Extended Work Schedules and Workplace Injury in Nurses

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Abstract

Occupational safety and health issue that was addressed: Extended work schedules—those that vary from the standard eight hours per day, 35 to 40 hours per week—are common and contribute to worker health problems. Because so many nurses work extended schedules, we collected longitudinal data to examine the relationship of such schedules to the incidence of nurse injury.

Importance of the problem: Nurses are at high risk for work-related musculoskeletal injury/disorders (MSD) and needlesticks. Because of the movement by health care organizations to reduce costs, generally by downsizing the nursing workforce, the occurrence of unhealthy scheduling practices to address workplace staffing of nurses has been increasing. Therefore, the purpose of this study was to examine the relationship of extended work schedules in nurses to the incidence of MSD and needlesticks.

Approach: Using a longitudinal, three wave survey of a probability sample of 2,624 registered nurses, we collected extensive data on nursing work schedules (Aim 1). We then related Wave 1 work schedule data to neck, shoulder and back (MSD) cases occurring in Waves 2 or 3 (Aim 2) and to prevalent and incident needlesticks (Aim 3).

Key **findings:** Adverse schedules were significantly related to nurse MSD and needlesticks. Schedule characteristics increasing MSD risk included 13+ hour/days; working many hours per week, working while sick, on days off, or without breaks; on-call hours, and mandatory overtime. Our research was the first to examine the impact of mandatory overtime, being on-call, working while sick or on a day off, and with less than 10 hours off, on nurse health. All of these scheduling practices were related to increased

risk of MSD. Needlestick risks were also significantly elevated by longer workdays, off shifts and weekends.

Use of findings to improve workplace safety and health: Based on these findings, preventive efforts should focus on adopting more healthful scheduling practices. Healthier schedules, including workdays less than 12 hours, limiting overtime hours, and reducing work on scheduled days off, would lower MSD risk, needlestick injuries and promote recovery from symptoms. This could allow nurses to remain in their jobs as they age, instead of having to leave jobs due to excessive demands combined with extended schedules.

Health care sector implications: Because of the large sample, we were able to examine schedules among important subgroups of the nursing workforce, such as single parents. In addition, we collected new data on the occurrence of other adverse work-schedule factors, such as mandatory overtime, on-call hours, and working on a scheduled day off. Although schedule modifications may initially require additional nursing staff, retention of a stable and healthier workforce has been shown to reduce employer costs, while greatly benefiting nurses and patient care quality. Because there are few major studies in the emerging area of extended work hours and health among nurses, there was a need for more research into the specific schedule characteristics that might have an adverse effect on nurses' health.

Highlights/Significant Findings:

Several work schedule characteristics were significantly related to MSD and to needlesticks. Working longer hours/day; hours/week; >13 hr/day; less than 10 hr off

between shifts, working while sick, on clays off, and mandatory overtime were significantly related to increased risk of neck, shoulder and back MSD. On-call involving weekly or more call-ins to work was significantly associated with back and shoulder MSD. Analysis of combinations of work schedule characteristics showed that the workday factor (encompassing items addressing hours/day, working 13+ hours/day, non-dayshifts, weekends, working with less than 10 hr off) and working on time off (working while sick, on days off, instead of taking breaks) were significantly related to neck, shoulder, and back MSD, when the other work schedule factors were taken into account. Except for back MSD, these findings were largely explained by physical demands of the job, suggesting that the longer hours increases exposure to such demands.

Many schedule variables were significantly associated with both incident and past year needlesticks (hours/day; weekends/month; working other than straight day shifts; working 13+ hours/day). Analysis of work schedule variables in combination showed that the workday factor (comprised of hours/day, working 13+ hours/day, non dayshifts, weekends, and <10 hours off) was significantly related to needlesticks, when all other work schedule factors were taken into account ($p<0.001$).

A substantial proportion of nurses reported working long hours, having few days off, and little time off between workdays. Furthermore, these nurses experienced frequent shift rotation, returned to work after insufficient time off, and worked overtime on short notice or on scheduled days off. We found that jobs with mandatory overtime were significantly more likely to also have on-call requirements. Most of these adverse work schedules characteristics occurred in combination, creating egregious working conditions and placing nurses at high risk for injuries. Single parents worked more off shifts than

other nurses, worked as many days in a row and had work hours similar to those with more than one job. Older nurses worked shorter days and fewer hours than all other nurses. Hospital nurses were most likely to work 12-hour shifts and worked fewer days per week than other nurses.

Translation of Findings

For many nurses, adverse working conditions don't occur singly but in combination, including frequent rotation, returning to work after insufficient time off, and working overtime on short notice or on scheduled days off. We found that jobs that included mandatory overtime were significantly more likely to have on-call requirements as well. Such combinations can make working extended hours unhealthy and even dangerous (Rodgers, 1997). Encouraging or requiring already tired nurses to work extra hours perpetuates a vicious cycle of fatigue, job change, and exit from the profession. This compounds staffing problems by creating shortages of nurses and the need for extended work hours. The fact that some nurses want to work long hours is sometimes given as a reason to encourage nurses to work extended hours. Our study asked whether nurses were required to work overtime, yet many nurses without such a requirement also reported working long hours. Studies of health effects of extended hours in other industries have found no correlation between those effects and whether extended hours are required or voluntary, suggesting that the health impact is comparable regardless of this distinction (Rogers, Hwang, Scott, Aiken, & Dinges, 2004). Other safety-sensitive industries, such as long-distance trucking, have regulated work hours for the sake of public safety.

Outcomes/Relevance/Impact

Our study documents the increased risk of MSD and needlesticks for nurses working long hours per day, per week, with less than 10 hours off, and overtime. We also described the nature and prevalence of extended work schedules for nurses in diverse jobs, settings and specialties, and identified those nurses with the greatest workplace needle exposure. It provides data to support modifications in nurses work schedules to improve their health. This along with findings from other studies indicating that extended work schedules affect patient safety should support improvement in nursing work schedules.

Scientific Report

Background: Dramatic changes have occurred in the health care industry in the past decade, largely because of an increased emphasis on reducing costs. Nurses, the largest segment of the healthcare workforce, are greatly affected by these changes (Lipscomb, 2004; Institute of Medicine, 2004; Lutz, 1998). Many health care facilities have eliminated jobs, resulting in extended work schedules for those nurses who remain. "Extended work schedule" is defined as a schedule that varies from the standard one of eight hours per day, 35 to 40 hours per week—for example, long work hours, irregular schedules, on-call requirements, mandatory overtime, and rotating shifts, or combinations of these. Research has shown that such scheduling practices have been used not only to address staffing crises but as a tool to meet daily staffing requirements (Jacobsen, 2002). According to the Institute of Medicine (TOM) report *Keeping Patients Safe:*

Transforming the Work Environment of Nurses, nurses' actual work times exceeded scheduled work times by more than one hour per day, on average (2004).

The use of extended work schedules, compounded by the current nursing shortage, is certainly problematic for the profession, because they affect nursing recruitment and retention (Shader, Broome, Broome, West, & Nash, 2001). Aiken and colleagues' 1998-1999 survey of more than 43,000 nurses in five countries found that 17% to 39% of respondents planned to leave their job within a year because of job demands (2001).

Recent literature has shown the detrimental effects of extended work schedules and excessive job demands on the health of nurses (Trinkoff & Storr, 1998; Lipscomb, Trinkoff, Geiger-Brown, & Brady, 2002; Lipscomb, Trinkoff, Brady, & Geiger-Brown, 2004; Josten, Ng, & Thierry, 2003; Geiger-Brown et al., 2004; Caruso, 2004). Increased hours in a work environment with high physical and psychosocial demands can adversely affect nurses' health. In fact, chronic stress over time is known to adversely affect the neurologic, immune, and cardiovascular systems (McEwen, 1998; Scott, 2000). Injuries from chronic exposure to high job demands are also more likely in nurses who work longer hours; more than one-third of approximately 1,400 RNs with active licenses had extended work schedules, which were associated with an increased likelihood of musculoskeletal injuries and disorders(Lipscomb et al., 2002).

Specific aims:

1. To examine the nature and prevalence of extended work schedules (hours/day, hours/week, mandatory vs. voluntary overtime, breaks) among nurses in a variety of settings.

2. To determine the relationship of extended work schedules to musculoskeletal pain/disorders (MSDs), measured longitudinally.

3. To determine the relationship of extended work schedules to needlestick injuries, measured longitudinally.

Methods:

Study design: A three-wave longitudinal survey of nurses as part of the Nurses Worklife and Health study (Trinkoff, Geiger-Brown, Brady, Lipscomb, & Muntaner, 2006) was conducted after obtaining University Institutional Review Board (IRB) approval. Five thousand randomly selected actively licensed nurses from Illinois and North Carolina were contacted were initially contacted to enroll in a three-wave longitudinal study. States were selected to provide a sample with geographical and ethnic diversity that was representative of the whole U.S. RN population. Of these nurses, 4,229 were sent questionnaires (138 had invalid addresses, and 633 declined to enroll). Longitudinal data were collected by a series of three questionnaires or waves between with data collected from November 2002 (wave 1) to March 2004 (wave 3). In Wave 1, returned questionnaires were received from 2,624 nurses, for a 62% enrollment rate. A follow-up response rate of 85% was obtained for wave 2 and 86% for wave 3. The average time between the return of questionnaires from Wave 1 to Wave 2 was six months and, from Wave 1 to Wave 3, 15 months.

Survey mailings: In Wave 1, nurses received an optically scannable mailed survey and an introductory letter in November 2002. A $2 incentive and study logo pencil were included in the first questionnaire packet to encourage response, as recommended by

Dillman (2000). A second and third questionnaire mailing and a reminder postcard, if needed followed this mailing. Wave 2 and 3 questionnaire mailings used the same procedures, except that the Wave 3 survey contained a $5 incentive.

Sample description: The resulting sample had demographic and job distributions (across facility type, position, and specialty areas) that were comparable to the National Sample Survey of Nurses (HRSA, 2000), supporting the generalizability of the sample to US registered nurses. The mean age for the sample was 45 years and the sample was 95% female.

Data collection and management: Three questionnaires assessing stability of work schedules, job characteristics and injury patterns (musculoskeletal and needlestick) were developed, designed, formatted and pilot-tested. All questionnaires were visually checked for stray marks and additional comments. Data entry included both scanned and keyed mechanisms. Quality assurance was performed on 10% of the surveys from each wave, with accuracy rates ranges of 96-98% for scanned data and 97-99% for keyed entry. Data were then cleaned, recoded and analyzed.

Study Variables

Work schedule: variables were derived from the Standard Shiftwork Index, which has been used internationally to standardize self- reporting measures used in shift work research (Simon Folkard, PhD, DSc, written communication, 2/4/02); (Barton , Spelten, Totterdell, et al., 1995; Smith et al., 2001). Three NIOSH work-schedule experts also examined the survey for content validity (Claire C. Caruso, PhD, RN, Roger R. Rosa, PhD, and Steven L. Sauter, PhD, oral communication, September 2002). The U.S. Bureau

of Labor Statistics has used similar methods since 2001 to measure typical work schedules, including usual hours worked and shift worked on "most days," as part of the U.S. Census Bureau report Current Population Survey.

In reporting their work schedules, nurses were asked to consider their typical work schedule in all jobs held during the previous six months. The six-month period was chosen to minimize the chance that participants would provide responses that covered an unusual or atypical work period (as might happen if they were asked to report their schedules in the "past week") thereby increasing the validity of schedule data, as had been done in other work schedule research (Barton, Spelten, Smith, Totterdell, & Folkard, 1993; Folkard, Spelten, Totterdell, Barton, & Smith, 1995). Also in keeping with previous research practice in this area, nurses were asked to report the hours they actually worked, including overtime, rather than the hours they were scheduled to work (Folkard et al., 1995; Rogers, 2004).

We collected data on the following work schedule variables: the number of hours worked per day and per week (the actual hours worked, including paid and unpaid overtime); the number of days worked per week; and the number of weekends worked per month. Space was provided on the questionnaire for respondents to write in the actual number of hours and minutes typically worked per shift. Participants were also asked to indicate the usual number of days they worked in a row and the most days they worked in a row without a day off, as well as whether they worked more than one job. Respondents were also asked to check all shifts that they typically worked (days, evenings, nights). Those who worked "off-shifts" (any shift other than the day shift) were asked, "How are

the off-shifts typically organized?" Response choices included occasional stretches per year, one or two stretches per month, some off-shifts every week, and off-shifts only.

