Abstract

Title of Dissertation: Nurses' Working Conditions and Obesity

Kihye Han, Doctor of Philosophy, 2011

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Background: Job stress and shift work are known risk factors for obesity, yet comprehensive measures of job stress/work schedules (JS/WS) in relation to nurse obesity have been little investigated. Moreover, the effect of JS on obesity can vary with WS characteristics because WS comprehensively influence workers' lives. Nonetheless, there are knowledge gaps about differences in factors which are associated with nurse obesity by WS status.

Purpose: This study aimed to 1) examine the proportion of overweight/obesity (OW/OB) among nurses, 2) investigate the relationship between JS/WS and nurse obesity, and 3) compare the relationship between JS and nurse obesity by WS status.

Methods: The conceptual framework was based on the Demand-Control-Support model which assumes workers' health is affected by stress-producing factors in employment settings. This study was a cross-sectional secondary data analysis of 2,103 female nurses. Obesity was measured using body mass index estimates. To examine associations of JS/WS with nurse obesity, binomial logistic regression models for OW/OB incorporated independent components of JS/WS. To compare associations between JS and nurse obesity by WS status, binomial regression models were stratified by WS status (favorable WS and unfavorable WS). All models included demographics, depressive symptoms, and health and family related covariates.

Results: The prevalence of OW/OB was 55%. In the overall nurse sample, longer work hours (OR=1.22, 95% CI=1.08-1.39) and jobs with lower physical exertion (OR=0.83, 95% CI=0.73-0.95) and more limited movement (OR=1.14, 95% CI=1.02-1.28) were significantly associated with OW/OB. When comparing associations between JS and nurse obesity by WS status, among nurses with favorable WS, OW/OB nurses reported significantly less supervisory support (OR=0.83, 95% CI=0.68-1.00). On the other hand, among those with unfavorable WS, no job stress components were significantly related to OW/OB. Only healthy behaviors (i.e., exercise and sleep) were significantly associated with decreased odds of OW/OB (OR=0.79, 95% CI=0.66-0.95).

Conclusion: Organizational supports to limit adverse WS are needed. In particular, for nurses with unfavorable WS, educational interventions about sleep hygiene and other lifestyle modifications for adaptation to their WS may help improve health. For nurses with favorable WS, organizational supports for alleviating nurses' home/family responsibilities and stress are needed.

Nurses' Working Conditions and Obesity

by
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CHAPTER I. Background

1.1 Introduction

Obesity has become recognized as a national health threat and a major public health challenge. The prevalence of obesity (body mass index [BMI] >30kg/m^2) has increased dramatically over the past five decades worldwide, reaching around one-third of the U.S. population, with another 30% being overweight (BMI of 25-30kg/m^2) (Flegal, Carroll, Ogden, & Curtin, 2010). This is unfortunate, as obesity increases the risk of many diseases and health problems (Janiszewski, Janssen, & Ross, 2007; Klein, et al., 2007; Pi-Sunyer, 1993; Reilly, et al., 2003; Ryan, Fenster Farin, Abbasi, & Reaven, 2008; Vazquez, Duval, Jacobs, & Silventoinen, 2007). The increase in obesity is clearly related to increased food intake and decreased physical activities. Simply, body fat increases when long-term energy intake is greater than energy expenditure over the same period of time (Hebebrand & Hinney, 2009; McAllister, et al., 2009). However, this is not a simple problem, because many factors influence diet patterns and physical activities (Hajian Tilaki & Heidari, 2007; Hubacek, 2009). Researchers increasingly speculate that other genetic, epigenetic, and environmental factors may augment the traditional concept of energy imbalance in the etiology and pathophysiology of obesity (Eisenmann, 2006; McAllister, et al., 2009; Tremblay & Chaput, 2008). It has been suggested that psychosocial factors might influence health behaviors (Lallukka, et al., 2008; Stansfeld & Marmot, 2002), and in particular, working conditions may cause inequalities in obesity (Chandola, Brunner, & Marmot, 2006; Marmot & Theorell, 1988).

The relationship between work and workers' health outcomes has been increasingly studied over recent years. A growing body of evidence supports the relationship between workplace characteristics and cardiovascular disease (CVD) (Hublin, et al., 2010; Knutsson, 1989; Kristensen, et al., 1998; Ostry, Radi, Louie, & LaMontagne, 2006; Schnall, Belki , Landsbergis, & Baker, 2000). Several characteristics of work, such as shift work (DeMoss, McGrail Jr, Haus, Crain, & Asche, 2004; Ostry, et al., 2006; Zhao & Turner, 2008), excess working hours (Ko, et al., 2006; Spurgeon, Harrington, & Cooper, 1997), and high job stress (Dembe, Erickson, Delbos, & Banks, 2005; Karasek & Theorell, 1994; Kristensen, et al., 1998; Orth-Gomer, Eriksson, Moser, Theorell, & Fredlund, 1994; Schnall, et al., 2000) are reported to be related to poor health outcomes within the workforce.

One profession in particular, nursing, exhibits many of these negative work characteristics. Working conditions in health care organizations are more stressful than ever (Aiken, 2005), and many nurses have adverse work schedules, such as extended work hours (i.e., 12 or more hours per day or more than 40 hours per week), mandatory overtime, or on-call (Trinkoff, Geiger-Brown, Brady, Lipscomb, & Muntaner, 2006), which are associated with nurse injuries (Trinkoff, Le, Geiger Brown, Lipscomb, & Lang, 2006). Working overtime is associated with decreased alertness, increased fatigue, decline in vigilance on task measures, and increased injuries (Caruso, Hitchcock, Dick, Russo, & Schmit, 2004). Moreover, because of physical and psychological demands, nurses are vulnerable to health problems (Bongers, Kremer, & ter Laak, 2002; Estryn-Behar, et al., 1990; Trinkoff, Lipscomb, Geiger-Brown, Storr, & Brady, 2003; Trinkoff, Storr, & Lipscomb, 2001), which can in turn impede the adequacy of the nursing workforce and, ultimately, affect patient outcomes (Aiken, Smith, & Lake, 1994; Hickam, et al., 2003; Kohn, Corrigan, & Donaldson, 1999). Most previous studies related to nurses' working conditions and health focused on disease as an outcome, and did not investigate the effect of working conditions on health practices. However, adverse working conditions related to high job demands and an unsupportive work environment may affect behavior patterns, such as diet and physical activity. Diet and physical activity are two important contributors to obesity (Hebebrand & Hinney, 2009; McAllister, et al., 2009), which is a leading contributor to a variety of poor health outcomes, including adult onset diabetes, hypertension, and heart disease (Janiszewski, et al., 2007; Klein, et al., 2007; Pi-Sunyer, 1993; Reilly, et al., 2003; Ryan, et al., 2008; Vazquez, et al., 2007). Therefore, the potential relationship between working conditions and obesity among nurses needs to be explored.

1.2 Statement of the Problem

Registered nurses (RNs) are the largest group of the health care work force. In the U.S., almost 2.9 million people were educated to practice as RNs in 2004, and this had grown by almost 8% from 2000 (Health Resources and Services Administration [HRSA], 2006). Of the RNs employed in nursing, 56% worked in hospital settings in 2004. In 2004, female RNs accounted for 94% of all RNs. The average age of RNs was 46.8 years, the highest average age since the first comparable report was published in 1980. Also, the proportion of the RNs 50 or more years old was 25% in 1980, 33% in 2000, and 41% in 2004. Only 8% of the RNs were under the age of 30 in 2004, compared with 25% in 1980 (HRSA, 2006). These growing numbers of RNs and the high proportion of older RNs suggest a need for more concerns about nurse health.

There is a lack of knowledge about nurse obesity and the potential relationship between nurses' work and obesity. The prevalence of overweight/obesity (OW/OB) among nurses has been reported as 55% in one study (Miller, Alpert, & Cross, 2008), which is slightly lower than that of the U.S. population (65%). Another study concluded that 65% of hospital nurses were OW/OB (Zapka, Lemon, Magner, & Hale, 2009). However, the generalizability of these estimates is questionable because of study limitations that included low response rates and oversampling of minority and male nurses. Moreover, nurse obesity can be affected by different aspects of working conditions through various mechanisms because nurses have shown diverse characteristics, such as age and marital status, by job settings (HRSA, 2006). However, there are limited studies about the topic of nurse obesity, especially across job settings.

Much of what we know about nurse health stems from a large cohort study, known as the Nurses' Health Study (NHS) (Colditz, Manson, & Hankinson, 1997). The NHS follows nurses as a convenience sample apart from their work environment, which includes varying workloads and schedules. Instead, the NHS has focused more on various items related to individual health behaviors (e.g., smoking, drinking) and health outcomes (e.g., heart disease, stroke, obesity) based on epidemiologic perspectives, rather than work life or working conditions (e.g., work schedule, practice environment). For instance, the NHS has examined obesity as a predictor for other diseases, such as CVD (Page, et al., 2009), type 2 diabetes (van't Riet, et al., 2010), pulmonary embolism (Kabrhel, Varraso, Goldhaber, Rimm, & Camargo, 2009), and multiple sclerosis (Munger, Chitnis, & Ascherio, 2009), or as an outcome of physical inactivity (Hu, Li, Colditz, Willett, & Manson, 2003) or adverse diet (Liu, et al., 2003). Consequently, the study tells us more about nurses' lifestyle and their health and less about the relationship between nurses' work and their health. In addition, the NHS has not thoroughly assessed working conditions, which are often nurse-specific. Therefore, the results of this study may not provide information about nurse health in an occupational health perspective.

Incorporating the occupational points of view, the Nurses' Worklife and Health Study (NWHS) sought information on the relationship between nurses' working conditions and health. This study has three parts: substance use and associated risk factors in the NWHS I (Trinkoff & Storr, 1997); neck, shoulder, and back musculoskeletal problems in the NWHS II (Trinkoff, et al., 2003); and musculoskeletal problems and needle-stick injuries, measured longitudinally, in the NWHS III (Trinkoff, Geiger-Brown, et al., 2006). This study had assessed a variety of work characteristics, such as work hours, shift rotation, and mandatory versus voluntary overtime/on-call, via anonymous mailed surveys, and identified work schedule factors in relation to nurse health. Based on randomly selected samples, the NWHS provides a better understanding about nurses' working conditions, and also includes assessments of lifestyle conditions, such as exercise, smoking, and alcohol use. The NWHS data are useful to investigate nurse obesity, which may be affected by their working conditions, controlling for lifestyle-related variables.

Occupational health researchers have been examining the hospital work environment as a stressful working condition. This socio-epidemiological approach suggests that certain work characteristics increase job stress, which causes negative health outcomes among employees in hospitals (Stansfeld & Marmot, 2002). However, researchers have not included all of the work-related variables together in one study, and thus there have been limitations on understanding the influence of working conditions on nurse health. McNeely (2005) found that previous studies about nurse health had limitations, such as missing a broad consideration of job demands or the organizational context for stress. Incorporating a variety of work-related variables, including job stress and work schedules, permits investigation of their effects and interactions with health and provides a deeper understanding about the nature of nurse health. Studies that investigate the specific health effects of nurses' work, such as workplace stressors, have limitations too. Researchers typically measure only physical demands/stress or only psychological demands/stress. Considering both psychological and physical job stress in relation to nurse obesity could provide comprehensive insights and make it possible to identify relationships between the two. In addition, the total work load nurses are expected to carry has been typically underestimated. Nurses, a predominantly female workforce, should be studied with a consideration of an exposure to stress originating in both work and home sources (e.g., care-giving at work and care-giving at home) (Killien, 2004; McNeely, 2005).

To cover the 24-7 operations of healthcare systems or to cover nursing shortages, nurses often have adverse work schedules, including extended work shifts, shift work, shift rotation, and overtime/on-call (Trinkoff, Geiger-Brown, et al., 2006). Long work hours and shift work decrease quality and quantity of sleep, which lead to increased fatigue, poor job performance, high accident rates (e.g., medication errors, drowsy driving), and cardiovascular mortality (Geiger-Brown & Trinkoff, 2010; Ohayon, Smolensky, & Roth, 2010). These adverse work schedules have been considered as a type of job stressor (Hurrell & McLaney, 1988; Karasek & Theorell, 1994). However, the effect of stress on obesity can vary with work schedule characteristics because work-time arrangement comprehensively influences workers' life, including sleep, diet, physical activities, social activities, and family life (Burch, et al., 2009; Caruso, et al., 2006; Tucker, et al., 2010). Shift schedules and long work hours can alter circadian rhythms, and this can bring reduction in quality and quantity of sleep (Ohayon, et al., 2010). Sleep deficiency may decrease both involuntary and voluntary physical activity, but lengthen the time for eating and increase hunger by altering appetite hormones, and finally lead to weight gain (Chaput, Klingenberg, & Sjodin, 2010). In addition, workers with non-standard work schedules experience more conflicts between work and family, and have more difficulties in seeking time and energy for social life (Caruso et al., 2006). To relieve stresses from job, family, and social life, workers with unfavorable work schedules often use unhealthy behaviors, such as smoking and drinking (Bushnell, Colombi, Caruso, & Tak, 2010; Trinkoff & Storr, 1998). However, there is a lack of knowledge about differences in the relationship between job stress and nurse obesity by work schedule status.

1.3 Purpose of the Study

In this study, the prevalence and nature of nurse obesity was investigated, especially by job settings as well as in the overall nurse population. In addition, working conditions (i.e., job stress and work schedules) and various covariates were comprehensively examined in relation to nurse obesity using nationally representative nurse data. The specific aims were proposed as follows:

1. To describe **obesity rates** among nurses overall and by job settings,
2. To determine the relationship between **job stress** and **obesity** among nurses who had worked in nursing in the past year,
3. To determine the relationship between **work schedules** and **obesity** among nurses who had worked in nursing in the past year,
4. To examine the relationship between **job stress and nurse obesity by work schedules status** among nurses who had worked in nursing in the past year.

For each aim, the research hypotheses were as follows:

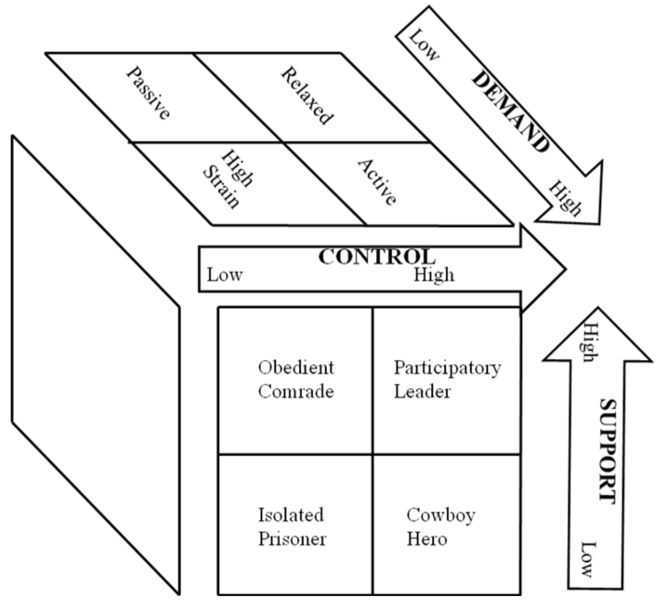
1. The proportions of nurse obesity are different by job settings (Aim 1),
2. Nurses who have high job stress are more likely to be overweight/obese (Aim 2),
3. Nurses who have unfavorable work schedules are more likely to be overweight/obese (Aim 3),
4. The relationship between job stress and nurse obesity is different by work schedule status (Aim 4).

1.4 Conceptual Framework

The conceptual framework is based on the Demand-Control-Support (DCS) model (Karasek & Theorell, 1994) that postulates workers' health is affected by stress-producing factors in employment settings. In this model, job strain occurs when job demands are high and job control and support from coworkers and supervisors are low (*Figure 1-1*). The first term, job demands, is an independent variable representing stress sources (stressors), such as workload demands in the work environment. Job control, i.e., decision latitude, has been defined as job decision-making authority and the opportunity to use and develop skills on the job. Job support is defined as “overall levels of helpful social interaction available on the job from both co-workers and supervisors” (Karasek & Theorell, 1994, p. 69). The job strain model assumes that workers have higher risk of physical and mental health from stress if they have high psychological workload demands or pressures combined with low control or decision latitude and social support at work. The Karasek job strain model has been used to describe many occupations in the U.S. and other countries. There are also many studies, which have attempted to apply the job strain model to nursing work. It was found that job strain among nurses was associated with depression, low job satisfaction, some symptoms of burnout (de Jonge, Janseen, & Van Breukelen, 1996; Landsbergis, 1988) as well as elevated blood pressure and cortisol levels (Fox, Dwyer, & Ganster, 1993). The discrepancies in results may be due to differences in the nature of the populations studied, in the methods of operationalizing the job strain construct, and the approach to testing the interactive effects (Bourbonnais, Comeau, & Vézina, 1999).

The DCS model emphasizes a need to distinguish features of the psychosocial work environments that can be categorized as demands, control, or support. It examines the interaction between demands, control and support, and explains stress-producing factors, but not individual perceptions, in employment settings. The main idea of the DCS model is that facility-level working conditions of high demand with low control and social support predict poor health of workers, such as high rates of CVD.

