

## Psychosocial risk factors for work-related musculoskeletal disorders of the lower-back among long-haul international female flight attendants

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### Abstract

**Title.** Psychosocial risk factors for work-related musculoskeletal disorders of the lower-back among long-haul international female flight attendants

**Aim.** This paper is a report of a study to examine the relationships between work-related psychosocial factors and lower-back work-related musculoskeletal disorders among long-haul international female flight attendants.

**Background.** Recent attention has focused on the influence of work-related psychosocial factors on work-related musculoskeletal disorders. To date, however, little is known about the influence of psychosocial factors at work on lower back work-related musculoskeletal disorders in female flight attendants.

**Method.** A cross-sectional, mailed survey was conducted in 2004 with flight attendants in one major airline who were randomly selected from a union membership list. The work-related psychosocial factors included psychological job demand, decision latitude, social support, job insecurity, and external environmental concerns. Physical load was defined by overall strenuousness across 41 job tasks and measured by a 4-point scale of strenuousness. Lower-back work-related musculoskeletal disorders were defined as lower-back symptoms that occurred at least once a month or lasted at least 1 week in the past year and caused at least moderate pain.

**Findings.** The flight attendants with lower back work-related musculoskeletal disorders, compared with those without lower-back work-related musculoskeletal disorders, had higher perceived psychological job demands, job insecurity, and physical load. After controlling for physical load and personal factors, high job insecurity significantly increased the risk for lower-back work-related musculoskeletal disorders.

**Conclusion.** Occupational health nurses in the airline industry should be cognizant of the importance of assessing the influence of both job tasks and work-related psychosocial factors on lower-back work-related musculoskeletal disorders.

**Keywords:** flight attendant, lower back, nursing, occupational health, psychosocial factors, questionnaire, workforce issues, work-related musculoskeletal disorders

## Introduction

Work-related musculoskeletal disorders (WMSDs) are disorders of the nerves, tendons, muscles, and supporting tissues that result from, or are made worse by, work conditions (Cohen *et al.* 1997). WMSDs are the single largest category of work-related health problems facing workers in many industrialized countries (Punnett & Wegman 2004) and also in Asian developing countries (Choi 2005). Due to the high incidence and prevalence of lower-back WMSDs and accompanying disability among various occupation groups worldwide, including nurses and nursing assistants, they are recognized as a source of the global burden of work-related health problems (Garofalo & Polatin 1999, Punnett *et al.* 2005). In flight attendants, the lower-back was shown to be the body region most commonly affected by musculoskeletal disorders (Haugli *et al.* 1994, Logie *et al.* 1998), accounting for up to 52% of the total direct workers' compensation claims among Canadian flight attendants (Logie *et al.* 1998). Flight attendants flying long-haul international flights have been known to be at even greater risk for lower-back problems than those flying short-haul flights (Haugli *et al.* 1994). Long-haul flights are generally considered to include a segment (i.e., individual non-stop flight between two cities; Grajewski *et al.* 2004) with a duration of six flight hours or more (Lapostolle *et al.* 2001, Whitaker *et al.* 2005).

Although lower-back WMSDs have been shown to result primarily from physical load or stress from biomechanical forces in the body induced by job tasks, there is increasing evidence that they may be precipitated by or worsened by work-related psychosocial factors (Bernard 1997, Linton 2001, National Research Council (NRC) and Institute of Medicine (IOM) 2001). Work-related psychosocial factors refer to the perceptions or beliefs that workers have about the way their work environment is organized (Toomingas *et al.* 1997, Buckle & Devereux 2002); they are often referred to as work organizational factors or job stressors (Amick *et al.* 1999, Huang *et al.* 2002, MacDonald *et al.* 2003, National Institute for Occupational Safety and Health (NIOSH) 2002, Warren 2001). Previous studies have shown that work-related psychosocial factors placed female workers at risk for lower-back WMSDs (Ahlberg-Hulten *et al.* 1995, Lagerstrom *et al.* 1995, Cole *et al.* 2001, Yip *et al.* 2001, Tsuboi *et al.* 2002). Occupational health nurses in the air transportation industry are at the frontline in assessing psychosocial factors in the work environment that may contribute to lower-back WMSD (Jackson 1991).

