CHAPTER 2

LITERATURE REVIEW

This chapter reviews the conceptualization of fatigue, fatigue in occupational health, fatigue and nursing in China, and factors influencing fatigue. Further, conceptual framework for the study is also presented.

Conceptualization of Fatigue

The term of fatigue is both Latin and French origin. The Latin word 'fatigare', from which the word fatigue is derived, means "to exhaust as with riding or working, to weary or to harass". Likewise, the French word 'fatigue' means to tire. These origins are reflected in the current dictionary definitions that predominantly describe the concept of fatigue as being related to exertion (Ream & Richardson, 1996).

In academic literature, defining fatigue has challenged scientists for many years as the complex interaction of the biological process, psychosocial phenomena, and behavioral manifestations involved (Ream & Richardson, 1996). In the occupational health discipline, burnout has been identified as a concept related to fatigue. Burnout is usually particularly referred to as a state of emotional exhaustion according to previous research findings. Olson (2007) verified that exhaustion was conceptually distinct from fatigue, and that they were two different concepts located along an adaptation continuum in a manner consistent with stress theory. Winwood and colleagues (2005) stated that burnout is not synonymous with generalized chronic fatigue in workplace. Huibers and colleagues (2003) also supported that burnout and

chronic fatigue conceptually overlap with each other, but they were different constructs. Although the definition of fatigue is still a subject of controversy, Olson (2007) conducted a systematic literature review about fatigue and categorized fatigue into two broad categories: “fatigue as a marker for alertness or functional status” and “fatigue as a stress response”.

Fatigue as a Marker for Alertness or Functional Status

Several research groups agreed with the conceptualization of fatigue as “a marker for alertness or functional status”. Grandjean (1968) stated that fatigue was part of a feedback system composed of the mechanism responsible for activation and inhibition. This mechanism included the thalamus; the reticular activating system; neural pathways linking regions in the cerebral cortex response for consciousness, perception, and thinking; and humoral factors. If a person’s inhibitory mechanism predominates, he or she experiences fatigue. With this in mind, fatigue can be conceptualized as a continuum, ranging from fresh to alert and sleepy to tired. Ryden (1977) indicated that any interference with transforming energy into a usable form might affect the availability of energy. Further, Piper, Lindsey, and Dodd (1987) explained the patterns or factors they thought most likely influence fatigue: accumulation of metabolites, depletion of energy-yielding substances, changes in the transmission or regulation of energy, oxygen, disease, treatment, and activities/rest patterns. They argued that these factors resulted in energy deficit, which contributed to fatigue. Piper’s work fits well with Winningham et al’s research (1994), which reported that fatigue may result from energy deficit caused by disease, treatment, decreased activity or rest, symptom perception, and functional status. Although Irvine,

Vincent, Graydon, Bubela, and Thompson (1994) attempted to show a relationship between a number of physiologic factors and the onset of fatigue, no significant factors were identified.

Fatigue as a Stress Response

An alternate conceptualization of fatigue, presented by Bartlett (1953), hypothesized that fatigue could develop over short periods of time, provided that the energy demand was sufficiently excessive. Bartlett disagreed with the idea of fatigue as an "early warning" signal and argued that because sensations associated with fatigue were the results of excessive of expenditure of energy, they arrived too late to be any practical value. This assessment is consistent with stress response as developed by Selye (1952, 1956). Selye (1952) described stress as the nonspecific response to any demand, whether pleasant or unpleasant. If present over time, stressors trigger the general adaptation syndrome (GAS), which comprises an alarm reaction, resistance, and exhaustion stage. Further, several authors underpinned the idea of "fatigue as a stress response". Cameron (1973) labeled factors that led to fatigue as stressors and noted that if a person were subjected to stressors over time, the GAS would be triggered. Rhoten (1982, as cited in Olson, 2007) conceptualized fatigue as part of a stress response triggered in the context of surgery and outlined stressors related to an individual's preoperative state, surgery and anesthesia, pain, and pain medication. Aistar (1987) stated that fatigue in the context of cancer is a function of the source of stress and that prolonged or intense exposure to stressors could lead to energy depletion. Glaus (1993) viewed fatigue as a stress response that is modified by the population in which it is experienced.

Olson (2007) concluded that two important differences should be noted between these “fatigue as marker of alertness or functional status” and “fatigue as a stress response” approaches. First, in the “fatigue as a stress response” approach, an individual might experience stressors of sufficient magnitude to trigger the GAS but might not be aware of this fact. On the other hand, using the fatigue as “marker of alertness or functional status”, perception is a hallmark of all of the conceptualization. Second, although Piper (1986) noted that objective and subjective correlates of fatigue exist, researchers working in the “fatigue as a marker of alertness or functional status” have not demonstrated links between the correlates. In the “fatigue as a stress response” approach, however, it is shown that psychosocial interventions can modulate the stress response. Cognitive appraisal of a threat and the coping strategies are viewed to be following primary mediators of the stress response.

Olson (2007, p.94) stated, “Although studies testing the ‘Fatigue as a stress response’ model were not identified, it has several features that make it more useful than the ‘fatigue as a marker of alertness or functional status’ model. First, it provides an explanation for the reasons that some individuals experience as a stress response under certain conditions but others do not. Second, adaptation, a key construct in stress theory, provides a theoretical mechanism for movement between tiredness (establishment of an alarm response), fatigue (maintenance of resistance), and exhaustion (depletion of capacity or resist).”

Fatigue definition in the present study is based on the work of Winwood and colleagues (2005), who defined fatigue as a state of impairment and disinclination to undertake further non-work activities or job tasks. It included acute fatigue and chronic fatigue. Acute fatigue referred to a lack of energy to engage with normal non-

work activities as a direct consequence of previous working tasks. Chronic fatigue referred to an inefficient action pattern, declining interest, involvement and commitment, reduced concentration and negative emotions about one's work. Their conceptualization of fatigue tends to take "fatigue as a response of stress" rather than as "a marker for alertness or functional status". Winwood and colleagues stated that acute fatigue is transient in nature and readily modified by rest/or task moderation, which generally is adaptive and not inevitably stressful. By comparison, persisting with activity while already fatigued, in response to internal and/or external pressures, generally would be experienced as stressful, which could be called chronic fatigue. Although these authors view fatigue as a stress response, they admit that fatigue and stress are different constructs, which tend to be the different sides of the same coin. As Winwood and colleagues stated, "it is practically meaningless to make any distinction between the constructs of fatigue and stress, for high levels of the one are associated with high levels of the other".

In conclusion, the conceptualization of fatigue in the present study resembles to "fatigue as a response to stress". Acute fatigue is similar to an early stage of GAS—establish an alarm reaction response to stress, and chronic fatigue resembles to the resistance stage of GAS—maintenance of resistance. The advantages of the conceptualization of fatigue in this way are (1) providing a way to detect early fatigue signals, and (2) helping to develop different measures regarding acute and chronic fatigue.

Fatigue in Occupational Health

As a symptom, fatigue has attracted more and more special attention in

occupational health. In this section, fatigue mechanism, type of fatigue, effect of fatigue on employees and measurements of fatigue in occupational health, as well as fatigue models in occupational health are proposed.

Fatigue Mechanism

Now that fatigue is viewed as a stress response, the mechanism of fatigue is perceived to be associated with the body's reaction to stress which is called the general adaptation syndrome (GAS). There are three stages to GAS. The first stage is called the alarm reaction. Here the body releases adrenaline and a variety of other psychological mechanisms to combat the stress and to stay in control. Because the body uses energy to combat the stress, the human being would feel muscles tense, heart beating faster, breathing and perspiration increasing, eyes dilating, and lack of energy (Selye, 1952).

If the cause is not removed, GAS goes to its second stage called the resistance stage. Here the body secretes further hormones that increase blood sugar levels to sustain energy and raise blood pressure. The adrenal cortex (outer covering) produces hormones called corticosteroids for this resistance reaction. If this phase continues for a prolonged period of time without periods of relaxation and rest to counterbalance the stress response, sufferers become prone to concentration lapses, declining interest, irritability, and lethargy as the effort to sustain arousal slides into negative stress (Selye, 1952).

The third stage of GAS is called exhaustion. In this stage, the body has run out of its reserve of body energy and immunity. Mental, physical and emotional resources suffer heavily. The body experiences "adrenal exhaustion". The blood sugar

levels decrease as the adrenals become depleted, leading to decrease stress tolerance, mental and physical collapse, as well as illness (Selye, 1952). If unchecked, exhaustion can lead to death (Olson, 2007).

Effect of Fatigue on Employees

There is a large body of laboratory data showing beyond a doubt that fatigue impairs human performance (Gaba & Howard, 2002). Fatigue interferes with a respondent's ability to engage in a number of routine activities and can result in difficulty concentrating, inability to remember, inability to think clearly, and even worsening other symptom (Mei, LeMone, McDaniel, & Bausler, 2001). Over the past several years, studies have provided unequivocal evidence that mood is worsened by fatigue, as indicated by increased scores on measures of depression, anxiety, confusion, and anger (Owens, 2001; Samkoff & Jacques, 1991).

In working populations, approximately 20% of employees reported symptoms that fall under the concept of fatigue (Kant et al., 2003). Fatigue in working populations has attracted attention to occupational health research, since it may affect the individual's performance and ability to function in the occupational and home setting (Kant et al., 2003). Employee fatigue can lead to increased accidents and injuries, illnesses, poor quality work, low morale, turnover, and poor member service. In addition, fatigued employees have problems with concentration, memory, communication, decision-making, and managing complex tasks (William, 1999).

Fatigue is also a critical issue for Chinese nurses because it cascades to under desirable outcomes, such as medication errors, degradation in performance, decreased mental acuity, social problem, and frequent requests to be removed from night shifts

(Shi et al., 2001; Xu et al., 2005). Especially, when there is insufficient opportunity for recovery, effects may be so serious that nurses may experience disability leading to long term or even indefinite absenteeism from nursing work. In this way, fatigue not only harms health care quality, but also threatens patients' safety and health care providers themselves.

Type of Fatigue

In occupational health, several scholars prefer to categorize fatigue into acute and chronic fatigue. The advantage of this discrimination is helpful for developing interceptive interventions on fatigue in workplace, and therefore providing effective measures to prevent acute fatigue progressing into chronic fatigue.

1. *Acute fatigue* usually appears intermittently. It often has a recent onset and is temporary in duration. After work has been done, certain levels of acute fatigue are expected. Thus, acute fatigue is usually perceived to be characterized by task specificity and reversibility (Beurskens et al., 2000; Winwood et al., 2005). Based on fatigue mechanisms, acute fatigue is very similar to the first stage of GAS. In this stage, the body uses energy to combat the stress and establish an alarm of response; therefore, the human being with acute fatigue is characterized by an energy lost status. Employees with acute fatigue perception usually feel lack of energy to engage with normal non-work activities because of previous working tasks.

