investigator.

For an appropriate administration of this scale in Chinese nursing population, the developer gave permission (see Appendix L) to use and modify this instrument. Based on developer's scale and literature review from published western and Chinese scholarly articles, three categories hazards in hospital work environments are identified: physical, chemical, and biological. Items have been added and deleted based on the literature review and evidence from previous studies. Finally, 20 items have been produced (including exposure to physical, chemical and biological

hazardous in hospital work environments). A 5-points Likert scale (1=never, 2=rarely, 3=sometimes, 4=often, and 5=always) has been adopted as response choices (see Appendix E).

The content validity of this modified scale has been tested by a panel of 7 experts (see Appendix J) to confirm the presentativeness of the concept. The expert reviewers were asked to rate each item's clarity and its relevance as well as whether the concept had been adequately covered by the set of items. A likert-type scale with four responses was used (1= not relevant, 2=somewhat relevant, 3=quite relevant, and 4=very relevant). Rating of 3 and 4 were considered "content valid" where ratings of 1 and 2 were considered "content invalid". The content validity index for each pair of the experts was computed. The CVI for each pair of experts ranged from .80 to 1, and the CVI for the EHHWE was .90.

The accuracy of translation was verified by the back-translation technique by the two bilingual experts (see Appendix I). After that, the reliability of Chinese version scale was tested among 15 Chinese nurses at HuaXi Hospital, Sichuan University. The test-retest reliability was .76 within 2-week interval and the Cronbach's alpha of the instrument was .82.

Scoring method of this scale is based on a sum of items scores. The interpretation of the result value is that, the higher scores in this scale, the more frequencies of exposure to hazards in hospital work environments.

Part VI Pittsburgh Sleep Quality Index (PSQI)

The PSQI is a 19-item self-report questionnaire originally developed by Buysse and colleagues (1989). The PISQ differentiates "poor" from "good" sleep by

measuring seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction over the last month. The client self-rates each of these seven components of sleep. The global PSQI had an overall reliability coefficient (Cronbach's alpha=.83), and global PSQI score of test-retest reliability coefficient was .85, indicating a high reliability. In addition, construct validity of the PSQI had been established to successfully distinguish the samples of healthy without sleep complaints and subjects with sleep complaints by using know-groups technique (Carpenter & Andrykowski, 1998). According to Buysse and colleagues, the PSQI global scores greater than 5 (indicating poor sleepers) were found to be sensitive and specific measures of poor sleep quality, yielding diagnostic sensitivity of 89.6% and specificity of 86.5% (kappa=.75, $p<0.01$).

The PSQI was translated into Chinese and has been validated in Chinese population by Liu and colleagues (1996). They made a study of the reliability and validity of PSQI in Chinese subjects of 112 normal adults, 560 colleague students, 45 patients with insomnia, 39 patients with depression, and 37 patients with neurosis. The results showed that Cronbach's alpha .84 for PSQI in all subjects. Each component score correlated with the global PSQI score with coefficient r ranging from .63 to .81; test-retest reliability of global PSQI score was .81; and split-half coefficient was 0.866 in all subjects. Factor analysis demonstrated that factor loadings on 7 components ranged from .59-.80; and factor loadings on each item were more than .30, which suggested one construct. The PQIS score showed a good construct validity, such as a score in normal adults (3.23) <a score in colleague students (5.61) <a score in patient groups (13.71). A global PSQI score over 7 yielded a diagnostic

sensitivity of 98.3% and specificity of 90.2% in distinguishing normal subjects from patients with sleep quality problems. The good clinical metrical properties of the PSQ1 suggest its utility both in Chinese psychiatric clinical practice and other research activities.

In this study, the reliability of the PSQI (Chinese version) (see Appendix F) was tested among 15 Chinese nurses at HuaXi Hospital, Sichuan University. The Cronbach's alpha was .73.