Figure 1-1. Demand-Control-Support model (Karasek & Theorell, 1994, p. 70, Figure 2-8. A 3-dimensional model of the psychosocial work environment)



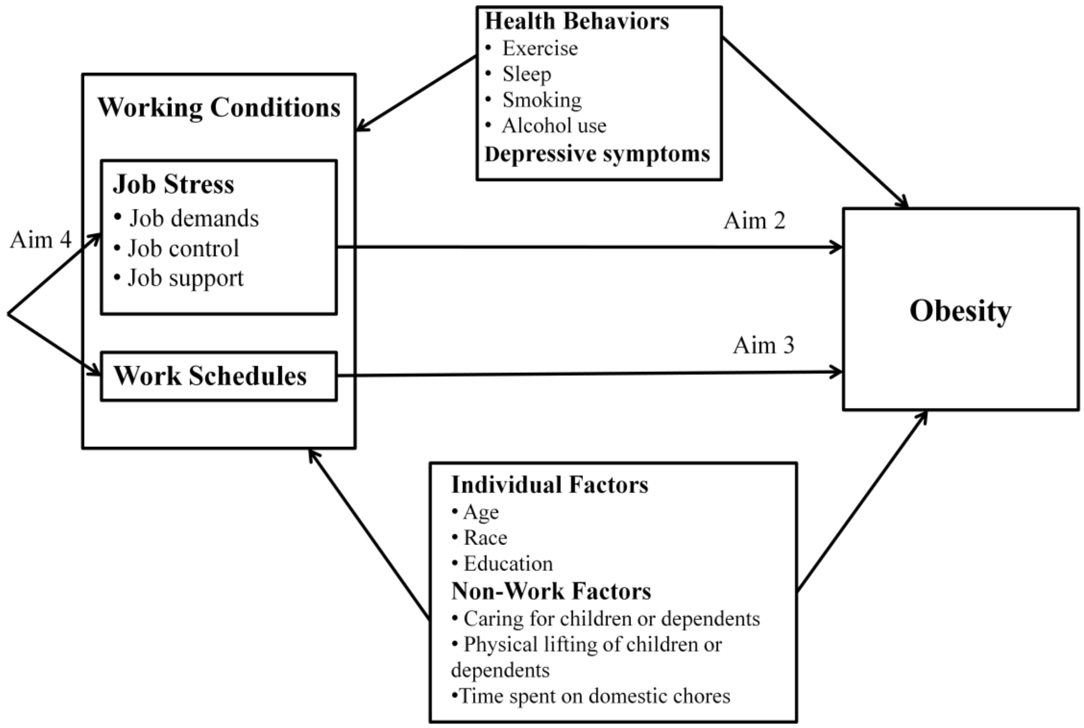
In this study, the concept of working conditions is an umbrella term which increase obesity among nurses, the main outcome of this study, and includes job stress and work schedules (*Figure 1-2*). In the context of the DCS model, job strain is exhibited as job stress that may affect nurse obesity. Job stress was constructed using three underlying concepts, job demands, control, and support, which are postulated through the DCS model (Karasek & Theorell, 1994). Although the job strain model defines job strain as the combination of high demands, low control, and low support in the original model, there is still uncertainty about whether the three concepts combine additively or interactively to affect health (Huang, Feuerstein, & Sauter, 2002). Therefore, each of the three constructs of job strain was tested as separate factors reflecting job stress.

Extending the DCS model, work schedule is added as another aspect of working conditions that affect nurse obesity. For work schedules, shift work, in particular, has been investigated as a kind of job stressor and an important factor which adversely affects workers' health. Other aspects of nurses' work schedules, such as work hours and overtime/on-call, have also been considered to have detrimental effects on nurse injuries and safety (Scott, et al., 2007; Trinkoff, Le, et al., 2006; Trinkoff, Le, Geiger-Brown, & Lipscomb, 2007). Therefore, in this study, various work schedules that nurses commonly experience were examined in relation to nurse obesity.

Even though adverse work schedules have been considered as a type of job stressor (Hurrell & McLaney, 1988; Karasek & Theorell, 1994), the effect of stress on obesity can vary with work schedule characteristics because work-time arrangement comprehensively influences workers' life, including sleep, diet, physical activities, social activities, and family life (Burch, et al., 2009; Caruso et al., 2006; Tucker, et al., 2010). Moreover, nurses with adverse schedules may require special support for preventing obesity as the schedule impacts are profound, whereas those with favorable schedules may have other opportunities to prevent obesity that may not be feasible for those with adverse schedules. Therefore, associations between job stress and nurse obesity were compared between nurses with favorable work schedules and those with unfavorable work schedules.

As confounders for the relationship between working conditions and nurse obesity, health behaviors, depressive symptoms, individual factors, and non-work factors were included (Hurrell & McLaney, 1988). Through integrating these individual factors, their contributions to the stress process were acknowledged and examined like other transactional models of occupational stress (French, Caplan, & van Harrison, 1982; Siegrist, 2002).

Figure 1-2. Conceptual framework of the relationship between working conditions (i.e., job stress and work schedules) and obesity.



1.5 Significance of the Study

The health problems linked to overweight or obesity are numerous and includes coronary heart disease, hypertension, stroke, type 2 diabetes, certain types of cancer, and premature death (Balkau, et al., 2007; Janiszewski, et al., 2007; Kabrhel, et al., 2009; Klein, et al., 2007; Munger, et al., 2009; Page, et al., 2009; Pi-Sunyer, 1993; Reilly, et al., 2003; Ryan, et al., 2008; van't Riet, et al., 2010; Vazquez, et al., 2007; Zhang, Rexrode, van Dam, Li, & Hu, 2008). Since employed adults spend many hours at work, it is important to determine the work-related factors related to obesity. One profession in particular, nursing exhibits many of the negative work characteristics, which may increase obesity rate among nurses. However, the prevalence of and the factors influencing nurse obesity is largely unknown. This study was the first to investigate nurse obesity using nationally representative nurse data from the NWHS, which has addressed the relationship between nurses' working conditions and such health issues as substance use and musculoskeletal disorders (Trinkoff, Geiger-Brown, et al., 2006; Trinkoff, Le, et al., 2006; Trinkoff & Storr, 1997; Trinkoff, et al., 2001).

The study findings could provide evidence of working conditions associated with obesity, and be used to make recommendations to reduce nurse obesity and improve their health. Nurse obesity and related health problems are correlated with high absenteeism, low retention, and high health care costs (Arnst, 2009; Lockley, et al., 2007). Thus, the study findings can be used as basic data for organizational policy recommendations as well as for improvement in nurse health. Moreover, all nurses from bedside caregivers to academic scholars should share a particular commitment to health promotion and primary prevention, as nursing has always claimed patient education and wellness among its most important missions. Nurses' role modeling of normal weight also may positively impact patients.

1.6 Methodological Approach

This section summarizes the methodology which was used to address the research aims. The study design, data source, sample, measures, analytical procedures, sample size adequacy. And human subject issues are described below.

1.6.1 Study Design

A secondary data analysis of the NWHS III Wave 1 dataset was conducted using a cross-sectional design.

1.6.2 Data Source

The data source of this study was the NWHS III, which was funded by NIOSH (project code: R01 OH007554; Alison Trinkoff, Principal Investigator). The NWHS III is a longitudinal study of RNs which was designed to assess work schedule characteristics, such as long work hours, mandatory overtime/on-call, working on scheduled days off or weekends, and shift rotation. Two main outcomes of musculoskeletal (i.e., neck, shoulder, back) disorders and needle-stick injuries were examined in relation to the various scheduling data. Confidential mailed surveys were used to collect data at baseline (Wave 1) and at six (Wave 2) and 15 months (Wave 3). The key strength of this study was that the longitudinal study design allowed them to investigate causal inferences of work schedules on the incidence of musculoskeletal disorders and needle-stick injuries.

The Wave 1 initial contact started in November 2002, and its data were collected until March 2003. The Wave 1 survey questionnaire was designed as a machine-readable form, 8 pages in length. An introductory letter, two questionnaire mailings along with a postage-paid return envelope and a reminder postcard were mailed to participants. As incentives to respond, a pen with the study logo and $2 were sent with the first questionnaire. All study protocol of the NWHS was approved by the University of Maryland, Baltimore Institutional Review Board (IRB).

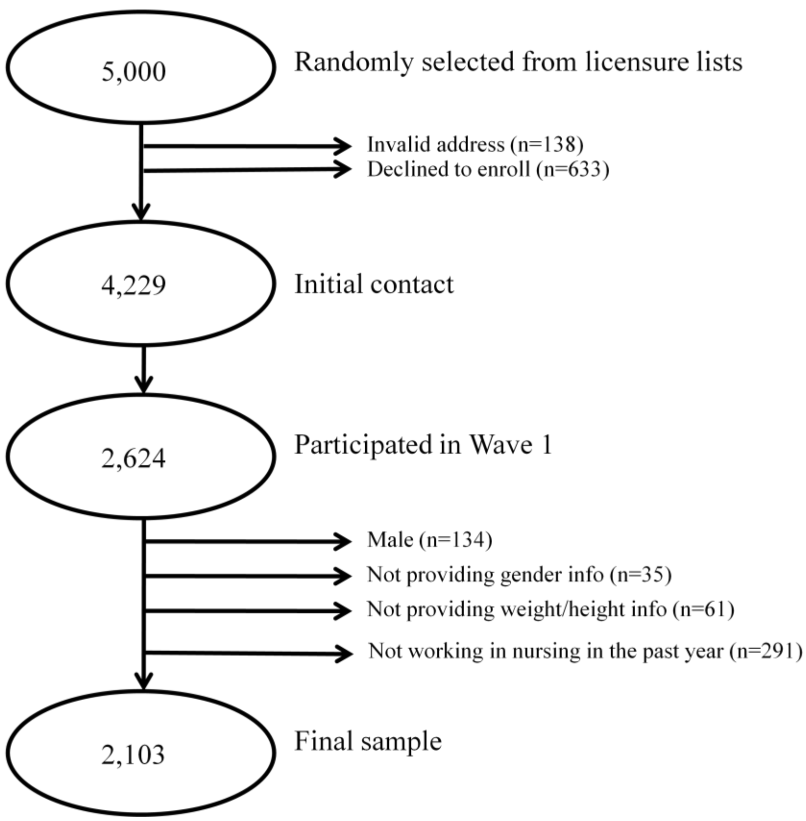
Among the three Waves of the NWHS III, the outcome variables of body weight and height in the study were assessed at Wave 1. Therefore, only the baseline data (Wave 1) were used in this project.

1.6.3 Sample

The Wave 1 data of the NWHS III were collected using a probability sampling method. For the recruitment process in detail, 5,000 nurses were randomly selected from licensure lists of two U.S. states, Illinois and North Carolina. These two states were selected based on their geographical and ethnic diversity among RNs, and for representativeness compared to the U.S. RN population. Of the 5,000 RNs contacted, 138 with invalid addresses and 633 who declined to enroll were excluded; 4,229 remained. In Wave 1, 2,624 RNs returned questionnaires, yielding a 62% enrollment rate. The final sample was comparable to the 2004 U.S. nurses in terms of demographics and job distributions (HRSA, 2006). Nurses' age averaged 45 years in the NWHS and 47 years in the overall U.S. RNs; RNs who were 50 or more years old were 42% of the NWHS and 41% of U.S. nurses. The proportion of female nurses was 95% in the NWHS and 94% in the U.S. RNs.

In this analysis, only female nurses were included, because obesity physiology is affected by gender (Ostry, et al., 2006). RNs were excluded who a) were male (n=134), b) did not provide their gender information (n=35), c) did not provide their body weight or height (n=61), or d) did not work in nursing in the past year (n=291). Finally, the survey data of 2,103 female RNs were analyzed. The sampling scheme is depicted in Figure 1-3.

Figure 1-3. Sampling Scheme



1.6.4 Measurements

1.6.4.1 Obesity

Nurse obesity was measured using BMI. In Wave 1 of the NWHS III, while height was continuously assessed, body weight was categorically measured: 1= less than 100 lbs; 2=100-129 lbs; 3=130-159 lbs; 4=160-189 lbs; 5=190-200 lbs; and 6= greater than 200 lbs. Thus, the exact BMI values could not be calculated. Instead, three types (minimum, median and maximum) of BMI estimates were calculated using the minimum, median and maximum values of body weight ranges within each category. For example, if a subject answered the third option (130-159 lbs) in the body weight item, the minimum, median and maximum BMI estimates were calculated using the minimum (130 lbs), median (145 lbs), and maximum (159 lbs) body weight values, respectively. The psychometrics and utility of the BMI estimates were evaluated by comparing to directly measured BMI values in Manuscript 1 (Chapter II). The BMI estimates had good reliability and validity. BMI was calculated as weight in kilograms divided by the square of height in meters. The overall calculated BMI values were classified as underweight ($<18.50 kg/m^2$), normal weight (18.50-$24.99 kg/m^2$), overweight (25.00-$29.99 kg/m^2$), and obese ($\geq 30.00 kg/m^2$) (World Health Organization, 2004) .

1.6.4.2 Job Stress

Job stress included job demands, control, and support, which were served by Karasek's job strain model (Karasek & Theorell, 1994).

1.6.4.2.1 Job demands

For job demands, psychological and physical demands were measured separately. Job demand items are presented in Table 1-1.

Psychological demands involved the presence and intensity of work. Seven items from the Job Content Questionnaire (JCQ) were used to measure psychological demands (Karasek, 1985). Responses included four Likert-type categories ranging from strongly agree (1) to strongly disagree (4), with higher scores meaning higher demands. The internal consistency was alpha=0.83 as estimated from the total study sample (n=2,103).

Physical demands represented duration, level, and frequency of physical exertion. This construct was assessed using 12 items (Karasek, 1985). Response options ranged from 1 (strongly disagree) to 4 (strongly agree). This study sample had an the internal consistency of alpha=0.90 for physical demands.

Table 1-1. Job demands questions

Psychological Demands Items	
I do not have enough time to get the work done.	alpha=0.83
My job requires working very hard.	
My job requires working very fast.	
My job requires an excessive amount of work.	
My job requires long periods of intense concentration.	
My job requires tasks that are often interrupted before they can be completed.	
My job requires waiting on work from other people/departments that often slows me down.	
Physical Demands Items	
My job requires lots of physical effort.	alpha=0.90
My job requires rapid and continuous physical activity.	
My job requires often moving/lifting heavy loads or patients.	
My job requires working for long periods with my head or arms in awkward positions.	
My job requires working for long periods with my body in awkward positions.	
I am often required to lift or lower patients/objects to/from the floor.	
I am often required to lift or lower patients/objects to/from shoulder height.	
I am often required to work while bent or twisted at waist.	
I am often required to push/pull heavy objects/people.	
I am often required to stand in one place/static position (30+min)	
I am often required to perform repetitive motions with hands/wrists.	
I am often required to apply pressure with hands/fingers (e.g., to prevent bleedings).	

1.6.4.2.2 Job control

Job control included task level controls over duties in the work setting (Table 1-2). Nine items were used to assess the amount of decision making authority and autonomy: five items obtained from the Nursing Work Index-Revised (Lake, 2002), and four additional items covering decision making culture which were obtained from the Procedural Justice Scale (Elovainio, Kivimaki, & Vahtera, 2002). Responses included four Likert-type categories ranging from strongly disagree (1) to strongly agree (4). Higher scores meant greater control at work. The nine task level control items had an internal consistency of alpha=0.82.

Table 1-2. Job control questions

I have freedom to make decisions.	alpha=0.82
I don't have to do things against my judgment.	
Nurses participate in controlling costs.	
Nurses participate in selecting equipment.	
I make my own schedule.	
In my job, policies/procedures are designed to get accurate information needed for decision making.	
In my job, policies/procedures are designed to allow opportunities to appeal or challenge decisions.	
In my job, policies/procedures are designed to generate standards so decisions can be made with consistency.	
In my job, policies/procedures are designed to hear of all affected by a decision.	

1.6.4.2.3 Job support

Job support was measured as reward and relationship with supervisor and peers (Table 1-3). Reward was assessed as salary adequacy. For relationship with supervisor/peers, seven items were obtained from the Nursing Work Index-Revised (Lake, 2002) and the JCQ supervisor and peer support domain (Karasek, 1985): four items related to boss support (alpha=0.90), two items related to peer support (alpha=0.94), and one item related to doctor/nurse relationship, yielding alpha for the seven items as 0.84. All items were provided as four point Likert-type questions from 1 (strongly disagree) to 4 (strongly agree). Higher scores meant more support from work.

Table 1-3. Job support questions

Reward	
Salary is very good.	
Relationship with Supervisor/Peers	
My boss considers my viewpoint.	alpha=0.84
My boss is able to suppress personal biases.	
My boss treats me with kindness and consideration.	
My boss deals with me in a truthful manner.	
My peers can be relied upon when I need help.	
My peers are helpful in getting the job done.	
Doctors and nurses have good working relationships.	

1.6.4.3 Work Schedules

Work schedules covered the duration and patterns of the typical work day in the past six months. To obtain data on workers' typical experiences of stress, a fixed time period of the past six months was provided to nurses (Folkard, Spelten, Totterdell, Barton, & Smith, 1995). Work schedules were measured using five items (hours worked per day; hours worked per week; number of weekends worked per month; number of breaks lasting 10 minutes or more including meals; and shift rotation) adopted from the Standard Shiftwork Index, and eight items (working 13 hours or more at a stretch; working with less than 10 hour off between shifts; working on a scheduled day off/vacation day; working while sick; working with mandatory overtime; required on-call; full time versus part time; and the usual number of days worked in a row) related to work schedule characteristics that nurses could experience. The Standard Shiftwork Index has standardized self-report work schedule measures (Barton, Spelten, Totterdell, Smith, & Folkard, 1995; Folkard, et al., 1995), and has been used internationally in shiftwork research (Trinkoff et al., 2011a; Trinkoff, Le, et al., 2006). The content validity of the survey was verified by three NIOSH experts (Roger Rosa, Clare Caruso, and Steve Sauter) (Trinkoff, Le, et al., 2006).

Work schedule items are listed in Table 1-4. While hours and number of days worked and number of weekends worked were continuously assessed, the other items were categorically measured based on their frequencies, e.g., never (1) to more than once a week (6). Full time work was assessed using a two option item: full time versus part time.