2. *Chronic fatigue* is considered excessive and constant, which may be cumulative. Chronic fatigue resembles the second stage of GAS, and sufferers become prone to concentration lapses, declining interest, irritability and lethargy. Thus, when employees are not recovered from acute fatigue or the causes are not removed, they

may become prone to chronic fatigue. Employees with chronic fatigue demonstrate an inefficient action pattern, declining interest, involvement and commitment, reduced concentration and negative emotions about the job (Winwood et al., 2005). In addition, recovery from chronic fatigue is not quickly anticipated and compensation mechanisms that were useful in reducing acute fatigue may be not effective in decreasing chronic fatigue.

The characteristics of acute fatigue and chronic fatigue indicate that interventions to reduce acute and chronic fatigue should be different. Thus, it denotes further investigation of influencing factors regarding acute and chronic fatigue in order to develop appropriate interventions.

Measurements of Fatigue in Occupational Health

Fatigue assessment is recognized as important by occupational health researchers. Measurement of fatigue can focus either on one dimension, usually severity, or on multiple dimensions. The measurement can also capture additional information about fatigue quality or impact, or about phenomena conceptually related to fatigue. Ancillary measurements (e.g. physiological parameters) can also be used to measure fatigue. Generally, the measurement of fatigue has both an objective and a subjective component. However, the best way to assess and measure fatigue is to determine a person's own perception of fatigue experience (Piper et al., 1987).

Subjective measures deal with self-perceived feelings (Aronson et al., 1999). Some scholars suggested that self-reported fatigue instruments, which measured an individual's subjective perception of fatigue, were essential to the understanding of this phenomenon. They also considered objective measure to be inappropriate because

of the subjective nature of fatigue and its multidimensionality (Aaronson et al., 1999; Mei et al., 2001; Tiesinga et al., 1996). Piper and colleagues (1987) suggested that an individual's own perception of fatigue was the best indicator of fatigue. Instruments available to assess subjective fatigue can be divided into unidimensional and multidimensional measurements.

1. Unidimensional fatigue measurements

Unidimensional measurements are designed to derive a single score that captures heterogeneous symptom and behaviors. Such instruments are relatively brief and useful as outcome measures in the large studies or as screening instruments (Dittner, Wessely, & Brown, 2004). Unidimensional fatigue measurements used in working populations include the Fatigue Severity Scale (FSS) (Krupp, LaRocca, Muir-Nash, & Steinberg, 1989), the Energy and Fatigue Subscale from World Health Organization Quality of Life assessment. (EFWHOQOL-10026) (WHOQOL group, 1998), and the Emotional Exhaustion Subscale from the Maslach Burnout Inventory (Maslach & Jackson, 1986).

1.1 The Fatigue Severity Scale (FSS) is one of the best known and most used fatigue scales. The FSS principally measures the impact of fatigue on specific types of functioning rather than the intensity of fatigue-related symptoms (Taylor, Jason, & Torres, 2000). The FSS has a high internal consistency (r=.88) and good test– retest reliability (r=.84). It also has a good concurrent validity with fatigue rated on visual analogue scale (Krupp et al., 1989).

1.2 The Energy and Fatigue Subscale derived from the World Health Organization Quality of Life assessment scale contains four items. Answers are given

on a five-point Likert scale (from 1, never, to 5, always): two positively phrased items using the term “energy” and two negatively phrased featuring the word “fatigue”. This scale has been found to have a good reliability (Cronbach’s alpha=.86) and validity (convergent validity ranging from .57-.71) in working populations (de Vries, Michielsen, & van Heck, 2003)

1.3 The Emotional Exhaustion Subscale of the Maslach Burnout Inventory comprises five items, and each with a seven point rating scale ranging from 1, never, to 7, always (Maslach & Jackson, 1986). The scale has well-established validity (convergent validity ranging from .51-.80) and high internal consistency (r=.88) in working populations (de Vries et al., 2003).

The use of unidimensional instruments excludes the possibility of a more complete description of fatigue and reorganization of the multidimensional nature of fatigue. Therefore, fatigue measurements usually choose multidimensional measurements.

2. Multidimensional fatigue measurements

The multidimensional fatigue measurements often used in working populations include the Swedish Occupational Fatigue Inventory (SOFI) (Ahsberg, Gamberale, & Kjellberg, 1997), the Need for Recovery (van Veldhoven & Broersen, 2003), the Checklist Individual Strength Questionnaire (CIS) (Beurskens et al., 2000), the Standard Shiftwork Index Chronic Fatigue Scale (Barton et al., 1995) and the Occupational Fatigue Exhaustion Recovery (OFER) (Winwood, Lushington, & Winefield, 2006).

2.1 The Swedish Occupational Fatigue Inventory (SOFI) was developed for measuring work-related perceived fatigue. It consists of 25 expressions which are categorized into five latent subscales. They are: lack of energy (LE), physical exertion (PE), physical discomfort (PD), lack of motivation (LM), and sleepiness (SL) (Ahsberg et al., 1997). Concurrent and discriminate validity were assessed by comparing the scores obtained by different types of worker (teachers, firemen, cashiers, bus drivers and engineers) on each dimension. Internal consistency of the subscales was satisfactory, with Cronbach's alpha of over .80, especially for LE (.92), LM (.92) and SL (.89). Slightly smaller values were obtained for PD (.81) and PE (.87).

2.2 The Need for Recovery Scale focuses on the recovery needed following the work shift which is a significant aspect of fatigue (van Veldhoven & Broersen, 2003). The Need for Recovery is suggested to be an operationalization for the measurement of early symptoms of fatigue in employee. Although this scale is multidimensional, including items regarding concentration, exhaustion, motivation, irritability, and time for recovery, each of the items requires a yes/no endorsement without quantification of frequency or intensity of the unique components of fatigue that are measured.

2.3 The multidimensional Checklist Individual Strength Questionnaire (CIS) is one of the instruments used to measure fatigue among working populations. It consists of 20-items, and four dimensions: the subjective feeling of fatigue, reduction in motivation, reduction in concentration and reduction in activity (Beurskens et al., 2000). Beureskens and colleagues conducted a study to evaluate validity of the CIS in occupational groups. The results suggested that the CIS was able to discriminate between fatigued and non-fatigued employees in occupational groups. The expected

agreement between the results of the CIS and related measures was confirmed. The CIS seems to be an appropriate instrument for measuring fatigue in working population. The psychometric properties of the CIS are good: Cronbach's alpha reliability coefficient for the entire CIS is .90. Cronbach's alphas for the subscales are .88 for subjective experience of fatigue, .92 for concentration, .83 for motivation, and .87 for activity (Bültmann et al., 2000).

2.4 The Standard Shiftwork Index Chronic Fatigue Scale (SSICFS) is a 10-item self report scale, which is the measure of only chronic fatigue for shift work researches, and has been widely used in shift work studies (Barton et al., 1995). Each item of the SSICFS consists of a five-point Likert scale ranging from 1 (not at all) to 5 (very much so). Internal consistency for the SSICFS ranges from .91-.93 in shiftworking nurses, industrial and service workers. Construct validity has been established in shiftworking nurses, industrial and service workers, with all ten items loading on a single chronic fatigue factor (Barton et al., 1995; Smith et al., 1999).

2.5 The Occupational Fatigue Exhaustion Recovery (OFER) was developed by Winwood, Lushington, and Winfiled (2006). This scale contains 15 items that assess subjective feeling of fatigue, including Chronic Fatigue Subscale (5 items), Acute Fatigue Subscale (5 items), and Intershift Recovery Subscale (5 items). Acute Fatigue Subscale and Chronic Fatigue Subscale intend to measure both acute and chronic fatigue respectively. Intershift Recovery Subscale measures recovery from acute work-related fatigue. The OFER possesses robust, gender-bias free psychometric characteristics. Its three subscales identify and distinguish between chronic work-related fatigue, acute end-of shift fatigue and effective fatigue recovery between shifts. Cronbach's alphas for the subscales are .89 for chronic fatigue, .84 for

acute fatigue, and .84 for intershift recovery. The test-retest correlations are .62 for chronic fatigue subscale, .61 for acute fatigue scale, and .62 for intershift recovery scale. Subscale correlation ranges from .53-.61, and confirmatory factor analysis demonstrated that X^2=210.9, Goodness of Fit Index is .95, Cumulative Fit Index is .97, Tucker-Lewis Index is .96, and root mean square error of approximation is .05, which demonstrated a high content validity (Winwood et al., 2006).

In summary, the measurement of fatigue in working populations are either unidimensional or multidimensional. Fatigue measurement is often multidimensional for the use of unidimensional instrument excluding the possibility of a more complete description of fatigue and reorganization of the multidimensional nature of fatigue. Among the multidimensional instruments for measuring fatigue in working populations, the SOFI is limited to measuring physical signs of acute post-work fatigue and is not appropriate for chronic fatigue assessment. In addition, it does not include any measure of recovery from fatigue or encompass the interaction of acute fatigue with chronic fatigue. For the Need for Recovery Scale, each of the items requires a yes/no endorsement without quantification of frequency or intensity of the unique components of fatigue that are measured. Despite the fact that the CIS was originally developed for chronic fatigue syndrome patients, the CIS had been validated for measuring fatigue in working populations. This occurs possibly because this instrument is available, rather than because of its suitability. In addition, the CIS is supposed to measure only chronic fatigue since it is originally developed for chronic fatigue syndrome patients. The SSICFS is appropriate for measuring fatigue in shift workers, such as nurses, but it is only a measure of chronic fatigue rather than acute fatigue. However, the OFER is a parsimonious scale with robust psychometric

properties whose subscales distinguish well between acute fatigue and chronic fatigue. This is not the intent of many dozens of fatigue measurement scales. Further, among published fatigue scales, intershift recovery is unique, which can be used to investigate its effect on acute and chronic fatigue. Using the OFER can help us to have a complete understanding of fatigue in employees. In addition, it is developed based on nursing samples; therefore, it is appropriate to be used in the present study.

Models of Fatigue in Occupational Health

If fatigue is viewed as "a stress response", it is no wonder job stressors are frequently investigated to examine their relationships with fatigue in occupational health area. From the existing literature, several models regarding job stressors were applied to fatigue researches in order to explore the influencing factors of fatigue in working populations. The commonly used models are the Person-Environment Fit Model (Van Harrison, 1978), the Effort-Reward Imbalance Model (Siegrist, Peter, Junge, Cremer, & Seidel, 1990; Siegrist, 1996), and The Job Demand Control Model (Karasek & Theorell, 1990).

1. The Person-Environment Fit Model states that the person and the environment are both represented by subjective and objective variables. The potential for fit is conceptualized in this way: there is a match between the person's skill and abilities and the demands and requirement of the job; or the job environment supplies the resources to fulfill the individual's needs and requirement. This model asserts no fit when there is a mismatch between the motives of the person and the resource of environment, or the demand of the job and the ability of the person to meet those demand (Van Harrison, 1978; Baker, 1985).