To examine some of the more recent trends in extended work schedules, respondents were also asked to indicate how often they worked 13 hours or more at a stretch, with less than 10 hours off between shifts, and on a scheduled day off or vacation day. Data were also collected on mandatory overtime and on-call requirements. Those with required call were asked how often they were called into work, on average, and were given response choices ranging from never to more than once a week. They were then asked to specify the amount of notice typically given for on-call work: less than two hours of notice, two to eight hours of notice, or more than eight hours of notice.

Other related variables: Data were also collected on breaks taken at work, activities outside of work, including time spent traveling or commuting, on time relaxing or pursuing activities they enjoyed; and on housework, child care, and other chores. Position, workplace, and specialty for the nurses' primary or main job were recorded. The classification of specialties was consistent with that in our prior studies and included 16 specialty classifications plus "other" (Trinkoff et al., 2006).

MSD: The presence of MSD was measured by reports of neck, shoulder, and/or back symptoms including pain, numbness, tingling, aching, stiffness, or burning, adapted from the Nordic questionnaire of musculoskeletal symptoms (Kuorinka et al., 1987). An "MSD case" was defined as report of a relevant symptom lasting 1 week or more, or occurring at least monthly, with moderate or more pain on average (Bernard et al., 1994), without a non-work injury/accident within 3 months prior to the onset of musculoskeletal

symptoms. Those at risk for MSD were identified separately for each body part (neck, shoulder, back). For example, nurses reporting neck symptoms that did not meet the neck MSD case definition at Wave 1 (because of insufficient frequency, duration, and/or pain intensity) and nurses reporting no neck symptoms were considered at risk for incident neck MSD at Wave 2 or Wave 3. In addition, nurses who had recovered from a Wave 1 neck MSD or a non-work related neck injury were also included in the group at risk for an incident neck MSD.

Needlesticks: A history of needlestick in the past year was defined as a self-reported needlestick injury occurring in the year prior to Wave 1 (baseline). Whereas an "incident needlestick" (longitudinal) was measured by a nurse's report of a workplace needlestick occurring since Wave 1. Daily needle use was estimated using 6 items from the Wave 1 baseline survey, e.g. giving injections, starting IVs, blood drawing, IVs injected/aspirated, recapping, and other invasive procedures requiring needles. Each item was measured on a 4-point scale: never (0); rarely (1-2 times/day); sometimes (3-9 times/day); and often (10+ times/day). For their most serious Wave 1 needlestick, nurses were asked about the consequences of the injury (e.g.- missed work) and whether the needle that was involved had a "safer" design (i.e.-self-blunting, self-sheathing, or retractable).

Data Analysis

Aim 1: Data were analyzed using SPSS software, version 11.0. The distribution of each work schedule, overtime, and on-call variable was analyzed using the total sample and then using the following subgroups: staff nurses working in hospitals (44.9%, n = 1,020); those working more than one job (19.4%, n = 440); single parents (8.4%, n = 188); and

nurses older than age 50 (38%, n = 865). The subgroup analysis was performed to determine whether these subgroups were disproportionately affected by extended work schedules, in comparison with the total sample. For example, hospital staff nurses might be more likely than others to have mandatory overtime or shift rotation as a job component. Single parents might work long hours to meet financial obligations, while older nurses might have better schedules because of their seniority. Missing data were handled using pairwise deletion. To test differences between subgroups and the total sample, we used the normal-theory method for a one-sample test for a binomial proportion (Rosner, 2000).

Aim 2: Descriptive analyses included the cumulative incidence of reported neck, shoulder, and back MSD occurring by Wave 3. Regression with age-adjustment was used to estimate the impact of each work schedule characteristic on incident neck, shoulder, and back MSD, with the score for number of breaks reversed to reflect consistency in the direction of odds ratios. Principal components analysis on 15 Wave 1 work schedule items were assessed for underlying patterns, extracting factors with eigenvalues >= 1.0. Five factors assessing groupings of multiple work schedule characteristics were created. The regression method was used to compute factor scores, which were then regressed on neck, shoulder, and back MSD. Finally, the potential impact of psychological and physical demands on the relationship between schedule factors and MSD was examined.

Aim 3: Both needlestick outcome measures (incidence and prevalence) were used in the analysis, similar to those presented by Aiken and colleagues (1997). To estimate the number of needle tasks performed daily, the midpoint of the response range was used, except for nurses reporting 10+ needles handled, for whom the value of 10 was substituted. To estimate

the daily total needle use, the needle use for all 6 tasks was summed, generating total scores ranging from 0 to 60. To estimate the odds of needlesticks by daily needle use, three needle use levels were formed based on these scores: none or low needle use (0-20 needles used per day); medium needle use (21-40 needles/day); and high needle use (41-60 needles/day). As with MSD, the history of needlesticks in the past year and estimated needle use (mean number of needles handled during a typical working day) were described by job position, workplace, and specialty. Consequences of the most serious Wave 1 needlestick were presented by type of needlestick (contaminated/possibly contaminated, uncontaminated). Finally, logistic regression with age-adjustment was used to estimate the impact of needle use during a typical work day on past year needlesticks. We also estimated the odds of needlesticks in relation to each individual work-schedule characteristic. We took the five factors assessing combinations of work schedule characteristics, using the regression method to compute factor scores, which were then regressed on prevalent and incident needlesticks, and then controlled on job demands.

Results

Aim 1: Nurses work schedules: Two-thirds (67%) of our study sample worked in staff-nurse, general duty, or private-duty positions, and more than half (59%) worked in a hospital setting. Over $^{1}/_{4}$ of the sample (28%) typically worked 12 or more hours per day including overtime. In fact, one-third worked more than 40 hours per week: 19% worked 41 to 49 hours, 8% worked 50 to 59 hours, and 6% worked 60 or more hours. Regarding days worked per week, 5% worked 6-7 days/week consistently, although 29% had worked six or more days in a row at least once in the previous six months. About 11%

worked three or four weekends a month (this percentage may include weekend-only positions) and nearly one-quarter (23%) rotated shifts.

Nurse subgroup schedules: Hospital staff nurses constituted the largest subgroup of nurses examined. All subgroup comparisons described below were significant *(P* < 0.001), using the normal-theory method for a one-sample test for a binomial proportion. Hospital staff nurses were most likely to work 12+ hours/day (52% vs. 28% of the entire sample), although they were half as likely to work 6-7 days/week, compared to the total sample (2.6% vs. 5.2%), suggesting workweek compression in hospital nurses. They were also more likely to work off-shifts, compared with the total sample. Nurses with more than one job were more likely to work 12+ hours per day (37% vs. 28% of the total sample) and 50+ hours/week (24% vs. 14% of the total). Compared with the sample as a whole, they more often worked consecutive days for long stretches (9% worked 13+ days in a row, vs. 4% of the total), with insufficient rest (14% worked with <10 hours off between shifts at least weekly, vs. 8% of the total), and during scheduled time off (13% did so at least weekly, vs. 5% of the total). Surprisingly, work schedules of single parents were most similar to the schedules for those with more than one job: both groups were as likely to report working long days (13 to 15 or more hours/day), long weeks (50 to 60 or more hours/week), and many consecutive days in a row. Single parents were more likely to work off-shifts, and with less than 10 hours off between shifts than the total sample and 24% had jobs with mandatory overtime. Nurses aged 50 and over were least likely to work long days (12 or more hours) and tended to work more days per week, as compared with the total sample.

In addition to regular work hours, 17% worked mandatory overtime, with two-thirds of these nurses required to do so with less than two hours' notice. On-call requirements were very common among the total sample (38.6%, n = 877) and were even more prevalent among hospital staff nurses (43.5%). Nonetheless, for both the overall sample and hospital staff nurses, jobs requiring on-call hours were significantly more likely to have mandatory overtime as well (Pearson x2 = 61.76 for the total sample and 29.49 for the hospital staff nurses, with 1 df for both groups; $P < 0.0001$ for both groups). In other activities outside of work, 20% of our sample spent more than two hours per day commuting, and 31% spent more than 20 hours per week on housework or childcare chores or both. Leisure time was also limited: 27% reported that they had 1 hour or less per day to relax or pursue activities that they enjoyed.

Aim 2: The cumulative incidence of MSD was 14.0% for neck, 17.3% for shoulder, and 21.1% for back problems. Regression of the work schedule characteristics, with age-adjustment revealed that many of these characteristics were significantly associated with all three types of MSD (hours/day; hours/week; >13 hr/day; less than 10 hr off between shifts, work while sick, on days off, and mandatory overtime). On-call involving weekly or more call-ins to work was significantly associated with back and shoulder MSD. Analysis of work schedule factors showed that the workday factor (hours/day, working 13+ hours/day, non dayshifts, weekends, working with less than 10 hr off) and working on time off (working while sick, on days off, instead of taking breaks) were significantly related to neck, shoulder, and back MSD, when the other work schedule factors were

taken into account. Mandatory overtime/ on-call was significantly related to shoulder MSD. These findings remained significant after adjusting for psychological demands. Except for back MSD, the effect of the workday factor was largely explained by physical demands, as were the effects of the overtime/on-call factor.

Aim 3: 15.6% nurses reported a history of needlesticks in the past year, and the cumulative incidence of needlesticks by Wave 3 was 16.3%. Similar proportions of past year and incident cases involved needles that were definitely or possibly contaminated (40% and 37%, respectively). One third were from needles that incorporated "safer" designs. Groups reporting more past year needlesticks included staff nurses, hospital nurses, and those working in emergency, adult critical care, operating room (OR), oncology/transplant/AIDS and catheterization lab/diagnostic specialties. These nurses also had higher estimated daily needle use, although specialties varied in the number and type of daily needle tasks performed.

Needle use during a typical workday was related to the odds of needlesticks. Nurses performing high (40+) or medium (21-40) numbers of needle using tasks daily were 2-3 times more likely to be stuck vs. those performing low/no (0-20) tasks. Similarly, for each individual task, nurses that often or sometimes performed it were more likely to report needlesticks than those never/rarely performing these tasks suggesting that our variables appropriately measured needle exposure. Regarding consequences, most nurses that were stuck by a contaminated or possibly contaminated needle reported their injuries (81%), whereas those with an uncontaminated needle rarely did so. Such nurses were also more likely to see a health provider, miss work, file a report, or use medications.

Regression of individual work schedule components with age-adjustment revealed that many schedule variables were significantly associated with both incident and past year needlesticks (hours/day; weekends/month; working other than straight day shifts; working 13+ hours/day). In addition, hours/week, work with less than 10 hours off between shifts, and work on days off were significantly associated with past year needlesticks. Analysis of work schedule factors showed that the workday factor (comprised of hours/day, working 13+ hours/day, non dayshifts, weekends, and <10 hours off) was significantly related to needlesticks, when all other work schedule factors were taken into account ($p<0.001$). The day factor remained significant only for incident needlesticks ($p<0.001$) after adjustment for demands, though this was also partially explained by physical demands of the job.

Conclusions

The work schedules of nurses described in this survey suggest that there should be industry-wide concerns about fatigue and health risks to nurses as well as the safety of patients in their care. Health effects of extended schedules were significant; incident neck, shoulder, and back injuries and needlesticks all were elevated due to extended schedules. Long hours, days, overtime and working during time off were significant injury risk factors.

A substantial proportion of nurses reported working schedules that conflict with the recommendations of the Institute of Medicine (not more than 60 hours in 7 days, with no more than 12 hours in 24), and with long hours, few days off, and little time off between workdays. Older nurses were least likely to work longer shifts, yet many hospitals have only those to offer. As the workforce ages, jobs with work schedules that

can accommodate the health needs of older workers will need to be reinstituted. Furthermore, with the increasing need for nurses in the next decade, redesigning work schedules to prevent injury and promote worker health will be essential.

Dissemination

Grant Presentations:

Symposium based on data from NIOSH grants, entitled: "New Methods for Studying Worker Exposures and Injuries in Health Care Settings" CANS- Council for the Advancement of Nursing Science Meeting, Washington, DC, October 13, 2006.

With presentations including:

Le, R., Trinkoff, A. Lipscomb, J., Geiger-Brown, J. "Work Schedule, Exposures, and Needlestick Injuries in Registered Nurses"

Trinkoff, A. "A Prospective Study of Work Hours, Mandatory overtime, and On-call in Relation to Nurse Musculoskeletal Problems."

"Long Work Hours, Mandatory Overtime, and MSD in Nurses" Trinkoff AM, Le R, Brady B, Geiger-Brown J, Lipscomb J. Sixth International Conference on Occupational Stress and Health, APA-NIOSH, Miami, Florida, March, 2006.

"The Longitudinal Relationship Of Extended Work Schedules To Musculoskeletal Problems In Nurses" Trinkoff AM, Le R, Geiger-Brown J, Lipscomb J. Presented at the NORA (National Occupational Research Agenda) Symposium 2006, sponsored by CDC/NIOSH, Washington, DC, April 18-20, 2006.