## Background

Although the job of a flight attendant is considered a high stress occupation (Winick *et al.* 2002), few studies have investigated work-related psychosocial factors (psychological job demands, decisional latitude, social support, job insecurity, external environmental concerns) experienced by flight attendants. Flight attendants from two U.S. commercial airlines reported high *psychological job demands* because their job required working very fast and long periods of intense concentration (MacDonald *et al.* 2003). Italian flight attendants mentioned that the psychological job demands increased by working with new colleagues on each flight and dealing with angry passengers on delayed flights (Ballard *et al.* 2004).

The degree of *decision latitude* was found to be moderate in U.S. flight attendants (MacDonald *et al.* 2003) and similar to the results for the U.S. general female worker population (Karasek *et al.* 1998). A study of 674 flight attendants from 32 countries showed that those who had low *decision latitude* were twice as likely as those with high decision latitude to experience musculoskeletal problems in different body regions (Morley-Kirk & Griffiths 2003). Flight attendants work in a team setting that requires close cooperation with each other (Logie *et al.* 1998) and perceived more *social support* from those in comparable positions than their supervisors (MacDonald *et al.* 2003). In Korean flight attendants, low social support from their supervisors was more likely to increase a risk of back pain (Han 2003).

The airline industry in the U.S. has faced increased economic pressure since the events of September 11, 2001. Many have suffered or threatened bankruptcy resulting in cut backs on the number of flight attendants to reduce operating costs (Whitelegg 2004). This can increase stress because of feelings of *job insecurity* among the airline work forces. Further, in the wake of the 9/11 terrorist attacks, flight attendants have expressed *external environmental concerns* that involve emergency situations such as terrorism threats (Lee *et al.* 2006). Flight attendants on international flights may perceive themselves to be at an increased risk for such external environmental problems due to the long time they spend in the cabin.

High psychological job demands, low decision latitude, low social support, high job insecurity and high external environmental concerns are all work-related psychosocial factors likely to increase psychological strain and influence changes in performance of job tasks, resulting in an increase of physical load, that contribute to lower-back WMSDs in this female-dominated occupational group. Little is known about the contribution of these work-related psychosocial

factors, in addition to the influence of physical load from job tasks, on lower-back WMSDs among U.S. female flight attendants.

## The study

### Aim

The aim of the study was to examine the relationships between work-related psychosocial factors and lower-back work-related musculoskeletal disorders among long-haul international female flight attendants.

### Design

A cross-sectional mailed survey was designed.

### Respondents

The eligibility criteria were flight attendants who (i) were female; (ii) had flown at least one long-haul (>6 hours) international flight in the previous 3 months; and (iii) had worked at least a 75-hour schedule in the previous month. Only female flight attendants were included because the majority (85%) of flight attendants in the study airline are female. On average, flight attendants fly 75 hours a month (U.S. Department of Labor 2005).

The desired sample size required for logistic regression was estimated using PASS (NCSS Statistical Software 2003). The odds ratios found in other studies examining risk factors of lower back pain in the female worker population has ranged from 2.7 for psychological distress (Estryn-Behar *et al.* 1990) to 2.9 for physical load (Macfarlane *et al.* 1997). Thus, we calculated our sample size based on an estimated odds ratio of 2.8 on lower-back WMSDs for work-related psychosocial factors. A total sample of 201 was required to achieve 80% power at a statistical significance level of 0.05.

The flight attendants targeted for this study were selected from one major U.S. airline that is a member of a trade union representing flight attendants. The union scheduling committee provided a list of the 2754 female flight attendants scheduled for international flights in October, 2004 from eight of the 12 airline base hub cities with international flights. From the list, 420 were randomly selected to obtain the desired sample of 201 based on a contact rate, an eligibility rate, and a response rate. The contact rate was estimated based on 20% of annual residence change of U.S. population (Putnam 1996). The eligibility rate was calculated by multiplying two eligibility criteria: work schedules with at least one long-haul flight in the previous 3 months (90%) and

a 75 hours or greater flight time in the previous month (90%). The response rate of 75% was estimated assuming that the response to the first mailing would be 50% (conservatively) and an additional 25% after two additional questionnaire mailings. The eligibility questions were included on the first page of the main survey questionnaire for self-screening.

Of the 420 questionnaires distributed, 276 (66%) were returned. Of those returning questionnaires, 10 did not wish to participate and 79 were ineligible because they had no long-haul flights or worked fewer than 75 flight hours. Of the 187 eligible women, 164 had complete data for lower back WMSD. The 23 women with missing data did not differ from the other 164 on demographic characteristics of age (53.4 vs. 54.2 years,  $t = 0.60$ , d.f. = 185,  $P = 0.55$ ), years of employment as a flight attendant (28.5 vs. 31.2 years,  $t = 1.58$ , d.f.=185,  $P = 0.12$ ), and base hub cities ( $\chi^2 = 2.79$ , d.f.=7,  $P = 0.90$ ).

