International Journal of Industrial Ergonomics 40 (2010) 19–24

Contents lists available at ScienceDirect

International Journal of Industrial Ergonomics

journal homepage: www.elsevier.com/locate/ergon

Low back symptoms among hospital nurses, associations to individual factors and pain in multiple body regions

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ARTICLE INFO

Article history:
Received 14 December 2007
Received in revised form
18 October 2009
Accepted 11 November 2009
Available online 25 November 2009

Keywords:
Musculoskeletal symptoms
Lower back pain
Nursing personnel
Lifestyle factors
Individual factors
Multiple symptoms

ABSTRACT

Nursing personnel ($n = 263$) employed in three hospitals in the United States completed questionnaires investigating musculoskeletal symptoms (MSS) in multiple body regions. The aims of this study were to: i) determine prevalence rates and significant associations between multiple MSS in the lower back and other body regions and ii) investigate significant associations between MSS in multiple body regions and individual/lifestyle factors. Results showed high prevalence rates of symptoms in the lower back, shoulders, and lower extremities. Significant associations were found between multiple MSS in the lower back and; i) upper back, neck, and shoulders and ii) lower extremities. Smoking, body mass index and work experience were found to be significantly associated with MSS in multiple body regions. In conclusion, symptoms in the lower back may lead to problems in other body areas *possibly* due to awkward postures, unintentional disregard for safe practices or transfer of pain due to biological factors. Interventionists should conduct periodic assessments to detect early symptoms and increase awareness to avoid proliferation of symptoms, comorbidity and chronicity.

Relevance to industry: The possibility that symptoms in one body region may be related to symptoms elsewhere emphasizes the importance of conducting periodic assessments on nursing personnel rather than wait for annual evaluations. Symptom reporting at the time of initial back pain can identify individuals at higher risk for developing chronic or comorbid musculoskeletal disorders.

1. Introduction

Work-related musculoskeletal symptoms (MSS) affect nearly a million workers in the United States (U.S.) each year (U.S. Bureau of Labor Statistics, 2004). Although MSS have shown to decline in recent years they continue to be the leading type of injury/illness in every major industry division (U.S. Bureau of Labor Statistics, 2004) and account for over 85% of all workers' compensation claims (Pransky et al., 2000).

Healthcare workers in particular have shown to experience higher rates of MSS than those in construction, mining, and manufacturing (Li et al., 2004; Crawford et al., 2008). Among healthcare workers, evidence shows that nurses in particular are at risk for MSS (Ando et al., 2000; Gerdle et al., 1994; Lagerstrom et al., 1995). Prior studies in nurses have primarily focused on the singular occurrence of MSS in various body regions (Lagerstrom et al., 1995; Engkvist et al., 1998; Hagen et al., 2006; Josephson et al., 1997; Josephson and Vingard, 1998; Leboeuf-Yde et al., 1997). However, it has been largely ignored that nurses can experience concurrent symptoms in the low back *as well as* other body regions. This scenario is likely, but too often overlooked.

In order to effectively assess, treat, and prevent MSS, it is important to identify and understand the underlying mechanisms leading to these problems (Genaidy et al., 2005). A widely held area of interest is the identification of the various risk factors leading to the onset of symptoms (physical, psychosocial, and organizational) (Devereux et al., 2002; Gonge et al., 2002; Smedley et al., 2003; Layer et al., 2009). When considering such factors it is important to include the possibility that symptoms in one area of the body may be an antecedent to the occurrence of symptoms in another area

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doi:10.1016/j.ergon.2009.11.004

(Smith et al., 2004). Ektor-Anderson et al. (Ektor-Anderson et al., 1999) emphasize the need to analyze the number of painful areas as 'mandatory as stratification for gender in causes for musculoskeletal pain'. Kamaleri et al., (Kamaleri et al., 2008c) concur stating "epidemiological research into musculoskeletal pain that concentrates on localized pain without assessing other pain sites will miss a crucial dimension". Indeed, in a later publication Kamaleri et al., (Kamaleri et al., 2009) showed that individuals who initially reported pain in multiple body regions continue to report multisite pain over a period of 14 years. Although a thorough understanding of the underlying biological mechanisms leading to and perpetuating MSS needs to be reached, it is implicit that the body functions as a whole and when subject to risk, it is likely it will respond as a whole. The injury or pain may occur in one body region, but the body is expected to utilize other regions to reduce the pain or compensate to counter that weakness.