"Research Findings on Nurse MSD and Needlesticks," University of Maryland School of Nursing, October 27, 2006.

"Nurses' Work Schedules-too long, too often" Brady B, Trinkoff AM, Geiger-Brown J, Le, R. Aging and Women's Health Research Poster Day, University of Maryland, Baltimore, 2005.

Symposium based on data from grant, entitled:
"What is the impact of extended work hours on health care workers? National Nursing Research Conference: Better Health through Nursing Research, State of the Science Congress, 2004.

With presentations including:

"Nurses and long work hours; a program of research into nurses' health outcomes and implications for patient safety" presented at the National Nursing Research Conference: Better Health through Nursing Research, State of the Science Congress, Washington, DC. 2004.

Dr. Trinkoff (PI) was the session leader for the *Mitigating And Aggravating Factors: Job And Personal Characteristics* breakout session of the NIOSH-sponsored conference: "Long Working Hours, Safety and Health Toward a National Research Agenda" (April 29-30, 2004).

"How long and how much are nurses now working?" (invited). Post-Conference on Long Working Hours in Health Care, sponsored by NIOSH, Baltimore, MD, April 30, 2004.

"Occupational Health of Nurses: Research findings and future directions", University of Maryland School of Nursing, Doctoral Seminar, November 14, 2003.

"Workplace injury and illness: not a condition of employment." Symposium. American Nurses Association convention, Philadelphia, PA, 2002.

Co-author, "Physical demands and musculoskeletal disorders of the neck, shoulder and back in registered nurses". Presented by J. Geiger-Brown. American Public Health Association annual meeting, Philadelphia, PA, 2002.

"Workplace injuries: Recognizing risks and how to prevent them" Maryland Nurses Association, Annual Meeting, Baltimore, MD, 2002.

Journal Articles:

Trinkoff, A.M., Geiger-Brown, J., Brady B., Lipscomb, J.A., Muntaner, C. (2006). How long and how much are nurses now working? American Journal of Nursing 106 (4): 60-71,continuing education test: p. 72.

Addresses aim 1- to describe the nature of nurses extended work schedules.

Trinkoff, A., Le, R., Brady, B., Geiger-Brown, J., Lipscomb, J., Lang, G. (2006). The longitudinal relationship of long work hours and mandatory overtime to MSD in nurses. *American Journal of Industrial Medicine,* 49(11), 964-971.

This article addresses Aim 2 by relating work schedule characteristics to incident and prevalent MSD.

Trinkoff A., Le, R., Brady B., Geiger-Brown J., Lipscomb, J. (2006). Work schedule, exposures, and needlestick injuries in Registered Nurses. *Journal of Infection Control and Hospital Epidemiology*, in press.

This article addresses Aim 3, by relating needlesticks to work schedule characteristics and relaying data on needle exposure throughout nursing work setting, by job title and specialty.

Book chapter:

Trinkoff, A., Geiger-Brown, J., Caruso, C.C., Lipscomb, J., Johantgen, M., Nelson, A. (2006). Personal Safety for Nurses. In: Advances in Patient Safety & Quality – an Evidence-based Handbook for Nurses., (ed. Ronda Hughes), Agency for Healthcare Research and Quality, in press.

In preparation:

Trinkoff, A., Geiger-Brown, J., Lipscomb, J., Johangten, M. (Invited). Nurses work schedules and subsequent injuries. Industrial Health, for special journal edition: "Occupational Health Issues specific to Health Care Workers" forthcoming, 2007.

Other contributions:

Institute of Medicine, provided study data on nurses working conditions for inclusion in their report issued November, 2004 entitled, "Keeping Patients Safe: Transforming the Work Environment of Nurses."

Media participation:

Interviewed for cover story featuring the research: Vance, J. Aches & Pains. In: Caring for the Ages: A Monthly Newspaper for Long-term Care Practitioners. American Medical Directors Association. 5(8): August, 2004.
http://www.amda.com/caring/august2004/aches.htm

Article summarizing the symposium I chaired on long work hours: Mason, DJ & Kany, KA. The State of the Science: Focus on Work Environments. American Journal of Nursing, 105(3):33- 34, March 2005.

Research featured in Journal of the American Medical Association article by Lamberg, L. "Impact of long work hours explored. 2004;292:25-26. <http://jama.ama-assn.org/cgi/content/extract/292/1/25>

Interview and article in Nurse Zone: Orlovsky, C. "Long Work Hours Prevail Industry Wide," From the World Wide Web, accessed April 4, 2006. http://www.nursezone.com/job/MedicalNewsAlerts.asp?articleID=14929

Printed also in: AMN Healthcare Newsletter, with link to full article in American Journal of Nursing. 2006. http://www.amnhealthcare.cominews.asp?ArticleID=14929

Article cited on NPlinx website: http://www.mdlinx.com/NPLinx/news-article.cfm/1483265

Article entitled, "Study looks at nurses long work schedules" UMB Voice, page 9, April, 2006.

American Journal of Nursing Article (Trinkoff et al., 2006) included in AHRQ Patient Safety Net (PSNet): What's New this Week," Highlighted the article for its comparison of nursing work hours to TOM recommendations, for the 4/19/06 edition at http ://psnet. ahrq.gov/resource.aspx?resourceID=3603

Trinkoff et al., 2006 work hours article findings summarized in, "Issue Exacerbating Problem of Nursing Recruitment, Retention and Quality of Care for Patients." In PA Nurses Healthlines, March, 13, 2006 http://www.panurses.org/c news march 2006.htm

Article findings and interview summarized in Kantz, Beth: RN Work Hours: Too Much, Too Long; Septemberl, 2006 in Nursing Spectrum at http://www2.nurseweek.com/Articles/article.cfm?AID=23018

Also reprinted in Nursing Spectrum on November 6, 2006 http://community.nursingspectrum.com/MagazineArticles/article.cfm?AlD=24590

Article summarizing findings, "Factors that Improve Work-related Injury Reporting." appeared in: The Risk Management Reporter: the Newsletter of the Healthcare Risk Control System. Page 17, October, 2005. http://www.ecri.org/marketingdocs/RMRep1005.pdf

Inclusion of Subjects

Inclusion of gender and minority study subjects: See Inclusion Enrollment Report Table

Inclusion of Children: No children participated in the study. In the event that a person under 21 years of age participated, they were established as consensual age as they were registered nurses in their state.

Materials available for other investigators

Copies of the survey instruments used to collect the data are available upon request.

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CE HOURS
Continuing Education
ORIGINAL RESEARCH

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How Long and How Much Are Nurses Now Working?

TOO LONG, TOO MUCH, AND WITHOUT ENOUGH REST BETWEEN SHIFTS, A STUDY FINDS.

ABSTRACT

OBJECTIVE: Extended work schedules—those that vary from the standard eight hours per day, 35 to 40 hours per week—are common in nursing and contribute to problems with nursing recruitment and retention, in addition to compromising patient safety and the health and well-being of nurses. This study describes the nature and prevalence of such schedules across nursing settings.

METHODS: Quantitative survey data collected as part of the Nurses Worklife and Health Study were analyzed. The sample consisted of 2,273 RNs. Demographic data, information about respondents' primary jobs (position, workplace, and specialty), and specific work schedule variables were analyzed, including data on off-shifts, breaks, overtime and on-call requirements, time off between shifts, and how often respondents worked more than 13 hours per day and on scheduled days off and vacation days. Respondents were also asked about activities outside of work, commuting time, and other nonnursing activities and chores.

RESULTS: More than a quarter of the sample reported that they typically worked 12 or more hours per day, as did more than half of hospital staff nurses and more than a third of those with more than one job. A third of the total sample worked more than 40 hours per week, and more than a third worked six or more days in a row at least once in the preceding six months. Nearly a quarter rotated shifts.

Almost one-quarter of nurses with more than one job worked 50 or more hours per week, and they were more likely to work many days consecutively, without sufficient rest between shifts, and during scheduled time off. Single parents were as likely as those with more than one job to work 13 to 15 hours per day, 50 to 60 hours or more per week, and many days consecutively. Seventeen percent of all nurses worked mandatory overtime, as did almost a quarter of the single parents. Nearly 40% of the total sample and more than 40% of hospital staff nurses had jobs with on-call requirements.

CONCLUSIONS: The proportion of nurses who reported working schedules that exceed the recommendations of the Institute of Medicine should raise industry-wide concerns about fatigue and health risks to nurses as well as the safety of patients in their care.

KEY WORDS: nurse staffing, adverse outcomes, extended work schedules, patient safety, nurse health

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Dramatic changes have occurred in the health care industry in the past decade, largely because of an increased emphasis on reducing costs. Nurses, the largest segment of the health care workforce, are greatly affected by these changes." Many health care facilities have eliminated jobs, resulting in extended work schedules for those nurses who remain. "Extended work schedule" is defined as a schedule that varies from the standard one of eight hours per day, 35 to 40 hours per week—for example, long work hours, irregular schedules, on-call requirements, mandatory overtime, and rotating shifts, or combinations of these. Research has shown that such scheduling practices have been used not only to address staffing crises but as a tool to meet daily staffing requirements." According to the Institute of Medicine (TOM) report *Keeping Patients Safe: Transforming the Work Environment of Nurses,* nurses' actual work times exceeded scheduled work times by more than one hour per day, on average.[3] The use of extended work schedules, compounded by the current nursing shortage, is certainly problematic for the profession, because they affect nursing recruitment and retention.' Aiken and colleagues' 1998-1999 survey of more than 43,000 nurses in five countries found that 17% to 39% of respondents planned to leave their job within a year because of job demands.'

Recent literature has shown the detrimental effects of extended work schedules and excessive job demands on the health of nurses.[1,,11] Increased hours in a work environment with high physical and psychosocial demands can adversely affect nurses' health. In fact, chronic stress over time is known to adversely affect the neurologic, immune, and cardiovascular systems.'" [13] Injuries from chronic exposure to high job demands are also more likely in nurses who work longer hours; more than one-third of approximately 1,400 RNs with active licenses had extended work schedules, which were associated with an increased likelihood of musculoskeletal injuries and disorders.1°

An extended work schedule can lead to fatigue, pain, and deficits in performance and reaction time, as a result of increased exposure to physical demands and insufficient recovery time.[14-18] Reduced rest and recovery time leads to physiologic depletion or exhaustion that continues into the next workday.[19] Long work hours are also associated with unhealthful behaviors such as smoking, excessive caffeine intake, alcohol consumption, poor diet, and a lack of exercise.2°

Studies of physicians in training also indicate that extended work schedules are associated with problems in job performance, with many reporting mistakes made as a result of fatigue." In two of the studies, the longer physicians worked with inadequate sleep, the more their performance was affected, including the ability to make decisions, the time it took to complete tasks, and the rate of errors."' [23] In another study, surgical residents reported that their extended hours interfered with their ability to provide care." Similarly, Rogers and colleagues found that hospital nurses who work extended hours are more likely to make errors that could adversely affect patient safety."

When nurses are required to work overtime, particularly mandatory overtime on short notice, they can't anticipate the long workday and pace themselves accordingly.[26] Many nurses work in positions that have on-call requirements, an arrangement that interferes with rest and recovery, reduces control over scheduling, and affects their social lives and commitments outside of the workplace.' The majority of nurses are women, who also may have other substantial responsibilities, including caring for children or other dependents and doing housework and other chores that limit for leisure time and rest.[28, 29] Such pressures can create conflicts between job and family.3°, 3'

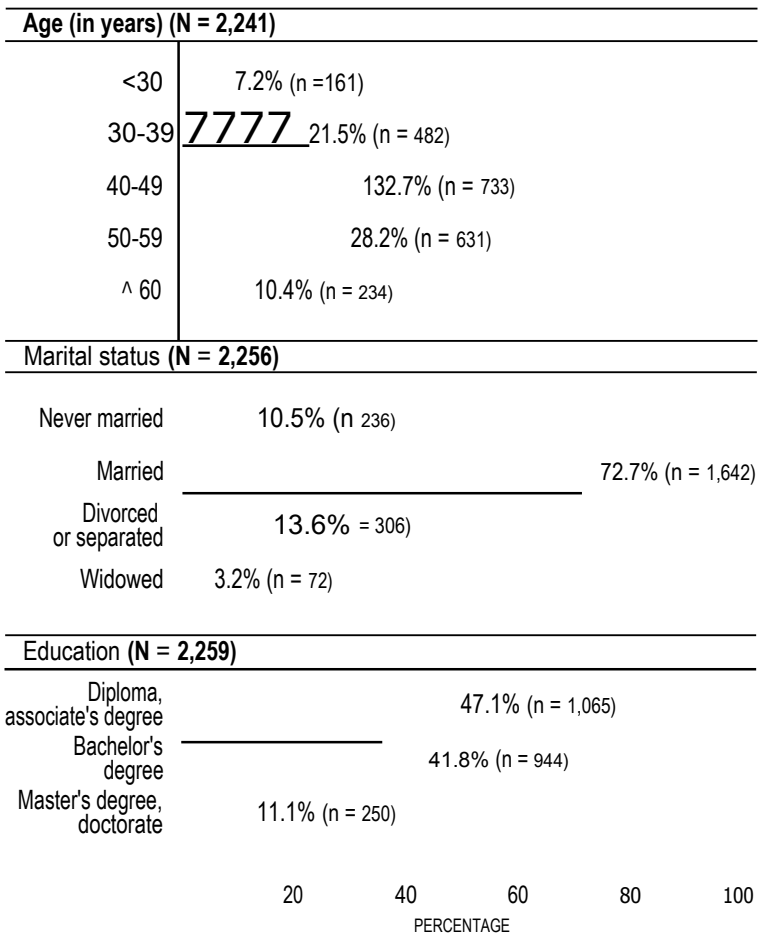
A substantial proportion of nurses reported working schedules that conflict with Institute of Medicine recommendations.