### Measures

#### Lower-back WMSDs

The presence, frequency, duration, and intensity of lower-back WMSD over the previous year was measured using the Nordic Musculoskeletal Questionnaire (NMQ; Kuorinka *et al.* 1987) and National Institute for Occupational Safety and Health Symptom Survey (Bernard *et al.* 1994). Symptom presence was defined as having experienced work-related discomfort, aches, or pain in the lower back in the previous year. This was determined by a modified single question with a yes/no response and a body map derived from the NMQ (Kuorinka *et al.* 1987). The NIOSH Symptom Survey was used to identify the frequency, duration, and intensity of a lower-back symptom in the previous year. The frequency of a lower-back symptom was measured using a 5-point scale ranging from 'almost never (every 6 months)' to 'almost always (daily).' The duration of a lower-back symptom was measured using a 7-point scale ranging from usually lasts 'less than 1 hour' to 'more than 3 months.' The intensity of lower-back symptoms was measured using a 5-point scale ranging from 'no pain' to 'worst pain ever experienced.' Women were identified as having or not having a lower-back WMSD. If the symptom (i) occurred at least once a month or (ii) lasted at least 1 week in the past year; and (iii) was at least 'moderate' on a 5-point symptom intensity scale, it was classified as a lower-back WMSD case (Bernard *et al.* 1994). The validity of the WMSD case definition was demonstrated in a study of nurses showing higher visits to doctors, missed work, reduced work and recreation and medication use in those meeting the case definition (Trinkoff *et al.* 2002).

*Work-related psychosocial factors*

*Psychological job demand* was defined as the effort required to carry out work (Karasek *et al.* 1998). It was measured with five items: work fast, work hard, no excessive work, sufficient time to get the job performed, and no conflicting demands and rated on a 4-point scale (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree). The items were scored by the weighted formula (Karasek 1985). Possible total scores ranged from 12 to 48. Higher scores indicate greater psychological demands. In this study, the Cronbach's alpha ( $=0.66$ ) was quite similar to that ( $=0.63$ ) observed in the U.S. Quality of Employment Survey ([U.S.QES], Karasek *et al.* 1998), which included occupational groups from manager to line workers.

*Decision latitude* was defined as the individual's potential control over the performance of her job and measured by two subscales: (i) skill discretion was measured by six items (learning new things, repetitive work, requires creativity, high skill levels, variety, and development of own abilities); and (ii) decision authority was measured by three items (allows own decisions, little decision freedom, and has a lot of say). All items were rated on a 4-point scale ranging from 1 (strongly disagree) to 4 (strongly agree) and scored by the weighted formula (Karasek 1985). Possible total scores ranged from 24 to 96. Higher scores indicated that the respondent was more likely to have control over the performance of her own job. In this study, the Cronbach's alpha ( $=0.64$ ) was close to that ( $=0.70$ ) reported in the study of flight attendants' job stress (MacDonald *et al.* 2003), but lower than the coefficient observed in the U.S.QES ( $=0.83$ ; Karasek *et al.* 1998).

*Social support* was defined as instrumental and socio-emotional support from co-workers and supervisors. Self-perception of coworker support was measured by four items: competent co-workers, coworkers' interest in me, friendly coworkers, and helpful coworkers. Perception of supervisor support was measured by four items: concerned about the welfare of those under him/her, pays attention to what others are saying, helpful in getting the job performed, and successful in getting people to work together. All items were rated on a 4-point scale ranging from 1 (strongly disagree) to 4 (strongly agree) and were summed across all eight items. Possible total scores ranged from 8 to 32. Higher scores indicated greater instrumental and socio-emotional support from coworkers and supervisors. Cronbach's alphas were 0.92 for supervisor support and 0.86 for coworker support in this study, which were slightly higher than those (0.83 vs. 0.81, respectively) observed in the U.S.QES (Karasek *et al.* 1998).

*Job insecurity* was defined as perceived threat or reality of job termination or layoff faced by workers and measured

with three items: steady work, job security, and future layoff. The items were measured on a 4-point scale ranging from 1 (regular and steady, strongly disagree, or not at all likely) to 4 (both seasonal and frequent layoffs, strongly agree, or very likely). The scores were summed across all three items (Karasek 1985). Possible total scores ranged from 3 to 12. Higher scores indicated that the respondent perceived the job as less secure. Cronbach's alpha for the job insecurity measure in this study was higher than that of the original scale (Karasek *et al.* 1998; 0.63 vs. 0.46, respectively).