When examining risks factors, studies limit their analysis by controlling or adjusting for individual or lifestyle factors. This does not allow for the examination of the independent contributions of these factors to MSS (Cole and Rivilis, 2004). Therefore, this investigation was conducted to consider the following two hypotheses: i) symptoms in the lower back will be significantly associated with symptoms in different body regions; ii) symptoms in multiple body regions will be significantly associated with individual and lifestyle factors.

The specific aims of this study were:

1. Determine 1-month and 1-year prevalence rates of MSS for each of ten body regions: neck, shoulders, elbows/forearms, hands/wrists, fingers, upper back, lower back, hips/thighs, knees/lower legs, and ankles/feet.
2. Examine significant associations between high intensity/high frequency (severe) MSS in the lower back and each of the nine remaining body regions.
3. Examine significant associations between severe MSS for each of the ten body regions and individual/lifestyle factors

Multiple sites of MSS are common in the general population (Natvig et al., 2001). However, to the authors' knowledge, no study has described the full range of specific musculoskeletal pain sites (not only defined as 'multi-site pain' or 'widespread pain') (Genaidy et al., 2005; Natvig et al., 2001) and their relation to each other as well as to demographic and lifestyle/individual variables in a cohort of nurses.

2. Methods

2.1. Study preparation

Data were gathered by means of a questionnaire at three U.S. hospitals located in the states of Ohio and Kentucky in 2003. Preliminary meetings with hospital administrators and unit managers were conducted in order to detail study procedures. Flyers were posted in nurses' stations and on hospital units for recruitment. All participants were briefed on the research objectives by unit managers and were required to sign consent forms prior to participation. Necessary authorization from the Institutional Review Board (IRB) was obtained from all parties involved prior to initiating the study. The nurses were asked to complete the questionnaires within a one-week period and were given $25 gift certificates upon completion. All completed questionnaires were returned in a sealed envelope with identification numbers known only to the investigators to ensure confidentiality. Hospital administrators allowed the nurses' time during their work schedule to fill out questionnaires and reminded staff during meetings and informal interactions, emphasizing the full support of management and encouraging participation. No reminders were sent out.

2.2. Study population

Of 407 questionnaires, 263 were returned (65% participation rate). This rate is a conservative estimate and may not be representative of the number of eligible nurses since, on several occasions, participating hospitals requested extra packets of questionnaires to place at nurses' stations if previously sent packets were lost or misplaced. Participants were primarily female (91.3%), registered nurses (68.8%) (Table 1). The majority of the participants worked in units characterized as having moderate to high workloads (Intermediate Care, Surgical/Invasive Procedure, Medical/Surgical, and Critical Care Units).

2.3. Assessment of symptoms

2.3.1. Musculoskeletal

Assessment was conducted using a modified version of the Nordic Musculoskeletal Symptom survey (Kuorinka et al., 1987). To assess musculoskeletal outcomes, participants were asked the following four questions:

1) "How *often* have you had, at any time during the last 12 months, aches, pains or discomfort in the following body regions?"; the frequency of symptoms was assessed using a six-point scale: '0 = 'Never' to '5' = 'Very often'.
2) "What is the *intensity* of aches, pains or discomfort, you may have experienced at any time during the last 12 months in the

Table 1
Descriptive statistics of participants.

Demographic ($N = 263$)	N/(%)
Age	
≤30 years	59 (22.4)
Over 30 yrs and ≤40 yrs	87 (33.1)
Over 40 years and ≤50 yrs	81 (30.8)
>50	36 (13.7)
Gender	
Male	23 (8.8)
Female	240 (91.3)
BMI	
Underweight < 18.5	9 (3.4)
Normal = 18.5–24.9	77 (29.3)
Overweight = 25–29.9	78 (29.7)
Obese ≥ 30	99 (37.6)
Marital status	
Single	50 (19)
Married	175 (66.7)
Divorced	38 (14.3)
Hospital	
Magnet	213 (81)
Non-magnet	50 (19)
Title	
Nurse managers	19 (7.2)
Registered nurse	200 (68.8)
Licensed practical	26 (9.9)
Nursing assistants	16 (6.1)
Technicians	16 (6.1)
Other	5 (1.5)
Units	
Intermediate care	74 (28.1)
Surgical/invasive procedure	57 (21.7)
Medical/surgical	52 (19.8)
Critical care	42 (15.9)
Outpatient services	21 (7.9)
Support services	10 (3.8)
Geriatrics	5 (1.9)

following body regions?"; the intensity of symptoms was assessed using a six-point scale: '0' = 'Zero', '1' = 'Very low' to '5' = 'Very high'. High frequency/intensity or *severe* symptoms were defined as nursing personnel reporting a score of ≥4 from at least one of the body regions in questions '1' and/or '2'.