A well-rested nursing staff is essential to providing the best care possible. The American Association of Critical-Care Nurses recently issued a statement opposing mandatory overtime, because of its relation to job stress, physical fatigue, and exhaustion, which can lead to errors.[32] Currently, the IOM recommends that nurses work no more than 12 hours in a 24-hour period and no more than 60 hours in a seven-day period, in order to reduce error-producing fatigue.'

Although the current evidence indicates that extended schedules can adversely affect nurses and patients, research on nurse scheduling has been limited, usually to certain work settings (such as hospitals), or certain schedule components (such as shift work or mandatory overtime only); more research is needed. The Nurses Worklife and Health Study (Part II) was the first to link a wide array of schedule components with musculoskeletal injuries and disorders in nurses.[1°] However, little is known about the prevalence of these extended work schedules across all nursing settings.

Therefore, we sought to describe the nature and prevalence of extended work schedules across the nursing profession. To enhance comparability with

FIGURE 1. DEMOGRAPHIC CHARACTERISTICS OF RN RESPONDENTS*



* N for each item (age, marital status, and education) is different from the total study N (2,273) because nonresponse rates for each question varied. The proportion of respondents who didn't answer these particular items ranged between 0.6% and 1.4%.

other research, we analyzed the schedules of several subgroups of nurses, including hospital staff nurses, those working more than one job, those who were single parents, and those 50 years of age and older. The proportion of nurses exceeding work hour limits proposed by the TOM was documented, along with recommendations for future research and policy directions.

METHODS

This study used quantitative survey data obtained as part of a longitudinal study of RNs funded by the National Institute of Occupational and Safety and Health (see *The Nurses Worklife and Health Study,* page 70). Data collection occurred between November 2002 and March 2003. The sample consisted of 2,273 randomly selected respondents in two states who worked as nurses during the preceding year. The mailed survey consisted of questions about various work schedule variables in the preceding six months, such as number of hours worked per day and per week, number of days worked per week, number of weekends worked per month, and overtime and on-call requirements. We also obtained demographic data that included work setting, position, and specialty. *More on Methods and Statistics* (page 64) provides additional information about the study methodology and data analysis.

RESULTS

Sample. The mean age of our sample of working nurses was 45 years. Our sample was predominantly female *(95%),* white (86%), and married (73%); nearly half (47%) held a diploma or associate's degree and 11% held a master's or doctoral degree (see Figure 1, at left—note that percentages given here are rounded to the nearest whole number; the percentages in the figures and the table are rounded to one decimal place). Almost 7% said they were black or African American and *5%* said they were Asian or Pacific Islander. Slightly more than 1% said they were Hispanic. Half of the nurses were caring for children in the home, and 12% were caring for another dependent such as an elderly parent. The demographic distribution of the nurses in our sample closely approximated that of the 2000 *National Sample Survey of Registered Nurses.* The mean age in the national sample survey was 45 years; 95% were female, 12% were racial or ethnic minorities, *55%* had children, and 72% were married.[42] As the highest level of education, our sample and the national sample survey reported equal proportions with master's or doctoral degrees (11%), although our sample had a lower percentage of nurses with diplomas or associate's degrees (47%) than the national sample survey (56%). The proportion of nurses who were single parents caring for children was 8%, exactly the same as the national sample survey estimate. Two-thirds (67%) of our study sample worked in staff-nurse, general-duty, or private-duty positions, and more than half (59%) worked in a hospital setting (see Figure 2, page 66), compared with 64% and 59%, respectively, in the national sample survey. In our sample, 19% of the nurses held more than one job, compared with 15% in the national sample survey. The distribution of specialties within the sample was consistent with a survey of 4,436 randomly selected RNs in 10 states that we conducted previously (the Nurses Worklife and Health Study [Part I])[43]; therefore, it's reasonable to suppose that our findings can be generalized to the national nursing population.

Work schedule. We focused on four subgroups within our sample: hospital staff nurses, nurses who held more than one job, nurses who were single parents, and nurses 50 years of age and older. Figure 2 describes the proportions of sampled nurses in the total sample and in the four subgroups

TABLE 1. PROPORTION OF RN RESPONDENTS WHOSE WORK HOURS EXCEED PROPOSED INSTITUTE OF MEDICINE LIMITS, BY POSITION, WORK SETTING, AND SPECIALTY*

	PERCENTAGE OF ALL RESPONDENTS TO THIS ITEM (n)	PERCENTAGE WHO WORK > 12 HOURS/DAY	PERCENTAGE WHO WORK > 60 HOURS/WEEK
POSITION (N = 2,270)			
Staff nurse, general duty	66.8 (1,516)	16.5	3.7
Manager, supervisor, other administrator	24 (545)	4.1	2.2
Advanced practice nurse (NP, clinical nurse specialist, certified nurse midwife, certified registered nurse anesthetist)	4.6 (104)	6.8	3
WORK SETTING (N = 2,271)			
Hospital	58.5 (1,328)	19.4	4.2
Ambulatory clinic, office, health maintenance organization	13.6 (309)	1	1.4
Nursing home, skilled nursing facility	7.7 (174)	5	1.9
Home health, hospice, assisted living facility	7.3 (165)	5.1	3.2
SPECIALTY (N = 2,257)			
Internal medicine, telemetry, medical-surgical not included in other specialties	16.3 (367)	15.9	5.3
Adult critical care (intensive care, cardiac care)	8.9 (200)	35.9	4.7
Operating room, ambulatory surgery	8.8 (199)	4.3	2.6
Women's health, labor and delivery	7.9 (179)	15.1	2.4
Family practice, other pediatrics	6.6 (150)	6.3	< 1
Emergency, trauma, triage	6.3 (143)	25.6	2.9
Psychiatric, mental health, substance abuse	5.8 (130)	5.7	1.7
Orthopedic, rehabilitation, neurology	3.9 (88)	1.2	3.8
Cardiac catheterization lab, diagnostics, hemodialysis	3.6 (82)	3.8	9
Neonatal, pediatric critical care	3.5 (79)	27.3	5.3
Oncology, transplantation, HIV and AIDS	3.1 (71)	14.3	4.3

* N for each item (position, work setting, and specialty) is different from the total study N (2,273) because nonresponse rates for each question varied. Fewer than 1% of respondents didn't specify their position, workplace, and specialty. Only the top four work settings, 'n terms of percentage of the total sample, and 11 selected specialties are represented. Specialties not included above are postanesthesia intensive care; case management, utilization review, discharge planning, administration; community health, occupational health, corrections; gerontology; school health; other.

who reported particular schedule variables. For example, 28.4% of the entire sample indicated that they typically worked 12 or more hours per day including overtime. Percentages were calculated based on nonmissing totals-in other words, the numbers of nurses who actually answered each question, rather than the total sample of 2,273 (the total number of respondents varied from question to question)-and the proportion missing for each schedule variable ranged from less than 1% to 6%. (Tersine, in a United States Census Bureau study of nonresponse rates for the 1996 American Commu-

More on Methods and Statistics

We conducted our analyses using quantitative survey data collected as part of Wave 1 of a longitudinal study of RNs funded by the National Institute of Occupational Safety and Health (NIOSH) (see *The Nurses Worklife and Health Study,* page 70). Approval was obtained from the institutional review board of the University of Maryland, Baltimore. Data were collected between November 2002 and March 2003, using a confidential mailed survey. (The questionnaire and survey procedures were designed and pilot tested as part of prior surveys on nurses' health.[1,34]) The survey consisted of an eight-page, optically scannable questionnaire. The mailing process consisted of an introductory letter, two questionnaire mailings, and a reminder postcard. A pen with the study logo and $2 were included in the first questionnaire mailing as incentives to respond, along with a postage-paid return envelope, as recommended by Dillman.35

Sample. For the recruitment process, 5,000 randomly selected nurses from licensure lists of two U.S. states were initially contacted to enroll in a three-wave longitudinal study. (The Wave 1 initial contact date was November 2002. The average time between the return of questionnaires from Wave 1 to Wave 2 was six months and, from Wave 1 to Wave 3, 15 months.) The states were selected to provide a sample with geographical and ethnic diversity that was representative of the whole U.S. RN population. Of those contacted, 138 had invalid addresses, and 633 declined to enroll. Two thousand six hundred twenty-four RNs out of the remaining 4,229 returned questionnaires, yielding a 62% enrollment rate. Only those who worked as nurses in the preceding year (N = 2,273) were included in this analysis.

Variables. Work-schedule variables were derived from the Standard Shiftwork Index, which has been used internationally to standardize self-reporting measures used in shift work research (Simon Folkard, PhD, DSc, written communication, February 4, 2002).36," Three work-schedule experts at NIOSH examined the survey for content validity (Claire C. Caruso, PhD, RN, Roger R. Rosa, PhD, and Steven L. Sauter, PhD, oral communication, September 2002). The U.S. Bureau of Labor Statistics has used similar methods since 2001 to measure typical work schedules, including usual hours worked and shift worked on "most days," as part of the U.S. Census Bureau report *Current Population Survey.* This indicates that the use of surveys to assess typical work schedules is accepted by qualified researchers and these methods are therefore appropriate for our study.

In reporting their work schedules, nurses were asked to consider their typical work schedule in all jobs held during the previous six months. The six-month period was chosen to minimize the chance that participants would provide responses that covered an unusual or atypical work period (as might happen if they were asked to report their schedules in the "past week"), thereby increasing the validity of schedule data, as had been done in other work schedule research."" Also in keeping with previous research practice in this area, nurses were asked to report the hours they *actually* worked, including overtime, rather than the hours they were scheduled to work.39.4°

We collected data on the following work schedule variables: the number of hours worked per day and per week (the actual hours worked, including paid and unpaid overtime); the number of days worked per week; and the number of weekends worked per month. Space was provided on the questionnaire for respondents to write in the actual number of hours and minutes typically worked per shift. Participants were also asked to indicate the usual number of days they worked in a row and the most days they worked in a row without a day off. We included the question, *Do you work more than one job?,* to which respondents could answer yes or no. Respondents were also asked to check all shifts that they typically worked (days, evenings, nights). Those who worked "off-shifts" (any shift other than the day shift) were asked, *How are the off-shifts typically organized?* Response choices included occasional stretches per year, one or two stretches per month, some off-shifts every week, and off-shifts only. Schedule variables were measured using items from a work schedule index we designed previously.'° To examine some of the more recent trends in extended work schedules, respondents were also asked to indicate how often they worked 13 hours or more at a stretch, with less than 10 hours off between shifts, and on a scheduled day off or vacation day; the response choices included never, a few times per year, once a month, every other week, once a week, or more than once a week. Respondents were also asked whether their job had an on-call requirement; those who answered yes were asked to indicate how often they were called into work, on average, and were given the same response choices (ranging from never to more than once a week).

About their primary job, respondents were also asked, Does *this job have mandatory overtime?* Those who answered yes were then asked to specify the amount of notice given: less than two hours' notice, two to eight hours' notice, or more than eight hours' notice. The questionnaire also asked, *During a typical workday, how many breaks lasting 10 minutes or more, including meals, do you take?* and provided 0, 1, 2, or 3+ breaks as response choices. Nurses were also asked about activities outside of work, including the average amount of time they spent traveling or commuting each day; the amount

of time they had to relax or pursue activities they enjoyed after an average work day; and the amount of time they spent per week on housework, child care, and other chores.