Scoring of the PISQ is based on a 0 to 3 Likert scale, whereby "3" reflects the negative extreme on each component. Scoring of the PISQ is based on the formula: (sum of seven components), with total scores ranging from 0-21. The interpretation of the result value is that a global sum of "0-4" indicates normal sleep quality and "5" or greater indicates poor sleep quality (Buysse et al., 1989).

Part Ⅶ Beck Anxiety Inventory (BAI)

The BAI is a 21-item self-report questionnaire originally developed by Beck, Steer, and Garbin (1988). It is a widely used instrument for measuring the severity of self-reported anxiety (Beck et al., 1988; Creamer, Foran, & Bell, 1995).

An analysis of the BAI's internal consistency yielded a high internal consistency for psychiatric patients (α=.92) and colleague students (α=.91), and high test-retest reliability over 1 week, (r=.75 for psychiatric patients, and r=.62 for colleague students) (Beck et al., 1988; Creamer et al., 1995). Concurrent validity of the BAI has been established in samples of healthy and anxious disorder adults, and the mean correlations of the BAI with Stai-Trait Anxiety Inventory and Stai-State Anxiety Inventory were .58 and .47, respectively, for anxious disorder patients. With

healthy subjects, the mean correlations of the BAI with Stai-Trait Anxiety Inventory and Stai-State Anxiety Inventory were .74 and .78, respectively (Creamer et al., 1995; Fydrich, Dowdall, & Chambless, 1992). For discriminant validity, the BAI is able to discriminate homogenous and heterogeneous anxious diagnostic group from other psychiatric group. In addition, The BAI was moderately correlated with the Hamilton Anxiety Rating Scale (r=.51), and was only mildly correlated with the Hamilton Depression Rating Scale (r=.25) (Beck et al., 1988), and a factor analysis showed that it can discriminates anxiety from depression in non-clinical samples (Creamer et al., 1995).

The BAI was translated into Chinese and has been validated in Chinese population (Che et al., 2006; Zheng et al., 2002). A study of the reliability and validity of BAI in Chinese had as subjects of 189 anxiety and depression disorder patients, 230 psychiatric patients, and 112 community individuals. Zheng and colleagues (2002) demonstrated that Cronbach's alpha was .95 and split-coefficient was .92 among anxiety disorder and depressed patients Che and colleagues (2006) showed that Cronbach's alpha was .95 and Guttman split-half coefficient was .91 in their subjects. Chinese version of the BAI also showed good convergent validity with Hamilton anxiety rating scale (HAM-A). (Pearson's correlation =.72). Factor analysis showed a two-factor structure: subjective anxiety and panic-somatic symptoms. The total variance explained was 58.04%, similar to Beck's original construct and supporting factor validity. These results support the reliability and validity of the Chinese version of the BAI.

In this study, the reliability of the BAI (Chinese version) (see Appendix G) was tested among 15 Chinese nurses at HuaXi Hospital, Sichuan University. The

Cronbach's alpha obtained was .93.

Scoring of answers is based on a 0 to 3 Likert scale. The BAI total score is the sum of the ratings given by the subject for each of the 21 items. The maximum score is 63. The interpretation of result value is that: total scores from 0-9 points reflect minimal level of anxiety, scores of 10-18 indicate mild levels of anxiety, scores of 19-29 reflect moderate levels of anxiety, and scores of 30-63 indicate severe anxiety (Creamer et al., 1995).

Part VIII Beck Depression Inventory (BDI)

The BDI is a 21-item self-report questionnaire originally developed by Beck and colleagues (Beck et al., 1961). It is one of the most widely used instruments for measuring the severity of self-reported depression in both healthy and psychiatric populations. Over a thousand research studies have employed this instrument (Groth-Marnat, 1999).

A meta-analysis of the BDI's internal consistency estimates yielded a mean coefficient alpha of .86 for psychiatric patients and .81 for non-psychiatric patients, such as university students, unemployed adults, adults in general health survey. Test-retest reliability ranged from r=.60-.83 for non-psychiatric patients. For concurrent validity, the mean correlations of the BDI with clinical ratings and the Hamilton Depression Rating scale were .72 and .73, respectively, for psychiatric patients. With healthy subjects (colleague students), the mean correlations of the BDI with clinical ratings and the HDRS were .60 and .74 respectively (Beck et al., 1988). In addition, the BDI is able to differentiate between non-depressed subjects and depressed by using known-group technique. It also can discriminate depression from anxiety (Beck

et al., 1988).