2. The Effort-Reward Imbalance Model states that the work role of the individual is a link between personal factors, such as self-esteem and self-efficacy, and the work place, the labor market and the world at large. Reciprocal relationship is assumed to exist between the individual role occupant and the larger society. Through an exchange process at the work place, one's effort was rewarded with money, esteem, and career opportunities. The model suggests that a lack of reciprocity between the efforts or contributions of the individual and socially recognized rewards will resulted in emotional distress, arousal of the automatic nervous system, and subsequent strain (Siegrist et al., 1990**;** Siegrist, 1996)

3. The Job Demand Control Model is a situation-centered model on which much of the current job stress research is based. In its basic form, the JDC postulates the primary characteristics of the job itself: job demand and job control. Job demand is defined as psychological and physical stressors present in the work environment. The term 'job control' has been described as the worker's ability to control his own activities and skill usage (Karasek & Theorell, 1990). The JDC proposed that job demand as the external stressors that related to a job, combined with two aspects of job control (decision authority and skill discretion), were thought to be involved in the development of fatigue on the job. The addition of support at work broadened the JDC by including the interpersonal relations with co-worker and supervisors (Karasek et al., 1998). Karasek and colleagues proposed that job demand, job control and support at work were social and psychological characteristics of a job, which can predict job-related symptoms, such as fatigue, illness and psychological distress. The JDC has been translated into a dozen of languages and has captured much attention.

In conclusion, the JDC was chosen as the basis for present study because it is

widely used in occupational health discipline for predicting job-related symptoms including fatigue and diseases. It also has been validated in studies of Chinese workers (Xie, 1996), Chinese Taiwanese workers (Cheng et al., 2003), and especially in Chinese health care workers (Sa et al., 2003; Li, Yang, Liu, Xu, & Cho, 2004). In Xie's study, it was verified that the JDC would generalize across cultures, and more specifically, that it would apply to China. In addition, several studies about fatigue in employees are based on the JDC (Andrea, Kant, Beurskens, Metsemakers, & van Schayck, 2003; Bültmann, Kant, & Kasl et al., 2002; Bültmann, Kant, & Schroer et al., 2002; de Croon et al., 2002; Janssen & Nijhuis, 2004). Therefore, it is reasonable to choose the JDC as a basis for the present study. However, it focuses mainly on psychosocial job characteristics. In order to have a complete view of influencing factors on fatigue in Chinese nurses, it is reasonable to combine the evidence and empirical findings from previous studies as the conceptual framework for the present study.

Fatigue and Nursing in China

In this section, the fatigue situation of Chinese nurses, nursing situation and fatigue in China, clinical hospital work environments and fatigue in China, as well as studies of fatigue in Chinese nurses is reviewed.

Fatigue Situation of Chinese Nurses

In China, several scholars have studied fatigue situation among Chinese nurses. Zhang, Luan, Gao, and Cao (1993) investigated 354 nurses, and found that 98.87% of them reported fatigue. These included 57.91% who reported severe fatigue,

40.96% who reported moderate fatigue, and only 1.13% who reported mild and no fatigue. Meanwhile, 68.82% of the same subjects reported general fatigue, 46.21% reported mental fatigue, and 39.26% reported physical fatigue. Meng, Wang, Yang, Diao, and Zhan (1998) investigated 481 female nurses, and discovered that: 92.03% of them reported both physical and mental fatigue; 0.63% reported only mental fatigue; 6.71% reported only physical fatigue; and 0.63% reported no fatigue. In their study of 1,901 nurses, Xu and colleagues (2005) reported that 91.27% of Chinese nurses experienced fatigue. Although direct comparison of fatigue prevalence in western countries with that in China is difficult because of different definition and measurement of fatigue, the results from the investigations in Chinese nurses clearly showed a high prevalence of fatigue. Wang (2004) proposed that nurses in China are prone to experience fatigue, a situation that merits attention not only from nursing managers, but also from policy-makers.

Fatigue is one of reasons accounting for errors in nursing work in China. Xue and Bao (2000) reported that nursing job error rate increased to nearly 10% when a nurse was fatigued. Feng (2002) also reported that fatigue could increase errors in nursing work, which could decrease quality of care in China. Fatigue is such a critical issue for Chinese nurses that it leads to undesirable outcomes, such as medication errors, degradation in performance, decreased mental acuity, social problems and frequent requests to be removed from night shifts (Shi et al., 2001; Xu et al., 2005). Thus, fatigue is a significant problem that requires further investigation in Chinese nurses.

Nursing Situation and Fatigue in China

Nursing is a practice discipline that effects changes in a client's bio-psychosocial environment to promote health, learning and growth, and the nursing work is thus supportive and therapeutic. Nurses interact with clients to explore their needs, feelings and goals in each situation (Potter & Perry, 1995). In 1990, holistic care based on total patient care was proposed and gradually popularized in China. Holistic health care considers the physical, emotional, social, economic, and spiritual needs of the patients, which requires nurses to become deeply involved in the field of human behavior (Cheng, 1998). Sympathy, understanding, compassion competence and personal involvement in the lives and death of other human beings are key elements in the process of caring and the professional nursing role. The intense interaction with patients, as well as complex personal involvement and interaction with patients' families or significant others, members of the health team, administrators and the community at large may produce fatigue in nurses (Zhao & Luo, 1998). In addition, there is little room for error in nursing practice that has the potential for setting high tension in the working environment. One possible consequence of exposure to stressful situations is fatigue (Shi et al, 2001; Li & Zhang, 2002).

Moreover, nursing shortage is one of problems in Chinese nursing society accounting for fatigue (Liu & Chen, 2004). According to Li's statistical report (2006), the population of China is about 13 hundred million, with 1.28 billion registered nurses, giving a ratio of nurses to populations was nearly 1:1,010. Where as in majority of countries in the world, the ratio of nurse to populations is higher than 1: 400. In China, the average ratio of nurse to bed is 0.35:1, and in rural areas, the ratio

is only 0.14:1. In the whole world, the average ratio of nurse: bed is 1:1. China is far below this standard. Because of nursing shortage problem in China, nurses are experiencing a high job demand, and this has been viewed as a significant contributor to fatigue (Li & Zhang, 2002; Li, X.H., 2002; Lv & Zhang, 2002; Shi et al., 2001; Xu et al., 2005).

Turnover is another problem in Chinese nursing profession and several research groups have identified this problem. In Zhang and Zhang's (1994) study, 384 nurses left nursing from 17 hospitals in Shanghai from January, 1992 to June, 1993. This was equal to 18.2% of the graduates from all secondary nursing schools in Shanghai for the same period. Wu, Zhang, and Gao (2000) studied the intention of turnover among 328 nurses in Peking Union Medical Hospital, and the results suggested that the 41.36% nurses had middle level intention of turnover. In addition, Cao (1999) reported that 40.1% of nurses intended to change their job in another survey of 192 nurses in three Chinese hospitals. Sun and colleagues (2001) investigated 241 nurses from 33 hospitals, and 84.2% mentioned that they would not to choose the nursing profession if they had the chance to change a job. Further, Cheng, Fang and Jin (2008) investigated nursing situations in 26 hospitals in Sichuan Province of China, and the results revealed that average turnover rate was 9.43%, and highest turnover rate was 26.95%, which is higher than 8.4% released by the PricewaterhouseCoopers' Health Research Institute in 2007 (AACN, 2008). Turnover problems can aggravate nursing shortages in China, contributing to higher job demand, which could result in fatigue (Lv & Lin, 2003). These authors further explained that one of reasons for turnover in Chinese nurses was fatigue. Therefore, fatigue contributes to turnover problems in Chinese nurses, and turnover aggravates fatigue,

which form a vicious circle.

Furthermore, Chinese society does not consider nursing work to be important when compared to physician's work. The socioeconomic status of nurses is low (Hong & Yang, 2004). This problem results in a lack of enough opportunity for promotion and continuing education for nurses in China, which results in high competition among nurses for the few opportunities available. High competition can induce strained relationships at work, which may contribute to fatigue among Chinese nurses (He & Yang, 2005).

Due to the nature of nursing work and holistic care carried out in China, problems in Chinese nursing profession, including nursing shortage and turnover, as well as underlying beliefs and values regarding the relative value of nursing to Chinese society, it is not surprising that the fatigue is a problem existing in Chinese nurses. In addition, the high prevalence of fatigue in Chinese nurses and potential impact of fatigue on quality of nursing care make the study of fatigue in Chinese nurses both important and significant.

Clinical Hospital Environments and Fatigue in China

In China, hospitals, health centers, health service centers for community, special disease prevention and treatment institutes, and outpatient departments are usually referred to as medical institutions. According to statistical data in 2007, 60.5% of medical visits and 71.1% of in-patients in medical institutions occurred in hospitals. Among all the hospitals, general hospitals accounted for 80.6% medical visits, 81.2% for in-patients and 75.04% of total beds. In addition, 81.71% registered nurses currently work in general hospitals (Ministry of Health P.R.China, 2007). A general

hospital is characterized by the treatment of various diseases and injuries, including some illnesses that may be critical and serious. General hospitals undertake a large amount of medical care services in China. Working in general hospitals, nurses interact with all types of clients and undertake various nursing services to meet clients' demands, which may bring heavy workload and requirements for nurses (Zhang, Cheng, Yi, & Zhang, 2006). Previous studies regarding fatigue in China were mainly conducted in general hospitals, and the findings showed that nurses working in general hospitals had a high prevalence of fatigue (Meng et al., 1998; Xu et al., 2005; Zhang et al., 1993).

Moreover, as a major place of employment of nurses, hospitals are complex sociological, technological, biological and psychological systems that produce powerful stimuli affecting the lives of both clients and health care providers. Nurses are consistently faced with clinical dilemmas, including crisis events, life and death situations, rapid technological advances, and daily exposure to various illnesses and diseases. Noxious agents such as bacteria and viruses, threat of nuclear radiation, crowded workspaces, and unpleasant odors represent some of the daily environments with which nurses must cope (Li & Luo, 2003). Currently, with rapid technological advances, the medical equipment and various types of chemicals are widely used in clinical setting in China. These are threats to nursing work environments, and exposure to such hazards in work environments produces fatigue in Chinese nurses (Li C.L., 2002). Fang (2007) also suggested that nurses with exposure to various hazards in work settings might represent a high-risk group for fatigue.

In summary, general hospitals in China account for the majority of medical visits and in-patients, and nurses working in them experience a higher prevalence of

fatigue comparing those working in other types of hospitals. In addition, nurses with exposure to complex hospital work environments represent a high-risk group for fatigue. Therefore, studying fatigue in Chinese nurses who work in general hospital is significant.