*External environmental concern* was defined as concerns about uncontrollable emergency situations specific to the flight attendant job. The measure was based on items from the Behavioral Risk Factor Surveillance Survey module on terrorism (Centers for Disease Control and Prevention 2002); discussion with key informants, including flight attendants and air safety staff from the flight attendant union; and the focus group with members of the target population (Lee *et al.* 2006). The four items included turbulence, threat of terrorism attacks, air rage or assault by passengers, and catastrophic equipment malfunctions (e.g., fire, engine control-system failure). Respondents were asked to rate the degree of their concern about each item on a four-point scale (1 = never, 2 = little, 3 = some, 4 = very much). The individual's overall external environment score was calculated by dividing the sum of each score by the number of items completed. Possible total scores ranged from 1 to 4, and higher scores indicated greater concern about external environmental factors. Good internal consistency (Cronbach's alpha = 0.82) and test-retest reliability (Pearson's  $r = 0.87$ ) were achieved in this study.

*Physical load*

Physical load was operationally defined by strenuousness of job tasks that flight attendants performed. The measure of physical load was originally adapted from a measure used with firefighters (Conrad *et al.* 2000). Briefly, the job task items consisted of 41 flight attendant-specific tasks related to handling carry-on baggage, handling carts, galley work, service, safety checks, and other tasks such as arming and disarming doors and standing or walking for a long time. The tasks were identified from the literature and feedback from union management. Further flight attendants participating in a focus group looked at the task list, illustrated contextual understanding of job tasks, and made the list task-specific (Lee *et al.* 2006). The strenuousness of each of the tasks was assessed with four response options (1 = not strenuous, 2 = somewhat strenuous, 3 = strenuous, and 4 = very strenuous). The scores for the 41 job task items were summed and divided by the number of items completed to obtain the total

strenuousness score, which ranged from 1 to 4. Cronbach's alpha has been reported for a firefighter population was 0.94, and the Rasch person reliability was 0.93 (Conrad *et al.* 2002). In the present study, although each item reflected a different job task performed by flight attendants, some wording to describe activities (e.g., bending, squatting) involved in each task was redundant. The high Cronbach's alpha of 0.96 could be due to this wording redundancy (Clark & Watson 1995) and the large number of items ( $n = 41$ ; Cortina 1993). Test-retest reliability for this study was 0.90.

#### *Personal factors*

Personal factors included age, years of employment as a flight attendant, work pattern, flight hours per month, flight hours per segment (individual non-stop flight between two cities), number of flight segments per week, and self-reported weight and height. Work patterns since first becoming a flight attendant were identified as continued without interruption, 1–5 years taken off, or > 5 years taken off (Nolan 1985). Body mass index (BMI) was calculated by dividing weight by height squared ( $\text{kg/m}^2$ ; National Heart, Lung, and Blood Institute 1998).

#### **Data collection**

Data were collected using a modified Dillman's (2000) survey-mailing protocol. This required a total of four first-class mailings: The first mailing included a cover letter, questionnaire and stamped return envelope. A postcard reminder was sent 2 weeks later to non-responders. At 5 and 11 weeks following the first mailing a complete packet was sent again to all non-responders. A second questionnaire was sent to the first 30 women who returned their questionnaire and agreed to participate in a reliability study of the physical load and external environmental concerns measures. Of these 30, 23 (77%) returned their completed reliability questionnaires.

#### **Ethical considerations**

The study was approved by the Institutional Review Board of the University of Illinois at Chicago. The survey cover letter informed potential participants that participation in the survey was voluntary and confidential. In addition, they were told the purpose of the study, benefits, and that completing and returning the questionnaires implied consent to participate in the study. Survey identification numbers on the questionnaires were only used to identify non-respondents for follow-up mailings and they were removed from both the questionnaires and the

mailing list after the questionnaires were returned to the investigator.

