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Low Back Pain in Student Nurses: Literature Review and Prospective Cohort Study

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There is consensus that registered nurses worldwide have a high prevalence of work-related musculoskeletal disorders, particularly of the back (Davis & Kotowski, 2015; Sadeghian, Hosseinzadeh, & Aliyari, 2014; Yassi, 2015). In a review of 132 articles on work-related musculoskeletal disorders in nurses, the mean prevalence was 55% for low back pain in the past 12 months (Davis & Kotowski, 2015). Low back pain often progresses to restricted or lost days and ultimately to disability (Ferguson & Marras, 1997) and is therefore a problem that threatens the productivity and stability of the registered nursing workforce. However, there have been only a limited number of prospective cohort studies to determine whether low back pain develops in student nurses during the course of their programs or begin upon full employment in the profession.

The highest risk for work-related low back pain is nursing activities, particularly patient handling (Yassi & Lockhart, 2013). Exposure to patient handling begins in nursing school with the amount of exposure varying with the length of the program and the number of clinical hours the student is required to complete. Despite this exposure, nursing schools have been slow to require evidence-based safe patient handling policies and programs to protect their students (Kneafsey & Smallwood, 2010), with some still teaching manual handling and the ineffective technique of “proper body mechanics” (Menzel, Hughes, Waters, Shores, & Nelson, 2007; Nelson et al., 2007; Zwerdling, 2015, February 11).

To determine whether low back pain was prevalent in student nurses, we conducted a literature review for articles published in English from January 1990 to November 2015 using four search engines: CINAHL, Google Scholar, PubMed, and Scopus. The search words used in combinations were *musculoskeletal disorders, low back, pain, injuries, discomfort, nurse, student, student nurse, and university*. In addition, we inspected the reference lists of all searched

articles to locate additional articles. We identified 21 articles (Table 1). Only six had a prospective cohort design, which allows inference about the change in prevalence over time (Cheung, 2010; Feyer et al., 2000; Klaber Moffett, Hughes, & Griffiths, 1993; Mitchell et al., 2010; Videman, Ojajärvi, Riihimäki, & Troup, 2005). However, none of the cohort studies quantified students' exposure to patient handling.

One cohort study of student nurses in Hong Kong found a 12-month low back pain prevalence rate of 18% at entrance increasing to a cumulative incidence of 79.7% at graduation (Cheung, 2010). Similarly, another cohort study found that back pain at admission to nursing school predicted later disability with lifetime prevalence increasing from 31% at entry to 72% at graduation and 82% after five years of employment. However, the increase in 12-month prevalence was much smaller (Videman et al., 2005). In contrast, two of the cohort studies did not show marked increases during nursing school (Klaber Moffett et al., 1993; Lövgren, Gustavsson, Melin, & Rudman, 2013). The two remaining cohort studies found that sizeable percentages of students who reported no back pain at baseline reported new episodes of back pain over the follow-up period (Feyer et al., 2000; Mitchell et al., 2010).

Cross-sectional studies were more frequent in the literature than longitudinal studies. One Australian study conducted cross-sectional studies on three levels of students and one group of new graduates and found very high 12-month low back pain prevalence rates (71%) across all student levels, with 90% prevalence after one year of work (Mitchell, O'Sullivan, Burnett, Straker, & Rudd, 2008). In contrast, Japanese student nurses reported the lowest 12-month prevalence rate of 17.5% (Smith, Omori, Mizutani, & Yamagata, 2002). However, it is difficult to compare prevalence rates among countries because data collection instruments varied, as did data collection points.

Table 1. Studies of Low Back Pain in Undergraduate Student Nurses

Author(s)	Participants/Country	Design	Response Rate	Instrument	Low Back Pain Prevalence
(Abledu & Offei, 2015)	157 freshmen students/Ghana	Cross-sectional	78.5%	Nordic Musculoskeletal Questionnaire	Point:15.3% 12-month: 23.6%
(Barnes, 2009)	103 students/United Kingdom	Cross-sectional	94%	Investigator-designed	Sometime during educational program (length not specified): 34%
(Cheung, 2010)	110 students in BSN four year program studied over 26 months/Hong Kong	Prospective cohort	97% at baseline; 93% at 26 months	Nordic Musculoskeletal Questionnaire	12-month prevalence at baseline: 18% Cumulative incidence (ratio of # new cases to population exposed) at 26 months: 79.7%
(Dawson, Steele, Hodges, & Stewart, 2009)	373 university students, from which 59 were selected for test-retest/Australia	Cross-sectional	81%	Nordic Musculoskeletal Questionnaire - Extended	12-month: 56%