Table 1-4. Work schedule questions

Hours worked per day
Hours worked per week
Number of weekends worked per month
Number of breaks lasting 10 minutes or more including meals
Shift rotation
Working 13 hour or more at a stretch
Working with less than 10 hours off between shifts
Working on scheduled day off/vacation day
Working while sick
Working mandatory overtime
Required to work on-call
Full time versus part time
Usual number of days worked in a row

1.6.4.4 Variable Construction

To construct explanatory variables, factor analysis was conducted within each construct (demands, control, support, work schedule). Through bringing intercorrelated variables together under more general underlying components, factor analysis prevents violation of statistical test assumptions which leads to a loss of precision and power (Rietveld & Van Hout, 1993). Thus, factor analysis offers not only the possibility of gaining a clear view of the data, but also the possibility of using the output in subsequent analyses (Field, 2005; Rietveld & Van Hout, 1993). Principal Component Analysis (PCA) with varimax rotation was chosen for factor analysis since PCA can create independent components underlying each construct and is preferred for purposes of data reduction (Field, 2005, pp. 631-632). Varimax rotation is the most common orthogonal rotation option, which has the effect of differentiating the original variables by extracted component, and makes it easy to identify each variable with a single component (Field, 2005, pp. 636-637). The numbers of components were identified based on Kaiser's criterion which retains all components with eigenvalues greater than 1 (Kaiser, 1960). This criterion is based on the idea that the eigenvalues represent the amount of variation explained by a component and that an eigenvalue of one represents a substantial amount of variation. Component scores were calculated using the regression method, which uses component score coefficients as weights in equations rather than using the component loadings (Field, 2005, pp. 625-637). In this method, the component loadings are adjusted to account for the initial correlations between variables; in doing so, differences in units of measurement and variable variances are stabilized.

To create composite scores for work schedules, individual component scores of work schedules were weighed by the component loadings and then summed together. This weighed and summed score was normally distributed and then dichotomized at the mean to define favorable work schedules (≤ mean) and unfavorable work schedules (> mean). Therefore, this composite measure of WS involves a combination of work schedule characteristics which nurses experience simultaneously, weighted by the importance driven by data from the study sample.

1.6.4.5 Potential Confounders

Potential confounders of the relationship between work conditions and obesity involved not only basic demographic characteristics, health behaviors, depressive symptoms, but also stress sources from home. Demographic characteristics included age, race (African-American versus other) and educational level (diploma/associated versus Bachelor's or higher). Health behaviors were assessed as current smoking status (yes/no), frequency of alcohol drinking (5 or more alcoholic drinks in the past year: 0 [1] to more than 11 [5]), vigorous exercise, and enough sleep (rarely [0] to all the time [3]).

Depressive symptoms was measured using the Center for Epidemiologic Studies Depression scale (CES-D) (Radloff, 1977). The CES-D is a self-report measure of depressive feelings and behaviors commonly used for research in the general population. The scale is a composite of 20 items which assess symptoms associated with depression. The values of each item range from 0 to 3 on the basis of "how often you have felt this way during the past week": 0 = rarely or none of the time (less than 1 day), 1 = some or a little of the time (1-2 days), 2 = occasionally or a moderate amount of time (3-4 days), and 4 = most or all of the time (5-7 days). Depressive symptom severity is calculated by summing all of the scores, and the range of the CES-D scores is from 0 to 60; higher scores indicate more severe depressive symptoms. In this project sample, the internal consistency among the 20 CES-D items was estimated as alpha=0.90.

Stress sources from home were incorporated to take account of the total exposure to stress sources at both work and home among the predominantly female workforce. Stress sources from home included a) caring for dependent children or dependents (e.g., elderly) on regular basis, b) physical lifting of children or dependents, and c) time spent on housework or chores.

1.6.5 Data Analysis

Analysis was performed using the Predictive Analytics Software (PASW) (Version 17.0; SPSS/IBM Inc., Somers, NY). A significance level of 0.05 was chosen for all comparisons.

First of all, exploratory data analysis was conducted. Outliers were checked. Continuous variables, such as age and hours worked per day, were range-checked for whether all variables had reasonable values and if any outliers were found. For instance, hours worked per day were defined as the number of hours worked at a stretch, and could have values of more than 24 hours. Categorical variables having an option of “not applicable” were recoded into strongly disagree or missing according to conceptual meanings. For example, “not applicable” of the item “my work requires excessive amounts of work” was recoded into “strongly disagree.”

Missing values were also screened. Missing value analysis was conducted for scale items using the regression method. The regression method uses linear regression to predict what the missing score would be on the basis of other variables that are present (Pickles, 2005). That is, multiple regression was used for data imputation by using non-missing data to predict the values of missing data. Missing values were imputed with regression estimated values only if one or two (less than 25% missing) items within each construct were missing (Afifi & Elashoff, 1966). Levels of missing which were acceptable for imputation were as follows; (a) one or two missing among seven psychological demands items (25 cases), (b) one or two missing among 12 physical demands items (35 cases), (c) one or two missing among nine control items (169 cases), and (d) one missing of eight support items (126 cases). If there were more missing items than described above, missing values were left as missing for 3.1% missing on psychological demands, 3.4% missing on physical demands, 10.5% missing on control, and 7.5% missing on support items. Of the 2,103 nurses, 379 cases (17.8%) had missing on any work schedule items.

Data analysis focused on the specific aims of the study. Aim 1 involved descriptions of the prevalence of nurse obesity in general (i.e., including all sample nurses) as well as by job settings (i.e., those having worked in hospitals versus those working in other nursing settings). Bivariate analysis of the data was conducted using contingency tables with chi-square. The proportion of nurse overweight/obesity were compared by job settings.

For Aims 2, 3, and 4, binomial logistic regression was performed to examine the association between work conditions and nurse obesity: for job stress in Aim 2, work schedules in Aim 3, and job stress stratified by work schedule status in Aim 4. Logistic regression can be used to predict a categorical dependent variable on the basis of continuous and/or categorical independents. In addition, logistic regression models can determine the effect size of the independent variables on the dependent and understand the impact of covariate control variables. The impact of explanatory variables on an outcome variable is usually explained in terms of odds ratios (explanatory variables with odds ratios greater than 1 indicated elevated odds of being OW/OB in this study). In general, logistic regression has less stringent assumptions: does not assume linearity of relationship between the independent and dependent variables; does not require normally distributed variables; and does not assume homoscedasticity. However, it requires that observations be independent.

Job stress (demands, control, support) and work schedule components extracted through PCA were included in the multiple logistic regression models for Aims 2 and 3, respectively. To examine the relationship between job stress and nurse obesity by work schedules status among nurses (Aim 4), multiple regression models including job stress components were stratified by work schedule status (i.e., favorable versus unfavorable). The order for entering covariates into the regression models predicting overweight/obese nurses versus underweight/normal weight nurses was determined by the backward stepwise method. In the backward method, all covariates' individual contributions are calculated to determine the order of covariates entered in the models. If a covariate is not significant compared to others, the contributions of the remaining predictors are then reassessed after the covariate is removed. The backward method is preferred because of low risk of making type II error (Field, 2005, pp. 160-161). All regression models were generated after adjusting for the potential confounders.

1.6.6 Sample Size Adequacy

In the preliminary data analysis (n=666), the effect sizes were R^2=0.04-0.20 in the three regression models (number of independent variables=11-13) for nurses' overweight/obesity (Han, Trinkoff, & Storr, 2010). In this project, when holding alpha=0.05 (type I error) and using 80% power as a conventional assumption, the total sample size of 2,103 was sufficient to detect a small effect size (R^2=0.02) in regression models (Cohen, 1992). G*Power, a general power analysis program, also showed 788 as the minimum number of cases required to detect a small effect size with alpha=0.05 and power=80%. According to Green's rule (a minimum sample size of 50+8k, if k is the number of predictors) (Green, 1991), this dataset (n=2,103) could allow up to 256 predictors in the regression models. The sample sizes of the subgroups, such as nurses with favorable WS (n=1,008) and those with unfavorable WS (n=716), allowed detecting of a small to medium effect size.

1.6.7 Human Subjects

This study employed a secondary data analysis using the Wave 1 dataset of the NWHS III, which study protocol was approved by the Institutional Review Board (IRB) of University of Maryland, Baltimore. This dissertation project used the existing data where subjects cannot be identified, and its protocol was also reviewed by the IRB and was determined to be exempt under Research Risks Code of Federal Regulations 45 CFR 46.101.b(4) (the IRB review of University of Maryland, Baltimore, March 9, 2010).

1.7 Introduction of the Three Manuscripts

This dissertation includes three manuscripts, which were developed based on the study aims of the dissertation project, as Chapters 2, 3, and 4.

The first manuscript (Chapter II) was a methodological paper about the BMI estimates created using the categorical body weight variable which was self-reported. In this manuscript, these BMI estimates were compared to the BMI calculated using self-reported continuous weight data and to directly measured BMI as the gold standard, using the National Health and Nutrition Examination Survey (NHANES). Self-reported categorical weight data had good reliability and validity when using median values of the body weight ranges for BMI calculation in comparison to directly measured weight data. Based on the evidence for the utility of the BMI median estimates, the second and the third manuscripts used these BMI estimates as the main outcome variable.

The second manuscript (Chapter III) included Aims 1-3. For Aim 1, the proportions of overweight (BMI $\geq$ 25kg/m^2) or obesity (BMI $\geq$ 30kg/m^2) were compared by job settings. For Aims 2 and 3, the relationships between job stress/work schedules and nurse obesity were examined using regression models. Through this analysis, job-related factors which were associated with overweight/obesity among the general nurse population were found.

The third manuscript (Chapter IV) compared associations of job stress and nurse obesity between nurses with favorable work schedules (WS) and those with unfavorable WS (Aim 4). The study results provide new information about differences in obesity-related factors by work schedule status among nurses.

CHAPTER II (Manuscript 1).

Body Mass Index Estimates Using a Categorical Body Weight Variable

2.1 Introduction

During the past 20 years, obesity rates have increased dramatically in the U.S. (Centers for Disease Control and Prevention, 2004; Flegal, et al., 2010) Obese adults are at increased risk for many serious health conditions, including coronary heart disease, hypertension, stroke, type 2 diabetes, certain types of cancer, and premature death (Balkau, et al., 2007; Onat, et al., 2007; Zhang, et al., 2008). In addition, obesity is also associated with psychological impairment, such as social stigmatization, discrimination, and reduced quality of life (Goldney, Dunn, Air, Dal Grande, & Taylor, 2009; MacLean, et al., 2009). Numerous studies have been conducted to identify the reasons and solutions for the obesity pandemic, requiring innovation in measurement as large scale population-based studies are conducted (Shiely, et al., 2010; Yanovski & Yanovski, 2011).

While precise and sophisticated techniques for measuring body fat distribution and body composition are available, e.g., computed tomography and magnetic resonance imaging, they are generally not useful outside specific research settings. Due to the practical value, simple anthropometric measurements have provided alternative obesity measurements for large-scale epidemiological studies. Body mass index (BMI) which relates weight to height, is the simplest measure of body size, and has been frequently used in obesity studies as well as to estimate the prevalence of obesity within a population (Flegal, et al., 2010). Increased BMI has been found to be consistently associated with an increased risk of cardiovascular diseases and type 2 diabetes (Ryan, et al., 2008; Vazquez, et al., 2007), yet this measurement does not account for variation in body fat distribution and abdominal fat mass, which can differ greatly across populations and can vary substantially within a narrow range of BMI (Flegal, et al., 2009; Rahman & Berenson, 2010). While BMI may be a suboptimal marker for total body fat percentage and less suitable to assess body fat distribution than waist circumference or waist-hip ratio, BMI provides a reasonable indicator of body fatness, overall adiposity, and weight categories that are associated with health problems (Ryan, et al., 2008). In addition, BMI is a useful and simple measure of obesity when studying behavioral influences on body size, rather than physiological pathways related to adiposity.

In large health surveys, body weight is often assessed via self-report. Self-reported body weight data represent an attractive alternative to actual measurements because they are easier and less expensive to obtain. However, self-reported body weight data have been considered questionable because underweight subjects are more likely to over-estimate their body weight, while overweight subjects are more likely to under-estimate their body weight, especially women (Gorber, Tremblay, Moher, & Gorber, 2007; Spencer, Appleby, Davey, & Key, 2002). When assessing validity of self-reported weight or BMI data in comparison to directly measured data, most studies have used continuous data (Gorber, et al., 2007). However, sensitive data are usually assessed using categorical, rather than continuous (i.e., open-ended) items (Dillman, Smyth, & Christian, 2009). Categorical information may contain fewer errors than continuous information because respondents may feel more comfortable using categorical items, and the gross values (e.g., the median of the range for categories) may provide a buffer against under- or over-reporting (Cleary, et al., 1994; Ellison, et al., 1997). If bias in self-reported data can be compensated for by using categorical variables, researchers may be able to obtain more accurate information even when using self-reported surveys. In addition, as categorical variables provide less chance to make errors than continuous variables (Cleary, et al., 1994), categorical weight data may be a more accurate substitute for measured weight data. However, there is a lack of knowledge about the validity of categorically assessed weight data. Because of the concerns about inaccurate self-reported body weight data as well as the sensitive nature of the topic of weight, the Nurses' Worklife and Health Study (NWHS) measured nurses' body weight using a categorical variable (1=less than 100 lbs; 2=100-129 lbs; 3=130-159 lbs; 4=160-189 lbs; 5=190-200 lbs; and 6=greater than 200 lbs).

The purpose of this report was to evaluate the reliability and validity of the self-reported BMI estimates created from categorical body weight responses, using the 2003 National Health and Nutrition Examination Survey (NHANES) and NWHS. This analysis focused on females because there are differences in reporting trends of weight data between males and females (Gorber, et al., 2007), and females may be more likely to consider the reporting of their exact weight as sensitive. Findings provide evidence to support the categorical approach for collecting self-reported BMI data.

2.2 Methods

2.2.1 Data and Sample

NHANES is an ongoing cross-sectional survey that collects data about the health and nutritional status of the U.S. population. Two kinds of data are collected: self reports via an interview (e.g., about health behaviors and weight history) and physical examinations that include measured height and weight. Data are released every two years. Detailed information about the NHANES design, procedures, and methodologies is provided on the National Center for Health Statistics website (Centers for Disease Control and Prevention, 2011). Because the NHANES dataset contains both self-reported and exact weight and height data (directly measured by weighing and gauging the respondents), it was used to evaluate concordance or differences between self-reported BMI and exact BMI values. The NHANES sample was restricted to female subjects who were 22-83 years old, currently employed, and educated (i.e., some college or more) for comparability to the NWHS. Only NHANES participants with both self-reported and directly measured weight/height data were included (n=606).

NWHS was a prospective study that explored nurses' working conditions as well as health behaviors and home demands in relation to their health (Trinkoff, Geiger-Brown, et al., 2006; Trinkoff, et al., 2007). NWHS randomly selected 4,229 nurses from two U.S. states (Illinois and North Carolina) and obtained baseline questionnaires from 2,624 nurses from November 2002-March 2003 (Trinkoff, Geiger-Brown, et al., 2006). For this analysis, the baseline survey data were used because it contained weight and height information. The NWHS sample was restricted to female nurses who were currently employed and provided their weight and height information. The final sample contained 2,203 female nurses (22-83 years old).

2.2.2 BMI Estimates

BMI was calculated by dividing weight in kilograms by the square of height in meters. In both datasets height was continuously assessed. The weight categories for this study were those used in the NWHS: 1=less than 100lbs; 2=100-129lbs; 3=130-159lbs; 4=160-189lbs; 5=190-200lbs; and 6=greater than 200lbs. Three sets of BMI estimates were calculated using the minimum, median, and maximum values of the body weight ranges for each category. The estimated BMI was then classified as underweight (UW, <18.5 kg/m^2), normal weight (NW, 18.5-24.9 kg/m^2), overweight (OW, 25.0-29.9 kg/m^2), and obese (OB, ≥ 30.0 kg/m^2) (World Health Organization, 2004).

To determine which of the BMI estimates was the most accurate among the three sets (minimum, median, and maximum), the same estimation strategy was then applied to the NHANES dataset. The self-reported NHANES weight values were collapsed into the NWHS weight categories, and then the minimum, median, and maximum BMI estimates were calculated using the body weight categories and the continuous height values, which were all self-reported. Additionally, continuous BMI estimates were calculated using the original continuous self-reported weight and height data from the NHANES. For the purposes of this study, self-reported BMI or BMI estimates refer to BMI calculated using self-reported weight and height values. As the BMI gold standard, height and weight values directly measured by gauging and weighing the respondents were used to create the exact BMI values. Then the various BMI estimates were evaluated by assessing their reliability and validity in comparison to these exact BMI values.

2.2.3 Statistical Analysis

2.2.3.1 Reliability

To examine the reliability of the BMI groups (UW, NW, OW, OB), the BMI estimates were compared with the exact BMI groups derived from the directly measured heights and weights in the NHANES dataset. Additionally, those of the NHANES were compared with those of the NWHS to evaluate reliability of the BMI estimates across the datasets.

2.2.3.2 Validity

Concordance: To test concordance, Pearson correlation coefficients of the BMI estimates with the exact BMI values were compared. To assess agreement in the BMI groups between the BMI estimates and the exact BMI, kappa statistics were calculated using four (UW, NW, OW, OB), three (UW/NW, OW, OB), and two (UW/NW, OW/OB) BMI grouping. In addition, the proportion of misclassified cases for the BMI estimates were calculated in comparison to the exact BMIs.

Criterion validity: Sensitivity (probability of a true positive) and specificity (probability of a true negative) were tested to assess the validity of the estimated BMI for determining overweight (BMI$\geq$ 25.0 kg/m^2) and obesity (BMI$\geq$ 30.0 kg/m^2) defined by the directly measured BMI values.

Known-group validity indicated the ability of the BMI estimates to distinguish between groups with known differences. For this, the relationships between the BMI estimate groups and well-known predictors for overweight or obesity (i.e., age, race/ethnicity, physical inactivity) were examined using the NHANES and the NWHS datasets. Age was measured continuously while race/ethnicity (African-American versus other) and physical inactivity (exercise vigorously over past 30 days, yes/no, by NHANES; exercise vigorously at least once a week, yes/no, by NWHS) were categorically assessed. To compare these characteristics of subjects who were OW/OB with those who were UW/NW, t-tests were used for the continuous variable (i.e., age) and contingency tables with chi-square for the categorical variables (i.e., race/ethnicity, physical inactivity).

All statistical analyses were conducted using Predictive Analytics Software (PASW) (Version 17.0; SPSS/IBM Inc., Somers, NY). When these analyses were re-examined using another nurse dataset collected from October 1999-February 2000 (Trinkoff, et al., 2003) and compared to the NHANES 1999-2000, the findings were similar, therefore only the results using the more recent datasets were presented. This study was reviewed and approved by the Institutional Review Board of University of Maryland, Baltimore.