#### **Data analysis**

The data were analyzed using the Statistical Package for the Social Sciences, version 12.0 (SPSS Inc., Chicago, IL, USA). First, descriptive statistics were calculated for all variables. Second, personal factors, work-related psychosocial factors and physical load were compared between flight attendants with and without lower-back WMSDs using Mann-Whitney test. Scores for items within each multi-item scale (psychological job demand, decision latitude, social support, job insecurity, and external environmental concern) were summed or scored by the formula so that the scales could be treated as continuous variables. Third, bivariate logistic regression analyses were conducted to examine the relationships between work-related psychosocial factors and lower-back WMSDs (1 = Yes, 0 = No). Fourth, multiple logistic regression analyses using a forward stepwise method were conducted in two separate models. The first model included all five work-related psychosocial factors. The second model included all psychosocial and physical load factors together. Both models were adjusted for personal factors (age, years of employment, work pattern, BMI, flight hours per month, and flight hours per segment). Results were considered statistically significant at a 5% ( $P < 0.05$ ) significance level.

### **Results**

#### **Personal factors and lower-back WMSDs**

The overall mean age of the flight attendants was 54 years ( $SD = 6.2$ ), ranging from 32 to 68 years (Table 1). The length of employment as a flight attendant varied, ranging from 7.5 to 43 years with a mean of 31 years ( $SD = 7.6$ ). Over half (60%) of the participants had worked as flight attendants without interruption, and only five had taken > 5 years off work. Their average BMI ( $23.3 \pm 3.5$ ) was in the normal range. The mean number of flight hours per month was 87.5 and ranged from 65 to 103 hours. On average, the flight hours per segment were 11 hours ( $SD = 3.2$ ), with an average of three segments per week. No statistically significant differences were found between flight attendants with or without low-back WMSD on personal factors.

#### **Lower-back symptoms and WMSDs**

Eighty-eight percent ( $n = 145$ ) of participants experienced work-related discomfort, aches, or pain in the lower back in

**Table 1** Comparison of personal factors between flight attendants with and without lower-back work-related musculoskeletal disorders (WMSDs)

Personal factors	Total ( <i>n</i> = 164) mean (SD)	WMSD ( <i>n</i> = 99) mean (SD)	No WMSD ( <i>n</i> = 65) mean (SD)	<i>z</i>	<i>P</i> -value
Age (year)	54.24 (6.23)	54.26 (6.58)	54.20 (5.69)	-0.63	0.53
No. years employed as a flight attendant	31.21 (7.58)	30.80 (8.05)	31.83 (6.82)	-0.58	0.56
Body mass index (kg/m <sup>2</sup> )	23.29 (3.51)	23.41 (3.61)	23.10 (3.39)	-0.67	0.51
Work hours/month (hour)	87.45 (7.42)	86.87 (7.34)	88.33 (7.52)	-1.23	0.22
Flight hours/segment (hour)	10.95 (3.19)	11.24 (2.95)	10.50 (3.48)	-1.63	0.10
No. segments/week	3.04 (1.59)	2.84 (1.29)	2.91 (1.10)	-0.88	0.38

**Table 2** Presence, frequency, duration, and intensity of lower-back musculoskeletal symptoms experienced by female flight attendants on long-haul international flights

Symptom component	<i>N</i> (%)
Symptom presence ( <i>n</i> = 164)	
Yes	145 (88.4)
No	19 (11.6)
Frequency ( <i>n</i> = 145)	
Every 6 months	5 (3.5)
Every 2–3 months	13 (9.0)
Once a month	36 (24.8)
Once a week	43 (29.7)
Daily	47 (32.4)
Missing	1 (0.7)
Duration ( <i>n</i> = 145)	
< 1 hour	8 (5.6)
1 hour–1 day	40 (28.2)
1 day–1 week	41 (28.9)
1–2 weeks	14 (9.9)
2–4 weeks	5 (3.5)
1–3 months	2 (1.4)
> 3 months	32 (22.1)
Missing	3 (2.1)
Intensity ( <i>n</i> = 145)	
No pain	3 (2.1)
Mild pain	39 (26.9)
Moderate pain	68 (46.9)
Severe pain	22 (15.2)
Worst pain ever experienced	13 (9.0)
Work-related musculoskeletal disorder case ( <i>n</i> = 164)	99 (60.4*)

\*Lower-back symptom (i) occurred at least once a month, or (ii) lasted at least 1 week in the past year and (iii) was at least 'moderate' on a five-point symptom intensity scale.

the previous year. Table 2 presents the frequency, duration, and intensity of lower-back symptoms experienced by the 145 flight attendants. About 87% of the women experienced lower back symptoms at least once a month. For over half (61%), the symptom lasted a week or less. However, 71% reported that their back pain was at least 'moderate' intensity. Twenty-four percent of the women reported 'severe' or 'worst pain ever experienced' in the lower back.