Author(s)	Participants/Country	Design	Response Rate	Instrument	Low Back Pain Prevalence
(Feyer et al., 2000)	694 students, followed every 6 months for 3 years of school, then 1 year after graduation/ Australia	Prospective cohort	32% by end of 3 years Not reported for 1 year after graduation.	Investigator-designed	At baseline: 12-month: 40% Over follow up: • Cases at baseline: 49% • Non-cases at baseline: 27%
(Kamwendo, 2000)	115 first year nursing students from three Swedish universities	Cross-sectional	95%	Investigator-designed	12-month: 59%
(Klaber Moffett et al., 1993)	199 students in two programs over 20 months/United Kingdom	Prospective cohort	At baseline, 53% of 376 students participated. No attrition during follow-up.	General Health Questionnaire	37% reported low back pain that lasted at least three days sometime during the study period

Author(s)	Participants/Country	Design	Response Rate	Instrument	Low Back Pain Prevalence
(Kneafsey & Haigh, 2007)	432 university level students/United Kingdom	Cross-sectional	75%	Investigator-designed	Sometime during educational program (length not specified): 26%
(Lövgren et al., 2013)	1153 students from all nursing programs over 2 years/Sweden	Prospective cohort	At baseline, 68% of 1700 students agreed. One year after graduation: 92%; 2 years after graduation: 90%	Investigator-designed	4 week prevalence remained constant at just over 40% at all measurement times over 2 years.

Author(s)	Participants/Country	Design	Response Rate	Instrument	Low Back Pain Prevalence
(Mitchell et al., 2008)	897 undergraduate students and 111 graduate nurses/Australia	Cross-sectional	54%	Nordic Low Back Pain Questionnaire	Undergraduates: • 12-month: 71% • 7 day: 31% Graduates with 12 months of experience • 12-month: 90% • 7 day: 39%
(Mitchell et al., 2009)	170 female university students/Australia	Cross-sectional	89%	Nordic Low Back Pain Questionnaire	12-month: 31%
(Mitchell et al., 2010)	117 female university students without low back pain at baseline, followed at 6 and 12-months/Australia	Prospective cohort	91% at 12 months	Nordic Low Back Pain Questionnaire	12-month: 29%

Author(s)	Participants/Country	Design	Response Rate	Instrument	Low Back Pain Prevalence
(Ofili & Sogbesan, 2002)	130 students/Nigeria	Cross-sectional	Not stated	Investigator-designed	Since beginning training: 88.5%
(Pugh et al., 2015)	65 undergraduates/ Australia	Cross-sectional	Not stated	Nordic Musculoskeletal Questionnaire-Extended 2	12-month: 43.3%
(Radhika, 2011)	829 undergraduate nursing schools/India	Cross-sectional	Not stated	Modified Oswestry Low Back Pain Questionnaire	Length not stated: 34%
(Singh, Devi, & John, 2010)	317 college students across three levels/ India	Cross-sectional	88%	Nordic Questionnaire	12-month: • 1st year: 50% • 2nd year: 60% • 3rd year: 67%

Author(s)	Participants/Country	Design	Response Rate	Instrument	Low Back Pain Prevalence
(Smith et al., 2002)	79 female university students/Japan	Cross-sectional	98.8%	Investigator designed	Point: 16.5% 12-month: 17.6%
(Smith, Sato, Miyajima, Mizutani, & Yamagata, 2003)	222 female university students/Japan	Cross-sectional	85.7%	Investigator designed	Point: 13.5%
(Smith, Wei, Zhang, Lian, & Wang, 2004)	57 female university students/China	Cross-sectional	100%	Investigator-designed	12-month: 28%

Author(s)	Participants/Country	Design	Response Rate	Instrument	Low Back Pain Prevalence
(Swain, Pufahl, & Williamson, 2003)	139 students/United Kingdom	Cross-sectional	94%	Not stated	12-month (for time off work due to back pain): Ages 18-25: 16% Ages 26-40: 84% Over 40: 100%
(Videman et al., 2005)	255 students finished the 2.5 year program; were followed 5 years ending 1992/Sweden	Prospective cohort	83% at admission; 77% one year after graduation; 65% five years after graduation	Investigator designed	12-month: 54% for first year in school, 57% first year as nurse, 64% for 5th year as nurse.