The BDI was translated into Chinese and has been validated in Chinese population by Zhang, Wang, and Qian (1990). They made a study of the reliability and validity of BDI in Chinese subjects of 268 normal adults and students, 38 patients with depression, and 29 patients with neurosis. The results showed that Cronbach'a was .89 for its 21 components and the split-half coefficient was .88 in all subjects. Each component score correlated with the global BDI score (r= .40-.70, $p<0.01$). Principal components analysis showed that factor loading on 21 items ranged from-.29-.75, which suggested all the items measure the same construct. Discriminant validity showed that normal adults and students had significantly lower the BDI score compared to depressed and neurosis patients. The BDI scores of neurosis patients were significantly lower than the depressed patients group. The good clinical metrical properties of the BDI suggest its utility both in Chinese non/psychiatric clinical practice and research activities.

In this study, the reliability of the BDI (Chinese version) (see Appendix H) was tested among 15 Chinese nurses at HuaXi Hospital, Sichuan University. The Cronbach's alpha was .88.

Scoring of the BDA is based on a 0 to 3 Likert scale. The BDI total score is the sum of the ratings given by the subject for each of the 21 items and the maximum score is 63. The interpretation of result value is that: total scores from 0-4 points reflect minimal level of depression, scores of 5-13 indicate mild levels of depression, scores of 14-20 reflect moderate levels of depression, and scores of 21-63 indicate severe depression (Beck et al., 1961)

In summary, the reliability coefficients (Cronbach's alpha) of the scales used

in this study ranged from .70 to .93, and for Exposure to Hazards in Hospital Work Environments scale, test-retest reliability was test with the value of .76. Polit and Hungler (1995) stated that reliability coefficients in the proximity of .70 may be sufficient although there is no absolute standard to determine what an acceptable reliability coefficient should be.

Protection of Human Rights

Ethical approval for this study was granted by research ethics committee, Institutional Review Board (IRB), Faculty of Nursing, Chiang Mai University, Thailand (see Appendix M). Permission was obtained from the authorities of Nursing Service Departments of five sampled hospitals, the nursing service directors (see Appendix N). An informed cover letter (Appendix O) was attached to the research instruments to inform each participant about the purpose of the study. The nurses who agreed to participate were asked to sign the consent form (Appendix O). Participants had the right to refuse to participate or to withdraw from the study at any time. All information was kept confidential. Confidentiality was ensured through the use of code numbers. The data obtained from the participants were secured during the study, and were used only for the purpose of the study and remain confidential. Nurses were apprised that all findings of the study would be reported as group results and be submitted for publication and presented as a dissertation. Written information and the researcher's address and phone numbers were also provided. All participants got a ten Yuan thank you gift as remuneration for research involvement.

Data Collection Procedures

Following approval of the Graduate Board Committee of the Faculty of Nursing, ChiangMai University, research ethics committee, Institutional Review Board (IRB) of the Faculty of Nursing, Chiang Mai University, and approval of the authorizes of selected hospitals, data collection was initiated:

(1) The researcher met with the nursing administrators and the heads of the department in each of the hospitals for an orientation to the study and informed them about the objectives of the study. The eligible criteria were outlined, and agreement obtained for accessing potential participants.

(2) The researcher got a list of eligible subjects from nursing service department in each of sampled hospitals, and then packages were prepared for all individuals selected to participate. The package included a cover letter, a consent form, the questionnaires, a teabag, and a stamped pre-printed post envelope with a return address on it. The cover letter advised individuals that their participation was entirely voluntary and that they could withdraw at any time with no questions asked. The packages were put in the mailboxes out side of the clinical units. Participants were requested to take the package home and complete it on their own time, and then returned it to researcher in the enclosed envelope within a one-week period, and 612 questionnaires were returned with a response rate of 91.62%.