Sixty percent (*n* = 99) met the definition of having a lower-back WMSD.

### Work-related psychosocial factors and physical load by lower-back WMSD

Overall the mean psychological job demand score of 36.5 (SD = 5.7) was toward the higher end (possible high 48), while decision latitude ( $60.3 \pm 9.3$ ) was in the middle of the range (possible range 24–96; Table 3). Perceived social support from both coworkers ( $11.9 \pm 1.6$ ) and supervisor ( $11.7 \pm 2.2$ ) was just above the midpoint (possible range 4 low–16 high support). Likewise, the mean score for job insecurity ( $7.9 \pm 1.76$ ) was above the midpoint (possible range 3 low–12 high insecurity). Ninety percent (*n* = 148) of the flight attendants indicated that they did not feel their job security was good. The mean score for the external environment concerns ( $3.0 \pm 0.6$ ) was between some concern (3) and very much concern (4). The percentage who reported some or very much concerns about the external environment was highest for terrorism threats (81%) and turbulence (79%). Psychological job demand and job insecurity were the only psychosocial factors that differed statistically significantly by lower-back WMSD. Psychological job demands and job insecurity were statistically significantly higher for flight attendants with lower-back WMSDs than without (Table 3). The mean score for physical load was in the somewhat strenuous range and was statistically significantly higher for flight attendants with lower-back WMSDs than those without lower-back WMSDs.

### Relationships between work-related psychosocial factors and lower-back WMSDs, controlling for physical load and personal factors

As seen in Table 4, respondents who reported high psychological job demand, job insecurity, and physical load scores were more likely to have lower-back WMSDs in bivariate logistic regression analyses. However, after controlling for

**Table 3** Comparison of work-related psychosocial factors and physical load between flight attendants with and without lower-back work-related musculoskeletal disorders (WMSDs)

	Possible range	Total ( <i>N</i> = 164), mean (SD)	WMSD		<i>z</i>	<i>P</i> -value
			Yes ( <i>N</i> = 99), mean (SD)	No ( <i>N</i> = 65), mean (SD)		
Work-related psychosocial factors						
Psychological job demand	12–48	36.47 (5.70)	37.26 (5.78)	35.29 (5.41)	–2.05	0.04
Decision attitude	24–96	60.31 (9.30)	60.61 (9.50)	59.85 (9.04)	–0.77	0.44
Social support	8–32	23.54 (3.11)	23.37 (3.19)	23.78 (3.00)	–0.85	0.40
Coworker support	4–16	11.93 (1.58)	11.86 (1.57)	12.03 (1.60)	–1.12	0.26
Supervisor support	4–16	11.65 (2.17)	11.51 (2.30)	11.84 (1.95)	–1.34	0.18
Job insecurity	3–12	7.90 (1.76)	8.26 (1.71)	7.38 (1.75)	–3.03	0.00
Concerns about external environment	1–4	3.02 (0.64)	3.07 (0.60)	2.95 (0.69)	–0.82	0.42
Physical load	1–4	2.50 (0.50)	2.60 (0.52)	2.33 (0.53)	–2.95	0.00

**Table 4** Bivariate and multiple logistic regression analyses of work-related psychosocial risk factors associated with lower-back work-related musculoskeletal disorders

Variables	Multiple logistic					
	Bivariate logistic	Model 1 (psychosocial only)		Model 2 (psychosocial and physical load)		
	<i>B</i> (SE)	OR (95% CIs)	<i>B</i> (SE)	OR (95% CIs)	<i>B</i> (SE)	OR (95% CIs)
Work-related psychosocial factors						
Psychological job demand	0.06 (0.03)*	1.07 (1.00–1.13)*				
Decision latitude	0.01 (0.02)	1.01 (0.98–1.05)				
Social support	–0.03 (0.06)	0.97 (0.87–1.09)				
Job insecurity	0.30 (0.11)**	1.35 (1.09–1.68)**	0.27 (0.10)**	1.31 (1.08–1.60)**	0.23 (0.10)*	1.26 (1.03–1.55)*
Concerns about external environment	0.29 (0.27)	1.34 (0.79–2.28)				
Physical load	0.95 (0.35)**	2.59 (1.32–5.10)**			0.83 (0.34)*	2.30 (1.18–4.47)*

\**P* < 0.05, \*\* *P* < 0.01.

*B*, coefficient; SE, standard error; OR, odds ratio; CIs, confidence intervals.