There are over 1800 pre-licensure registered nurse programs in the United States (National League for Nursing, 2014), with 157,372 graduates taking the NCLEX Examination for the first time in 2014 (National Council of State Boards of Nursing, 2015). Despite these high numbers of nursing students, none of the studies was conducted in the United States (U.S.). Addressing this geographic gap, we conducted a cohort study to observe the prevalence of low back pain in nursing students in a U.S. program.

Methods

Participants were drawn from three successive cohorts of male and female students entering for the first time in an upper division 16 month (4 trimester) nursing program at an urban university in the southwestern United States. All students took the same curriculum, which did not change during the duration of their program (2009-2011). The curriculum specified theory and clinical practice courses organized by specialty (e.g., medical-surgical, obstetrics, pediatrics, critical care, etc.). The students had to earn 23 credits (1,035 hours) of clinical practice, the majority of which was in acute care hospitals. Students who repeated any trimester of the program were excluded to standardize the exposure to clinical practice time.

The university's institutional review board approved this prospective cohort study. We recruited participants during orientation to the 16-month nursing program (T1). After giving informed consent, participating students created an easy to recreate unique identifier for use throughout the study. When the first author was in a position of authority over participants when teaching a class in the fourth trimester, the third author collected data.

Participants at baseline completed three questionnaires: a demographic survey, an extracurricular work exposure history, and the low back portion of the standardized Nordic

Musculoskeletal Questionnaire. The demographic questionnaire collected data on age, gender, self-reported height and weight, and current smoking status. Smoking is considered a confounder for low back pain (Andersen et al., 2014). The work exposure history asked about the number of hours of employment per week as a nurse apprentice, nursing aide, or other type of direct patient care provider in the previous 12 months. This question assessed whether the participant had any exposure to physical workload above the exposure in the nursing program. After 12 months in the program (T2), data were collected again on work exposure and low back pain.

The Nordic Musculoskeletal Questionnaire has acceptable validity and reliability (Kuorinka et al., 1987) and has been used in other studies of low back pain in student nurses and nurses (Cheung, 2010; Mitchell et al., 2008; Smith, Mihashi, Adachi, Koga, & Ishitake, 2006). It provides an anatomical figure and assesses 7-day and 12-month "trouble with the locomotive organs." This study used only those questions relating to low back pain, as well as information on severity, such as whether low back pain prevented the respondent from work or home activities.

Data Analysis

The data were analyzed with IBM SPSS Statistics 21 using descriptive and inferential statistics. We assessed change over time with paired *t*-tests, and compared differences between groups (students who had vs. who did not have low back pain) with independent samples *t*-tests (parametric test) for continuous variables (e.g., age, body mass index) and Chi-square tests (non-parametric test) for nominal variables (e.g., outside exposure to nursing employment). The level of significance was set at $\alpha=0.05$.

Results

There was an initial response rate of 86%, with 119 of 138 eligible students completing surveys. The majority (82%) were female; the average age was 25. The body mass index (BMI) was calculated from height/weight data; the average fell within the normal range (23.5). About half reported a history of low back pain in the past year, but a far lower percent had low back pain in the past week (Table 2). Internal consistency reliability was acceptable for the 18 item Nordic Musculoskeletal Questionnaire (Cronbach's α= 0.79 at T1, 0.78 at T2).

Table 2

Low Back Pain Prevalence in the Original Sample at T1 (*N*=119)

Low Back Pain	Frequency	%
12-month	64	53.8
7-day	22	18.5

There was no significant association between low back pain prevalence and age, BMI, outside exposure to nursing employment, or current smoking status. Independent *t*-tests results indicated that there was no significant mean differences in age and body mass index, comparing students who had low back pain and those who did not have low back pain.