3) "Have you, at any time during the last 12 months, been prevented from doing your normal work (at home or away from home) because of aches, pains or discomfort in any of the following regions?" – indicating *functionally limiting* MSS; answers were either 'yes' or 'no'.
4) "Have you at any time during the last 30 days had aches, pains or discomfort in any of the following body regions?"; answers were either 'yes' or 'no'.

The body regions referred to in these questions were; neck, shoulders, elbows/forearms, hands/wrists, fingers, upper back, lower back, hips/thighs, knees/lower legs and ankles/feet.

2.3.2. Individual/lifestyle factors

Individual factors (age, gender, height, weight, marital status, nursing experience) were collected using a demographic survey. Concerning 'smoking', 'alcohol', and 'prayer', the participants were asked; "How often do you perform the following items?" answered by a six-point scale from 'Never' = '0' to 'Very often' = '5'. The variables 'smoking', 'alcohol' and 'prayer' received ratings ranging from 1 to 5 for each variable. No variable received a rating of zero. Scores of ≥4 were considered high frequency or *heavy* and assigned the variables: 'H_Alcohol', 'H_Smoking' and 'H_Prayer'.

2.4. Data analysis

Upon completion of data collection and data entry, accuracy was verified for all of the questionnaires. This was carried out by cross-referencing all items in the sampled questionnaire with entries in the database by a third party not involved in the data collection. All discrepancies were corrected.

Statistical analysis was performed using the Statistical Analysis System v9.1 (SAS) software program (2002–2003). Cutoff points for age and BMI were as indicated in Table 1. The procedures used to analyze the raw data included the PROC FREQ procedure for proportions to calculate descriptive statistics and prevalence rates for MSS. Prevalence rates were calculated as the ratio of the number of reported symptoms (from a particular body region) to the total number of participants ($n = 263$). PROC CATMOD was used to investigate interdependence between multiple body regions. Measures of association were reported using the χ^2 statistic. Univariate analysis was used to examine relationships between individual/lifestyle factors. *P*-values of ≤0.05 were considered statistically significant and only statistically significant associations were reported.

3. Results

3.1. Prevalence of MSS in single body regions

Five body regions (neck, shoulders, lower back, knees/lower legs and ankles/feet) showed 1-month rates of approximately 50% or higher (Table 2). The 1-year prevalence of symptoms that were functionally limiting, range from 2.7% for fingers to 28.6% for the lower back. One-year prevalence rates were calculated using scores of '0' = No and '1' = Yes from question '3'.

One-year *severe* MSS were defined as nurses reporting a score of ≥4 in questions '1' and/or '2'. Clearly, severe lower back symptoms were the most frequently reported (48.8%) (Table 2).

Table 2
Prevalence rates for 1-month, 1-year functionally limiting, & 1-year severe musculoskeletal symptoms.

Region	1-Month symptoms *N* (%)	1-Year (functionally limiting) Symptoms *N* (%)	1-Year *Severe* Symptoms *N* (%)
Neck	145 (55.2)	29 (11.1)	86 (32.6)
Shoulders	132 (50.0)	34 (13.0)	87 (33.2)
Elbows/forearms	32 (12.3)	9 (3.4)	19 (7.3)
Hands/wrists	68 (25.7)	14 (5.3)	45 (17.2)
Fingers	54 (20.7)	7 (2.7)	27 (10.3)
Upper back	106 (40.2)	22 (8.4)	63 (24.1)
Lower back	195 (74.1)	75 (28.6)	128 (48.8)
Hips/thighs	99 (37.5)	27 (10.3)	57 (21.7)
Knees/lower legs	131 (49.8)	33 (12.6)	80 (30.3)
Ankles/feet	138 (52.5)	37 (14.1)	92 (34.9)

3.2. Combined symptoms in the lower back and other body regions

Table 3 shows that approximately 2 in 10 nurses experienced severe symptoms in the lower back and the lower extremities (knees/lower legs or ankles/feet) and the lower back and upper extremities (neck or shoulders). Significant correlations were found for the lower back and the remaining single body regions: and the lower back and multiple body regions.