Studies on Fatigue in Chinese Nurses

Chinese nursing scholars are gradually realizing the impact of fatigue on nurses and are trying to find the possible factors influencing fatigue in Chinese nurses. They have also written about possible related factors to fatigue in order to develop proper intervention in the future. These factors have included job demand, exposure to hazards in work environments, shift work, sleep quality, job dissatisfaction, support at work, decision authority, and psychological factors, such as anxiety and depression (Feng, 2002; Li C.L., 2002; Li & Zhang, 2002; Liu & Wang, 2000; Lv & Zhang, 2002; Wang, Xi, & Feng, 2003; Zou, 2000). However, the above-mentioned writings were not empirical studies, thus they cannot provide strong evidence. In China, there were only two empirical studies which examined factors related to fatigue in nurses. Xu, Zhang, Lin, Zheng, and Chen (2005) conducted an empirical study to examine the relationship of fatigue and occupational stressors in Chinese nurses. The results showed that fatigue was predicted by job monotony (R^2 =.11, p<.01), job demand (R^2=.15, p<.01), and support from colleagues (R^2 =.17, p<.01). Another study conducted by Xu, Zheng, Zhang, Lin, and Wang (2006) demonstrated that job strain and fatigue was correlated with each other (r=.36, p<.01); and single nurses reported significantly more fatigue than that of married nurses (F=-4.18, p<.01); bachelor degree nurses reported significantly more fatigue than that of associate degree nurses

and technical certificate nurses ($F=7.75$, $p<.01$); nurses aged 25-35 years reported significantly more fatigue than that of nurses aged below 25 years or above 35 years.

In conclusion, reviews of research on fatigue in Chinese nurses clearly showed that there is a lack of a sufficient number of empirical studies to examine influencing factors of fatigue. In addition, there is no research on the direct and indirect effect of predictors on fatigue in Chinese nurses too. Furthermore, previous studies conducted in Chinese nurses were not intended to study acute and chronic fatigue at one time or to differentiate acute fatigue and chronic fatigue, which may interfere with developing appropriate interventions regarding different type of fatigue. Hence, developing a model to show how these predictors interact with each other to produce acute and chronic fatigue has a crucial role in expanding fatigue knowledge in Chinese nurses.

Factors Influencing Fatigue

Based on the Job Demand Control Model (Karasek & Theorell, 1990), a conceptual framework of study titled "Fatigue at Work" (Kant et al., 2003), results of previous empirical studies, and the given definition of fatigue, the influencing factors of fatigue in this study are mainly considered to be work-related and manageable. These factors include shift work, job demand, job control, support at work, exposure to hazards in work environments and job dissatisfaction.

Sleep quality, although it is not directly perceived as a work-related factor, many studies found poor sleep quality or sleep disturbances to be a major complain of shift-workers (Rotenberg et al., 1998). Shift work nurses, especially night or evening shift, are prone to problems of sleep (Niedhammer et al., 1994; Xia et al., 2005). Several empirical studies have verified that poor sleep quality is a significant

predictor of fatigue in nurses or working populations (Akerstedt et al., 2004; Ruggiero, 2003; Smith et al., 1999). Therefore, sleep quality is proposed as one of the factors influencing fatigue in nurses and is included in the present study. Additionally, anxiety and depression are common psychological disturbances in shift workers (Costa, 1997; Prizmic et al., 1995; Scott et al., 1997). Nurses, especially those working in night time hours, may suffer anxiety and depression (Munakata et al., 2001). There is some evidence that anxiety and depression are positively associated with fatigue in otherwise healthy populations and employees (including nurses) (Libbus et al., 1995; Ruggiero, 2003; Theorell-Haqlow et al., 2006; Zheng et al., 2006). Therefore, it is reasonable to take into account anxiety and depression in this study. Further, intershift recovery is added because studying the relationships of chronic fatigue with intershift recovery and acute fatigue can provide an overall understanding of fatigue (Windood et al., 2005) and be useful for developing interceptive interventions.

In the last decade, western studies have examined the relationships among previously cited variables and fatigue, and this has provided theoretical evidence for carrying out such a study in China. Although some Chinese nursing scholars wrote about the same factors that western studies have examined, there is still a lack of a sufficient number of empirical studies to examine these factors in relation to fatigue in Chinese nurses. However, previous western studies did not intent to examine indirect effects of predictors on fatigue, and also did not study on acute and chronic fatigue simultaneously in one study. This hampers the complete understandings of overall fatigue. Furthermore, the variables selected for study can enable nursing administrator or concerned persons to assist nurses by improving both physical and psychosocial working conditions, increasing psychological well-being, enhancing good sleep

quality, and designing appropriate shift work patterns to prevent and decrease fatigue in workplace.

Variables including 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 are perceived as influencing factors to fatigue in Chinese nurses. In addition, acute fatigue is perceived to influence chronic fatigue in Chinese nurses in this study.

Shift Work

Shift work is a work schedule in which groups of people working together alternate with other groups to create a cohesive and productive workplace 24 hours a day, and seven days a week (Shen et al., 2006). To provide health care, the need of 24-hour nursing care requires nurses to work a shift system. The most common shift patterns in a nursing system are permanent shift system, such as a permanent day shift, night shift, or evening shift, as well as rotating shift systems, which include a slowly rotating shift system (e.g. changing shifts weekly or less often), and a rapidly rotating shift system (e.g. rotating different shifts within one week). The common duration of each shift systems in each pattern utilizes a 7-8 hours shift although some unions and workforces favor longer shifts, such as 9-12 hours (Knauth, 1996; Wilson, 2002).

In China, shift patterns of nursing work usually adopt a permanent day shift, as well as rotating shift systems, including day, evening and night shifts on a rotating basis. Duration of each shift in clinical setting usually fixed to 7-8 hours. Day shift usually refers to the typical daytime 08:00-16:00 time frame, or 08:00-12:00 and 14:00-18:00 time frame. Night and evening shift work are outside of typical time

frame of 08:00 to 18:00. Evening shift begins and ends between the hours of 18:00 and 02:00, while night shift begins and ends between the hours of 02:00 and 09:00 (Wu & Luo, 2003). Besides above mentioned, permanent night or evening shift, as well as evening and night shift on a rapid or slow rotating basis were also found in emergency room or operation room (Lin, Fan, & Tang, 2000; Luo, Wu, Luo, & Cai, 2003; Wang, Hua, & Gao, 1993).

In Chengdu city, shift patterns of nursing working in in-patient departments usually adopt permanent day shift system and rotating shift systems, including a slowly rotating shift system and a rapidly rotating shift system (Cheng, Song, Xiang, & Fang, 2007). In the permanent day shift system, nurses have no nigh and evening shifts. In the slowly rotating shift system, numbers of night and evening shifts are one or less than one within a week. Thus, nurses working in a slowly rotating shift system usually have 1-4 night and evening shifts per month. In a rapidly rotating shift system, numbers of night and evening shifts are more than one and less than two, as well as two or more than two night and evening shifts within a week. Therefore, nurses working in a rapidly rotating shift system have 5-7 or ≥8 night and evening shifts per month. In this way, nurses working in a rapid rotating shift may have less intershift recovery contributing to fatigue.

Studies have found that nurses working on rotating shift patterns experienced more physical and psychological problems than those on permanent shifts, and rotational shift nurses also showed significantly higher incidences of fatigue, nervousness and inadequate sleep (Brown, 1988; Wilson, 2002). Because the circadian-driven propensity for sleep is strongest at night, night sleep is perceived as

the most restful and restorative. Night workers must work during the nocturnal release of melatonin and sleep during the day without it, and also try to sleep against the cortisol-induced desire for morning wakefulness. Night workers are therefore found to be subjected to more sleep problems and fatigue (Fletcher & Dawson, 1997; Muecke, 2005).

Permanent day shift and rotating shift with day, evening and night shift are the most common shift patterns taken in China. Based on previous studies, it is possible for us to infer that Chinese nurses having rotating shifts with more evening or/and night time duty could conceivably have higher level of fatigue.

Relationship of Shift Work to Fatigue

Shift work schedules disrupt diurnal circadian rhythms and sleep pattern, resulting in fatigue and other adverse effects that may affect workers' performance and health. Researchers reported that shift workers often experience fatigue (Novak & Auvil-Novak, 1996; Oginska, Pokorski, & Oginski, 1993).

A cross-sectional study of 1,280 nurses conducted by Winwood, Winfield, and Lushington (2006) showed that nurses with regularly working on a rotation, including night duty, have more significant acute fatigue ($F(1,815)=6.5$, $P=<.001$) and chronic fatigue level ($F(1,815)=5.4$, $P=<.001$) compared to nurses with only day work, only night work, or rotating shift without night duty. The researchers concluded that the most important factor determining acute and chronic fatigue outcome was the shift pattern worked, particularly rotation shift with night duty. Further, a qualitative study about night shift work experience among Chinese nurses by Xia and colleagues (2005), demonstrated that nurses experienced acute fatigue after nighttime work.

Additionally, nurses with exposure to a long-time rotating shift work with night duty were more prone to chronic fatigue, and psychological disturbance, such as anxiety and depression, as well as impaired family function. However, the inconsistent findings in Ruggiero's (2003) study in 147 female critical care nurses revealed that no significant difference in chronic fatigue level in permanent day shift nurses and nurses rotating with night duty.

Furthermore, Shen and colleagues (2006) compared the fatigue level among 489 workers who had a different frequency of shift work (never, 1-2 days per week, 3 days or more per week). A significant group effect ($F(3,404)=5.19$, $p=.00$) on fatigue score was found when the frequency of shift work was used as the dependent variable. The results indicated that more frequent shift work had an effect on subjective fatigue experienced. The Fatigue Scale used in this study did not differentiate acute and chronic fatigue. Akerstedt, Fredlund, Gillberg, and Jansson (2002) analyzed the relationship of fatigue and shift work among 58,115 individuals by using multiple logistic regression. The results demonstrated that the shift workers with day duty (OR=1.05, 95%CI: .99-1.12) and with night duty (OR=1.04, 95%CI: .93-1.16) were not predictors of fatigue.

Based on the above, some researchers provided evidence that shift work influenced both acute and chronic fatigue. Although Shen et al (2006) and Akerstedt, Fredlund, et al (2002) did not differentiate acute and chronic fatigue in relation to shift work in their studies because of the limitations of the instruments used, it is reasonable to hypothesize that shift work has a positive effect on both acute and chronic fatigue based on empirical findings and the conceptualization of fatigue in the present study.

Relationship of Shift Work to Sleep Quality

Some empirical and evidence-based studies have demonstrated the relationship of shift work to sleep quality. Muecke (2005) conducted a literature review on the effect of rotating night shifts. She concluded that sleep that occurs during times when an individual is biologically driven to be awake tends to be shorter and have decreased quality of sleep. Night duty rotation has adverse effects on the quality of sleep in nurses.

Escriba, Perez-Hoyos, and Bolumar (1992) conducted a cross-sectional epidemiological study among 606 female nurses and 367 male nurses. The findings suggested that those who worked permanent night shift or rotating shifts showed a greater percentage of alternation in their quality of sleep compared to those on permanent day shift. The difference was statistically significant between nurses on rotating shift and those on permanent day shift ($p<.001$). Furthermore, Ruggiero (2003) studied sleep quality in 142 female critical care nurses. The result revealed that sleep quality was positively correlated with the presence of night shifts ($r=.24$, $p<.01$). Independent t-tests revealed that rotating shift nurses with night duty had poorer sleep quality than that in permanent day shift nurses ($t=-2.94$, $p<.01$).