(3) The researcher reviewed all the data, checked for completeness, then, data were put into computer and organized for data analysis. Finally, 581 questionnaires (86.98%) were completed, then, data were put into computer and organized for data analysis.

Analysis of Data

All data obtained from questionnaires were analyzed by using SPSS 13.0 program and LISREL 8.7 program. The overall level of significance was set at the alpha of 0.05. SPSS version 13.0 was used for data analysis of descriptive statistics. LISREL 8.7, a structural equation modeling program, was used for path analysis with several statistical techniques presented as follows.

1. Descriptive statistics including frequency, percentage, range, the mean and standard deviation were used to delineate characteristic of the sample and study variables of interest in this study.

2. Pearson correlation was conducted to examine the relationships among study variables.

3. Violation of the assumption for path analysis was checked before the hypothesized model was tested. These assumptions were normality, linearity, and homoscedasticity and multicollinearity. The researcher presented examination of each assumption as followings:

Normality. The normal distribution of each variable in this study was tested by skewness, kurtosis statistics and normal probability plot. If the skewness value was within the range ±2 and $Z_{kurtosis}$ (kurtosis divided by the standard error) and did not exceed ±1.96, the distribution had a normal curve (Jacobsen, 1997). In this study, the skewness value of each variable was within the range ±2. With regard to $Z_{kurtosis}$ value, only two variables (sleep quality and exposure to hazards in work environment) had $Z_{kurtosis}$ value of -1.28 and -1.18 which indicating the normal distribution. The other variables were not in acceptable range as they had $Z_{kurtosis}$ value all exceeding ±1.96, absolute value varying from 2.10 to 18.10 (see Table 3). Furthermore, West, Finch,

and Curran (1995) suggested that when variables are highly non-normal (e.g., skewness=3; $Z_{kurtosis}$=21), the standard errors of parameter estimates are underestimated, resulting in an untrustworthy result. In this study, $Z_{kurtosis}$ value did not exceed 21 and skewness value did not exceed 3. All the interesting variables were not highly non-normal. In addition, maximum likelihood (ML) procedure provided by LISREL 8.7 was used in the model testing and ML was quite robust to the violation of normality (Bentler, 1995; Chou & Bentler, 1995). Therefore, its estimates are good even when the data is not normally distribution (Schumacker & Lomax, 1996). Moreover, all the normal probability plots of dependent variables formed a straight diagonal line (see Appendix P).

Linearity. The linearity relationship between independent and dependent variables were tested by the residual plot which is the graph between the standardized residuals (y-axis) versus the predicted value (x-axis). If the assumption of linearity is met, the standardized residuals should scatter randomly about a horizontal line (Stevens, 2002). The residual plots of seven dependent variables including sleep quality, job dissatisfaction, anxiety, depression, intershift recovery, acute fatigue and chronic fatigue all showed linear relationship (see Appendix P).

Homoscedasticity means that in every value of the independent variable (X), the distribution of dependent variable scores (Y) must have approximately equal variability (or equal variance). This assumption was checked by scatter plot. When standardized residual values are plotted against observed values, the data should form a straight line from the lower-left corner to the upper-right corner, indicating no violation of the assumption (Tabachnick & Fidell, 1996). In this study, plots of residual standardized of seven dependent variables (sleep quality, job dissatisfaction, anxiety,

depression, intershift recovery, acute fatigue and chronic fatigue) between standardized residual values and observed values showed homoscedasticity (see Appendix P).

Multicollinearity refers to the predictor variables that have high intercorrelation. In this study, multicollinearity of variables was examined through three criteria comprising simple correlation among the predictors, tolerance value and the variance inflation factor (VIF). The common cut-off points of multicollinearity are that correlation coefficient is less than .80 (Hair, Anderson, Tatham, & Black, 1998) or .85 (Munro, 1997), tolerance value is greater than .10, and VIF is less than 10 (Hair, et al., 1998). In this study, the results showed that the correlations among independent variables ranged from .01 to .71 (see Table 5), tolerance ranged from .56 to 1, and VIF ranged from 1 to 2.48 (see Table1). These indicated that no evidence of multicollinearity existed among predictor variables.