2.3 Results

2.3.1 Reliability

When comparing the proportions of the four BMI groups (UW, NW, OW, OB) in the NHANES dataset, the BMI median and continuous estimates were the most similar to the exact BMI values (Table 2-1). When comparing the proportions of OW/OB (BMI$\geq$ 25.0 kg/m^2), the BMI median (55.8%) and continuous (54.6%) estimates were closer to the exact BMI (61.4%) than the minimum (44.7%) and maximum (71.8%) estimates. For the proportion of obesity (BMI$\geq$ 30.0 kg/m^2), the BMI median estimates

(33.7%) were closer to the exact BMI value of 34.0% than the continuous estimates (29.4%). While the proportions of OW (BMI, 25.0-29.9 kg/m^2) and OB (BMI$\geq$ 30.0 kg/m^2) were higher and lower, respectively, in the NWHS than those in the NHANES, the distributions of the BMI groups were similar across the two datasets: whereas, the BMI minimum estimates over-estimated the proportion of UW/NW while the maximum estimates over-estimated the proportion of OW/OB.

Table 2-1. Proportions (%) of body mass index (BMI) groups by types of estimates: females 22-83 years old, currently employed, and at least a college education

	NHANES (n=606)	NWHS (n=2,203)
Self-reported BMI estimates		
BMI minimum estimates		
underweight	18.0	15.7
normal weight	37.3	44.4
overweight	24.1	24.0
obese	20.6	15.9
BMI median estimates		
underweight	4.1	2.1
normal weight	40.1	42.8
overweight	22.1	27.8
obese	33.7	27.3
BMI maximum estimates		
underweight	0.2	0.3
normal weight	28.1	25.6
overweight	28.2	36.2
obese	43.6	37.9
BMI continuous estimates		
underweight	2.3	
normal weight	43.1	
overweight	25.2	
obese	29.4	
Directly measured BMI (Gold Standard)		
underweight	2.0	
normal weight	36.6	
overweight	27.4	
obese	34.0	

NHANES, National Health and Nutrition Examination Survey; NWHS, Nurses' Worklife and Health Study; BMI minimum/median/maximum estimates, BMI calculated using self-reported data of continuous height and minimum/median/maximum values of body weight categories; BMI continuous estimates, BMI calculated using self-reported data of continuous height and weight

2.3.2 Validity

Concordance: The correlation coefficient of the BMI median estimates with the exact BMI values differed little (r=0.89 for median versus r=0.87 for minimum and r=0.88 for maximum). The BMI continuous estimates had the highest correlation with the exact BMI (r=0.95). When comparing the results for the number of BMI groups, the two-group BMI assignments (i.e., UW/NW versus OW/OB) showed higher agreement and fewer misclassified cases than the three- or four-group assignments. For level of agreement and misclassification tests, among the minimum, median, and maximum estimates, the BMI median estimates showed the highest levels of agreement with the exact values (kappa=0.78) for the two-group assignment, indicating excellent agreement and the lowest proportion of misclassified cases: 10.6% for the two-group assignment (Table 2-2). For the BMI median estimates, the two-group assignment had 10.6% misclassification compared to 19.1% for the three-group and 22.8% for the four-group assignment. In terms of misclassification patterns, the minimum and maximum BMI estimates tended to be mostly under- and over-estimated, respectively, whereas the median estimates showed both under- and over-estimation, indicating a well-balanced misclassification pattern.

Table 2-2. Agreements (kappa) and proportions (%) of misclassified cases by types of BMI estimates in the NHANES 2003-2004 dataset compared to BMI classifications obtained using the exact BMI values: females 22-83 years old, currently employed, and at least a college education

	Four-Group Assignment (UW/NW/OW/OB)	Three-Group Assignment (UW-NW/OW/OB)	Two-Group Assignment (UW-NW/OW-OB)
Agreement, kappa (95% CI)			
BMI minimum estimates	0.38 (0.36-0.41)	0.55 (0.53-0.58)	0.67 (0.64-0.70)
BMI median estimates	0.66 (0.64-0.69)	0.71 (0.68-0.73)	0.78 (0.76-0.81)
BMI maximum estimates	0.56 (0.53-0.58)	0.55 (0.58-0.61)	0.66 (0.63-0.69)
BMI continuous estimates	0.76 (0.74-0.78)	0.78 (0.76-0.80)	0.83 (0.81-0.85)
Misclassification, %			
BMI minimum estimates	44.6	29.2	17.0
BMI median estimates	22.8	19.1	10.6
BMI maximum estimates	29.9	28.1	15.3
BMI continuous estimates	16.2	14.5	8.4

BMI, body mass index; NHANES, National Health and Nutrition Examination Survey; UW, underweight; NW, normal weight; OW, overweight; OB, obese; BMI minimum/median/maximum estimates, BMI calculated using self-reported data of continuous height and minimum/median/maximum values of body weight categories; BMI continuous estimates, BMI calculated using self-reported data of continuous height and weight

Criterion Validity: Among the minimum, median, and maximum estimates, the BMI median estimates had the highest values for both sensitivity and specificity in the NHANES (Table 2-3). For example, for overweight, the BMI median estimates had sensitivity=86.8% and specificity=93.6%, whereas the BMI minimum estimates had a high false negative rate (27.4%, sensitivity=72.6%), and the BMI maximum estimates had high false positive rates (33.3%, specificity=66.7%). The BMI median estimates had higher sensitivity but lower specificity values for obesity than the continuous estimates: sensitivity=85.4% and specificity=93.0% for the BMI median estimates versus sensitivity=83.0% and specificity=98.3% for the BMI continuous estimate, though sensitivity and specificity for the median estimates was quite acceptable.

Table 2-3. Sensitivity (%) and specificity (%) for overweight* and obesity* of the three BMI estimates in the NHANES 2003-2004: females 22-83 years old, currently employed, and at least a college education

	Overweight ($BMI \geq 25.0 kg/m^2$)		Obesity ($BMI \geq 30.0 kg/m^2$)	
	sensitivity	specificity	sensitivity	specificity
BMI minimum estimates	72.6	99.6	60.2	99.8
BMI median estimates	86.8	93.6	85.4	93.0
BMI maximum estimates	96.0	66.7	94.7	82.8
BMI continuous estimates	87.6	97.9	83.0	98.3

*, defined using the exact BMI values; BMI, body mass index; NHANES, National Health and Nutrition Examination Survey; BMI minimum/median/maximum estimates, BMI calculated using self-reported data of continuous height and minimum/median/maximum values of body weight categories; BMI continuous estimates, BMI calculated using self-reported data of continuous height and weight

*Known-group validity***:** According to the reliability and validity test results above, the two-group assignment of the BMI median estimates was the most accurate among the minimum, median, and maximum estimates when compared to the exact BMI values. As they also performed well psychometrically, the median estimates were therefore selected and assessed for known-group validity. For both NHANES and NWHS, OW/OB groups measured using the BMI median estimates showed significant positive relationships with age, African-American ethnicity, and less exercise (Table 2-4). For instance, in the NWHS, those who were OW/OB were significantly older ($t=5.76$, $p<0.01$), significantly more likely to be African-American ($\chi^2=30.88$, $p<0.01$), and exercised less ($\chi^2=18.17$, $p<0.01$) than those who were UW/NW.

Table 2-4. Differences in age, race/ethnicity, and exercise by the underweight/normal weight versus overweight/obese groups based on the BMI median estimates: females 22-83 years old, currently employed, and at least a college education

	Underweight /Normal weight	Overweight /Obese	
National Health and Nutrition Examination Survey 2003-2004 (n=606)			
Age (mean±SD)	36.4±12.3	43.2±12.5	t=6.68 ($p<0.01$)
Race/ethnicity (%)			
African-American	24.8	75.2	χ^2=24.09 ($p<0.01$)
Other	49.3	50.7	
Exercise vigorously over past 30 days (%)			
No	37.2	62.8	χ^2=19.17 ($p<0.01$)
Yes	55.6	44.4	
Nurses' Worklife and Health Study (n=2,203)			
Age (mean±SD)	44.8±10.8	47.4±10.3	t=5.76 ($p<0.01$)
Race/ethnicity (%)			
African-American	22.5	77.5	χ^2=30.88 ($p<0.01$)
Other	46.5	53.5	
Exercise vigorously at least 1/week (%)			
No	42.3	57.7	χ^2=18.17 ($p<0.01$)
Yes	52.9	47.1	

BMI, body mass index; BMI median estimates, BMI calculated using self-reported data of continuous height and median values of body weight categories

2.4 Discussion

This analysis found good reliability and validity for self-reported categorical weight data when using median values of the body weight ranges for each category for BMI calculation, in comparison to directly measured data on weight and height. The BMI median estimates calculated using a categorical weight variable also had comparable reliability and validity to the BMI estimates based on continuous weight data when compared to the exact BMIs. In addition, the BMI median estimates produced similar proportions of OW/OB (BMI$\geq$ 25.0 kg/m^2) or obesity (BMI$\geq$ 30.0 kg/m^2) to the exact values and showed higher sensitivity for obesity than the continuous estimates.

BMI values calculated using self-reported height and weight data have been reported to under-estimate the true prevalence of obesity because of the trends of under-reporting for weight and over-reporting for height, especially among females (Gorber, et al., 2007; Lee, Shin, Kim, Yoo, & Sung, 2011). This under-estimation trend is increasing over time. A recent study found that the proportions of under-reported BMIs in Irish national surveys were 14%, 21%, and 24% in 1999, 2002, and 2007, respectively, and highlighted a need for better indicators of obesity (Shiely, et al., 2010). Several demographic and health-related characteristics have been reported to affect the accuracy of self-reported height and weight data when assessed continuously (Lee, et al., 2011). For example, women tend to under-estimate their weight, while men tend to over-estimate their height (Niedhammer, Bugel, Bonenfant, Goldberg, & Leclere, 2000; Spencer, et al., 2002). Under-estimation of weight data among females is greater in younger than older women (Niedhammer, et al., 2000). Also females are more likely to have missing data on weight than males (Tiggemann, 2006). These findings suggest more concerns about assessing self-report weight among female subjects.

Although response rates are often lower in mail surveys than in other modes, such as face-to-face interviews or telephone surveys, sensitive information can be obtained through mail surveys more completely and accurately than other modes because of complete privacy in anonymous mailed surveys (Link, Battaglia, Frankel, Osborn, & Mokdad, 2006). In the NWHS, the non-response rate of BMI-related items (2.3%) was lower than for other mailed survey studies: 6.0% among female respondents (MacFarlane, Abbott, Crawford, & Ball, 2010); 3.4% among male and female respondents (Link, et al., 2006); and 2.7% among nurses (Overgaard, Gamborg, Gyntelberg, & Heitmann, 2006). This also supports the utility of the categorical weight variable for obtaining complete information on weight.

This study findings should be interpreted with care. The BMI estimates used in this study might not fully reflect the use of categorical data, because they were calculated using categorical weight and continuous height values. However, assuming that women provide reasonably accurate and complete data for their height, but not for their weight (Gorber, et al., 2007), this analysis focused on the utility of categorical weight data to generate an accurate estimate of BMI.

2.5 Conclusions

Although direct measures provide optimal data, self-reported measures are still widely used in obesity studies because of their time- and cost-efficiency. The study findings provide support for the use of categorical anthropometric data in self-report measures in large scale studies. Considering characteristics of the study population, researchers can use alternative methods for obtaining more accurate weight or height data. Additional studies are needed to more thoroughly investigate how endpoints of the categories can affect the accuracy of the data. If the trend of under- or over-reporting varies with participants’ weight, different ranges may be useful to get more complete and accurate information. Categorical anthropometric items can feasibly be used in public research settings if direct measures are limited. Furthermore this study provides psychometric support for the use of these measures.

CHAPTER III (Manuscript 2).

Job Stress and Work Schedules in Relation to Nurse Obesity

3.1 Introduction

The obesity epidemic in the U.S. is a widely recognized major national health threat as obesity increases the risk of many health conditions and psychological impairments (MacLean, et al., 2009; Zhang, et al., 2008). Annual medical costs associated with obesity are expected to double every decade to $861-960 billion by 2030, or 16-18% of total U.S. healthcare costs (Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008). In workplaces, obese employees have more fatigue, sleepiness, and physical limitations, which lead to higher risks of occupational injury than among non-obese (Pollack & Cheskin, 2007). Nurse obesity and related health problems may be related to high absenteeism, retention, and high health care costs (Goetzel, et al., 2010).

A socio-epidemiological approach suggests that certain work characteristics and conditions may cause negative health behaviors and outcomes among employees (Stansfeld & Marmot, 2002). According to the Demand-Control-Support (DCS) model (Karasek & Theorell, 1994), job strain occurs due to high psychological demands, combined with low control/decision latitude and lack of social support on the job. In this context, job strain is exhibited as job stress that may affect eating behavior and food choices, e.g., a tendency to eat more sweet and energy dense foods (Wallis & Hetherington, 2009). In nursing, high workload, low staffing levels, and shorter work breaks have all been reported as barriers to nurses' healthy eating (Faugier, Lancaster, Pickles, & Dobson, 2001a, 2001b). Disordered eating was more prevalent among nurses with high job stress, and the relationship between disordered eating (i.e., binging) and obesity was exacerbated by psychological stress (Allison, 2005). Moreover, Lallukka et al. (Lallukka, et al., 2008) found job stress related to decreased physical activity and unhealthy diet habits (e.g., low vegetable or fruit consumption, not choosing whole grains).

Work schedules also may influence nurse health by causing job strain or altering health behaviors (Caruso et al., 2006). Adverse work schedules could lead to obesity among nurses; for instance, shift work and long work hours disrupt normal eating times and reduce access to healthy food (de Assis, Kupek, Nahas, & Bellisle, 2003; Faugier, et al., 2001a, 2001b). Because of a lack of available food service, nightshift workers tend to eat unhealthy food (e.g., high salt, sugar) from vending machines or pre-packaged foods (Waterhouse, Buckley, Edwards, & Reilly, 2003). Nightshift nurses reported that their work schedules affected their stamina, frequency of exercise, and social and family life more than those working other shifts (Burch, et al., 2009). However, few nurse obesity studies have incorporated work schedule variables.

There is also a lack of knowledge about the prevalence of nurse obesity and of the potential relationship between nurses' work and obesity. The prevalence of nurse overweight/obesity (OW/OB) was 55% in one study (Miller, et al., 2008)(17), slightly lower than for the U.S. population (65%). Another study found 65% of hospital nurses were OW/OB (Zapka, et al., 2009). However, low response rates and oversampling of minority and male nurses hamper generalization of these estimates.

The purpose of this manuscript was to: a) describe OW/OB rates among a more representative sample of nurses, and b) examine the relationship between job stress/work schedules and nurse obesity. Demographic and work characteristics, depressive symptoms, health behaviors, and home demands were also examined in these analyses. Study findings can provide evidence of working conditions related to obesity and could support recommendations to reduce nurse obesity and improve their health.

3.2 Methods

3.2.1 Sample and Data Collection

This was a secondary data analysis using cross-sectional data from Wave 1 of the Nurses' Worklife and Health Study (NWHS). NWHS was a three-wave longitudinal survey of nurses' working conditions and injuries (Trinkoff, Geiger-Brown, et al., 2006; Trinkoff, et al., 2007), but only the baseline questionnaire contained variables necessary for this study. The NWHS randomly selected 5,000 nurses from 2 U.S. states (Illinois and North Carolina). Wave 1 data were collected from November 2002-March 2003. Of 4,229 RNs with valid addresses who agreed to participate, 2,624 RNs (95% women) returned questionnaires, yielding a 62% enrollment rate (Trinkoff, Geiger-Brown, et al., 2006). The sample was comparable to the 2004 U.S. nurse population in terms of demographic and job characteristics (HRSA, 2006). The study was approved by the Institutional Review Board, University of Maryland, Baltimore.

The sample for this analysis was restricted to women (because of gender differences in obesity physiology (Ostry, et al., 2006)) who were working in nursing in the year prior to Wave 1 (87%). This analysis excluded 61 women with missing weight and height data. The characteristics of the eligible sample of 2,103 nurses (average

age=46 years, 86% white, and 58% working in hospitals) were similar to U.S. nurses (average age=45 years, 88% white, and 56% working in hospitals) (HRSA, 2006).

3.2.2 Study Variables

Obesity was based on a derived body mass index (BMI), dividing weight in kilograms by the square of height in meters, which was then categorized into 2 weight groups: underweight/normal (UW/NW) (BMI<25.0kg/m^2) and OW/OB (BMI≥ 25.0kg/m^2) (Fernandez, Su, Winters, & Liang, 2010). Height was assessed as a continuous variable, and weight categories provided ranges to decrease nonresponse of what many consider a sensitive variable: 1=less than 100lbs; 2=100-129lbs; 3=130-159lbs; 4=160-189lbs; 5=190-200lbs; and 6=greater than 200lbs. Three sets of BMI estimates were calculated using the minimum, median, and maximum values of the body weight ranges for each category.

To identify the most valid BMI estimate among the minimum, median, and maximum estimates, the 2003-2004 National Health and Nutrition Examination Survey (NHANES) was analyzed. The highest level of agreement was found between the BMI median estimates and the exact BMI values (kappa=0.78, substantial agreement). In addition, the BMI median estimates exhibited both under- and over-estimation, unlike for the minimum and maximum estimates, suggesting a well-balanced misclassification pattern. Because the BMI median estimates showed the strongest validity, the median estimates were used to measure BMI.

Three elements of job stress (demands, control, and support) were assessed. All items related to job stress had 4-point Likert-type responses. Psychological demands (alpha=0.90) and physical demands (alpha=0.83) were assessed using items adapted from the Job Content Questionnaire (JCQ) (Karasek, 1985), plus additional nurse-specific items (Trinkoff, et al., 2003). Nine items measured decision making authority and autonomy (job control, alpha=0.82): 5 from the Nursing Work Index-Revised (NWI-R) (Lake, 2002), plus 4 from the Procedural Justice Scale (Elovainio, et al., 2002). Job support (alpha=0.82) was assessed by 7 items from the JCQ support domain (Karasek, 1985) and the NWI-R (Lake, 2002). To obtain data on workers' typical schedules, schedules were measured over the past 6 months (Folkard, et al., 1995; Trinkoff, Geiger-Brown, et al., 2006) using 13 items (Folkard, et al., 1995; Trinkoff et al., 2011a).