Moreover, Akerstedt, Fredlund, Gillberg, and Jansson (2002) studied the relation of shift work and sleep quality among 58,115 employees by using multiple logistic regression. The results suggested that shift work with day duty (OR=1.33, 95%CI, 1.23-1.45), especially shift work with night duty (OR=1.56, 95%CI, 1.36-

1.79), were significant predictors of disturbed sleep. Another study by Parkes (1999) examined shift work and sleep complaints among 1,426 industrial personnel. The results revealed that shift patterns positively correlated with sleep problems (r=.19, p<0.01). Logistic regression analysis showed that shift workers with night rotations (OR=1.81, 95% CI: 1.36-2.42) were more likely to report sleep complaints compared to permanent day workers.

Relationship of Shift Work to Anxiety and Depression

Night workers experience more mood disturbances than daytime workers, and such disturbance often persists even after transfer to day work. Nurses rotating with night shifts report greater anxiety and depression than that in permanent day nurses (Tasto, Colligan, Skjei, & Polly, 1998). Some research findings have demonstrated that shift work, especial with nighttime duty, has a positive relation with anxiety and depression.

Munakata and colleagues (2001) studied the psychological state of day work nurses and night shift nurses. The results suggested that depression and anxiety levels were significantly higher in night shift nurses than that in day work nurses and control group (F-value: 5.93; 9.05; p<.01). In addition, Ruggiero (2003) explored anxiety and depression in 142 female critical care nurses. Depression was correlated with presence of night shifts (r=.21, p<.05). Independent t-tests revealed that rotating shift nurses with night duty had higher levels of depression than that in permanent day work nurses (t=-2.60, p<.01). However, anxiety level was not significantly higher among rotating shift nurses with night duty comparing to that with permanent day work nurses (t=-.84, p>.05).

Further, Kaneko and colleagues (2004) examined the effects of shift work on the mental state of factory workers in Japan. The depression and anxiety tendency scores of the men were higher among the shift worker group than that among the permanent day worker group ($p<.01$). Meanwhile, the depression and anxiety tendency scores of the female two-shift workers (day and night shifts) were higher than that of the female permanent day workers ($p < .05$).

Relationship of Shift Work to Job Dissatisfaction

Cao and Yu (2000a) conducted a study about factors related to job satisfaction among Chinese nurses. The findings revealed that the nurses with permanent day work have the highest scores on job satisfaction (229.52±31.73), and nurses having shift work, without night duty, have the middle score on job satisfaction (209.52±27.14), while nurses having shift work, with evening and night duty have the lowest score on job satisfaction (193.99±41.22) (F-value: 4.72, $p<.0001$). Another study by Flinkman and colleagues (2007) investigated 147 young nurses about their reasons for intention to leave the profession and reasons for job dissatisfaction. One of the main reasons for job dissatisfaction was inconvenience of shift work/work hours. Many of participants wrote that they would like to have a regular day job (no nights, evenings and weekends work).

In view of this evidence, nurses or workers with more frequency of shift work, especially those with more night or evening work, may have higher levels of acute and chronic fatigue. Considering the inconsistent findings that emerged, this factor needs to be further investigated. In addition, existing studies also have provided inferential evidence that shift work, especially with more night and evening duty can

result in poorer sleep quality, and higher levels of anxiety and depression. Shift work may interrupt regular family life and circadian rhythms, which may induce job dissatisfaction in nurses. Because of previous inconsistent findings and a lack of empirical studies in nursing populations, further study is needed to investigate the relationship of shift work to acute fatigue, chronic fatigue, sleep quality, and job dissatisfaction, as well as anxiety and depression in nurses.

Job Demand, Job Control and Support at Work

Job demand, job control and support at work are variables derived from the Job Demand Control Model. Job demand includes psychological job demand, such as subjectively perceived difficulty of work and work pace, and physical job demand, such as physical effort required by the work. Psychological job demand overlaps with workload, which is defined as the amount of work assigned to or expected from a worker in a specified time period. Workload measure can be subjective and objective. Objective measurement focuses on the quantitative amount of work being performed. However, perceived subjective workload is usually measured because persons doing the same amount of work may have different perceptions on their workload. In this way, workload can be measured by assessing the psychological demands of the work being performed (Spector & Jex, 1998). Job control refers to the perception of the ability to control one's own activities, influence others, and utilization of creativity, unique abilities and skill in the work. Job control has two aspects: decision authority and skill discretion. Support at work includes co-worker and supervisor support, which refers to perception of individual's receiving practical and emotional support from peers and supervisors. All of these three variables are perceived as important

psychosocial work characteristics that can influence employee's health, and predict job-related symptom, such as fatigue (Karasek et al., 1998).

Relationships of Job Demand, Job Control, Support at Work to Fatigue

Eriksen (2006) identified work factors that predict persistent fatigue in a 5,547 sample of nurses' aides in a prospective study, and found that job demand was a significant predictor of persistent fatigue in this group (OR=2.36; 95%CI: 1.61-3.46). In addition, Janssen and Nijhuis (2004) conducted a study about fatigue and psychosocial job characteristics among 5,256 employees. Findings demonstrated that fatigue was correlated with job demand ($r=.17$, $p<.01$), job control ($r=-.21$, $p<.01$) and support at work ($r=-.24$, $p<.01$). Hierarchical regression analyses revealed that job demand ($\beta=.09$, $p<.001$), job control ($\beta=-.08$, $p<.001$) and support at work ($\beta=-.04$, $p<.05$) significantly influenced fatigue. Another study by Bültmann, Kant, Schroer, and Kasl (2002) examined the association between psychosocial job characteristics and fatigue in employees. Psychological job demand ($r=.18$, $p<.01$), job control ($r=-.17$, $p<.01$), co-worker support ($r=-.18$, $p<.01$), and supervisor support ($r=-.23$, $p<.01$) significantly correlated with fatigue in female employees. Logistic regression revealed that high psychological job demand (OR=1.36, 95%CI: 1.02-1.81), low job control (OR=1.82, 95%CI: 1.36-2.44), low supervisor support (OR=1.71, 95%CI: 1.35-2.16) and low co-worker support (OR=1.30, 95%CI: 1.01-1.69) were significantly associated with chronic fatigue when adjusted for age, education level, living alone, presence of disease, employment status, and psychological distress in female employees. Furthermore, Bültmann, Kant, van den Brandt, and Kasl (2002) examined prospectively a wide range of psychosocial job characteristics as possible risk factors

for the onset for fatigue. Logistic regression revealed that high psychological job demand (OR=1.28, 95%CI: 1.00-1.64), low job control (OR=1.59, 95%CI: 1.23-2.06), low supervisor support (OR=1.38, 95%CI: 1.12-1.69) and low co-worker support (OR=1.45, 95%CI: 1.18-1.78) were significantly associated with chronic fatigue. Linear regression analyses for each psychosocial job characteristics separately showed that after adjustment for potential confounding variables, psychological job demand (β=.14, p<.01), physical job demand (β=1.95, p<.01), job control (β=.09, p<.01), supervisor support (β=-.21, p<.01), and co-worker support (β=-1.105, p<.01) were predictors of fatigue.

In addition, de Croon and colleagues (2002) examined the job demand, job control and the interaction effect between job control and job demand on fatigue among 1,181 lorry drivers. Job control(r=-.33, p<.01), physical job demand (r=.44, p<.01), and psychological job demand (r=.29, p<.01) were significantly correlated with fatigue. Stepwise multiple regression analyses for fatigue indicated that the proportion of variance that accounted for fatigue increased from .00 to .22 with the addition of job control and psychological job demand. The entry of physical job demand and supervisor support in step two accounted for another 3% of variance in fatigue. Job control (β=-.14, p<.01), physical job demand (β=.09, p<.01), psychological job demand (β=.26, p<.01), and supervisor support (β=.16, p<.01) were uniquely related to fatigue. In other studies, for example, Hardy and colleagues (1997) reported that high job demand significantly predicted high levels of fatigue (R^2=.13, p< .001); and Poleg and Kleber (2003) reported that lack of support from a supervisor was found to be a significant predictor of fatigue. Lack of support from supervisors accounted for an additional 3% variance (R^2=.03, p<.05) on fatigue in 123 ambulance

workers. Bystrom, Hanse, and Kjellberg (2004) identified that psychological workload (psychological job demand) was a significant predictors of fatigue (β=.42, p<.01) among 305 worker by using the Swedish Occupational Fatigue Inventory (SOFI).

Fatigue measures in above-mentioned studies mainly included the Checklist Individual Strength (CIS), which is a scale focusing on chronic fatigue measure. These verified that job demand, job control and support at work related to chronic fatigue. Furthermore, Bystrom and colleagues (2004) demonstrated that job demand, job control and support at work were associated with acute fatigue by using acute fatigue measurement-the SOFI. Therefore, it is reasonably posited that job demand, job control, and support at work are influencing factors to both acute fatigue and chronic fatigue.

Relationships of Job Demand, Job Control, and Support at Work to Sleep Quality

Existing empirical studies have demonstrated the relationship of job demand, job control, and support at work to the quality of sleep. Akerstedt, Fredlund, et al. (2002) examined the relationship between working factors and sleep quality among 58,115 employees by using logistic regression. The results suggested that a physically strenuous job (physical job demand) (OR=1.24, 95%CI, 1.15-1.33) and hectic work (psychological job demand)(OR=1.39, 95%CI, 1.31-1.48) were significant predictors of sleep quality. Another study conducted by Akerstedt, Knutsson, et al. (2002) examined the multivariate relationship between disturbed sleep and different work-related factors among 5,720 healthy employed men and women. The multiple logistic regression analyses showed that high job demand (OR=2.15, 95%CI: 1.29-3.58), high

job control (OR=0.54, 95%CI: .34-.87), high social support (OR=.44, 95%CI: .27-.72) were significantly associated with disturbed sleep. Further, Nakata and colleagues (2001) conducted a cross-sectional study to clarify the contribution of job demands, job control, and support at work to insomnia in shift workers. The results demonstrated that lower support at work was significantly associated with a greater risk of sleep problem, than a higher level of support at work (adjusted OR=2.5). High job demand, low job control with low support at work increased the risk of sleep problem, compared to lower job demand, higher job control with higher support at work (crude OR=1.8; adjusted OR=1.5). The findings also suggested that a low level of support at work was independently associated with insomnia in shift workers.

Relationships of Job Demand, Job Control, Support at Work to Anxiety and Depression

Anxiety and depression were perceived as common psychological problems in the workplace. Yeung and So-kum Tang (2001) reported that job characteristics such as job demand, job control and support at work have been shown to relate to working women's psychological health. Further, several empirical studies have demonstrated the relationship of job characteristics to anxiety and depression among nurses and working population.