Position, workplace, and specialty for the nurses' primary or main job were recorded. Positions were classified as follows: staff, general duty; manager, supervisor, other administrator; advanced practice nurse (including NP, clinical nurse specialist, certified nurse midwife, and certified registered nurse anesthetist); educator, researcher; and other. Workplaces were classified as follows: hospital; nursing home, skilled nursing facility; ambulatory clinic, office, health maintenance organization; home health agency, hospice, assisted living facility; school of nursing; other school; government, community agency; business, industry; and other. The classification of specialties was consistent with that in our prior studies and included 16 specialty classifications plus "other" (see Table 1, page 63, for a complete list of specialties).

Data analysis. Data were analyzed using SPSS software, version 11.0. The distribution of each work-schedule, overtime, and on-call variable was analyzed using the total sample and then using the following subgroups: staff nurses working in hospitals (44.9%, n = 1,020); those working more than one job (19.4%, n = 440); single parents (8.4%, n = 188); and nurses older than age 50 (38%, n = 865). Missing data were handled using pairwise deletion (that is, in analyzing the correlation between any two variables, responses that didn't provide data on both variables were deleted, rather than substituting mean data). To test differences between subgroups and the total sample, we used the normal-theory method for a one-sample test for a binomial proportion." (This method tests the hypothesis that a subgroup is significantly different from the total study population.)

The subgroup analysis was performed to determine whether these subgroups were disproportionately affected by extended work schedules, in comparison with the total sample. For example, hospital staff nurses might be more likely than others to have mandatory overtime or shift rotation as a job component. Single parents might work long hours to meet financial obligations, while older nurses might have better schedules because of their seniority. We examined the proportion of nurses in the entire sample who reported long work hours in relation to mandatory overtime and on-call requirements. We then repeated this analysis for hospital staff nurses only, using the Pearson x^2 test of significance. Finally, the proportion of nurses who reported that they exceeded the maximum recommended by the IOM (more than 12 hours in 24 or more than 60 hours in seven days) was examined according to position, workplace, and specialty.

nity Survey, considered nonresponse rates of less than 7% not to be of concern or to warrant further analysis in terms of sample selection, instrument design, or other factors. Similarly, we considered nonresponse rates of less than 7% to all items in our questionnaire a strength of our study.44)

Among all nurses in the sample (those working full and part time, across all work settings, and across all job types), one-third worked more than 40 hours per week: 19% worked 41 to 49 hours, 8% worked 50 to 59 hours, and 6% worked 60 or more hours (see Figure 2, page 66). Regarding days worked per week, 5% of respondents worked six or seven days per week consistently, although more than a quarter (29%) had worked six or more days in a row at least once in the previous six months. About 11% worked three or four weekends a month (this percentage may include weekend-only positions). Nearly a quarter of the nurses (23%) rotated shifts.

Nursing subgroup schedules. Hospital staff nurses constituted the largest subgroup of nurses examined. All subgroup comparisons described below were significant ($P < 0.001$), when the normal-theory method for a one-sample test for a binomial proportion was used. The hospital staff nurses were most likely to work 12 or more hours per day (52% versus 28% of the entire sample), although they were half as likely to work six to seven days per week, as compared with the total sample (2.6% versus 5.2%), suggesting that compression of the workweek into fewe$_4$ longer days was prevalent among this subgroup. They were also more likely to work off-shifts, as compared with the total sample.

Nurses with more than one job were more likely to work 12 or more hours per day (37% versus 28% of the total sample) and 50 or more hours per week (24% versus 14% of the total). Compared with the sample as a whole, they more often worked consecutive days without breaks for long stretches (9% worked 13 or more days in a row, versus 4% of the total), with insufficient rest (14% often worked with less than 10 hours off between shifts at least once per week, versus 8% of the total), and during scheduled time off (13% did so at least once per week, versus 5% of the total).

The work schedules of single parents with children were most similar to the schedules of those who often worked more than one job: both subgroups were as likely to report working long days (13 to 15 or more hours per day) (see Figure 3, page 63), long weeks (50 to 60 or more hours per week), and many consecutive days in a row. Compared with the total sample, they were more likely to work off-shifts, and with less than 10 hours off between shifts. Twenty-four percent of single parents had jobs that included mandatory overtime.

Nurses 50 years old and older were less likely to work long days (12 or more hours) than the over-

FIGURE 2. PROPORTION OF RN RESPONDENTS IN TOTAL SAMPLE AND FOUR SUBGROUPS REPORTING SELECTED WORK SCHEDULE CHARACTERISTICS (N = 2,273)*

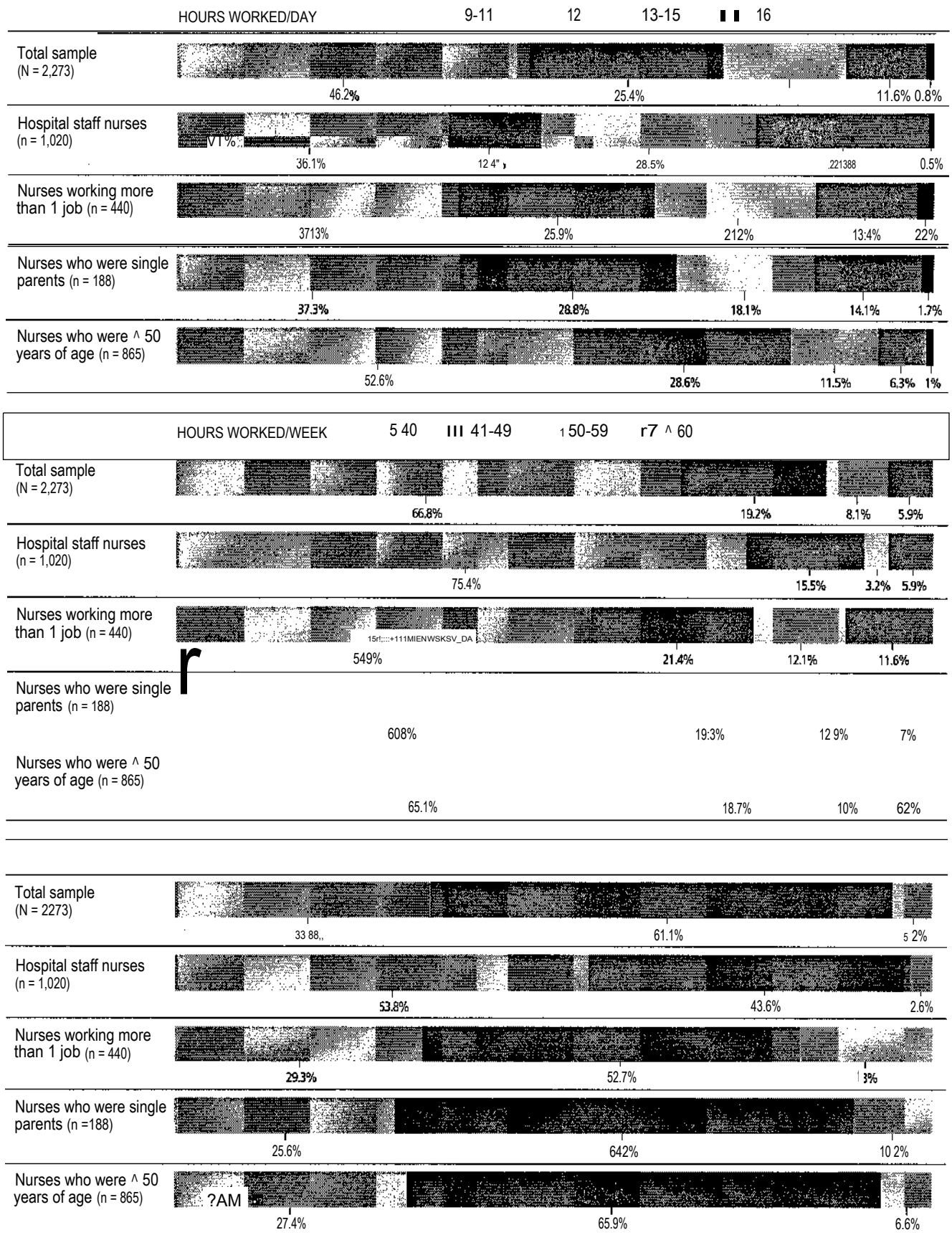
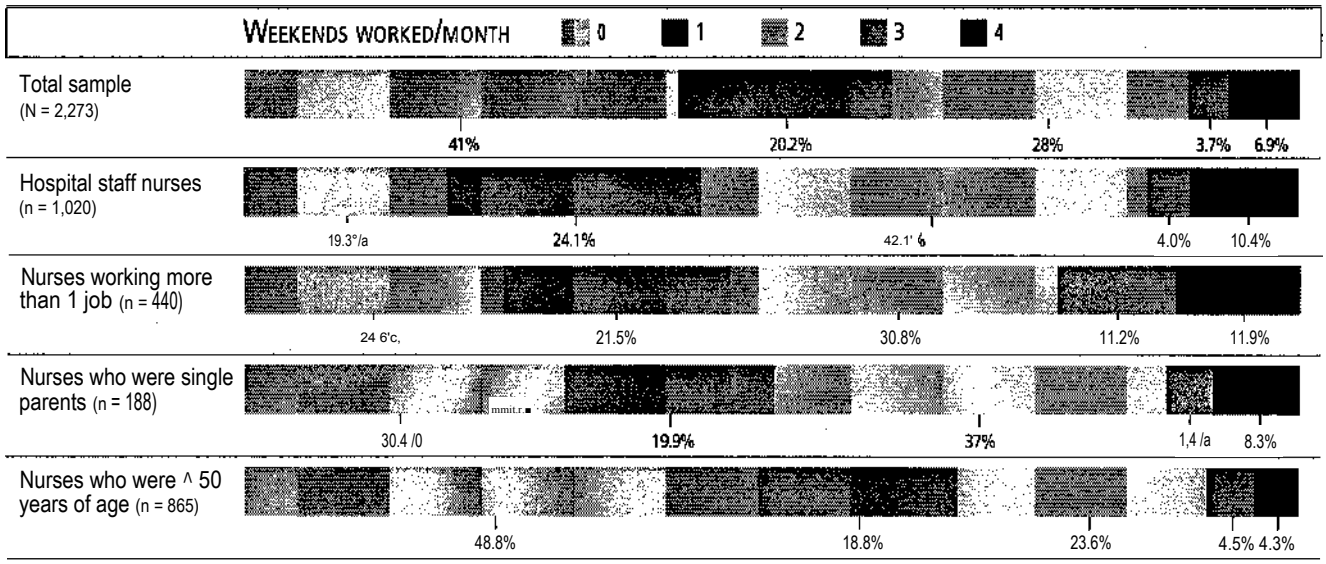


FIGURE 2. CONTINUED



* Percentages may not add up to 100% because of rounding. Work schedule characteristics represent the "typical work schedule" in the six months preceding the completion of the questionnaire.

all sample (19% versus 28%). They also had the highest proportion of nurses who worked days only (66%) and tended to work more days per week, as compared with the total sample.

Overtime, on-call status, breaks, other nonwork activities. For many nurses, time off the job was not well protected. In addition to regular work hours, 17% worked mandatory overtime, with two-thirds of these nurses required to do so with less than two hours' notice. Examining race, sex, ethnicity, and years of experience across the total sample, we found no significant differences in the proportions who reported working jobs with mandatory overtime, although nurses with master's or doctoral degrees were less likely to have jobs with mandatory overtime (Pearson χ^2 = 7.05, with 1 degree of freedom [df]; P = 0.004). In the analysis of hospital staff nurses, there were no differences in overtime worked when demographic characteristics were examined. Furthermore, there was no difference in the prevalence of mandatory overtime among hospital staff RNs, compared with the overall sample, those working more than one job, and nurses 50 and older. As was noted earlier, single parents were most likely to report working jobs with mandatory overtime (24%).