Chi-square tests indicated there was no statistically significant difference in 12-month or 7-day low back pain prevalence between students who had outside exposure to nursing employment and those who did not ($\chi 2 = .570$, $df = 1$, $p = .450$ for 7-day low back pain, and $\chi 2 = .468$, $df = 1$, $p = .494$ for 12-month low back pain, respectively). Only five students reported being a current smoker, making the Chi-square test of no association between low back pain and smoking status not meaningful.

At T2, only 54% of the original participants responded, with the remainder not eligible due to failure to progress with their cohorts. There was no statistically significant change in the 12-month or 7-day low back pain prevalence between T1 and T2 measurements (Table 3). The T1 to T2 percentage change in prevalence of low back pain is -9.7%, $p = .787$ for low back pain during the past 12 months (matched $n = 56$), and -9.1%, $p = .999$, for low back pain during the last 7 days (matched $n = 46$).

Table 3

Low Back Pain Prevalence

At Time 2	T1		T2	
Low back pain	*n*	%	*n*	%
12-month	31/56*	55.4	28/56	50
7-day	11/46*	23.9	12/46	26.1

*Denominators varied according to number of respondents at each time period.

Discussion

Similar to some other longitudinal studies (Klaber Moffett et al., 1993; Videman et al., 2005), no statistically significant increase in 12-month or 7-day prevalence of low back pain in the first year of the program was found. Because musculoskeletal disorders are cumulative trauma, it is possible that the students did not have exposure to the amount of force, repetition, and awkward postures needed to cause damage during their nursing program. They had limited clinical rotations of 18 hours a week in six hour blocks. Students cared for one or two patients at a time, a very different exposure from employed nurses who care for five or six patients.

The students' clinical schedule also allowed for lengthy periods of recovery, which may have been protective. One study of 450 workers in materials handling found that a significant

predictor of low back disorder risk was cumulative rest duration (Marras, Ferguson, Lavender, Splittstoesser, & Yang, 2014). Those with shorter daily rest periods had increased risk.

Limitations of this study include self-report of exposure to nursing tasks and possible response bias by not screening about awareness and knowledge of the respondents about back problems and risk factors. The high dropout rate, a recognized hazard of prospective studies (Frris & Sellers, 2014), was related to academic failure. Only 42% of admitted students graduated with their original cohort, which severely restricted eligibility. Study results from follow up after graduation were not reported due to the low response rate (23%).

Dropout was not contingent on the presence of low back pain at T1. Among T1 participants who did not have low back pain during the past 12 months (n = 55), 54.5% dropped out at T2, compared to a 51.6% T2 dropout rate among those participants who had low back pain during the past 12 months at T1 (n = 64), $\chi^2 = .106$, $df = 1$, $p = .854$. Of the original T1 sample (N = 119), the overall dropout rate was 76.4% among those who did not have low back pain during the past 12 months at T1, and 79.7% among those who had low back pain during the past 12 months at T1, $\chi^2 = .191$, $df = 1$, $p = .665$.

Generalizability is limited to students in 16 month baccalaureate programs with similar exposure to clinical practice. Future studies should include incentives for responding and quantification of hours exposed to patient handling in each clinical course and in outside employment. Keeping participant identities confidential instead of anonymous would have assisted in follow-up.

Because student nurses are not employees, researchers in the United States are unlikely to obtain federal funding designated for occupational health research. However, more research may

not be needed. Based on existing studies, the inference is strong that nursing students worldwide are at high risk of low back pain.

Because previous musculoskeletal disorders are the strongest predictor of future disorders (Marras et al., 2014; Moshe & Levin, 2005), the optimum time to prevent low back pain and other disorders by reducing exposure to physical risk factors may be during the nursing educational program. If nursing graduates enter the profession with a significant history of recent low back pain, they will be at high risk for recurrence, disability, and lost time despite safe patient handling programs. Therefore, the onus is on nursing education programs to protect their students from exposure to damaging physical workloads.

In light of the fact that nursing remains overwhelmingly a female profession and women have only half the upper body strength as men (Miller, MacDougal, Tarnoposkly, & Sale, 1993), nursing schools must protect their students by teaching evidence-based safe patient handling techniques (Kneafsey & Haigh, 2007; Menzel et al., 2007), empowering students to refuse unsafe manual lifts (Kneafsey & Smallwood, 2010; Waters, 2007), and ensuring that the clinical settings with which they affiliate have adequate assistive devices available (Cornish & Jones, 2007, 2010).

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