Eriksen, Tambs, and Knardahl (2006) conducted a prospective cohort study to identify work factors that predicted anxiety and depression among 5,070 nurses' aides. Handling heavy objects (β=.022) (physical work demand), less support and less encouragement (β=.136) when changing work tasks, and low work pace (psychological job demand) (β=-.123) were significant predictors of anxiety and depression. Another study conducted by Bourbonnais, Comeau, and Vezina (1999)

examined the demand-control, support at work and psychological disturbances among 1,741 nurses. The results demonstrated that low support at work (OR=1.69, 95%CI: 1.43-1.99) was associated with psychological distress including anxiety and depression, and a combination of high psychological job demand with low job control (OR=2.31, 95%CI: 1.78-3.00) was associated with psychological disturbances, including anxiety and depression.

In addition, Mausner-Dorsch and Eaton (2000) examined the relationship between psychosocial work environment and three type of depression (major depressive episode, depressive syndrome, and dysphoria) by using logistic regression analyses among 905 employees. The findings demonstrated that job control has the strongest relationship to three forms of depression (major depressive episode: OR=.20, 95%CI: .08-.51; depressive syndrome: OR=.40, 95%CI: .22-.74; dysphoria: OR=.52, 95%CI: .31-.90). Moreover, high job demand with low job control has a significant relationship with 3 types of depression (major depressive episode: OR=7.16, 95%CI: 2.72-17.81; depressive syndrome: OR=4.06, 95%CI: 1.85-8.39; dysphoria: OR=3.06, 95% CI: 1.46-6.04). Furthermore, Sanne and colleagues (2005) examined the job demand, job control and social support at work in relation with anxiety and depression by using multiple statistical methods in working population. The results showed that anxiety was associated with psychological job demand (unstandardized regression coefficient: .22 for men, .13 for women, R^2=.05 for men; .02 for women), job control (SRC: -.11 for men, -.06 for women, R^2=.02 for men; .01 for women), and support at work (SRC: -.20 for men, -.22 for women, R^2=.08 for men; .07 for women). Depression was correlated with psychological job demand (standardized regression coefficient: .16 for men, and .07 for women; R^2=.02 for men, and .01 for women), job

control (SRC: -.16 for men, -.10 for women, R^2=.04 for men; .02 for women), and support at work (SRC: -.23 for men, -.23 for women; R^2=.09 for men, .07 for women). The researchers also found that combined high job demand, low job control and low support was a risk factor for anxiety and depression. Moreover, Landserbergis and colleagues (1992) examined the relationship of job demand, job control, and support at work to anxiety and depression among 297 working men. The results demonstrated that anxiety and depression correlated positively with job demand (r=.12, p<.05; r=.09, p>.05), and negatively associated with job control (r=-.19, p<.01; r=-.05, p>.05) and support at work (r=- .17, p<.01; r=-.14, p<.01).

Relationships of Job Demand, Job Control, Support at Work to Job Dissatisfaction

A few studies have provided evidence about the relationship of job demand, job control and support at work to job dissatisfaction among nurses and working populations. For example, Ruggiero (2005) explored the relationships and relative contributions of selected work factors to job satisfaction among 247 critical care nurses. The findings demonstrated that physical work demand (r=-.16, p<.05) and psychological work demand (r=-.16, p<.05) significantly correlated with job satisfaction. Another study conducted in 212 health professionals by de Jonge, Bosma, Peter, and Siegrist (2000) revealed that psychological job demand (β=-.31, p<.05) and job control (β=.22, p<.05)were significantly predictors of job satisfaction.

Additionally, Yeung and So-kum Tang (2001) investigated the relationship of job demand, job control, support at work and job satisfaction among 193 Chinese single working women. The job satisfaction was significantly associated with job control (r=.52, p<.01), but was unrelated to both psychological job demand (r=-.05,

p>.05) and physical job demand (r=-.13, p>.05). Furthermore, de Croon and colleagues (2002) examined the job demand, job control and the interaction effect between job control and job demand on job dissatisfaction among 1,181 lorry drivers. Job control (r=-.32, p<.01), physical job demand (r=.50, p<.01), psychological job demand (r=.39, p<.01), and supervisor support (r=.45, p<.01) significantly correlated with job dissatisfaction. Stepwise multiple regression analyses for job dissatisfaction showed a significant increase in R^2 from .00 to .26 when job control and psychological job demand were entered into the equation. The entry of physical and supervisor support in step two accounted for 7% of additional variance in job dissatisfaction. Job control (β=-.10, p<.01), physical job demand (β=.15, p<.01), psychological job demand (β=.27, p<.01), supervisor support (β=.21, p<.01) and the interaction between job control and psychological job demand (β=.14, p<.01) were found to contribute significantly and uniquely to the variance of job dissatisfaction. Moreover, Karasek (1979) also analyzed survey results from both USA and Swedish population. He reported that individuals in occupations with high demands and low job control suffered the most severe psychosomatic complaints and the highest level of both depression and job dissatisfaction.

Previous empirical studies and conceptualization of fatigue in the present study provided evidence that job demand, job control, and support at work are predictors of both acute and chronic fatigue in working populations. In addition, they are perceived to have effects on anxiety and depression in nurses as well. Furthermore, they have effects on sleep quality and job dissatisfaction, which are perceived to be mediator variables to chronic fatigue.

Exposure to Hazards in Work Environments

Hospitals are major workplaces of employment of nurses. Occupational hazards for nurses within hospital environments can be of chemical, biological and physical nature (Triolo, 1989). Physical environmental hazards commonly found in hospitals include noise, high/low temperature, inadequate ventilation, crowed space, radiation, electrical hazards and unpleasant odor. Chemical occupational hazards are among the most insidious to hospital staff nurses and female worker (Kooker, 1987). The chemical agents that hospital nurses frequently exposed to are waste anesthetic gases, anticancer or cytotoxic drugs, antibiotic, disinfectants, and detergent. Biological agents are other type of environmental threats with which hospital nurses must cope. Bacteria, viruses, blood, body excretion, and patients' fluids are all considered biological risk factors that can bring potential infection and injury to hospital nurses (Triolo, 1989). Huang (1997) investigated 141 Chinese nurses' occupational exposure in hospital environments. The results suggested that exposure to anti-cancer drugs (65.96%), massive contact with antibiotic drugs (55.32%), ill-ventilation (62.25%), and exposure to patient's blood, secretion and excretion (60.28%) were the top four concerning occupational exposure problems in Chinese hospital nurses. Li (2003) reported that major hazardous exposure in hospital environments included needle injury, anti-cancer or cytotoxic drugs, and contagious virus or bacteria and detergents based on her investigation of 162 Chinese nurses.

Nurses with exposure to adverse hospital work environments may be at risk for disease to their central nervous system, immune system, and respiratory system etc. Nurses may have symptoms such as nausea, dizziness, headache, chronic cough, hair loss, sore throat, eye irritation and viral infection (Li, 2003; Triolo, 1989). Disease and

symptoms may increase energy expenditure and decrease body endurance, thus causing fatigue. Moreover, inadequate ventilation can decrease oxygenation levels in the blood that can influence fatigue (Piper et al., 1987). Piper and colleagues stated that working under noise, inappropriate temperature, in crowed spaces may increase oxygen and energy expenditure, make staff easily irritated, resulting in decreased tolerance, and influence the development of fatigue. Feng (2002) reported that nurses' exposures to adverse work environments are prone to fatigue, headache and decreasing concentration. Therefore, exposure to hazards in hospital work environments may be a factor influencing the development of fatigue among Chinese hospital nurses.

Relationship of Exposure to Hazards in Work Environments to Fatigue

A qualitative study about fatigue experience among Chinese hospital nurses conducted by Fang (2007) demonstrated that an adverse hospital work environments with noise, poor-ventilation, and exposure to chemical and biological hazards in hospital environments, were part of causes that accounted for both acute fatigue and chronic fatigue in Chinese hospital nurses. Additionally, Li and Luo (2003) reported that physical exposure, such as the noise of a medical machine, poor ventilation, and chemical exposure (including anesthesia gases and disinfecting agents) as well as biological exposure (like blood, virus and secretion from the patients) may influence the development of acute and chronic fatigue among Chinese hospital nurses. Moreover, Kjellberg, Muhr and Skoldstrom (1998) studied the contribution of noise exposure to fatigue in a survey study and three field studies. The results suggested that fatigue was found to be more common among the noise exposed groups than the non-

exposed group, even after control for the effects of other critical variables.

According to previous studies and the conceptualization of fatigue in the present study, exposure to hazards in work environments is perceived to influence both acute and chronic fatigue in Chinese nurses.

Relationship of Exposure to Hazards in Work Environments to Job Dissatisfaction

Siu (2002) investigated the factors influencing job satisfaction among 258 Hong Kong nurses. Resulted demonstrated that a good environment (the physical condition in the work area) was significantly correlated with job satisfaction ($r=.20$, $p<.05$). Hierarchical regression analyses also revealed that environment (physical condition in work area) was significantly related to job satisfaction ($\beta=.26$, $p<.01$). Another study by Tong and Luo (2003) compared the differences of job satisfaction among nurses, doctors and administrative personnel in a hospital. The results demonstrated that nurses and doctors had lower job satisfaction compared to administrative personnel ($F=5.634$, $p<.01$). In addition, nurses and physicians had higher scores on exposure to adverse work environments ($F=5.626$, $p<.01$) compared to hospital administrative personnel. These researchers suggested that poor work environments is one of reasons accounting for job dissatisfaction.

Based on the above, exposure to hazards in work environments, such as chemical, biological, and physical hazards, may have an influence on the development of both acute and chronic fatigue. In addition, the exposure to hazards in work environments is perceived as positively influencing job dissatisfaction. Further empirical studies are needed to verify these relationships among nurses.

Job Dissatisfaction

Job dissatisfaction is a negative feeling about one's job. Job satisfaction, contrary to job dissatisfaction, has been found to be related to performance within the work setting (Landeweerd & Boumans, 1988). Therefore, it is not surprising that the concept of job satisfaction or dissatisfaction has attracted much attention. In the nursing area, job dis/satisfaction is an important concept as it has an effect on turnover, intention to quit, fatigue and even burnout (Lu, While, & Barriball, 2005). In China, Cao and Yu (2000b) investigated the job satisfaction among Chinese nurses by using a self-developed job satisfaction scale. The result demonstrated that general level of job satisfaction of Chinese nurses is in the middle range, and the satisfaction to job salary is at the lowest level.

Relationship of Job Dissatisfaction to Fatigue

Kant and colleagues (2003) conducted an epidemiological study of fatigue at work among employee. They proposed that job dissatisfaction, which is perceived as perception of work, has an effect on the development of chronic fatigue. In addition, MacDonald and colleagues (2003) examined the relationship between job dissatisfaction and fatigue among 73 female flight attendants, where job dissatisfaction was positively correlated with fatigue ($r=.32$, $p<.01$). Another study by de Croon and colleagues (2002) explored the relationship of job dissatisfaction and fatigue among 1,181 lorry drivers. Their job dissatisfaction was positively correlated with fatigue ($r=.49$, $p<.01$). Fatigue measurement in this study was the Checklist Individual Strength, which is a scale used to measure chronic fatigue. Further, de Fatimau, Messing, Menezes, and Cho (2002) examined the relationship of chronic

fatigue and job dissatisfaction among 735 Brazil bank workers. Logistic regression analysis revealed that job dissatisfaction was a risk factor for chronic fatigue (OR=3.5, 95%CI: 1.5-7.9).