To construct independent variables within job demands, control, support, and work schedules, factor analysis was conducted using principal components analysis with varimax rotation (Kim & Mueller, 1988). The number of components was based on Kaiser's criterion (eigenvalues>1), which determines components explaining enough variations in the sample (Kaiser, 1960): components accounted for 57-79% of the variances of the underlying dimensions, indicating the components as reliable measures in this sample. Component scores were calculated using the regression method (Table 3-1). This technique has been used similarly in studies investigating nursing work environments (Trinkoff et al., 2011a; 2011b). When this technique was re-examined using another nurse dataset collected from 1999-2000 (Trinkoff, et al., 2003), the findings were similar, supporting the reliability of these measures.

Potential confounders of the relationship between working conditions and obesity were demographics, work characteristics, depressive symptoms, health behaviors, and home demands. Demographics included age, race/ethnicity and educational level. For work characteristics, nursing position was included to control for the sedentary nature of some positions. Years of RN experience was excluded due to multicollinearity with age ($r=0.80$). Depressive symptoms was measured using the Center for Epidemiologic Studies Depression scale ($\alpha=0.90$) (Radloff, 1977). Health behaviors were assessed as exercise, sleep quantity, current smoking, and alcohol use. Home demands included time spent on domestic chores, regularly caring for children or dependents, and physical lifting of children or dependents.

Table 3-1. Principal components analysis with varimax rotation: demands, control, support, and work schedules

	Loadings	
	item	component
Job Demands		
1: High physical exertion		38.95
During a usual workday, I often push/pull heavy loads or patients	0.82	
My job requires lots of physical effort	0.77	
My job requires often moving/lifting heavy loads or patients	0.75	
During a usual workday, I often lift/lower patients/objects to/from shoulder	0.74	
During a usual workday, I often lift/lower patients/objects to/from floor	0.72	
My job requires rapid and continuous physical activity	0.70	
During a usual workday, I often work while bent/twist at waist	0.67	
During a usual workday, I often apply pressure with hands/fingers	0.62	
2: Excessive psychological exertion		12.28
My job requires an excessive amount of work	0.81	
Tasks are often interrupted before they can be completed	0.72	
My job requires long periods of intense concentration	0.68	
My job requires me to work very hard	0.67	
I don't have enough time to get the work done	0.67	
My job requires me to work very fast	0.66	
Waiting on work from other people/departments often slows me down	0.52	
3: Frequent awkward posture		6.53
My job requires long periods with my head/arms in awkward positions	0.85	
My job requires long periods with my body in awkward positions	0.83	
4: Limited movement		5.66
During a usual workday, I often perform repetitive motions with hands/wrists	0.71	
During a usual workday, I often stand in on place/static position (30+min)	0.53	
Job Control		
1: Nurse input		43.98
In my job, all concerns affected by a decision are heard.	0.83	
In my job, I get accurate info needed for decision making	0.82	
In my job, opportunities to appeal or challenge decisions are allowed	0.82	
In my job, standards make decisions made with consistency	0.81	
2: Enough work control		13.59
In my job, I have freedom to make decision	0.71	
In my job, I participate in selecting equipment	0.67	
In my job, I don't have to do things against my judgment	0.64	
In my job, I make my own schedule	0.60	
In my job, I participate in controlling costs	0.60	
Job Support		
1: Supportive boss		46.73
My boss deals with me in a truthful manner	0.90	
My boss treats me with kindness and consideration	0.87	
My boss considers my viewpoint	0.86	
My boss is able to suppress personal biases	0.84	
2: Supportive peers		19.34

My peers can be relied upon when I need help	0.95	
My peers are helpful in getting the job done	0.95	
3: Supportive system		12.59
Salary is very good	0.84	
Doctors and nurses have good working relationships	0.70	
Work Schedules		
1: Long work hours		23.93
Hours worked per day	0.78	
Working 13 hours or more at a stretch	0.71	
Number of weekends worked per month	0.68	
Shift rotation	0.66	
Working with less than 10 hours off between shifts	0.61	
Working on scheduled day off/vacation day	0.44	
2: Weekly burden		15.41
Hours worked per week	0.84	
Full-time vs. part-time	0.83	
Usual number of days worked in a row	0.78	
3: Required on-call/overtime		9.73
Required to work on-call	0.75	
Working mandatory overtime	0.73	
4: Lack of rest		8.24
Number of breaks lasting 10 min or more including meals	0.70	
Working while sick	0.63	

3.2.3 Analysis

Analysis was performed using Predictive Analytics Software (PASW) Version 17.0. To compare OW/OB and UW/NW nurses, bivariate analysis was conducted using t-tests for continuous variables and chi-square contingency tables for categorical variables. To examine the relationship between job stress/work schedules and obesity, binomial logistic regression models were generated using backward entry, and all models were adjusted for the potential confounders. Components with odds ratios greater than 1 indicated elevated odds of being OW/OB.

3.3 Results

The prevalence of OW/OB (BMI$\geq$ 25.0kg/m^2) for the sample was 55.0%, and 27.1% of the sample were obese (BMI$\geq$ 30.0kg/m^2). There was no variation in these prevalences by place of employment (hospital versus non-hospital). When compared with UW/NW nurses, OW/OB nurses were about 2.5 years older ($p<0.01$), more likely to be African-American ($p<0.01$), with less education ($p<0.01$), worked as RNs longer ($p<0.01$), and more likely to work full-time ($p=0.02$) (Table 3-2). In addition, OW/OB nurses reported significantly more depressive symptoms ($p<0.01$), perceived their health as worse ($p<0.01$), performed less exercise ($p<0.01$), and had more frequent restless sleep ($p=0.03$) than UW/NW nurses, whereas sleep quantity did not differ between the 2 groups ($p=0.40$).

Table 3-2. Demographic, work, health behavior, and home demands characteristics (%) of underweight/normal weight female nurses compared to overweight/obese female nurses (n=2,103)

	Underweight /Normal weight (n=947)	Overweight /Obese (n=1,156)	χ^2	p
Age, mean±SD	44.5±10.8	47.1±10.2	t=-5.76	<0.01
20-29 years old	10.1	5.1	38.55	<0.01
30-39 years old	24.0	19.2		
40-49 years old	33.1	32.4		
50-59 years old	23.4	31.5		
≥60 years old	9.3	11.7		
Race/ethnicity				
White	87.6	84.3	31.22	<0.01
African-American	3.3	9.0		
Others	9.1	6.7		
Highest degree achieved				
Diploma/Associate	41.6	52.8	25.97	<0.01
Bachelor's	46.0	37.7		
Master's/Doctoral	12.4	9.5		
Marital status				
Married	74.7	71.8	3.14	0.21
Widowed/Separated/Divorced	15.6	18.4		
Never married	9.7	9.8		
Years of RN experiences, mean±SD	18.7±11.4	20.0±11.5	t=-2.73	<0.01
Work setting				
Hospital	58.5	57.3	0.95	0.62
Nursing home	7.6	7.0		
Other (e.g., school, government, business)	33.8	35.7		
Position in nursing				
Staff/General duty	67.1	66.9	0.01	0.91
Other	32.9	33.1		
Full-time				
Full-time	70.4	75.1	5.86	0.02
Part-time	29.6	24.9		
Depressive symptoms (CES-D score, range 0-60), mean±SD	9.7±8.9	10.9±9.6	t=-2.74	<0.01
Health perception				
Poor	1.1	0.6	144.21	<0.01
Fair	7.7	16.0		
Good	52.5	66.8		
Excellent	38.7	16.5		
Exercise vigorously at least 1 day/week				
Rarely/None (<1 day/week)	47.4	61.1	41.98	<0.01
Some/Little (1-2 days/week)	24.5	18.6		
Occasionally (3-4 days/week)	19.4	15.5		

Most/All the time (5-7 days/week)	8.7	4.9		
Sleep enough				
Rarely/None (<1 day/week)	17.2	19.0	2.93	0.40
Some/Little (1-2 days/week)	27.1	24.6		
Occasionally (3-4 days/week)	30.6	29.6		
Most/All the time (5-7 days/week)	25.1	26.8		
Sleep restlessly			8.84	0.03
Rarely/None (<1 day/week)	40.5	35.5		
Some/Little (1-2 days/week)	33.0	32.7		
Occasionally (3-4 days/week)	16.8	19.5		
Most/All the time (5-7 days/week)	9.8	12.4		
Current smoking				
Yes	13.0	13.4	0.06	0.81
Alcohol use, 5+ alcohol drinks on one occasion in the past year				
never	68.4	72.2	7.99	0.09
1-2 times	16.6	13.2		
3-5 times	7.6	7.1		
6-10 times	2.9	3.9		
11+ times	4.5	3.6		
Time spent on domestic chores				
< 10 hours/week	32.8	35.5	1.55	0.21
≥ 10 hours/week	67.2	64.5		
Caring for any children				
Yes	51.3	49.3	0.88	0.35
Caring for any dependents (e.g., elderly)				
Yes	11.3	13.5	2.41	0.12
Physical lifting of children or dependents				
Yes	47.3	49.7	1.15	0.28

CES-D, Center for Epidemiologic Studies Depression scale

Models adjusted for the potential confounders are summarized in Table 3-3. For Model 1, jobs with limited movement provided the only component significantly associated with OW/OB (OR=1.17, 95% CI=1.06-1.29, $p<0.01$). This did not change after adjustment for job control and support (OR=1.15, 95% CI=1.04-1.28, $p=0.01$) (Model 2). For work schedule (Model 3), nurses who reported long work hours were significantly more likely to be OW/OB (OR=1.14, 95% CI=1.01-1.28, $p=0.03$). In the full model (Model 4), limited movement and long work hours remained significant, although the relationship between long work hours and OW/OB was strengthened (OR=1.23, 95% CI=1.08-1.40, $p<0.01$). In addition, OW/OB nurses were significantly less likely to report jobs with high physical exertion (OR=0.82, 95% CI=0.72-0.95, $p=0.01$). Nursing position (e.g., staff nurse) was not associated with nurse obesity in the four models.

Table 3-3. Adjusted* odds ratios of overweight/obesity by job stress and work schedule: female nurses working in nursing (n=2,103)

	Model 1		Model 2		Model 3		Model 4	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Job Demands								
high physical exertion	0.92 (0.83-1.03)	0.16	0.92 (0.82-1.04)	0.17			**0.82 (0.72-0.95)**	**0.01**
excessive psychological exertion	1.04 (0.94-1.16)	0.40	1.02 (0.91-1.15)	0.68			1.00 (0.88-1.14)	0.99
frequent awkward posture	0.98 (0.89-1.08)	0.72	0.98 (0.88-1.08)	0.67			0.96 (0.85-1.07)	0.46
limited movement	**1.17 (1.06-1.29)**	**<0.01**	**1.15 (1.04-1.28)**	**0.01**			**1.14 (1.02-1.28)**	**0.03**
Job Control								
nurse input			1.01 (0.89-1.14)	0.89			1.04 (0.91-1.19)	0.56
enough work control			0.95 (0.84-1.08)	0.47			0.95 (0.83-1.10)	0.50
Job Support								
supportive boss			0.92 (0.81-1.05)	0.20			0.94 (0.82-1.08)	0.36
supportive peers			1.04 (0.94-1.16)	0.43			1.04 (0.92-1.16)	0.54
supportive system			1.03 (0.92-1.15)	0.67			1.04 (0.92-1.17)	0.56
Work Schedules								
long work hours					**1.14 (1.01-1.28)**	**0.03**	**1.23 (1.08-1.40)**	**<0.01**
weekly burden					1.08 (0.96-1.21)	0.19	1.06 (0.93-1.20)	0.38
required on-call/overtime					1.04 (0.94-1.16)	0.45	1.08 (0.97-1.22)	0.17
lack of rest					0.98 (0.88-1.09)	0.73	0.98 (0.87-1.11)	0.76

Model 1 by job demands; Model 2 by job stress (demands, control, support); Model 3 by work schedules; Model 4 by job stress (demands, control, support) and work schedules

*, adjusted for age, race, education, depressive symptoms, work position, exercise, sleep, smoking, alcohol use, time spent on domestic chores, caring for children or dependents, and physical lifting of children or dependents

3.4 Discussion

This manuscript is one of the few to investigate nurse obesity using population-based data to assess working conditions and obesity in nurses, and the first to demonstrate an association between nurses' long work hours and obesity. Shift rotation and long work hours may alter circadian rhythms, with a detrimental effect on sleep quality and quantity (Caruso et al., 2006; Geiger-Brown & Trinkoff, 2010). Disrupted day/night cycles and sleep patterns suppress melatonin, which affects metabolic processes such as physical activity, food efficiency (i.e., body weight change divided by food intake) and visceral adiposity (Wideman & Murphy, 2009). Fonken et al. (2010) found that those working at night reported increased food consumption and body mass and decreased glucose tolerance. Additionally, a reduction in leptin levels while working at night led to smaller but more frequent meals, and to weight gain (Qin, et al., 2003). Extended work hours also adversely affect sleep patterns. The Nurses' Sleep Study showed that nurses working successive 12-hour shifts slept 5.5 hours on average between shifts (Geiger-Brown & Trinkoff, 2010).

The results also found an inverse relation between obesity and job-related physical exertion. Higher physical exertion might reflect job-related exercise, which could reduce overweight and obesity among nurses. In addition, UW/NW nurses reported recreational exercising significantly more than OW/OB ones. Occupational and leisure time physical activities have been suggested as indicators of good health (Abu-Omar & Rutten, 2008), whereas sedentary work and low physical job demands are important risk factors for obesity (Choi, et al., 2010; Philipson, 2001). However, several studies reported that energy expenditure on the job was not related to OW/OB, while leisure time activity was related (Kaleta, Makowiec-D browska, & Jegier, 2007). Another explanation is that obese nurses might avoid jobs requiring high physical exertion and prefer those with less movement (Park, Singh, Levy, & Jung, 2009). Physical demands were reported to be highest for staff nurses and nurses working in critical care, emergency, or operating room/post-anesthesia care units (Trinkoff, et al., 2001), and burnout or stressful work environment was reported by 45% of nurses who left nursing jobs (HRSA, 2006), suggesting a need for additional efforts for ergonomic job design for obese nurses on these units. On the other hand, the relationship between occupational physical activity and nurse obesity was significant only after work schedule variables were controlled. Shift rotation may play a role; in one study, appetite-related hormone levels (e.g., ghrelin, leptin) after exercise differed between day and night, indicating differing responses to activity by time of day (Morris, et al., 2010). Further studies are needed to investigate the interactions of occupational activities and work schedules on obesity.

3.5 Limitations

The study findings should be interpreted cautiously. First, because all data were self-reported, nurses' responses might be affected by recall or denial. On the other hand, work environments and demands measured in survey questionnaires have been found to be reliable when compared with direct observations (Torgen, Winkel, Alfredsson, & Kilbom, 1999). Though body weight is often self-reported in large epidemiological studies, respondents tend to under-report their weight (Gorber, et al., 2007). Because of this concern about inaccurate self-reported body weight data, plus the sensitivity of weight data in females, the NWHS measured weight using a categorical variable. As the prevalence estimates in this analysis were congruent with other studies, this suggests that bias from the variable construction was minimal. Another limitation was that secondary data analysis does not permit collection of additional items, such as diet quality or behaviors and familial obesity (Hebebrand & Hinney, 2009), which were not measured in the original survey. This analysis did include many variables related to demographics, depressive symptoms, health behaviors, and home demands, a strength compared to previous research. Finally, as this was a cross-sectional design, it was not possible to determine the temporal order of relationships between working conditions and obesity. The results may reflect that being OW/OB led nurses to avoid jobs with exertion, but it is less likely that nurses' weight affected their work schedules.

3.6 Implications

The study results provide evidence-based information for nurse executives and administrators. To decrease nurse obesity rates, collective action is needed. Considering more than half of nurses are overweight or obese, increasing availability of healthy food and providing sufficient time to consume it may reduce the risk of obesity and future health problems. Organizational support for offering healthier food choices and meal breaks to eat a proper meal instead of non-nutritious snacks can help to decrease obesity risks. For instance, several hospitals have introduced on-site farmer's markets to increase access to healthy food for health care workers, who work non-standard hours. Providing healthy vending machine choices and food services delivered to the work unit can also increase food quality and access for nightshift nurses. Moreover, long work hours and shift work adversely affect quantity and quality of sleep, which often interferes with adherence to healthy behavior (Burch, et al., 2009; Bushnell, et al., 2010; Caruso et al., 2006) and increases obesity (Chaput, et al., 2010). Therefore, educational interventions about sleep hygiene and strategies for adapting work schedules, should be offered. A favorable organizational climate that supports napping in the workplace can help to prevent work-related sleep deprivation, reduce fatigue, and increase energy for healthy lifestyle behaviors (Sack, et al., 2007). As shown in the 2004 National Sample Survey of Registered Nurses, more than 40% of nurses who left nursing pointed out the reason for leaving their nursing jobs as scheduling or working too many hours (HRSA, 2006). To restrict unhealthful scheduling and help nurse retention, state regulations related to total work hours or mandatory overtime may play an important role in improving nurse scheduling and retention (Bae & Brewer, 2010).

This study incorporated a variety of work-related variables, including both job stress and work schedules, and found that long work hours and activity on the job were related to obesity. Further studies investigating nurse obesity using objective measures and developing solutions to improve nurse and patient health and safety are needed. Findings relating nurse obesity to long work hours provide yet another reason to consider altering nurses' work schedules. Adverse health impact of work schedules on nurses should be given careful attention by administrators and other nursing stakeholders.

CHAPTER IV (Manuscript 3).