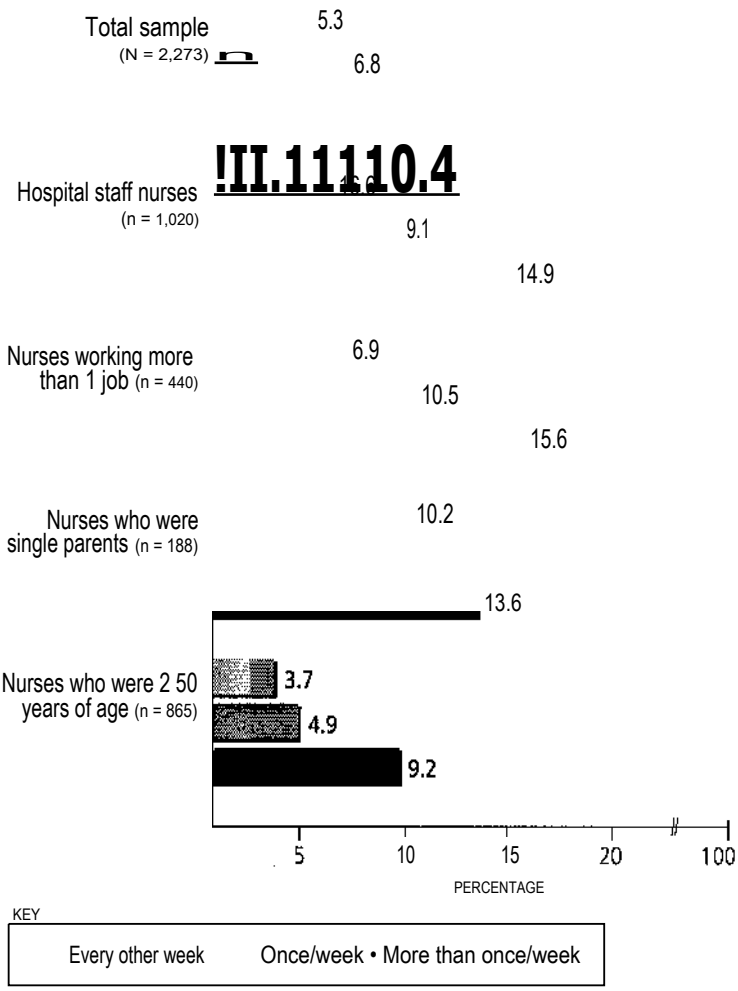
On-call requirements were very common among the total sample (38.6%, n = 877) and were even more prevalent among hospital staff nurses (43.5%). See Figure 4, page 69. In the total sample, among nurses with on-call requirements, 22% were called in monthly, 12% weekly, and 7% more than once a week, and we found similar percentages among the hospital staff nurses. Despite the long hours that nurses reported working, few took breaks; 11% of nurses reported that they typically took no breaks during their work shift. This figure varied little across the subgroups.

Among the total sample, those whose jobs included mandatory overtime worked significantly longer hours (Pearson $\chi 2$ = 15.64, with 3 df; P = 0.004), whereas among hospital staff nurses, the proportion of those who worked mandatory overtime did not differ by hours worked per day (Pearson $\chi 2$ = 5.06, with 4 df; P = 0.24). For on-call hours, the same pattern was seen: among the overall sample, on-call hours were directly related to hours worked per day (Pearson $\chi 2$ = 32.10, with 4 df; P < 0.0001). Among hospital staff nurses, the proportion having on-call hours was not related to hours worked (Pearson. χ^2 = 2.13, with 4 df; P = 0.71). Nonetheless, for both the overall sample and hospital staff nurses, jobs requiring on-call hours were significantly more likely to have mandatory overtime as well (Pearson χ^2 = 61.76 for the total sample and 29.49 for the hospital staff nurses, with 1 df for both groups; P < 0.0001 for both groups).

In other activities outside of work, 20% of our sample spent more than two hours per day commuting, and 31% spent more than 20 hours per week on housework or childcare chores or both. Leisure time was also limited: 27% reported that they had an hour or less per day to relax or pursue activities that they enjoyed.

Schedules compared to IOM recommendations. The data show that 17% of staff nurses, 4% of managers, and 7% of advanced practice RNs exceeded the IOM's proposed work-time guidelines on a regular basis. Compared with those in other workplaces, hospital nurses (19%) most frequently worked more than 12 hours; compared with those in other specialties, adult and pediatric critical care nurses were most likely to report working such schedules (36% and 27%, respectively), followed by ED nurses (26%). Four percent of staff nurses, most

FIGURE 3. PROPORTION OF RN RESPONDENTS WHO REPORTED WORKING 13 OR MORE HOURS PER DAY (N = 2,273)



of them working in hospitals, exceeded the recommendation of a maximum 60-hour workweek.

DISCUSSION

A substantial proportion of nurses reported working schedules that conflict with the recommendations of the IOM, with long hours, few days off, and little time off between workdays. The work schedules of nurses described in this survey suggest that there should be industry-wide concerns about fatigue and health risks to nurses as well as the safety of patients in their care. (Indeed, in one study, excessive overtime and fatigue were implicated in an outbreak of bacterial infection in a hospital environment.4s)

Rogers and colleagues reported that shifts of more than 12 hours tripled the risk of making an error.[25] Our findings complement and extend their hospital-based diary studies by contributing survey data on schedules from a large, population-based sample of nurses working in diverse settings. Because of the large sample, we were able to examine schedules among important subgroups of the nursing workforce, such as single parents. In addition, we collected new data on the occurrence of other adverse work-schedule factors, such as mandatory overtime, on-call hours, and working on a scheduled day off. Because there are few major studies in the emerging area of extended work hours and health among nurses, there is a need for more research into the specific schedule characteristics that might have an adverse effect on nurses' health.

For many nurses, these adverse working conditions don't occur singly but in combination, including frequent rotation, returning to work after insufficient time off, and working overtime on short notice or on scheduled days off. We found that jobs that included mandatory overtime were significantly more likely to have on-call requirements as well. Such combinations can make working extended hours unhealthy and even dangerous." Rosa and colleagues found that shifts of 12 or more hours of continuous work were associated with greater reported fatigue and a decline in work performance over time." (For more on the consequences of fatigue, see "Are You Tired?" *First Do No Harm,* March 2004.) In addition, some nurses have to provide care outside the workplace, juggling these responsibilities with extended work hours and other adverse conditions (for example, frequent rotation combined with consecutive long days or weekend work).

Even if nurses' work schedules are restricted to those that comply with the IOM's recommendations, there still may be health consequences, particularly if their schedules also contain other adverse components, such as shift rotation or mandatory overtime. Encouraging or requiring already tired nurses to work extra hours perpetuates a vicious cycle of fatigue, job change, and exit from the profession. This compounds staffing problems by creating shortages of nurses and the need for extended work hours. Conversely, improving nurses' working conditions has actually been shown to decrease vacancies and shortages, reducing the need to hire temporary staff nurses with their attendant higher costs.47

The fact that some nurses want to work long hours is sometimes given as a reason to encourage nurses to work extended hours. Our study asked whether nurses were required to work overtime, yet many nurses without such a requirement also reported working long hours. Studies of health effects of extended hours in other industries have found no correlation between those effects and whether extended hours are required or voluntary, suggesting that the health impact is comparable regardless of this distinction." Other safety-sensitive industries, such as

long-distance trucking, have regulated work hours for the sake of public safety.

Because study data were based on self-reports, some possible limitations of the study should be considered. Other survey research, such as that of the Harvard Nurses' Health Study, has shown that nurses can provide valid and reliable data on their own risk factors and health outcomes [4x,50] Because our survey population was similar, we believe such findings support the appropriateness of using a survey design to measure scheduling. However, the findings of all studies that rely on self-reporting should be interpreted with caution. Self-reporting may be compromised by difficulty in recalling what actually occurred, as well as by other factors such as denial or deception. We limited the recall period for work schedules to six months, in part, to promote accurate recall. Other limitations included a lack of some detailed data, such as whether or not breaks taken by nurses were interrupted, nurses' reasons for holding more than one job, the consequences of refusing mandatory overtime, and whether nurses were compensated for all hours worked.

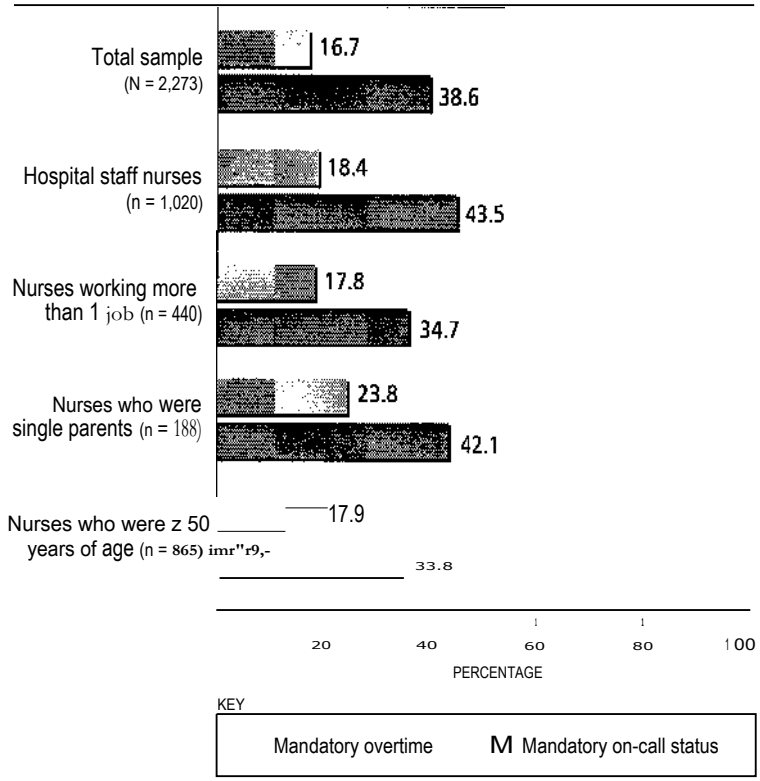
Another concern is possible nonresponse and selection biases: those who tend to participate in surveys may not resemble the population of RNs as a whole. Nonetheless, when we compared the characteristics of our respondents to those of the 2000 National Survey of Registered Nurses, distributions were very similar. Finally, because the analysis was limited to currently working nurses, we may have excluded nurses who had left jobs because of excessive scheduling demands or other health conditions that precluded their continuing to work such schedules. For that reason, our findings may be conservative.

Recommendations. Health care providers and legislators need to recognize the limits within which nurses can practice safely. Nursing leadership and health facility management should encourage adequate staffing by promoting optimal working conditions that appeal to employees and create loyalty and stability in the workforce. Data indicate that the extension of nurses' schedules beyond what they can comfortably and reasonably work is discouraging many nurses from remaining in the profession.'

Collective action is needed to improve scheduling. One nurse simply refusing to work mandatory overtime, for example, can jeopardize his or her livelihood." Currently, 10 U.S. states have regulations or have passed legislation to prohibit mandatory overtime for nurses (California, Connecticut, Maine, Maryland, Minnesota, New Jersey, Oregon, Texas, Washington, and West Virginia). In addition, 15 other states have introduced such legislation (Colorado, Florida, Georgia, Hawaii, Illinois, Iowa, Massachusetts, Michigan, Nebraska, New York, Ohio, Pennsylvania, Rhode Island, Tennessee, and Vermont). Washington, California, and Maine have enacted laws protecting nurses who refuse to work more than 12 consecutive hours from disciplinary action.' Nurses in Maine must have 10 hours off duty before returning to work, with exemptions only during a declared public emergency." At the federal level, bills to improve nurse staffing levels and limit the practice of mandatory overtime, known as the Safe Nursing and Patient Care Act of 2005 (HR 791; S 351), have been introduced. These efforts should be studied to examine their effects on nurse retention and shortages. The impact on actual schedules worked should also be examined.

Nurses prefer working in facilities with predictable work hours and schedules and appropriate patient loads.' Allowing them to have greater control of their work schedule may reduce the risk of future health problems,'" but more data are needed on the impact of work schedule modifications. Furthermore, provision of more healthful scheduling with minimal overtime could address the nursing shortage by retaining and attracting nurses.'" Nurses, employers, nursing organizations, and labor representatives can focus attention on this important issue

FIGURE 4. PROPORTION OF RN RESPONDENTS WHO REPORTED THAT THEIR PRIMARY JOB HAD MANDATORY OVERTIME OR ON-CALL HOURS (N = 2,273)



The Nurses Worklife and Health Study

The Nurses Worklife and Health Study is an ongoing program research that examines how nursing work influences nurses' health. Alison Trinkoff, ScD, RN, FAAN, is the principal investigator. The research has been funded by the National Institute for Occupational Safety and Health (Parts II and III) and the National Institute on Drug Abuse (Part I). Each of the studies listed below used a different population-based sample of RNs, and data were collected using mailed surveys; response rates were good.

PART 1(1993 to 1998). This cross-sectional study examined various aspects of nursing, such as specialty, work schedule, and job strain, on patterns of substance use among more than 4,400 RN s

PART 11 (1998 to 2001). This cross-sectional study of 1,428 RNs from diverse settings looked at patterns of neck, shoulder, and back injuries and disorders in relation to physical demands, work schedule, and health care changes that influence nursing work (for example, increased job responsibility, floating off unit, unfilled positions, layoffs, high patient loads and acuity, shorter lengths of stay, and use of unlicensed personnel).