Table 1

Assessment of Multicollinearity among Variables in the Model (N=581)

Variable	Tolerance	VIF
1. The first equation (DV = Sleep quality)		
Shift work	.98	1.02
Job demand	.97	1.03
Job control	.89	1.13
Support at work	.92	1.09
2. The second equation (DV=job dissatisfaction)		
Shift work	.98	1.03
Job demand	.77	1.30
Job control	.88	1.14
Support at work	.91	1.10
Exposure to hazard in work environment	.76	1.32
3. The third equation (DV=intershift recovery)		
Sleep quality	1.00	1.00

Note: DV=Dependent Variable

Table 1 (Continued)

Assessment of Multicollinearity among Variables in the Model (N=581)

Variable	Tolerance	VIF
4. The fourth equation (DV=anxiety)		
Shift work	.96	1.04
Job demand	.71	1.40
Job control	.84	1.19
Support at work	.86	1.16
Sleep quality	.76	1.31
Job dissatisfaction	.63	1.58
5. The fifth equation (DV=depression)		
Shift work	.96	1.04
Job demand	.71	1.40
Job control	.84	1.19
Support at work	.86	1.16
Sleep quality	.76	1.31
Job dissatisfaction	.63	1.58
6. The sixth equation (DV=acute fatigue)		
Shift work	.98	1.03
Job demand	.78	1.30
Job control	.88	1.14
Support at work	.91	1.10
Exposure to hazard in work environment	.76	1.32
7. The seventh equation (DV=chronic fatigue)		
Shift work	.94	1.07
Job demand	.56	1.77
Job control	.77	1.29
Support at work	.84	1.19
Exposure to hazard in work environments	.68	1.48
Sleep quality	.51	1.95
Job dissatisfaction	.56	1.77
Anxiety	.40	2.48
Depression	.41	2.46
Intershift recovery	.41	2.45
Acute fatigue	.45	2.22

Note: DV=Dependent Variable

4. A proposed model was specified, its parameters estimated, and its fit was tested. The LISREL 8.7 program provided maximum likelihood (ML) estimates for all model parameters (Hou, Wen, & Cheng, 2004). Although ML was developed under

the multivariate normality assumption, it is quite robust to the violation of normality (Bentler, 1995, Chou & Bentler, 1995). Therefore, its estimates are good even when the data is not normally distribution.

The proposed model was modified based on modification indices, which were indicators to suggest adding paths. From these modification indices, the modified model was estimated and the resulting modification indices were examined again. Then, the proposed model was trimmed by dropping all non-significant paths and by adding significant correlations among exogenous variables.

Testing the fit of the hypothesized full model was evaluated according to chi-square (X^2), 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). Good fit is indicated by a non-significant X^2. In addition, CFI, NFI, NNIF, GFI values ranged from 0 to 1, with values greater than or equal to .90, indicating a good fit (Bentler, 1995). With regarding to RMSEA, the value of less than .05 is an indictor of a good fit model (Hou et al., 2004).

Moreover, the path coefficients and squared multiple correlations (R^2) were estimated to determine the variance acute and chronic fatigue explained by influencing factors. A standardized path coefficient was used as an estimate of a structural effect. Beta (β) was used as a structural effect of an endogenous variable on another endogenous variable. Gamma (γ) represents the structural effect of an exogenous variable on another endogenous variable. Further, in path analysis, there are three types of structural effects: direct, indirect, and total effects. Total effects = Direct effects + Indirect effects (Munro, 1997). These structural effects were presented.

In summary, this chapter presented research methodologies including design, population and sample, research setting, instruments, data collection procedures and protection of human right. It also proposed analysis procedures, including testing of assumptions of path analysis.