Fatigue measurements in the above-mentioned studies mainly used the Checklist Individual Strength (CIS), which is referred to as a chronic fatigue measurement in working populations. The study of MacDonald and colleagues (2003) did not differentiate chronic or acute fatigue measurement. Based on the conceptualization of fatigue in the present study, job dissatisfaction, being considered as a consequence from previous working activities, can be reasonably posited as an influencing factor of chronic fatigue rather than acute fatigue.

Relationship of Job Dissatisfaction to Anxiety and Depression

Feng and colleagues (1998) investigated the relationship of job dissatisfaction and psychological distress including anxiety and depression among 747 female Chinese hospital nurses. Chi-square analysis revealed that the higher job dissatisfaction score group had higher scores on psychological distress, including anxiety and depression (χ^2=144.139, p<.01). In addition, logistic regression analysis demonstrated that job dissatisfaction significantly contributed to psychological distress, including anxiety and depression (β=.044, p<.01).

Landserbergis and colleagues (1992) examined the relationship of job dissatisfaction to anxiety and depression among 297 working men. The results demonstrated that anxiety (r=.25, p<.001) and depression (r=.20, p<.01) positively correlated with job dissatisfaction. Another study by Andrea and colleagues (2004) examined the relationship of anxiety, depression and job dissatisfaction among 7,842

employees using multiple regression analysis. The results demonstrated that, after adjustment of the socio-demographics and the presence of a chronic condition, anxiety (OR=3.67, 95%CI: 2.75-4.91) and depression (OR=4.35, 95%CI: 3.26-5.82) were positively associated with negative job satisfaction. In addition, a study conducted by Xie (1996) revealed that anxiety ($r=-.23$, $p<.01$) and depression ($r=-.39$, $p<.01$) were negatively correlated with job satisfaction among 1,200 Chinese employees.

A meta-analysis of 485 studies conducted by Faragher, Cass, and Cooper (2005) evaluated research evidence linking self-report measures of job satisfaction to measures of mental and physical well-being. Job satisfaction was most strongly associated with mental/psychological problems, and the strongest relationships were found for depression ($r=-.428$) and anxiety ($r=-.420$), as well as a more modest correlation with subjective physical illness ($r=-.287$).

Job dissatisfaction can be demonstrated as one influencing factor for chronic fatigue. Anxiety and depression are perceived as mediator variables between job dissatisfaction and chronic fatigue based on empirical findings. However, further investigation is needed to explore these relationships among a nursing population.

Sleep Quality

Sleep is a basic human need and is widely recognized as being fundamental to normal functioning. Sleep is considered as the mechanism for restoring the tissue and function as well as for maintaining energy and health (Spenceley, 1993). Good sleep enhances the immune system, helps to consolidate memory, and improves mood (Oginska & Pokorski, 2006). Sleep quality is a complex phenomenon that includes

quantitative aspects of sleep, such as sleep latency, sleep duration, or a number of arousals, as well as some purely subject aspects, such as depth or restfulness of sleep (Buysse et al., 1989). Dimensions of sleep quality include sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, sleep medication, and daytime dysfunction (Buysse et al., 1989).

Sleep problems are common in shift workers and healthy women (Owens & Matthews, 1998; Rotenberg et al., 1998). Nurses, with shift work, especially night or evening shift, are prone to have sleep problems (Niedhammer et al., 1994; Xia et al., 2005). In China, some scholars studied sleep situations in Chinese nurses. Ding (2002) investigated this among 126 clinical nurses. The results suggested that they had significantly lower sleep scores (23.22±4.78) than the general Chinese population (22.14±5.48). Zhang, He, and Chen (2004) studied the sleep situation and influencing factors among 177 hospital nurses. Their findings revealed that 63.84% of nurses had sleep problems. Insufficient sleep (3.28±.78, $p<.01$), sleep disturbance (2.23±1.09, $p<.01$), use of sleep medicine (1.59±.91, $p<.01$), and early awakening (2.68±1.04, $p<.01$) had higher scores than those in the general Chinese population. Seventy percent of nurses with night/evening shift work duty had sleep problems, while the prevalence was 48% in permanent daytime shift nurses. Chi-square calculation showed that the prevalence of sleep problem in these two groups of nurses were significantly different. This study demonstrated that Chinese hospital nurses, especial nurses having rotating shifts with night/evening duty had more sleep problems and poorer sleep quality.

Relationship of Sleep Quality to Fatigue

Ruggiero (2003) examined the contribution of sleep quality to chronic fatigue among 142 female critical care nurses. The results demonstrated that sleep quality was correlated with chronic fatigue ($r=.49$, $p<.01$). Multiple logistic regression analysis revealed that sleep quality was a significant factor contributing to chronic fatigue ($\beta=.22$, $p<.01$). Furthermore, in a sample of 1,532 nurses working rotating shifts in the United Kingdom, self-reported sleep quality was found correlated with chronic fatigue ($r=.37$, $p<.01$). The result of a path analysis further revealed that self-reported sleep quality predicted chronic fatigue ($\beta=.29$, $p<.01$) (Smith et al., 1999).

Akerstedt and colleagues (2004) conducted a study to examine the relationship of fatigue and disturbed sleep among 5,720 healthy employed men and women. The data were analyzed by using a multiple logistic regression method. The result showed that disturbed sleep was the main predictor of fatigue among employees (OR=4.31; 95%CI: 3.50-5.45), followed by difficulties falling asleep (OR=1.94; 95% CI: 1.45-2.59), premature awakening (OR=1.54; 95%CI: 1.20-1.98) and repeated awakening (OR=1.51; 95%CI: 1.11-2.05). Furthermore, studies have demonstrated that poor sleep quality is also related to fatigue in healthy adults. Pilcher and Ott (1998) found that poor sleep quality was related to fatigue ($r=.43$, $p<.001$) in a sample of 75 colleague students. In 64 middle-aged and older adults ($r=.44$, $p<.01$), and in 87 colleague students ($r=.26$, $p<.05$), fatigue was found to be positively correlated with sleep quality (Pilcher, Schoeling, & Prosansky, 2000). A study conducted by Belza (1995), found that sleep quality was associated with fatigue ($r=.65$, $p<.01$) in 46 middle-aged adults. Fatigue in that study was measured by the Multidimensional Assessment Fatigue Scale (MAFS). The MAFS is a scale to measure physical, mental

and a general feeling of fatigue, and is not intended to differentiate acute or chronic fatigue.

Among the above-mentioned studies, Ruggiero (2003) and Smith et al (2003) used the Standard Shiftwork Index Chronic Fatigue Scale to measure only chronic fatigue in their studies. Other researchers, such as Akerstedt et al (2004), Pilcher and Ott (1998), Pilcher et al (2000), and Belza (1995) did not differentiate acute or chronic fatigue because of either one-item fatigue measurements or the fatigue scale used in their studies. However, according to the conceptualization of fatigue in the present study, sleep quality is posited as an influencing factor to chronic, rather than acute fatigue.

Relationship of Sleep Quality to Anxiety and Depression

Previous studies have provided evidence regarding the relationship of sleep quality, anxiety and depression. In nursing population, Ruggiero (2003) examined the relationship of sleep quality, anxiety and depression among 142 female critical care nurses. The results demonstrated that sleep quality has a positive correlation with anxiety ($r=.49$, $p<.01$) and depression ($r=.43$, $p<.01$).

Further, Cao and colleagues (2005) examined the relationship between sleep quality, depression and anxiety among 170 medical school students. The results demonstrated that sleep quality was positively related to depression ($r=.25$, $p<.01$), and also significantly related to anxiety ($r=.30$, $p<.01$). Moreover, Zhang and Diao (2006) investigated the sleep quality and influencing factors among 313 Chinese college students. The result showed that sleep quality was correlated with psychological disturbance, including anxiety and depression ($r=.36$, $p<.01$). Stepwise

regression analysis revealed that psychological disturbance including anxiety and depression explained 6.8% variance of sleep quality (R^2=.068, β=.249). Another study by Yang, Zhang, Yue, and Ji (1999), explored the relationship of sleep quality, anxiety and depression among Chinese medical college students. The result showed that sleep quality was positively associated with anxiety (r=.46, p<.05) and depression (r=.39, p<.05).

Relationship of Sleep Quality to Intershift Recovery

Some recovery from occupational fatigue may be achieved within the workplace itself, during official work breaks or spontaneous breaks between tasks. Nevertheless, the majority of recovery from work-related fatigue occurs in non-work period between the work shifts (Winwood et al., 2005). Sleep is considered as the mechanism for restoring the tissue and function as well as for maintaining energy and health (Spenceley, 1993). Therefore, good sleep quality is essential for recovery and plays an important role in maintaining our health.

Studies have shown associations between sleep difficulties and physiological illness. For example, sleep loss appears to adversely affect the recovery of tissue cells to maintain normal growth, development, as well as a healthy immune system. In addition, good sleep quality also contributes to recovery from mental and social difficulties. Meijer, Habekothe, and van den Wittenboer (2001) reported that poor sleep quality related to poor mental health, lower sociability and intellectual efficiency. Good sleep quality is essential for recovery of physiological and psychological functions. Therefore, it is reasonable to hypothesize that good sleep quality has a positive effect on intershift recovery.

According to above-mentioned studies, sleep quality has an effect on chronic fatigue, and it is also a factor influencing anxiety, depression and intershift recovery. Further studies are needed to explore the direct and indirect relationship of sleep quality, anxiety, depression, intershift recovery and chronic fatigue among nurses.

Anxiety and Depression

Anxiety and depression are common psychological disturbances in shift workers (Costa, 1997; Prizmic et al., 1995; Scott et al., 1997). Nurses, especially working in night time hours, may suffer anxiety and depression (Munakata et al., 2001). In China, several research groups have reported anxiety and depression situations among Chinese nurses. Li, Hou, and Zhang (2004) investigated depression among 454 clinical nurses by using the Beck Depression Inventory. They found that 63.7% reported depression, including 56.6% mild and moderate depression, and 5.9% severe depression. Chen and colleagues (2002) reported that 45.9% clinical nurses had depression in their study, including 45.15% mild and moderate depression, and 0.75% severe depression. Both their studies suggested the prevalence of depression in clinical nurses was higher than that (around 15.1-22.5%) in the general Chinese population (Zhang, 1987). Another study conducted in Chinese nurses (Tian, Zhang, & Wang, 2003) revealed that anxiety scores (35.69±0.64) and depression scores (41.87±0.75) were significantly higher compared to scores in the general Chinese population (29.78±10.07; 33.46±8.55). Wang, Wang, and Chen (2002) had a similar finding in a study of 300 Chinese clinical nurses.