Relation of Job Stress and Obesity in Nurses with Favorable and Unfavorable Work Schedules: A Cross-Sectional Secondary Data Analysis

4.1 Introduction

Obesity is recognized as a major public health challenge. Traditionally, poor diet patterns and physical inactivity are acknowledged as immediate causes of weight gain or obesity (McAllister, et al., 2009), yet reduced physical activity and abundant energy intake cannot completely entirely explain body weight gain (Hubacek, 2009). Because eating behaviors and physical activities are known to be affected by many psychosocial factors, working conditions, in particular job stress, have been investigated to explain inequalities in obesity (Lallukka, et al., 2008). For example, job stress increases epinephrine and cortisol secretion, which enhance motivation for food and insulin and promote food intake (Dallman, 2010). High job stress is associated with preference for energy dense foods. Pleasurable feeding then reduces activity in the body's hormonal stress-response network, reinforcing the feeding habit. Thus, stress leads to overeating, so-called stress-induced eating, which results in weight gain (Greeno & Wing, 1994). Stress-induced eating is found more frequently among females than males (Greeno & Wing, 1994).

Nurses, a largely female occupation, often have adverse work schedules, including extended work shifts, shiftwork, shift rotation, and overtime/on-call (Trinkoff, Geiger-Brown, et al., 2006). In a six-year study, Overgaard and colleagues(2004) reported that higher weight gain was found in nurses who reported lack of time to manage their own work, due to excessive work. This research team found that psychological workload, reflected by a combination of high job demands and low influence on the job, predicted weight gain during the six study years among the overall sample of nurses and in those nurses with a familial predisposition to obesity (Overgaard, et al., 2006). Barriers to nurses' healthy eating including low staffing levels and shorter breaks due to high workload have been reported (Faugier, et al., 2001a, 2001b). Nurses may not be able to take meal breaks during a workday because they are too busy.

The effect of job stress on obesity can vary with work schedule characteristics because work schedules influence workers' lives in many ways, including sleep, diet, physical and social activities, and family life (Burch, et al., 2009; Caruso et al., 2006; Tucker, et al., 2010). Shift schedules and long work hours can alter circadian rhythm, and this can reduce the quality and quantity of sleep (Ohayon, et al., 2010). Moreover, these adverse work schedules cause short sleep and restless sleep (Geiger-Brown, Trinkoff, & Rogers, 2011) which can lead to fatigue, poor job performance, high accident rates (e.g., medication errors, drowsy driving), and cardiovascular mortality (Ohayon, et al., 2010; Scott, et al., 2007). Shiftwork and long work hours, in particular, have been considered to hinder healthy eating due to a lack of access to nutritious food and time to eat (Waterhouse, et al., 2003). Thus, nightshift nurses often consume meals or snacks high in fat and sugar from vending machines (Faugier, et al., 2001a). Sleep deficiency may decrease both involuntary and voluntary physical activity, but lengthen the time for eating and increase hunger by altering appetite hormones, and finally lead to weight gain (Chaput, et al., 2010).

In addition, workers with non-standard work schedules experience more conflicts between work and family, and have more difficulties in seeking time and energy for social life (Caruso et al., 2006). To relieve stresses from job, family and social life, workers with unfavorable work schedules (WS) often use unhealthy behaviors, such as smoking and drinking (Bushnell, et al., 2010; Trinkoff & Storr, 1998). However, there is a lack of knowledge about differences in factors that are associated with nurse obesity by work schedule status. Previously, long work hours and jobs with less physical exertion and more limited movement were found to be related to nurse obesity (Han, Trinkoff, Storr, & Geiger-Brown, 2011). Nurses with adverse schedules may require special support for preventing obesity as the schedule impacts are profound. On the other hand, those with favorable schedules may have other opportunities to prevent obesity that may not be feasible for those with adverse schedules. The purpose of this study was to compare associations of job stress and nurse obesity between nurses with favorable WS and those with unfavorable WS. Findings can provide evidence to improve nursing working conditions and nurse health.

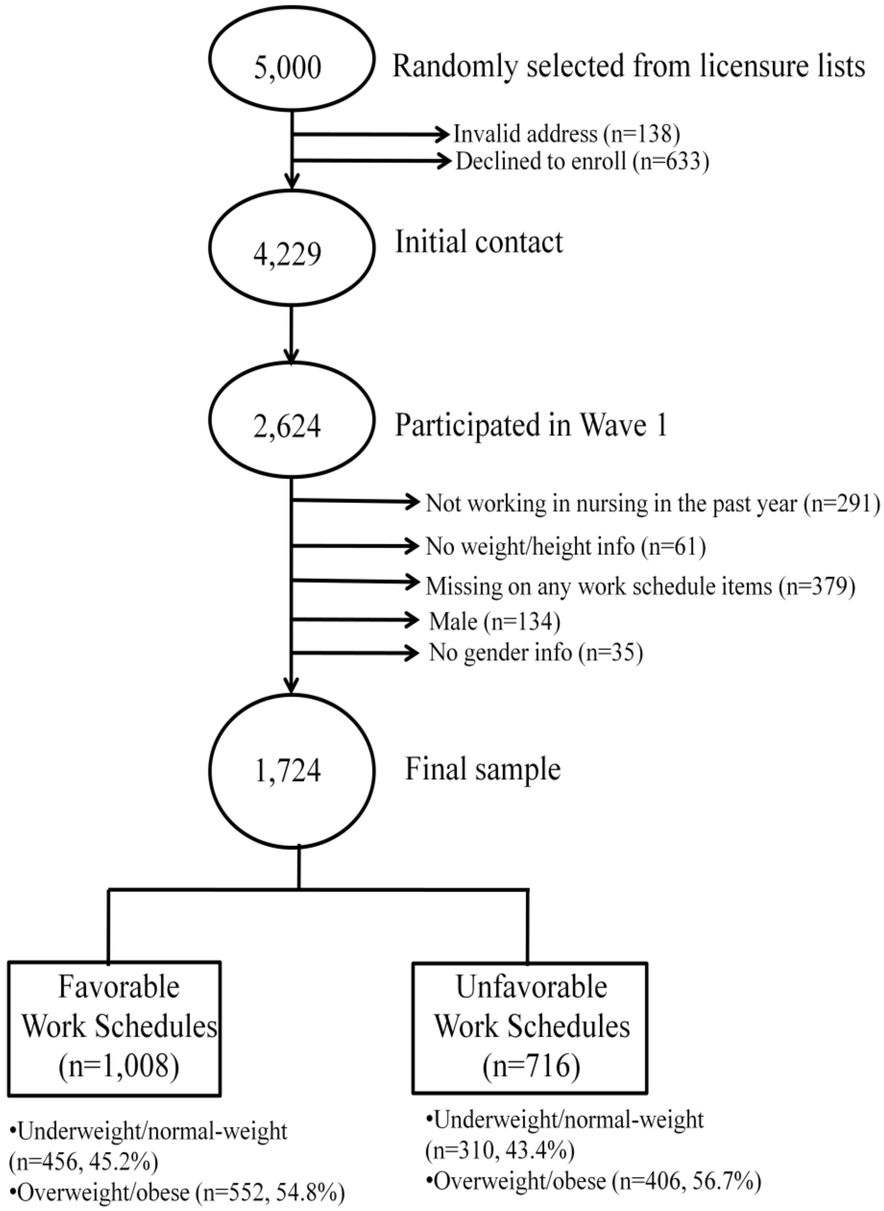
4.2 Methods

4.2.1 Sample and Data Collection

This study used a cross-sectional design incorporating nurse survey data from the baseline wave of the Nurses Worklife and Health Study III (NWHS III), collected from November 2002-March 2003 (Trinkoff, Geiger-Brown, et al., 2006). The NWHS was a three-wave longitudinal mailed survey of nurse injury and working conditions, including job demands and scheduling. The NWHS randomly selected 5,000 actively licensed nurses in two states (Illinois and North Carolina), and mailed baseline surveys to the 4,229 nurses with valid addresses. Returned questionnaires were received from 2,624 nurses (62% enrollment rate with 85% follow-up for Waves 2 and 3). The sample characteristics were comparable to the 2004 U.S. nurse population (HRSA, 2006). The Institutional Review Board of University of Maryland, Baltimore approved this study.

This analysis was restricted to the 1,724 respondents who reported working in nursing within the past year (89%) and completed information on weight, height, and work schedule (*Figure 4-1*). Only female nurses were included, due to differences in male-female obesity physiology (Ostry, et al., 2006). The sample characteristics were comparable to overall U.S. nurses. The mean ages of both participants and U.S. nurses were 45 years (HRSA, 2006). Out of 1,724 study nurses, 88% were Caucasian and 58% working in hospitals versus 88% Caucasian and 56% working in hospitals for U.S. nurses.

Figure 4-1. Flow diagram for the study sample



4.2.2 Variables

Obesity was measured using body mass index (BMI) estimates. Because of concerns related to inaccurate self-reported weight data, a sensitive variable in female respondents, weight was assessed using a categorical variable (1=less than 100lbs; 2=100-129lbs; 3=130-159lbs; 4=160-189lbs; 5=190-200lbs; and 6=greater than 200lbs), while height was continuously assessed. Thus, exact BMI values (weight in kilograms divided by the square of height in meters) could not be calculated. Instead, three sets of BMI estimates were calculated using the minimum, median, and maximum values of body weight ranges within each category. Based on the evidence of reliability and validity of these BMI estimates, the BMI median estimates calculated using the median weight values of the body weight ranges for each category were selected (Han, et al., 2011). The BMI estimates were dichotomized as underweight/normal weight (UW/NW, $<25.0kg/m^2$) and overweight/obese (OW/OB, $\geq 25.0kg/m^2$) (Fernandez, et al., 2010; Mummery, Schofield, Steele, Eakin, & Brown, 2005).

Work schedules were measured using 13 items (Folkard, et al., 1995; Trinkoff et al., 2011a), e.g., hours worked per day and per week. To provide data on their usual/typical schedules, nurses were asked to answer for their typical schedules over the past six months (Folkard, et al., 1995; Trinkoff, Geiger-Brown, et al., 2006). For job stress, the Karasek model of job strain (Karasek & Theorell, 1994) served as the basis for three underlying constructs: demands, control, and support (Han, et al., 2011). **Job demands** included seven psychological demand items adapted from the Job Content Questionnaire (JCQ) (Karasek, 1985) and 12 items captured physical demands (Bernard, 1997; Rasanen, Notkola, & Husman, 1997; Trinkoff et al., 2011b). For **job control**, nine items assessed nurses' decision making authority and autonomy, derived from the Nursing Work Index-Revised (NWI-R) (Lake, 2002) and the Procedural Justice Scale (Elovainio, et al., 2002). **Job support** covered satisfaction with salary, and relationships with supervisor and peers using eight items (Karasek, 1985; Lake, 2002)). For work schedules and job demands, higher scores represent more adverse working conditions, whereas for job control and support, higher scores reflect better working conditions.

To create independent components and remove multicollinearity, principal components analysis (PCA) with varimax rotation was conducted. Components with eigenvalues >1 were retained (Kaiser, 1960) with scores calculated using the regression method (Han, et al., 2011). Briefly, PCA extracted four components related to work schedules (long work hours, weekly burden, required on-call/overtime, lack of rest), and were used to define favorable versus unfavorable WS. Individual component scores of work schedules were weighed by the component loadings, and then summed together. This weighed and summed score was normally distributed and dichotomized at the mean to define favorable WS and unfavorable WS. This demonstrated validity using known-groups, e.g., nurses with unfavorable WS worked longer hours and had less time off between shifts than those with favorable WS; 41% of nurses with unfavorable WS worked more than 40 hours per week versus only 26% of those with favorable WS; and 68% of nurses with unfavorable WS often had less than 10 hours off between shifts versus only 25% of those with favorable WS. For job stress, four components for job demands, two for control, and three related to support were extracted through PCA.

Covariates of the relationship between job stress and nurse obesity included health behaviors, depressive symptoms, home demands and demographic characteristics.

Again, using PCA two independent components of health behaviors were created: unhealthy behaviors (component loading=30.3%), smoking status and alcohol use, and healthy behaviors (component loading=26.0%), vigorous exercise and getting enough sleep. Depressive symptoms were measured using 20 items of the Center for Epidemiologic Studies Depression (CES-D) scale (Radloff, 1977) range 0-60. Home demands were assessed using three items: 1) caring for children or dependents on a regular basis, yes/no; 2) physical lifting of children or dependents, yes/no; and 3) time spent on housework/childcare/chores, ≥ 10hours/week versus <10hours/week. Home demands variables were included in this analysis to account for exposures to stress at home related to balancing work and family demands (e.g., parenting) among female nurses(Killien, 2004; Mulsow, Caldera, Pursley, Reifman, & Huston, 2002). Demographic characteristics included age, race (African-American versus other), and education (diploma/associates versus bachelor's degree or higher).

4.2.3 Analysis

To compare demographic, work- and health-related characteristics and home demands between nurses with favorable and unfavorable WS and between nurses who were UW/NW and OW/OB within each of the WS groups, t-tests for continuous variables and contingency tables with chi-square for categorical variables were conducted. To compare the association of job stress and the other covariates with nurse OW/OB between nurses with favorable WS and unfavorable WS, binomial logistic regression models for OW/OB (versus UW/NW) nurses stratified by WS status were generated. In bivariate logistic regression models, each of the job stress components and covariates (i.e., health behaviors, depressive symptoms, home demands, and demographics) were tested in relation to nurse OW/OB. In multiple regression models, job stress (i.e., demands, control, support) and the other covariates were all included to examine the effect of job stress adjusted for the other covariates in relation to nurse OW/OB. No multicollinearity across the independent variables was found, and model adequacies were good (omnibus tests, all significant; Hosmer-Lemeshow tests, all non-significant).

4.3 Results

Compared to nurses with favorable WS, nurses with unfavorable WS were significantly younger ($p<0.01$), had less education ($p<0.01$), fewer years of RN experience ($p<0.01$), and were more likely to work in hospitals ($p<0.01$) (Table 4-1). Those with unfavorable WS reported significantly more stressful conditions (higher demands, less control, and less support) than those with favorable WS ($p \leq 0.01$). Nurses with unfavorable WS also had more depressive symptoms ($p<0.01$), slept less ($p<0.01$), and had more restless sleep ($p<0.01$) than those with favorable WS, whereas the proportion of being OW/OB did not differ between the two WS groups. For home demands, those with unfavorable WS were more likely to care for children or dependents ($p<0.01$) than those with favorable WS.

Table 4-1. Sample characteristics by work schedules (WS): female nurses working in nursing (n=1,724)

	Favorable WS (n=1,008)	Unfavorable WS (n=716)	p
Demographic Characteristics			
Age, mean (SD)	46.0(10.3)	44.0(10.1)	<0.01
Racial/ethnic background, %			
White	87.2	88.4	0.53
Black/African-American	5.6	5.7	
Other	7.2	5.9	
Highest degree achieved, %			
Diploma/Associate's	42.4	52.8	<0.01
Bachelor's	45.5	37.3	
Master's/Doctoral	12.1	9.9	
Marital status, %			
Married	76.0	71.0	0.07
Widowed/Separated/Divorced	14.9	17.9	
Never married	9.1	11.0	
Work-related Characteristics			
Years of RN experience, mean (SD)	19.7(11.2)	17.7(10.8)	<0.01
Work setting in nursing, %			
Hospital	55.3	63.1	<0.01
Nursing home	6.0	8.4	
Other (e.g., school/government/business)	38.8	28.5	
Job Stress			
Job Demands, mean (SD)			
high physical exertion (range: -2.98, 2.37)	-0.14(0.98)	0.23(0.99)	<0.01
excessive psychological exertion (range: -3.17, 2.71)	-0.16(0.94)	0.26(0.95)	<0.01
frequent awkward posture (range: -3.02, 3.59)	-0.11(0.95)	0.18(1.05)	<0.01
limited movement (range: -3.15, 3.71)	-0.04(1.02)	0.12(0.95)	<0.01
Job Control, mean (SD)			
nurse input (range: -4.01, 3.37)	0.04(0.95)	-0.10(1.04)	<0.01
enough work control (range: -4.71, 3.04)	0.12(0.96)	-0.19(1.01)	<0.01
Job Support, mean (SD)			
supportive boss (range: -3.44, 2.16)	0.11(0.94)	-0.16(1.06)	<0.01
supportive peers (range: -3.86, 2.00)	0.06(0.97)	-0.07(1.05)	0.01
supportive system (range: -3.70, 2.46)	0.12(0.97)	-0.12(1.03)	<0.01
Health-related Characteristics			
Obesity, %			
underweight/normal-weight	45.2	43.3	0.43
overweight/obese	54.8	56.7	
Depressive symptoms (CES-D score, range: 0, 60),	8.9(8.3)	12.3(10.2)	<0.01

mean (SD)			
Exercise vigorously, %			
rarely/none (less than 1 day/week)	56.4	54.1	0.47
some/little (1-2 days/week)	20.9	22.2	
occasionally (3-4 days/week)	15.9	18.0	
most or all of the time (5-7 days/week)	6.8	5.8	
Sleep enough, %			
rarely/none (less than 1 day/week)	15.1	23.7	<0.01
some/little (1-2 days/week)	24.1	28.5	
occasionally (3-4 days/week)	32.7	27.8	
most or all of the time (5-7 days/week)	28.1	20.1	
Restless sleep, %			
rarely/none (less than 1 day/week)	39.8	33.8	<0.01
some/little (1-2 days/week)	35.1	30.1	
occasionally (3-4 days/week)	15.2	22.4	
most or all of the time (5-7 days/week)	9.9	13.7	
Current smoking, %			
Yes	14.0	13.1	0.59
Alcohol use, 5+ alcohol drinks on one occasion in the past year, %			
never	70.5	66.5	0.41
1-2 times	14.9	16.5	
3-5 times	7.3	8.2	
6-10 times	3.5	3.6	
11+ times	3.8	5.2	
Home Demands			
Caring for children or dependents, %			
Yes	53.3	60.5	<0.01
Physical lifting of children or dependents, %			
Yes	49.1	47.1	0.43
Time spent on domestic chores, %			
≥10hours/week	66.0	65.0	0.66

WS, work schedules; CES-D, Center for Epidemiologic Studies Depression scale

In bivariate regression models (Table 4-2), among nurses with favorable WS, OW/OB nurses reported significantly more jobs with limited movement (OR=1.17, 95% CI=1.04-1.32, p=0.01) and less boss support (OR=0.87, 95% CI=0.76-0.99, p=0.04) than UW/NW nurses, whereas health behaviors, depressive symptoms, and home demands were not significantly related to being OW/OB. Among nurses with unfavorable WS, OW/OB nurses had significantly less nurse input on their jobs (OR=0.86, 95% CI=0.74-1.00, p=0.05), were less likely to practice healthy behaviors (OR=0.76, 95% CI=0.66-0.89, p<0.01), and more likely to have depressive symptoms (OR=1.02, 95% CI=1.01-1.04, p<0.01) than UW/NW nurses.