PART III (2001 to 2006). This longitudinal study of RNs was designed to obtain detailed information on work schedules, including long work hours, on-call and mandatory overtime requirements, working on scheduled days off, and shift rotation. The relationship of these scheduling factors to two important outcomes, musculoskeletal disorders and needlestick injuries, was also examined. Mailed surveys were used to examine variables at baseline and at six and 15 months. This allowed the researchers to make causal inferences about the effect of these work patterns on the incidence of musculoskeletal disorders and needlestick injuries. The current study used baseline data from 2,273 RNs who were working as nurses during the previous year.

and work to develop solutions to protect the health of nurses and patients. Studies examining the impact of such solutions will be important to carry out, in order to provide evidence-based information for policy makers and administrators.

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- discuss the methodology, statistical results, and limitations of the study.
- outline the authors' conclusions and recommendations as they relate to scheduling practices and the hours nurses work.

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Longitudinal Relationship of Work Hours, Mandatory Overtime, and On-call to Musculoskeletal Problems in Nurses

Alison M. Trinkoff, ScD, RN, FAAN,* **Rong Le,** PhD, RN, **Jeanne Geiger-Brown,** PhD, RN, **Jane Lipscomb,** PhD, RN, FAAN, **and Gary Lang,** MSN, RN

Background *Nurses are at very high risk for work-related musculoskeletal injury/disorders (MSD) with low back pain/injury being the most frequently occurring MSD. Nurses are also likely to work extended schedules (long hours, on-call, mandatory overtime, working on days off). The purpose of this study was to examine the relationship of extended work schedules in nurses to MSD.*

Methods *Using a longitudinal, three wave survey of 2,617 registered nurses, Wave 1 work schedule data were related to neck, shoulder, and back (MSD) cases occurring in Waves 2 or 3.*

Results *Schedule characteristics increasing MSD risk included 13+ hour/days, off-shifts, weekend work, work during time off (while sick, on days off, without breaks), and overtime/on-call. These increases in risk were not explained by psychological demands, but were largely explained by physical demands.*

Conclusions *Adverse schedules are significantly related to nurse MSD. Healthier schedules, less overtime, and reducing work on days off would minimize risk and recovery time. Am. J.* Ind. Med. 49:964-971, 2006. © *2006 Wiley-Liss, Inc.*

BACKGROUND

Americans are working longer hours and more weeks per year, with average time on the job currently exceeding that for most other industrialized nations [Caruso et al., 2004]. The health care industry is especially affected by the trend toward longer workdays [Landsbergis et al., 1999] because of demands for increased cost efficiencies, accomplished primarily by reducing staffing. As a result, job demands [Bourbonnais et al., 2005] and unhealthy scheduling practices such as overtime have been increasing [Berney et al., 2005].

Nursing is the largest sector of health care employees, and the changes in work patterns are having a great impact on the nursing profession [Lipscomb et al., 2004]. Many nursing positions now require extended work schedules (>8 hr/day and/or >40 hr/week). These positions also may include mandatory overtime and on-call activities, working on days designated as time off, and working while sick [ANA, 2001] to maintain staff complements.

Recent data indicate that nurses are at high risk for work-related musculoskeletal disorders (MSD) [Ando et al., 2000; Maul et al., 2003; Smedley et al., 2003; Smith et al., 2004]. Low back pain/injury is the most frequent musculoskeletal injury/disorder in nurses, followed by neck and shoulder problems [Alexopoulos et al., 2003]. In 2004, health care ranked second among 15 industry sectors for non-fatal occupational injuries [Bureau of Labor Statistics (BLS), 2005]. Nursing homes and residential care facilities had an incidence rate of 9.7 injuries/100 full-time workers, while

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hospitals had an incidence rate of 8.3/100 full-time workers [BLS, 2005].

Nursing work is physically demanding, requiring heavy lifting, bending and twisting, and other awkward postures that are implicated in MSD [Yip, 2001; Trinkoff et al., 2003; Menzel et al., 2004]. Physical demands increase the odds of injury [Fredriksson et al., 2002; Punnett et al., 2004] due to creation of compression, rotation, and shear forces that exceed body tolerances [Marras et al., 1999; Forde et al., 2002; Hoozemans et al., 2002]. Psychological job demands can amplify the effects of physical exertion [Ariens et al., 2002; Davis et al., 2002; Devereux et al., 2002]. Furthermore, lack of ability to control time on and off work—which is inherent in mandatory overtime and on-call work—disproportionately affects women, who may have additional home responsibilities such as child care [Ala-Mursula et al., 2004; Jansen et al., 2004].

Because extended work schedules increase exposure to job demands, while limiting rest and recovery time, such extended hours may result in increased MSD [Spurgeon et al., 1997; Jansen et al., 2003]. Engkvist et al. [2000] found that Swedish nurses working full-time (>35 hr/week) were at increased risk of back injury (OR 2.4, 95% CI 1.6-3.6). Engels et al. [1996] found that back and leg symptoms were positively associated with hours worked per week by nursing home staff, and Lipscomb et al. [2002] found that MSD was related to extended work hours, especially off-shift and weekend hours.

Despite these findings, no research has systematically examined the health impact on nurses of newer scheduling characteristics (mandatory overtime, on-call, working on days off, etc.). The present study evaluates these characteristics in relation to reported neck, shoulder, and back MSD and examines the impact of multiple work schedule characteristics, grouped using factor analysis, on reported MSD.

METHODS

Sample and Data Collection Procedure

A three-wave longitudinal survey of nurses as part of the Nurses Worklife and Health Study [Trinkoff et al., 2006] was conducted after obtaining University Institutional Review Board (IRB) approval. Five thousand randomly selected actively licensed nurses from two US states were contacted. Of these nurses, 4229 were sent questionnaires (138 had invalid addresses, and 633 declined to enroll).

In Wave 1, nurses received an optically scannable mailed survey and an introductory letter in November 2002. A $2 incentive and study logo pencil were included in the first questionnaire packet to encourage response, as recommended by Dillman [2000]. A second and third questionnaire mailing and a reminder postcard, if needed followed this mailing. Wave 2 and 3 questionnaire mailings used the same procedures, except that the Wave 3 survey contained a $5 incentive.

The resulting sample had demographic and job distributions (across facility type, position, and specialty areas) that were comparable to the National Sample Survey of Nurses [HRSA, 2000], supporting the generalizability of the sample to US registered nurses.

Study Variables

The following work schedule characteristics were measured at the Wave 1 baseline: hours per day; hours per week; days per week; weekends per month; number of breaks lasting 10 min or more; full-time versus part time status; number of jobs (one vs. more than one); and shifts (straight days vs. other). The frequency with which nurses worked 13 hr or more; with less than 10 hr off between shifts; while sick; or on a day off/vacation day, mandatory overtime, and required on-call (dichotomized as 1= called into work at least weekly vs. 0 = called in less frequently or not at all); and the longest stretch worked without a day off were measured and dichotomized. Work schedule variables were derived from the Standard Shiftwork Index [Barton et al., 1995; Smith et al., 2001], and three NIOSH experts examined the survey for content validity (Roger Rosa, Clare Caruso, and Steve Sauter; Personal communication, 9/2002). In the Wave 1 survey, nurses were asked to consider their typical work schedule for the past 6 months, for all jobs held. The use of a 6-month period was designed to increase the validity of schedule data, by minimizing the chance that participants would provide responses that covered an unusual or atypical work period [Folkard et al., 1995]. Nurses were asked to report the hours they had actually worked, including overtime, not the hours they were scheduled to work [Folkard et al., 1995]. To compare our findings to earlier cross-sectional findings [Lipscomb et al., 2002], a similar work schedule index (WSI) was constructed using the schedule components listed above. All variables were dichotomized as 0, 1 variables for the WSI, with the exception of hours per day and hours per week which were coded as 0-2. For hours per day: 1= 9-11 hr, and 2 = 12+ hours per day; for hours per week: 1= 41 to 49 hr, and 2 = 50+ hours per week, so that WSI scores ranged from 0 to 10.

MSD was measured by reports of neck, shoulder, and/or back symptoms including pain, numbness, tingling, aching, stiffness, or burning, adapted from the Nordic questionnaire of musculoskeletal symptoms [Kuorinka et al., 1987]. An "MSD case" was defined as report of a relevant symptom lasting 1 week or more, or occurring at least monthly, with moderate or more pain on average [Bernard et al., 1994], without a non-work injury/accident within 3 months prior to the onset of musculoskeletal symptoms.

Those at risk for MSD were identified separately for each body part (neck, shoulder, back). For example, nurses reporting neck symptoms that did not meet the neck MSD case definition at Wave 1 (because of insufficient frequency, duration, and/or pain intensity) and nurses reporting no neck symptoms were considered at risk for incident neck MSD at Wave 2 or Wave 3. In addition, nurses who had recovered from a Wave 1 neck MSD or a non-work related neck injury were also included in the group at risk for an incident neck MSD. Nurses reporting no neck, shoulder, or back problems at Wave 3 served as the reference group [Rothman and Greenland, 1998].

The impact of psychological and physical demands on the relationship between schedule characteristics and MSD was examined using scale items that were dichotomized, summed, and treated as continuous variables in the analysis. For psychological demands, 7 items from the job content questionnaire (JCQ) were used [Karasek, 1985]: working very hard, very fast, excessive work, long periods of intense concentration, enough time to get the job done, tasks often interrupted, and waiting on work from other people/departments. These were dichotomized and summed as a continuous variable ranging from 0 to 7 (alpha = 0.76). To measure perceived physical demands, we used the JCQ and incorporated additional occupation-specific physical demand items, as recommended by Karasek [1985] when studying a single occupation. For physical demands, 12 items measured the frequency of awkward postures, heavy lifting, and pushing and pulling heavy loads on the job (alpha = 0.85). [Karasek, 1985; Karasek and Theorell, 1990; Bernard et al., 1994; NIOSH, 1997; Trinkoff et al., 2003]. It was also assessed whether the respondent changed jobs during the follow-up period.

Data Analysis

Descriptive analyses included the cumulative incidence of reported neck, shoulder, and back MSD occurring by Wave 3. Regression with age-adjustment was used to estimate the impact of each work schedule characteristic on incident neck, shoulder, and back MSD, with the score for number of breaks reversed to reflect consistency in the direction of odds ratios.

Principal components analysis on 15 Wave 1 work-schedule items were assessed for underlying patterns, extracting factors with eigenvalues >1.0. Five factors assessing groupings of multiple work schedule characteristics were created (Table I). The regression method was used to compute factor scores, which were then regressed on neck, shoulder, and back MSD. Finally, the potential impact of psychological and physical demands on the relationship between schedule factors and MSD was examined. Because job change (occurring after baseline) had no effect on the relation between schedule and MSD in the regression models, the results presented do not include this variable.

TABLE Factor Analysis for the Work-Schedule Variables, [a] Eigenvalues for Nurses Working in Nursing in the Past Year at Baseline (N = **2273)**

Factor	Workday	Week	Mandatory overtime and on-call	Number of jobs/most days in a row	Work on time off
Hours/day	**0.782**				
Weekends/month	0.671				
Work 13 hr or more	**0.694**				
Shift	**0.627**				
<10 hr off between shifts	0.615				
Hours/week		**0.840**			
Full time versus Part time Status		**0.840**			
Days/week		**0.786**			
Required On-call			**0.755**		
Mandatory overtime			0.697		
Number of jobs				**0.762**	
Most days worked in a row				**0.536**	
Work while sick					0.727
Breaks/day					**0.523**
Work on a day off/vacation day					**0.569**

[a]Rotated component matrix, factors with eigenvalues of 1.0 or higher were extracted using a principal component analysis as the extraction method with Varimax rotation.

RESULTS

In Wave 1, returned questionnaires were received from 2,624 nurses, for a 62% enrollment rate. Follow-up rates for Waves 2 and 3 were 85% and 86%, respectively. The average time between questionnaire returns from Wave 1 to 2 was 6 months (180 days) and from Wave 1 to 3, 15 months (454 days). The mean age for the sample was 45 years and the sample was 95% female. For the analysis reported here, respondents had to have worked in nursing during the year prior to Wave 1.

The cumulative incidence of MSD was 14.0% for neck, 17.3% for shoulder, and 21.1% for back problems. Regression of the work schedule characteristics, with age-adjustment revealed that many of these characteristics were significantly associated with all three types of MSD (hours/day; hours/week; >13 hr/day; less than 10 hr off between shifts, work while sick, on days off, and mandatory overtime (Table 11). On-call involving weekly or more call-ins to work was significantly associated with back and shoulder MSD. The work schedule index (WSI) was significantly associated with all three types of MSD.