All models were adjusted for personal factors (age, years of employment as a flight attendant, work pattern, Body Mass Index, flight hours per month, and flight hours per segment).

personal factors, high job insecurity was the only work-related psychosocial factor that remained statistically significant in the multiple logistic regression analyses (Model 1). When physical load was added, women who had higher job insecurity and physical load continued to be at the highest risk of having lower-back WMSDs (Model 2).

## Discussion

The prevalence of lower-back WMSDs (60.4%) was very high in this sample of U.S. flight attendants. This is consistent with findings from previous studies of flight attendants conducted in Korea (Han 2003), Norway (Haugli *et al.* 1994) and Canada (Logie *et al.* 1998). Furthermore, the percentage who had lower-back WMSDs in the current

study was much higher than the U.S. female adult population who participated in 2002 National Health Interview Survey (16.7%; Strine & Hootman 2007). For close to a quarter of the flight attendants who had experienced lower back symptoms in the previous year the duration of symptoms was quite long, indicating the chronic nature of these symptoms (22% > 3 months duration; Mäntyselkä *et al.* 2003). Also, as expected and verified by earlier studies (Bernard 1997, National Research Council (NRC) and Institute of Medicine (IOM) 2001), physical load had an independent effect on lower back WMSD.

The mean score for psychological job demand on the flight attendants was greater than the results for a general U.S. female worker population (36.5 vs. 30.9, respectively; Karasek *et al.* 1998). Overall, flight attendants perceived

that their job was psychologically demanding with respect to the work being fast, hard, and excessive, with insufficient time to complete the work, and conflicting job demands. Increased psychological job demand was statistically significantly associated with lower-back WMSDs in bivariate logistic regression analyses. In multiple logistic regression analyses including the physical load factor, however, the positive association no longer existed. This may be explained by its indirect effect via the physical load on the occurrence of lower-back WMSDs, as addressed in extensive reviews of WMSD studies (Bongers *et al.* 1993, Bernard 1997).

The degree to which respondents reported that they had authority to make decisions about how to work was similar to that of the U.S. female worker population at-large (60.3 vs. 60.0, respectively; Karasek *et al.* 1998) and female flight attendants (58.6) with two U.S. commercial airlines (MacDonald *et al.* 2003). Unlike findings from a study of flight attendants from 35 national airlines (Morley-Kirk & Griffiths 2003), however, no association was found between decision latitude and lower-back WMSDs in the current study. This may be explained by different seniorities between the two studies. In Morley-Kirk and Griffiths (2003) study, only two-thirds of the participants had been flight attendants for eight or more years, whereas in our study they had all been flight attendants for at least 8 years. Senior flight attendants are more likely to have management positions such as a purser or lead in the cabin, and have more decision latitude or freedom to decide how to work. Also, they may have more freedom to determine their work schedules and their positions in the cabin because the scheduling is performed through a bidding system by seniority.

The mean score for social support in this study was slightly less than for the general female work population in the U.S. (23.5 vs. 26.0, respectively; Karasek *et al.* 1998). The mean scores for coworker support and supervisor support were similar in this study. Contrary to findings from a sample of Korean flight attendants that showed that back pain was statistically significantly less in participants who had support from their supervisors than those who did not (Han 2003), no such relationship was found in the current study.

Flight attendants are often faced with a feeling of job insecurity that accompanies organizational restructuring or labour market dynamics. The majority of our respondents reported job insecurity. This clearly demonstrates that the increased need for airlines to continue to operate more effectively with fewer resources has left flight attendants contemplating the future of their current jobs with growing uncertainty and ambiguity. Interestingly, more of the flight attendants in this study perceived that their jobs were insecure than in MacDonald *et al.*'s (2003) study (90% vs.

27%). The difference between the two studies may be explained by their dates (1995 vs. 2005). The airline selected for this study has been cutting back on the number of flight attendants to reduce operating costs as it filed for bankruptcy protection in 2002. Remaining flight attendants may feel that the undesirable situation threatens the security of their jobs. Higher feelings of job insecurity were associated with a higher incidence of lower-back WMSDs. Job insecurity may lead to 'physiological vulnerability' of muscles (Lundberg *et al.* 1994, Melin & Lundberg 1997) and to the sensation of pain. It may be that when the job insecurity that these flight attendants experienced was combined with high physical load factors, such as pushing heavy carts and frequent back bending, this may increase the risk of occurrence of lower back WMSDs.