Table 4-2. Bivariate logistic regressions relating each job stress component and covariate to nurse obesity: female nurses working in nursing (n=1,724)

	Favorable Work Schedules		Unfavorable Work Schedules	
	OR (95% CI)	p	OR (95% CI)	p
Job Stress				
Job Demands				
high physical exertion	0.88 (0.78-1.00)	0.06	0.88 (0.76-1.02)	0.09
excessive psychological exertion	1.05 (0.92-1.20)	0.57	0.95 (0.81-1.11)	0.52
frequent awkward posture	0.93 (0.82-1.06)	0.27	0.97 (0.84-1.12)	0.68
limited movement	**1.17 (1.04-1.32)**	**0.01**	1.11 (0.95-1.30)	0.19
Job Control				
nurse input	1.09 (0.95-1.25)	0.20	**0.86 (0.74-1.00)**	**0.05**
enough work control	0.88 (0.77-1.01)	0.63	0.94 (0.81-1.09)	0.42
Job Support				
` supportive boss	**0.87 (0.76-0.99)**	**0.04**	0.93 (0.81-1.08)	0.35
supportive peers	1.05 (0.92-1.20)	0.46	0.93 (0.80-1.07)	0.32
supportive system	0.97 (0.85-1.11)	0.67	0.99 (0.85-1.14)	0.85
Covariates				
Health Behaviors				
unhealthy behaviors	1.05 (0.93-1.20)	0.42	0.88 (0.76-1.01)	0.08
healthy behaviors	0.89 (0.79-1.01)	0.08	**0.76 (0.66-0.89)**	**<0.01**
Depressive symptoms	1.01 (0.99-1.02)	0.29	**1.02 (1.01-1.04)**	**<0.01**
Home Demands				
caring for children or dependents				
yes	0.83 (0.65-1.07)	0.15	1.19 (0.88-1.62)	0.25
no	1.00		1.00	
physical lifting of children or dependents				
yes	1.17 (0.91-1.50)	0.22	1.07 (0.80-1.44)	0.64
no	1.00		1.00	
time spent on domestic chores				
≥10hours/week	0.83 (0.64-1.09)	0.19	1.02 (0.74-1.40)	0.91
< 10hours/week	1.00			
Demographics				
age	**1.02 (1.01-1.04)**	**<0.01**	**1.03 (1.01-1.04)**	**<0.01**
race				
African-American	**3.20 (1.67-6.14)**	**<0.01**	**3.45 (1.58-7.57)**	**<0.01**
other	1.00		1.00	
education				
diploma/associate	**1.39 (1.08-1.79)**	**0.01**	**1.68 (1.25-2.27)**	**<0.01**
bachelor’s degree or higher	1.00		1.00	

In the full models including all job stress components and covariates (Table 4-3), for nurse with favorable WS, jobs with limited movement were no longer significant (OR=1.13, 95% CI=0.98-1.30, p=0.10): instead, OW/OB nurses reported having significantly more nurse input (OR=1.21, 95% CI=1.02-1.44, p=0.03) and a less supportive boss compared to nurses who were UW/NW. Among nurses with favorable WS, OW/OB nurses also reported significantly more unhealthy behaviors (OR=1.19, 95% CI=1.02-1.38, p=0.02) and more physical lifting of children or dependents (OR=1.43, 95% CI=1.06-1.93, p=0.02). On the other hand, among nurses with unfavorable WS, OW/OB nurses were significantly less likely to practice healthy behaviors (i.e., exercise and sleep) than UW/NW nurses (OR=0.79, 95% CI=0.66-0.95, p=0.01). No job stress components were significantly related to being OW/OB among those with unfavorable WS. Being older, African-American, and less educated were all positively associated with nurse obesity in both WS groups.

Table 4-3. Full models including all job stress components and covariates: female nurses working in nursing (n=1,724)

	Favorable Work Schedules		Unfavorable Work Schedules	
	OR (95% CI)	p	OR (95% CI)	p
Job Stress				
Job Demands				
high physical exertion	0.90 (0.77-1.05)	0.16	0.83 (0.69-1.00)	0.05
excessive psychological exertion	1.04 (0.89-1.23)	0.61	0.94 (0.76-1.15)	0.53
frequent awkward posture	0.95 (0.81-1.11)	0.50	1.02 (0.86-1.21)	0.82
limited movement	1.13 (0.98-1.30)	0.10	1.13 (0.94-1.37)	0.20
Job Control				
nurse input	**1.21 (1.02-1.44)**	**0.03**	0.87 (0.71-1.08)	0.20
enough work control	0.92 (0.76-1.11)	0.37	0.94 (0.76-1.16)	0.58
Job Support				
` supportive boss	**0.83 (0.68-0.99)**	**0.04**	1.02 (0.83-1.25)	0.85
supportive peers	1.08 (0.93-1.27)	0.32	1.01 (0.85-1.20)	0.95
supportive system	0.98 (0.84-1.16)	0.84	1.11 (0.92-1.33)	0.29
Covariates				
Health Behaviors				
unhealthy behaviors	**1.19 (1.02-1.38)**	**0.02**	0.86 (0.73-1.02)	0.08
healthy behaviors	0.95 (0.81-1.10)	0.48	**0.79 (0.66-0.95)**	**0.01**
Depressive symptoms	1.01 (0.99-1.03)	0.21	1.02 (1.00-1.04)	0.09
Home Demands				
caring for children or dependents				
yes	0.92 (0.67-1.26)	0.60	1.22 (0.82-1.83)	0.33
no	1.00		1.00	
physical lifting of children or dependents				
yes	**1.43 (1.06-1.93)**	**0.02**	0.97 (0.68-1.40)	0.88
no	1.00		1.00	
time spent on domestic chores				
≥10hours/week	0.81 (0.58-1.12)	0.20	0.78 (0.51-1.19)	0.25
< 10hours/week	1.00		1.00	
Demographics				
age	**1.03 (1.01-1.04)**	**<0.01**	**1.03 (1.01-1.05)**	**<0.01**
race				
African-American	**4.15 (1.90-9.05)**	**<0.01**	**3.43 (1.34-8.77)**	**0.01**
other	1.00		1.00	
education				
diploma/associate	**1.36 (1.00-1.83)**	**0.05**	**1.53 (1.07-2.18)**	**0.02**
bachelor’s degree or higher	1.00		1.00	

4.4 Discussion

This study provides an important finding that job stress and health behavior components which were associated with nurse obesity varied with work schedule status. For nurses with unfavorable WS, only healthy behaviors, such as exercise and sleep, were important in decreasing the odds of being OW/OB. In addition to the previous finding that long work hours were associated with increased odds of OW/OB among nurses, this finding suggests that adverse work schedules may be an overriding work-related factor for nurse obesity. This is not surprising as nurses with unfavorable WS reported poor sleep and worse sleep than those with favorable WS. Short sleep duration is known as an independent risk factor for obesity (Chaput, et al., 2010), which is more important than even physical inactivity and high fat intake (Chaput, et al., 2009). Sleep-deprivation decreases glucose tolerance, increases cortisol levels, alters appetite-stimulation hormone, and leads to hunger and appetite (Chaput, Despres, Bouchard, & Tremblay, 2007). In addition, long work hours and shiftwork and related lack of sleep and recovery time may make it difficult to find time and energy to participate in regular exercise but increase time available for unhealthy eating habits (Bushnell, et al., 2010; Chaput, et al., 2010). Although study nurses did not report significant differences in exercise levels by work schedules, unfavorable WS could require additional efforts from nurses to access exercise and healthy foods (Atkinson, Fullick, Grindey, & Maclaren, 2008).

In addition to demanding schedules, nurses with unfavorable WS reported more home demands than those with favorable WS. High home demands among those with unfavorable WS could be another source of stress, which also may exacerbate stress responses leading to obesity. This could explain why more depressive symptoms were reported by those with unfavorable WS than those with favorable WS.

It had been hypothesized that low job control would be related to nurse obesity, yet this was not supported. Nurse input among nurses with favorable WS was positively associated with nurse obesity. Job control has been reported to have inconsistent relationships with several health outcomes, although it has a fairly consistent negative relationship to cardiovascular diseases (Karasek & Theorell, 1994). For example, in the review of the relationship between psychosocial factors and upper extremity problems among workers, Bonger et al. (2002) found that more than half of studies presented positive findings of job control, i.e., decision latitude, in relation to work-related musculoskeletal disorders. Among nurses with favorable work schedules, compared to nurses who were UW/NW, OW/OB nurses reported more nurse input on their jobs and more physical lifting of children or dependents on their family, but less supportive bosses, suggesting a lack of social support at work for OW/OB nurses with high responsibility at both work and home. These may cause OW/OB nurses with favorable WS to practice unhealthy behaviors, such as smoking and alcohol use (Trinkoff & Storr, 1998). These findings suggest organizational supports and modified scheduling for nurses with heavy family demands.

Interpretation of the findings should be considered along with the study limitations. Because the overall design was cross-sectional, it was not possible to determine temporal order of the relationships. In addition, this study used secondary data analysis, which limits the analysis to variables that were assessed in the original survey. For example, diet-related variables or genetic information were not included in this analysis, though they are related to obesity. Nonetheless, many other variables related to demographic, depressive symptoms, and home demands were incorporated. All data were based on self-report, and thus might be influenced by denial and recall. Despite this, there has been a high correlation in working conditions between self-reports and direct observation (Torgen, et al., 1999). Regarding obesity measures, because BMI calculation was based on self-reported categorical weight data, estimates could be biased. However, categorical items, instead of open-ended questions, can enable respondents to complete sensitive items more accurately (Dillman, et al., 2009). For instance, non-response rates for the BMI-related variables in this study (2.3% missing) were lower than those in other mailed surveys (6.0% missing among female respondents (MacFarlane, et al., 2010); 3.4% missing among male and female respondents (Link, et al., 2006)) and comparable to those for face-to-face interviews (1.9% missing among female adults in NHANES 2003-2004).

Research findings suggest differences in health behaviors by work schedule status. The mounting body of evidence associates adverse work schedules with nurse injuries, adverse health (De Castro, et al., 2010; Scott, et al., 2007) and poor patient outcomes (Olds & Clarke, 2010; Trinkoff et al., 2011a). Considering the associations of work schedules with obesity and potential obesity-related health outcomes (Chaput, et al., 2010), more healthful scheduling should be provided to nurses. In particular, for nurses with unfavorable WS, organizational support should be implemented for promoting healthy behaviors. Educational interventions about sleep hygiene and other lifestyle modifications for adaptation to their work schedules may be helpful to improve health and quality of life. For nurses with favorable work schedules, emphasis on nurses' home/family responsibilities and stress may be useful, for example, providing daycare services for children or elderly. Interventions for preventing unhealthy behaviors as smoking and alcohol use should also be offered. Finally, future occupational health research should consider impact of work schedules on various aspects of workers' lives and behaviors.

CHAPTER V. Discussion

This chapter begins with a brief summary of the study findings, and then presents discussion in relation to existing literature. Addressing the study limitations, implications for practice and policies, and a possible next step for future research is suggested.

5.1 Summary of Findings

This project is one of the few studies investigating nurse obesity using population-based nurse data to assess various working conditions and obesity in nurses. In addition to well-known socio-demographic factors related to overweight/obesity (e.g., age, race/ethnicity), work schedules and job stress were associated with nurse obesity. The four main study findings are:

- More than half of the nurses in this study were overweight (Aim 1).

  An estimated 55% (95% CI=52.9-57.1%) of females working in nursing were overweight (OW, BMI≥25.0kg/m^2) and 27% (95% CI=25.2-29.0%) obese (OB, BMI≥30.0kg/m^2). There were no variations by place of employment (54.4% hospital and 55.7% nonhospital OW, 26.0% hospital and 28.6% nonhospital OB) and by work schedule status (54.8% favorable WS and 56.7% unfavorable WS OW, 26.6% favorable WS and 29.2% unfavorable WS OB).

- Job stress components associated with nurse obesity (Aim 2).

  Jobs with limited movement were the only component associated with being OW/OB, after controlling for job control and support. After adjusting for work schedule components along with other potential confounding variables (e.g., age, race/ethnicity, depressive symptoms), an association were found between OW/OB and jobs with limited movement and little physical exertion.

- Work schedules are associated with nurse obesity (Aim 3).
  Nurses who reported long work hours were more likely to be OW/OB, and this did not change after controlling for job stress components.
- The relationship between job stress and nurse obesity varies with work schedule status (i.e., favorable versus unfavorable work schedules) (Aim 4).
  Among nurses with unfavorable WS, no job stress components were significantly related to being OW/OB; only healthy behaviors, such as exercise and sleep, were inversely associated with OW/OB. On the other hand, among those with favorable WS, compared to nurses who were underweight/normal-weight, OW/OB nurses reported significantly more nurse input in their jobs, a less supportive boss, more unhealthy behaviors, and more physical lifting of children or dependents.

5.2 Discussion of Findings

5.2.1 Nurse Obesity

The prevalence of overweight (BMI$\geq$25.0kg/m^2) in the study nurses was 55%, which is slightly lower than that of the U.S. population (65%). Similarly, Miller, Alpert, and Cross (2008) found the prevalence of overweight in nurses as 55%, while Zapka et al. (2009) reported the overweight rate among hospital nurses as 65.4%. This difference may be explained by differences in study population or BMI measures. Miller, Alper, and Cross (2008) used self-reported weight and height data from a population-based nurse sample in a mailed survey which had the same design as the NWHS survey. On the other hand, Zapka et al. (2009) directly measured weight and height by gauging and weighing their subjects as a part of a worksite intervention study. In this study, Zapka et al. (2009) recruited the sample nurses through a stratified sampling method by minority group and gender, thus resulting in an oversample of minority and male nurses. Considering that self-reported BMI has been reported to underestimate the true prevalence of overweight or obesity (Gorber, et al., 2007), the true prevalence of overweight/obesity ($BMI \geq 25.0 kg/m^2$) among nurses may be higher than 55%, closer to the rates found by Zapka and colleague (2009). However, because the BMI median estimate calculated using self-reported data of continuous height and the median values of body weight categories can produce the true obesity rate ($BMI \geq 30.0 kg/m^2$) more accurately than self-reported BMI calculated using continuous height and weight values, the true prevalence of obesity ($BMI \geq 30.0 kg/m^2$) may be close to the figure of 27% described in this study.

5.2.2 Job Stress and Obesity

Among the three constructs underlying job stress (i.e., job demands, control, support), only the job demand components were associated with nurse obesity. Physical activities on the job had significant relationships with nurse obesity. More jobs requiring low physical exertion and limited movement were reported by OW/OB nurses as compared to UW/NW nurses. Because this study used cross-sectional data, causal relationships between occupational activities and nurse obesity could not be inferred. Based on the study assumptions that postulated nurse obesity as a consequence of adverse working conditions, occupational physical exertion may function as physical activity that reduce obesity. Similarly, limited movement on the job may reflect physical inactivity, which increases risks for obesity. The opposite relation may explain the findings. That is, it could be that obese nurses may leave jobs with high physical exertion for more sedentary work positions.

In addition to the job stress components examined in this study, various aspects of nurses' job stress have been reported to be associated with nurse obesity. High workload, low staffing levels, and shorter breaks were reported as barriers to nurses' healthy eating. In another study, nurses reported that they could not take meal breaks during a workday because they were too busy (Faugier, et al., 2001a, 2001b). A study of 435 RNs in Ohio (King, Vidourek, & Schwiebert, 2009) showed that disordered eating was prevalent among nurses, especially with high job stress. The relationship between disordered eating (i.e., binge eating) and obesity was augmented by nurses' psychological stress (Allison, 2005). Overgaard and colleagues (2004) reported that higher weight gain during six study years was found in nurses who reported that it was difficult to manage their work due to heavy workloads. They also found that nurses who reported stable workloads (i.e., being busy *sometimes*) gained less weight. This research team conducted another study using the same data of 6,404 Danish nurses who were 45-65 years old (Overgaard, et al., 2006). They confirmed that psychological workload, reflected by a combination of high job demands and low influence on the job, predicted weight gain among the overall nurse sample and for nurses with a familial predisposition to obesity (Overgaard, et al., 2006).

As a composite measure, job stress has been reported to be associated with hypertension, CVD, immune disorders, depression, musculoskeletal conditions, and all-cause mortality (Karasek & Theorell, 1994; Orth-Gomer, et al., 1994; Sauter & Murphy, 1995). In addition, the pressure and demands of work may affect workers' lifestyle, such as eating habits, and activity patterns, which can lead to overweight and obesity (Yamada, Shizaki, & Tsuritani, 2002). For example, workers having intense job stress tend to eat more sweet and energy dense food (Wardle, Steptoe, Oliver, & Lipsey, 2000). In a recent study (Toyoshima, et al., 2009), the link of satiation eating to increased body weight was found among those with a high level of stress, but not those with a low level of stress. These results did not change when controlled for energy intake as well, indicating the stress effect on obesity was independent of energy intake. Moreover, the likelihood of having adverse health behavior, such as smoking and heavy drinking, increased by 30% in situations of high job strain (Kouvonen, et al., 2007).

5.2.3 Work Schedules and Obesity

Among the four components reflecting nurses' work schedules, long work hours was the only component that was significantly associated with nurse obesity. This was congruent with previous findings. Long work hours have also been reported as one of the detrimental working conditions influencing workers' health (Ostry, et al., 2006). Those with long working hours (more than 9 hours) and short sleeping duration (less than 6 hours) had the highest BMI and waist circumference in both men and women among the Hong Kong working population (Ko, et al., 2006).