In addition, other studies support that anxiety and depression are positively associated with fatigue in healthy population and employee (including nurses) (Libbus

et al., 1995; Ruggiero, 2003; Theorell-Haqlow et al., 2006; Zheng et al., 2006). Zheng, Xie, and Wu (2006) examined the relationship of anxiety, depression and fatigue among 200 Chinese head nurses. The results suggested that anxiety ($r=.354$, $p<.01$) and depression ($r=.484$, $p<.01$) were positively correlated to fatigue. Further, Ruggiero's 2003 study also examined the contribution of anxiety and depression to chronic fatigue among 142 female critical care nurses. Anxiety ($r=.46$, $p<.01$) and depression ($r=.63$, $p<.01$) were positively assocaited with chronic fatigue. Multiple logistic regression analysis revealed that depression was a significant factor contributing to chronic fatigue ($\beta=.47$, $p<.01$), but anxiety did not contribute significantly to the explanation of the variance of chronic fatigue ($\beta=.13$, $p>.05$).

Moreover, Theorell-Haqlow and colleagues (2006) conducted a study about relationship of anxiety, depression and fatigue among 5,508 healthy women (response rate 73.3%) aged 20 to 60 years by using a multiple logistic regression analyses. The results demonstrated that the combination of anxiety and depression was the greatest risk factor to fatigue (OR=7.00, 95%CI: 5.39-9.10). Anxiety (OR=2.84, 95%CI: 2.25-3.59) and depression (OR=4.15, 95%CI: 2.71-4.63) were significantly correlated with fatigue respectively. Another study conducted among healthy women (Libbus et al., 1995) revealed that depression was correlated with fatigue ($r=.49$, $p<.0001$), and depression was a significant predictor of fatigue ($\beta=.29$, $p<.001$). Some studies conducted among patients, such as cancer patients, also found that anxiety ($r=.44$; $r=.63$) and depression ($r=.43$; $r=.68$) were positively associated with fatigue (Dalopakarn, 2002; Dimeo, Stieglitz, Novelli-Fischer, Fetscher, & Keul, 1999).

Some fatigue measurements in the above-mentioned studies did not intend to differentiate acute and chronic fatigue, such as the Fatigue Scale used by Zheng and

colleagues (2006), the Piper Fatigue Scale used by Libbus and colleagues (1995) and the one-item fatigue measurement used by Theorell-Haqlow and colleagues (2006). Regarding the Standard Shiftwork Index Chronic Fatigue Scale used by Ruggiero (2003), this provided evidence that anxiety and depression related to chronic fatigue, but not acute fatigue. Combining the definition of fatigue in the present study, anxiety and depression are not directly referred to as work-related activities. Therefore, it is reasonable to perceive these two variables as influencing factors to chronic fatigue rather than acute fatigue.

Intershift Recovery

According to a study by Winwood and colleagues (2005), it is hypothesized that low intershift recovery from high levels of acute fatigue is associated with higher level of chronic fatigue. They verified that intershift recovery negatively correlated with chronic fatigue ($r=-.64$, $p<.01$), while acute fatigue positively correlated with chronic fatigue ($r=.61$, $p<.01$). They also performed a cross-tabulation analysis. The results indicated a theoretically appropriate match in 596 of 767 (80%) cases in which "high" chronic fatigue was associated with "high" acute fatigue and "low" intershift recovery; and "low" acute fatigue in company with "high" intershift recovery is associated with "low" chronic fatigue.

Due to a lack of appropriate instruments to measure acute and chronic fatigue simultaneously, there is a paucity of research on the relationship of acute fatigue and intershift recovery to chronic fatigue. Therefore, acute fatigue and intershift recovery are included in the present study for a better understanding of an overall fatigue in Chinese nurses.

In conclusion, some studies showed that shift work had a positive relationship with acute and chronic fatigue. However, an inconsistent relationship between shift work and fatigue was also demonstrated. Thus, shift work needs further testing. Exposure to hazards in work environments was posited as a positive influencing factor to both acute and chronic fatigue according to findings from empirical studies. Previous studies support that job demand, job control and support at work were the predictors of both acute and chronic fatigue. In the present study, job demand is hypothesized to have a positive effect on acute fatigue and chronic fatigue, while job control and support at work are hypothesized to have a negative effect on both acute fatigue and chronic fatigue. Most studies accept that sleep quality is positively related to fatigue and a significant predictor of fatigue. Combined with the theoretical basis of fatigue in the present study, it is anticipated that sleep quality is hypothesized to have a positive effect on chronic fatigue. Evidence from previous literature demonstrated job dissatisfaction is an influencing factor to chronic fatigue, but further empirical studies are needed to verify it in nursing population. Regarding anxiety and depression, they are hypothesized to have positive effects on chronic fatigue. Intershift recovery is hypothesized to negatively influence chronic fatigue. Furthermore, acute fatigue is perceived to positively influence chronic fatigue based on findings from previous studies. All of the above-mentioned factors with their effects on fatigue need further testing in the nursing population.

Conceptual Framework

Conceptual framework of this study is based on the Job Demand Control Model (Karasek & Theorell, 1990), a conceptual framework for a cohort study titled

"Fatigue at Work" (Kant et al., 2003) and results of empirical studies. In the current study, five variables are regarded as affecting both acute fatigue and chronic fatigue, including shift work, job demand, job control, support at work, and exposure to hazards in work environments. Further, job dissatisfaction, sleep quality, anxiety, depression, intershift recovery, as well as acute fatigue are perceived to influence chronic fatigue.

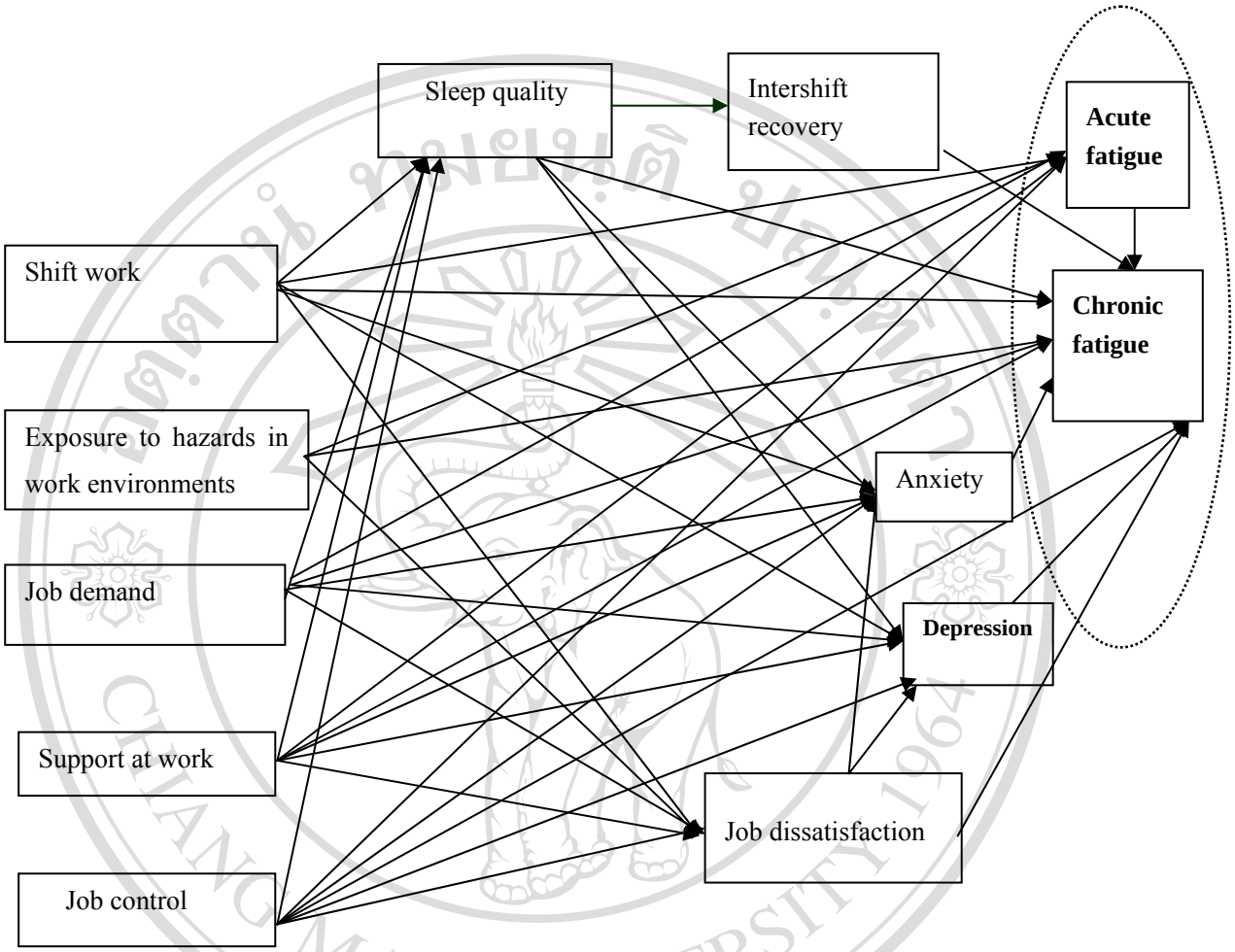
The presence of shift work, job demand, job control and support at work are also recognized as contributing to sleep quality and job dissatisfaction. Furthermore, job dissatisfaction and sleep quality lead to psychological disturbance, such as anxiety and depression. Sleep quality and job dissatisfaction are viewed as mediating variables between those factors (shift work, job demand, job control, support at work) and psychological disturbance (anxiety and depression). Moreover, anxiety and depression are considered mediating variables between variables (job dissatisfaction, sleep quality) and chronic fatigue. In addition, four variables including sleep quality, job dissatisfaction, as well as anxiety and depression are considered to be mediating variables between shift work, job demand, job control as well as support at work and chronic fatigue. Regarding exposure to hazards in work environments, this contributes to chronic fatigue mediating through job dissatisfaction. Furthermore, intershift recovery is viewed as a mediating variable between sleep quality and chronic fatigue.

Based on what is mentioned above, the model for predicting fatigue has five exogenous variables and seven endogenous variables. 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). Shift work, exposure to hazards in work environments, job demand, job control and support at

work serve as exogenous variables in this model as they have arrows coming from them but none leading to them (Page, 1993).

Endogenous variables are effects of exogenous variables and do not causally affect the exogenous variables, although the endogenous variables may causally affect other endogenous variables (Cohen & Cohen, 1983; Norris, 1997). The endogenous variables include sleep quality, job dissatisfaction, anxiety, depression, intershhift recovery, as well as acute and chronic fatigue, as these variables have arrows pointing to them (Page, 1993). Moreover, sleep quality, job dissatisfaction, anxiety, depression, and intershift recovery are also mediating variables, while acute and chronic fatigue are also outcome variables in this model. The variables proposed to influence acute fatigue and chronic fatigue in Chinese nurses are presented in Figure 1.

Figure 1: A proposed model for predicting fatigue in Chinese nurses in the study



Note : ⟶ Structural effect