Analysis of work schedule factors showed that the workday factor (hours/day, working 13+ hours/day, non dayshifts, weekends, working with less than 10 hr off) and working on time off (working while sick, on days off, instead of taking breaks) were significantly related to neck, shoulder, and back MSD, when the other work schedule factors were taken into account (Table III). Mandatory overtime/ on-call was significantly related to shoulder MSD. These findings remained significant after adjusting for psychological demands. Except for back MSD, the effects of the workday factor was largely explained by physical demands, as were the effects of the overtime/on-call factor.

DISCUSSION

Using a longitudinal study design, we found that work schedule independently increased nurses' risk of developing an MSD. This was not explained by psychological demands, though physical demands (such as lifting) explained the effects of some work schedule characteristics. We found similar effects in a previous cross-sectional examination of these variables [Lipscomb et al., 2002]. The effect of the workday factor on MSD is also consistent with other studies showing increased MSD and other health problems for those working longer days, off-shifts and weekends [Smith et al., 1998; Schernhammer et al., 2003; van der Hulst, 2003; Horwitz and McCall, 2004]. The present study is the first to examine the impact of mandatory overtime, being on-call, working while sick or on a day off, and with less than 10 hr off. All of these scheduling practices were related to increased risk of MSD. In a recent study of male civil servants, working while sick was related to increased risk of adverse cardiac events [Kivimaki et al., 2005]. Working while sick among nurses has been increasing in work settings with limited staffing, due to pressure from supervisors and loyalty to co-workers [Crout et al., 2004]. The adverse health effects of working during time off may be related to encroachment on recovery and recuperation time during and between workdays [Sluiter et al., 2003; Hughes and Stone, 2004]. As time off diminishes, for example, workdays with less than 10 hr off in between, nurses have fewer opportunities to heal or recover to baseline. In one intervention study, shorter work hours markedly decreased neck, shoulder, and back pain [Wergeland et al., 2003].

An important finding in our study was the impact of mandatory overtime and on-call on all types of MSD, indicating that this is not a healthful practice. The relationship of overtime to injury has been reported for many industry sectors, with injury risks increasing as hours increased [Dembe et al., 2005; Dong, 2005]. Professional nursing advocacy groups have suspected this, though reports of adverse health effects to date have been limited [Nicol and Botterill, 2004]. In this sample, 16.7% had jobs with mandatory overtime and 38.6% had required on-call hours [Trinkoff et al., 2006]. There is anecdotal evidence that employers are removing mandatory overtime from nurse schedules and increasingly substituting on-call requirements. This practice will not provide any safety benefit to nurses if it still leads to extra hours in the workplace, and it may signal a need to incorporate on-call work into mandatory overtime prohibition laws. There are also potential consequences for the quality of care provided, as Rogers et al. [2004] found that nurses working more hours reported greater likelihood of making an error.

Mandatory overtime has now been prohibited in many US states, is disliked by nurses [Jacobsen et al., 2002] and is related to lower job satisfaction among workers in general [Golden and Wiens-Tuers, 2005]. On the other hand, some nurses voluntarily request long work hours, a practice that is not limited by mandatory overtime laws, despite the health consequences of long work hours. Without controls on unhealthy scheduling practices, the risk for nurse injury is high [Spurgeon et al., 1997] as is turnover of nurses [Aiken et al., 2001]. In California, which has minimum nurse staffing requirements, shortages have been diminishing due to an influx of nurses into the state seeking the improved working conditions that have resulted [Robertson, 2004; Spetz, 2004; Spetz et al., 2004]. The introduction of more healthful scheduling thus not only can protect the health of working nurses but also provide incentives for nurses to remain on the job, saving costs and relieving shortages for health care facilities [Shader et al., 2001; Reineck and Furino, 2005].

The longitudinal design of the study made it possible to assess the temporal sequence of work schedule components and MSD. A high rate of follow-up of the baseline sample in Waves 2 and 3 (85% and 86%, respectively) increased the

TABLE II. Age Adjusted Odds Ratios (OR) for Reported Incident Cases of Muscu l oskeletal Disorders by Work-Schedule Characteristic, for Nurses with >1 Year Worked in Nursing at Baseline, 2003-2004

	Musculoskeletal disorder					
	Neck*(N = 226)		Shoulder** (N = 281)		Back*** (N = 308)	
Work-schedule variable	OR	95% CI	OR	95% CI	OR	95°/0 CI
Hours/day	1.07	0.99-1.16	1.08a	1.01-1.16	1.08a	1.01-1.16
Hours/week	1.01a	1.00-1.03	1.01a	1.00-1.03	1.01a	1.00-1.02
Days/week	1.01	0.88-1.15	1.00	0.89-1.14	0.97	0.86-1.09
Weekends/month	1.10	0.96-1.26	1.06	0.93-1.21	1.18b	1.05-1.34
Breaks/day	1.11	0.90-1.36	1.13	0.93-1.36	1.32b	1.10-1.59
Status						
Part-time	1.00		1.00		1.00	
Full-time	1.42	0.97-2.08	1.38	0.97-1.95	1.26	0.90-1.76
Number of jobs						
One	1.00		1.00		1.00	
More than one	1.15	0.77-1.72	1.11	0.75-1.62	1.03	0.71-1.50
Shift						
Straight Days	1.00		1.00		1.00	
Other	1.18	0.84-1.65	1.29	0.94-1.77	1.27	0.94-1.72
Work 13+ hrs						
No	1.00		1.00		1.00	
Yes	1.94b	1.38-2.74	1.87`	1.35-2.58	1.87[b]	1.37-2.55
Less than 10 hr off between shifts						
No	1.00		1.00		1.00	
Yes	1.58b	1.12-2.23	1.92`	1.39-2.64	1.55[b]	1.13-2.11
Work While Sick						
No	1.00		1.00		1.00	
Yes	2.40b	1.47-3.91	1.84[b]	1.21-2.80	1.48[a]	1.01-2.17
Work on a day off/vacation day						
No	1.00		1.00		1.00	
Yes	1.89b	1.28-2.80	1.89[b]	1.32-2.72	1.41[a]	1.01-1.97
Mandatory overtime						
No	1.00	—	1.00		1.00	
Yes	1.56a	1.00-242	2.17[b]	1.46-3.23	1.55[a]	1.03-231
On-call						
None-monthly	1.00		1.00		1.00	
Weekly or more	1.41	0.77-2.56	1.99[a]	1.16-3.38	1.88[a]	1.16-3.16
Most days worked in a row						
0-5 days	1.00	—	1.00		1.00	
6+days	1.42	0.99-2.04	1.42a	1.01-2.00	1.01	0.71-1.42
Work Schedule Index	1.08	0.99-1.17	1.09a	1.01-1.19	1.12b	1.03-1.22

Reference group, respondents who were completely asymptomatic in all body parts at wave 3 (*N = 481, **N = 483, ***N = 487).
95% CI, 95% Confidence Interval.
[a]rwo tailed significance at 0.05 level.; [b]0.01 level.; [C]o.001 level.

credibility of the findings. The limitations of our study stem from self-report, which can be affected by recollection and recall. Use of typical and average schedule descriptors in collecting schedule characteristics, increases the validity of the findings, since average reported schedules are less likely to reflect an unusual time period [Folkard et al., 1995]. Others have measured typical work schedules [Bureau of Labor Statistics, 2002] and number of years that nurses

TABLE Age Adjusted Odds Ratios (OR) of Reported Incident Cases of Musculoskeletal Disorders by Baseline Work-Schedule Factor Scores,for Nurses with > 1 year Worked in Nursing at Baseline, 2003-2004

	Musculoskeletal disorder					
	Neck* (N = 226)		Shoulder** (f4 = 281)		Back*** (N = 308)	
Work-schedule factor	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Age adjusted model						
Workday factors	1.30[c]	1.06-1.59	1.37c	1.13-1.67	134c	1.11 – 1.62
Week factor	1.05	0.86-1.30	1.09	0.89-1.33	0.95	0.79-1.13
Mandatory overtime and on-call factor	1.07	0.87-1.32	1.24a	1.03-1.49	1.15	0.95-1.38
Number of jobs/most days worked in a row	1.05	0.85-1.28	1.05	0.86-1.28	1.11	0.92-1.35
Working on time off factor	1.39[4]	1.12-1.71	1.29c	1.07-1.56	1.18	0.99-1.40
Model adjusted for all of the above plus psychological demands						
Workday factor	1.26[a]	1.03-1.55	1.344	1.10-1.63	1.304	1.08-1.58
Week factor	1.05	0.85-1.29	1.08	0.89-1.32	0.93	0.78-1.12
Mandatory overtime and on-call factor	1.05	0.85-1.29	1.22a	1.01-1.47	1.12	0.93-1.36
Number of jobs/most days worked in a row	1.06	0.86-1.30	1.05	0.86-1.28	1.12	0.92-135
Work on time off factor	1.33[a]	1.07-1.66	1.25a	1.03-1.52	1.13	0.94-1.36
Psychological demands	1.09	0.98-1.22	1.07	0.96-1.18	1.09	0.99-1.20
Model adjusted for all of the above plus physical demands						
Workday factor	1.19	0.95-1.49	1.19	0.96-1.48	1.22	0.99-1.51
Week factor	1.05	0.85-1.29	1.10	0.90-1.35	0.94	0.78-1.13
Mandatory overtime and on-call factor	1.03	0.83-1.27	1.19	0.98-1.43	1.10	0.91-1.33
Number of jobs/most days worked in a row	1.05	0.85-1.29	1.03	0.84-1.27	1.11	0.91-1.34
Working on time off factor	1.32[a]	1.06-1.64	1.23a	1.01-1.50	1.12	0.93-1.35
Psychological demands	1.06	0.94-1.19	1.01	0.90-1.13	1.05	0.95-1.17
Physical demands	1.05	0.97-1.12	1.09a	1.02-1.17	1.05	0.98-1.12

95% CI, 95% Confidence Interval.

[a]Two tailed significance at 0.05 level.; [b]aw level.; 90.001 level

Reference group, respondents who were completely asymptomatic in all body parts at wave 3 ("N = 481, *"N = 483, **"N = 487).

[t]Workday factor-hours/day, weekends/month, shift, 13+ hr days, <10 hr off between shifts; Week factor-hours/week, full versus part-time; Working on time off factor-work while sick, on a day off or vacation day, breaks taken.

worked off-shifts [Kawachi et al., 1995; Schernhammer et al., 2001]. Furthermore, researchers have found survey questionnaires measuring work demands to have acceptable reproducibility over time [Torgen et al., 1999] and when compared to observations [Pope et al., 1998]. The reliability and validity of self-reported MSD assessed by survey method has also been found acceptable for the purposes of assessing risk factors [Bjorksten et al., 1999; Kaergaard et al., 2000] and as a screening tool [Baron et al., 1996]. Survey data generally correlates well with physical findings [Punnett and Wegman, 2004].

The present study provides evidence that adverse work schedules are related to reported incident nurse MSD. Prevention efforts should include movement to more healthful and reasonable scheduling practices. Although schedule modifications may initially require additional nursing staff, retention of a stable and healthier workforce will ultimately benefit nurses, workplaces and patients.

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Principal Investigator/Program Director (Last, First, Middle): Trinkoff, Alison M.

Inclusion Enrollment Report

This report format should NOT be used for data collection from study participants.

Study Title: Extended Work Schedule and Workplace Injury in Nurses

Total Enrollment: 2624 **Protocol** Number: 1001105

Grant Number: 5 R 01 OH007554

PART A. TOTAL **ENROLLMENT REPORT: Number of Subjects Enrolled to Date (Cumulative) by Ethnicity and Race**

Ethnic Category	Sex/Gender			
	Females	**Males**	**Unknown or Not Reported**	Total
Hispanic or Latino	27	3	0	30 **
Not Hispanic or Latino	2,131	114	7	2,252
Unknown (individuals not reporting ethnicity)	143	6	40	189
Ethnic Category: Total of All Subjects*	2,301	123	47	2,471 *
Racial Categories				
American Indian/Alaska Native	4	0	0	4
Asian	102	11	0	113
Native Hawaiian or Other Pacific Islander	0	0	0	0
Black or African American	133	12	2	147
White	2,003	94	7	2,104
More Than One Race	34	3	0	37
Unknown or Not Reported	25	3	38	66
Racial Categories: Total of All Subjects*	2,301	123	47	2,471 *

PART B. **HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)**

Racial Categories	Females	Males	Unknown or Not Reported	Total
American Indian or Alaska Native	0	0	0	0
Asian	1	0	0	1
Native Hawaiian or Other Pacific Islander	0	0	0	0
Black or African American	1	0	0	1
White	12	2	0	14
More Than One Race	9	1	0	10
Unknown or Not Reported	4	0	0	4
Racial Categories: Total of Hispanics or Latinos**	27	3	0	30 **

* These totals must agree.
** These totals must agree.