Considering the component of long work hours was based on hours worked per day, working 13 hours or more at a stretch, shift rotation, working with less than 10 hours off between shifts, and number of weekends worked per month, nurses who were high for this component may have more difficulties related to less and worse sleep and more fatigue. Participating in shift work often causes workers to be uninvolved in leisure activities because of a lack of energy (Eriksen & Bruusgaard, 2004). In addition, nurses with shift rotation or evening/night shifts tend to work on weekends, so they have problems participating in organized group exercises (Atkinson, et al., 2008). Even though shift workers are able to exercise, biological responses to exercise can be altered if sleep-deprived shift workers work out at unusual times when their bodies are not ready to exercise (Atkinson, et al., 2008). Regarding another cornerstone for obesity, diet patterns, night shift workers might have higher intake of calories. One Japanese study reported that among male workers, the total energy intake was the highest in shift workers with midnight shifts compared to fixed day workers (Morikawa, et al., 2008). However, Sudo and Ohtsuka (2001) assessed dietary intake for three working days and one off day among female workers, and found that shift workers consumed 200-400 kcal less than day workers, and protein, fat, and carbohydrate intakes were lower in shift workers than day workers. These conflicting findings could be attributed to gender differences. While total energy intake may or may not be influenced by shift work, diet quality is often affected (Atkinson, et al., 2008; de Assis, et al., 2003; Faugier, et al., 2001a). Furthermore, metabolic and endocrine responses to eating in shift workers should be evaluated. Eating at night decreased glucose tolerance and increased the LDL/HDL cholesterol ratio in a general population in Sweden (Karlsson, Knutsson, & Lindahl, 2001; Lennernas, Akerstedt, & Hambraeus, 1994). People were also observed to eat more frequently at night, even though they ate smaller amounts of food each time (Qin, et al., 2003). The investigators suggested that this be caused by reduced leptin levels during the night, which tends to inhibit food intake. Due to smaller but more frequent meals, the prevalence of obesity in female night shift workers was higher than day workers (Karlsson, et al., 2001); however, this was not true for males. Recent studies suggested that working at night could lead to excess weight gain by disrupting the timing of food intake and metabolic signals. In an animal model, lower melatonin levels were found among rats exposed to constant light compared to those exposed to constant dark or light/dark cycles (Wideman & Murphy, 2009). The suppressed melatonin affects metabolic processes with less food intake and activity, high feed efficiency (i.e., more weight gain with small food intake), and high visceral adiposity (Wideman & Murphy, 2009).

When the study nurses were divided into two work schedule groups (i.e., favorable versus unfavorable work schedules), the relationships of job stress, health behaviors, and home demands to nurse obesity varied by work schedule status. Among nurses with unfavorable work schedules, no job stress related components were significantly associated with nurse obesity. Only healthy behaviors were significantly associated with decreased odds of being overweight/obese. Nurses with favorable work schedules may have opportunities to prevent obesity, which may not be accessible for those with adverse schedules. On the other hand, nurses with unfavorable schedules may require different supports for preventing obesity as the schedule impacts are profound. This suggests that individual and organizational efforts to promote healthy behaviors, such as exercise and sleep, may play an important role in reducing obesity among nurses with unfavorable work schedules.

5.3 Limitations

5.3.1 Secondary Data Analysis

Secondary data are data which were previously collected by someone else other than the user. Secondary data analysis can save time and money that would otherwise be spent for collecting data. However, there are several things to take into consideration when using pre-existing data. Secondary data does not permit the progression from formulating a research question to collecting data to answer the question. It is also not feasible for researchers to engage in the habitual process of making observations and developing concepts. These limitations may hinder the ability of the researchers to focus on their original research question (Smith, 2008). Data quality is always a concern because their sources may not be trustworthy. For this study, the NWHS dataset was used in a secondary data analysis. All three parts of the study employed random sampling procedures and yielded comprehensive and representative samples of RNs. Data were collected via confidential mailed surveys, which had an excellent enrollment rate of 62% with 85% follow-up for Waves 2 and 3. These factors support the use of the NWHS dataset for this project.

Also, some variables of interest were not available or measured optimally. For example, the BMI variable in this study were calculated using a self-reported categorical body weight variable, which is suboptimal to exact body weight values directly measured. Secondary data does not permit collection of additional items nor alteration of those items used in the primary data gathering. Thus, diet quality or diet behaviors, which are principal contributors to obesity but were not measured in the original survey, could not be incorporated into this study. Also, familial obesity, which has been reported to account for 40-60% of obesity (Hebebrand & Hinney, 2009), could not be controlled. Despite this, many other variables related to demographics, depressive symptoms, health behaviors, and home demands were included in this study, which is a strength compared to previous research.

5.3.2 Cross-Sectional Design

Because this was a cross-sectional design, it was not possible to determine the temporal order of relationships between working conditions and obesity. Although the conceptual model of the study presented working condition as explanatory factors for nurse obesity, the alternative model could be proposed. That is, the results may reflect that stress experienced by OW/OB nurses was related to their weight, or that being OW/OB led nurses to perceiving high job stress, but it is less likely that nurses' weight affected their work schedules. In addition, a cross-sectional design allows identification of high risk subgroups for nurse obesity.

5.3.3 Self-Reported Data

Of the self-reported measures in this study, two are of particular concern: job stress and obesity. First of all, job stress is a difficult concept to measure, unlike assessing physical illness or injury, for which more objective measurements can be taken (Cranwell-Ward & Abbey, 2005). Most job stress questionnaires are self-reporting and so rely on use of assessments that are subjective and may not give the true picture. Some respondents might consider criticizing their organizations to be socially undesirable, and therefore, alter their responses. However, ensuring confidentiality of the data collection could decrease this problem. In addition, in the U.S. workplace, self-reported job demands were reported to be highly correlated with job demands that raters assessed (Muntaner & Schoenbach, 1994).

Secondly, body weight has been usually self-reported in large epidemiological studies. Self-reported body weight data represent an attractive alternative to actual measurements because they are easier and less expensive to obtain. However, it is questionable whether self-reported body weights are valid substitutes for directly measured weights (Cameron & Evers, 1990). Underweight subjects tended to overestimate their body weight (Charney, Goodman, McBride, Lyon, & Pratt, 1976), while overweight subjects seemed to underestimate their body weight (Jalkanen, Tuomilehto, Tanskanen, & Puska, 1987; Palta, Prineas, Berman, & Hannan, 1982). Because of this concern about inaccurate self-reported body weight data as well as sensitivity of weight data, the NWHS measured nurses' body weight using a categorical variable (1=less than 100 lbs, 2=100-129 lbs, 3=130-159 lbs, 4=160-189 lbs, 5=190-200 lbs, and 6= greater than 200 lbs). Minimum, median, and maximum values of body weight in each category produced minimum, median, and maximum BMI estimates, respectively. Since the NWHS data did not contain exact body weight values, possible misclassifications of the BMI estimates were a limitation that could not be fully explored within the NWHS. Thus, NHANES datasets, which have directly measured exact body weight values, were used to examine reliability and validity of the categorical BMI estimates. When compared to directly measured BMI values, the BMI median estimates, which were calculated using continuous height data and the median values of the body weight categories, presented good reliability and validity: for example, the BMI median estimates had excellent agreement (kappa=0.78) in two BMI group assignments (underweight/normal-weight versus overweight/obesity); the BMI median estimates had sensitivity=86.8% and specificity=93.6% for overweight, and sensitivity=85.4% and specificity=93.0% for obesity; and OW/OB groups measured using the BMI median estimates showed significant positive relationships with age, African-American ethnicity, and less exercise, supporting its known-group validity. If bias in self-reported data could be compensated for by using categorical variables, more accurate information could be obtained.

5.4 Implications

5.4.1 Implications for Practice and Policies

Considering more than half of nurses are overweight or obese, collective action for reducing nurse obesity needs to be implemented. Long work hours and shift work adversely affect quantity and quality of sleep, which often interferes with adherence to healthy behavior (Burch, et al., 2009; Bushnell, et al., 2010; Caruso et al., 2006) and increases obesity (Chaput, et al., 2010). Therefore, educational interventions about sleep hygiene and strategies for adapting work schedules should be offered. Nurses who experience difficulties in adapting to their shift work schedules should be educated about various strategies covering comprehensive aspects of life. For example, nurses should avoid eating or reduce food intake between midnight and 6am (Lowden, et al., 2004). To avoid waking due to hunger, night shift nurses are recommended to eat breakfast, but should avoid eating large meals 1-2 hours before daytime sleep.

A favorable organizational climate that supports napping in the workplace can help to prevent work-related sleep deprivation, reduce fatigue, and increase energy for healthy lifestyle behaviors (Sack, et al., 2007). A 2-3 hour night shift nap was shown to help to maintain alertness and decrease fatigue during the 12-16 hour night shift among nurses (Daurat & Foret, 2004). Studies have shown that a 15 to 20 minute nap in the daytime improve alertness, and this effect was confirmed by both subjective and objective measures (Hayashi, Watanabe, & Hori, 1999; Takahashi, Fukuda, & Arito, 1998). The Standards Practice Committee of the American Academy of Sleep Medicine recommends planned naps before and during night shifts (Morgenthaler, et al., 2007; Sack, et al., 2007). For removing the cultural barriers and implementing a system for using naps during work breaks, it may be helpful to provide nap rooms, encourage nurses to take naps, and plan how nurses are scheduled for naps. To reduce risks and minimize buildup of fatigue, information about relaxation techniques, such as warm baths, relaxation breathing and meditation can be offered.

Study results found an inverse relation between obesity and job-related physical exertion, indicating job-related exercise may reduce overweight and obesity among nurses. Another explanation is that obese nurses might avoid jobs having physical burden (Park, et al., 2009). Burnout or stressful work environment was reported by 45% of nurses who left nursing jobs (HRSA, 2006), and physical demands were reported to be highest for staff nurses and nurses working in critical care, emergency, or operating room/post-anesthesia care units (Trinkoff, et al., 2001). Therefore, additional efforts to provide ergonomic job design for obese nurses, especially for those working in highly demanding work places, are needed.

Economic constraints have led to downsizing in health care systems, which results in personal job insecurity, disrupted group performance, reduced productivity, and increased staff turnover (Blythe, Baumann, & Giovannetti, 2001; Vahtera, Kivimaki, & Pentti, 1997). The nursing workforce has also been reduced to inadequate levels (Blythe, et al., 2001). Inadequate nurse staffing could not meet the needs of increasingly complex and acute patients (Sochalski, 2004). Furthermore, a lack of adequate finances has led to organizational restructuring that usually reduces management support and supplements core nursing hours with contract workers and overtime (Norrish & Rundall, 2001).

The low staffing levels and the lack of organizational supports tend to result in adverse work schedules (e.g., long work hours, on-call), which could increase occupational stress. Through these changes, nursing work activities become less controllable, and nurses' ability to deliver effective care is compromised (Blythe, et al., 2001). Currently, nurses are frequently involved in adverse work schedules, such as long work hours, shift rotation, and overtime/on-call (Trinkoff, Geiger-Brown, et al., 2006). As shown in the 2004 National Sample Survey of Registered Nurses, more than 40% of nurses who left nursing pointed out the reason for leaving their nursing jobs as scheduling or working too many hours (HRSA, 2006).

To restrict unhealthful scheduling and help nurse retention, state regulations related to total work hours or mandatory overtime can improve nurse scheduling and retention (Bae & Brewer, 2010). When overtime or long work hours are unavoidable, additional services to reduce non-work demands can help nurses to take time off to rest and sleep. For instance, services may include laundry for work clothes, child care, and transportation. Supervisor support for avoiding pressuring nurses to work extra shifts should be emphasized. This is also important to prevent patient care errors (Trinkoff et al., 2011a).

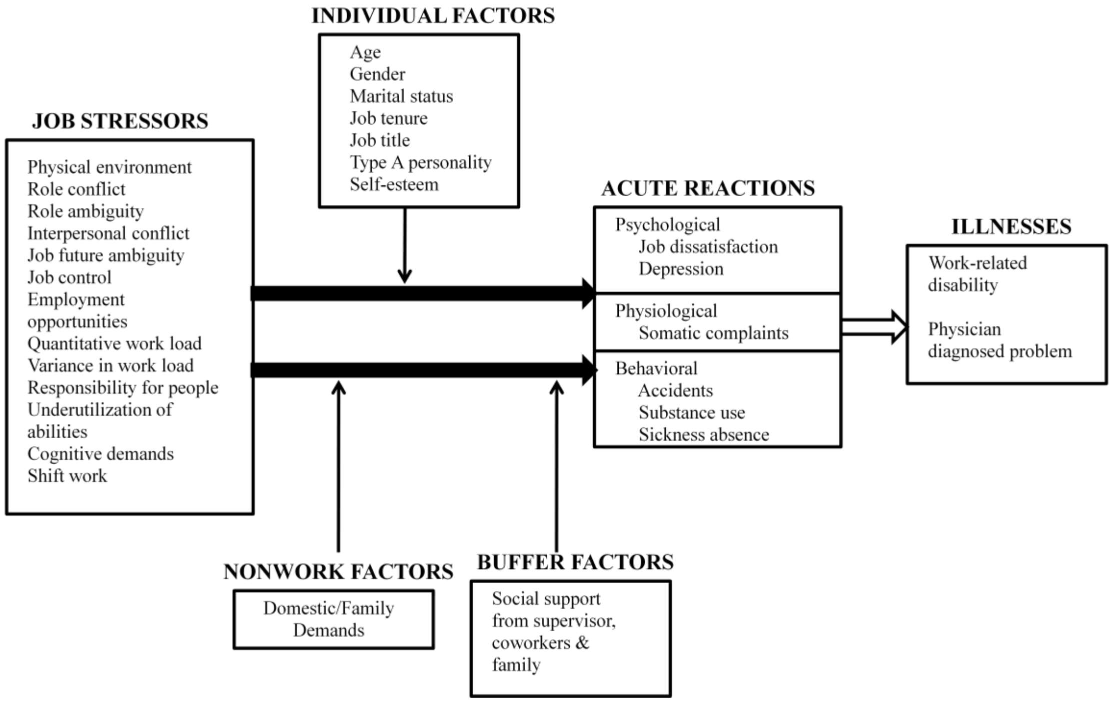
5.4.2 Implications for Future Research

Considering previously mentioned methodological issues, future research can be proposed. Researchers need to develop original research questions about nursing work conditions and obesity in future studies. In the new studies, many variables of interest can be measured for more accurate findings. For instance, researchers should control for such factors as diet patterns and familial obesity when examining working condition impacts on nurse obesity. Additionally multi-level data can account for correlations in working conditions among nurses within facilities. To achieve a causal inference, a prospective research study with longitudinal design is necessary. In a longitudinal study about weight gain among nurses (Overgaard, et al., 2004, 2006), weight gain during six years was associated with nurses' high workloads, but the research team did not consider the duration of exposure to the adverse working conditions among nurses. Repeated measures about working conditions and weight can find thresholds of the duration of the adverse working conditions for negative health outcomes.

In addition, because all measures in this study were self report, objective measures should be used in future research. Biological markers of stress (e.g., salivary cortisol) and facility-level data about nurses' work schedules (e.g., payroll data) can provide more objective information. Directly measured weight and height (by weighing and gauging the participants) can provide optimal BMI data. Additionally, other obesity measures, such as waist circumference and waist-hip-ratio, can be used in comparison to the findings using BMI as an outcome.

For additional directions for future research, to better understand nurse obesity, the covariates, which were controlled for to find job related relationships to nurse obesity in this study, should be examined for their moderating or mediating functions. In the Hurrell and McLaney's model of job stress and health (Hurrell & McLaney, 1988), individual factors (e.g., age, gender, personality, self-esteem), non-work factors (e.g., domestic demands), and buffer factors (e.g., social support) are proposed as moderators between job stressors and acute reactions, and acute reactions are assumed to function as mediators from job stressors to illnesses (*Figure 5-1*). In a study including many of these variables, structured equation models can be tested to find out their functions. Consistently with the Karasek's job strain model that gives primacy to the role of workplace factors in the etiology of job stress which affect workers' health, functions of individual, non-work, and buffer factors, and acute stress reactions can be addressed. Future research can also use more advanced and appropriate methods. Many job-related factors at individual-level data are correlated within work places. Therefore, multilevel data and analysis, which account for the variation associated with each level of nesting (Snijders & Bosker, 1999), can provide more accurate information on relationships between job-related factors and workers' health.

Figure 5-1. Model of job stress and health (Hurrel & MaLaney, 1988, pp. 28)



As a possible next step in this line of research, a prospective cohort study of nursing students can be proposed. As the findings showed that comprehensive lifestyle modification, as well as job-related factors, is important for reducing risks of nurse obesity, early education about how to adapt themselves to worklife and personal behaviors can be provided to nursing students. If nursing students learn about possible changes in their life due to nursing work and strategies to address them, adverse effects of their work schedules may decrease because they can be better prepared. In addition, organizational strategies to help nurses to adapt well to work and family life should include periodic educational sessions with a consideration of nurses' ages and their domestic responsibilities. Especially, many new nurses leave their nursing jobs because of severe work demands and work-family conflicts (Flinkman, Laine, Leino-Kilpi, Hasselhorn, & Salanter, 2008); therefore, intervention for young nurses is important to nurse retention as well as nurse health.

5.5 Summary

Notwithstanding several important limitations, this study incorporated a variety of work-related variables, including both job stress and work schedules, and found that long work hours and job-related physical activity were related to nurse obesity. Moreover, work schedules were found to have overriding effects on nurse obesity. Despite the fact that many job-related determinants of obesity have been identified, there is limited empirical evidence that addresses the effects of alleviating these determinants of nurse obesity. Various factors have not been applied together to reduce workers' obesity. Further studies should be implemented to develop solutions to improve nurse health at both the individual and organizational levels. Organizational efforts for limiting adverse work schedules and providing ergonomic job design for obese nurses are needed. Also lifestyle modification efforts should be examined for nurses. Future occupational health research should include work schedule characteristics.

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