A large proportion of the flight attendants reported that they were 'some' or 'very much' concerned about all of the uncontrollable external environmental factors. The threat of terrorism, followed by turbulence, was the external environmental factor of greatest concern. Terrorism has probably become more important since the 9/11 terrorist attack on New York. As shown in previous surveys conducted after 9/11 (Schuster *et al.* 2001, Lating *et al.* 2004), flight attendants are more likely to be exposed to terrorist threats than those in other occupations. Also flight attendants working international flights may have a greater chance of exposure to turbulence because of the long duration of stay in the large aircraft cabin. Dealing with violent or aggressive passengers was also a concern for our respondents, as it was for participants in previous flight attendant studies (MacDonald *et al.* 2003, Ballard *et al.* 2004).

The association between lower-back WMSDs in flight attendants and work-related psychosocial factors is consistent with the findings from extensive reviews of lower-back WMSD in various occupational groups (Bernard 1997, National Research Council (NRC) and Institute of Medicine (IOM) 2001). This suggests that occupational health nurses in the airline industry need to be aware of the unique psychosocial factors of the flight attendant job while conducting assessment and surveillance of health hazards at work, which is one of essential occupational health nursing practices (Salazar 1997). Occupational health nurses need to incorporate assessment of work-related psychosocial factors into baseline screening surveys and periodic evaluations to determine, which ergonomic risk factors need a close attention. In addition to using various existing measures for assessing WMSD risk factors presented in a recent review (David 2005), the measures of physical load and external environmental concerns developed for this study would allow occupational health nurses and ergonomic teams to prioritize

### What is already known about this topic

- Lower-back work-related musculoskeletal disorders are among the musculoskeletal problems most commonly reported by flight attendants.
- Work-related psychosocial factors are risk factors for lower-back work-related musculoskeletal disorders.
- Female flight attendants working on long-haul international flights are exposed to psychosocial factors at work that may impact lower-back work-related musculoskeletal disorders.

### What this paper adds

- Flight attendants with lower-back work-related musculoskeletal disorders, compared with those without lower-back work-related musculoskeletal disorders, had higher perceived psychological job demands and job insecurity.
- Perceived job insecurity was a significant work-related psychosocial risk factor for lower-back work-related musculoskeletal disorders, in addition to physical load factors among the flight attendants working on long-haul international flights.
- Further research is warranted to explore these links in other similar occupations, such as nursing, where there is a high incidence of work-related lower-back disorders.

flight attendant specific risk factors for intervention. Further, understanding of contributing psychosocial factors may assist in the identification of non-pharmacological interventions such as stress management. Horneij *et al.* (2001) found that a work stress management intervention was effective in improving lower-back symptoms in home-care personnel.

### Study limitations

Caution is called for in generalizing these findings. The sampling frame was limited to flight attendants who were scheduled for an international flight during 1 month of the year. Thus, those who were eligible for and flew international flights, but took vacations or sick leave, or were scheduled for domestic flights during the designated sampling month were excluded. It is difficult to conclude that there would have been no systematic difference in the relationship between psychosocial factors and WMSDs if the target population as a whole had participated. Therefore, generalizability is guardedly limited to flight attendants of one airline. Although flight

attendants from other airlines work on the same routes on the same types of aircrafts, the context of their work organization may differ. In addition, the response rate was lower than estimated based on a conservative response rate of 50% and additional 25% by two more follow-up mailings. By design the potential participants were predominantly working internationally, but this had the potential of long delays before they accessed their mail. The use of email or web-based questionnaires in future studies would facilitate ease of access.

### Conclusion

As expected, the physical load of job tasks performed by flight attendants working long-haul international flights are related to lower-back WMSD. In addition, there appear to be psychosocial factors unique to their work environment including feeling of job insecurity that had independent impact on lower-back WMSD. Occupational health nurses in the airline industry should be aware of the importance of assessing the influence of both job tasks performed and psychosocial factors on lower-back WMSD. Our findings could inform the development of interventions to both prevent and treat the high prevalence of lower-back problems in flight attendants. It is possible that the links we found between job-specific psychosocial factors and work-related lower-back WMSD occur in other female-dominated occupational groups such as nurses and nursing assistants with a high prevalence of lower-back WMSDs. Further research to explore this would be valuable.

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### Author contributions

HKL, JW, MJK and AM were responsible for the study conception and design and the drafting of the manuscript. HKL and JW performed the data collection and data analysis. HKL and JW obtained funding and HKL, JW and AM provided administrative support. HKL, JW, MJK and AM made critical revisions to the paper. HKL provided statistical expertise. HKL and JW supervised the study.

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