3.3. Individual/lifestyle factors and symptoms in multiple body regions

Details regarding age, gender, BMI and marital status were presented in Table 1. Twenty-five percent of participants reported they smoked, of these, 51% were heavy smokers (smoking 'Fairly often' or 'Very often'); 71% consumed alcohol, 5.4% of these were heavy consumers of alcohol; and 95% pray, of these 60% prayed frequently. No significant associations were found for MSS and: age, gender, marital status, smoking, alcohol and prayer. However, *heavy* smokers were over twice as likely to experience severe symptoms in one or more body regions and *heavy* consumers of alcohol showed an increased risk of over five times for severe symptoms in

Table 3
Prevalence rates and significant associations for severe symptoms in the lower back and other body regions.

Lower back &	Body region	Prevalence *N* (%)	Chi-square value	*P*-value
One region	Neck	62 (23.4)	20.9	<0.0001
	Shoulders	63 (24)	23.6	<0.0001
	Elbows/forearms	17 (6.5)	4.5	0.035
	Hands/wrists	36 (13.7)	16.8	<0.0001
	Fingers	20 (7.6)	7.9	<0.005
	Upper back	53 (20.2)	17.5	<0.0001
	Hips/thighs	50 (19.1)	27.6	<0.0001
	Knees/lower legs	64 (24.4)	34.9	<0.0001
	Ankles/feet	61 (23.3)	26	<0.0001
Two regions	Upper back & neck	35 (13.4)	9.2	0.002
	Upper back & shoulders	37 (14.1)	8.9	0.003
	Hips/thighs & ankles/feet	31 (11.8)	6.9	0.009
	Hips/thighs & knees/ lower legs	37 (14.1)	12.3	0.004
	Hands/wrist & fingers	18 (6.9)	4.4	0.035
	Elbows/forearms & hands/wrists	13 (4.9)	6.3	0.012
Three regions	Hips/thighs & knees/ lower legs & ankles/feet	26 (9.9)	8.9	<0.0001
	Upper back & shoulders & neck	33 (12.6)	34.6	<0.0001

the hands & wrists (Table 4). Reports of a score of ≥4 (0 = 'never' and 5 = 'very often') were considered *heavy*.

BMI (kg/m^2) was found to be associated with severe symptoms in one or more body regions (OR 1.07–1.11). Work experience showed to be a slight protective factor (OR −0.97) when associated with symptoms in the lower back and lower back/knees & lower legs.

4. Discussion

While there have been numerous studies investigating work-related musculoskeletal risk factors, it is critical that a broader understanding of the underlying mechanisms is established. The concept that MSS in one body area may be associated (if not a precursor) to symptoms in another requires exploration: this investigation is an initial attempt at addressing this matter.

4.1. Prevalence of MSS

Prevalence rates reported here were slightly more pronounced than those found in European investigations and provided further implication to the significance of MSS for nursing personnel in the U.S (Engkvist et al., 1998; Josephson and Vingard, 1998). For example, 1-month prevalence of any MSS in the neck, shoulder, and lower back regions found in Smedley et al. (Smedley et al., 1998) ranged only from 16% to 19% compared to 50–74% in this study. It is important to keep in mind that data comparisons are challenging due to the lack of standardized methodologies, reporting mechanisms (Menzel, 2004; Kee and Seo, 2007) and cross-cultural differences between nurses in the U.S. and Europe.

The higher values reported for 1-month rates may be due to the ease of recall within the past 30 days, while symptoms within the past year may be slightly more difficult to remember and likely to result in an underestimation of prevalence (Menzel, 2004). Also, one-month prevalences may be higher due to the nature of the question, which only asked for "aches, pains or discomfort", whereas questions regarding the 1-year period asked about symptoms that "prevented from doing your normal work (at home or away from home)" which would be functionally limiting, more serious in nature and likely to be less prevalent.

Table 4
Associations between severe musculoskeletal symptoms and individual/lifestyle (I/L) factors.

I/L Factor	Symptom	OR (95%CI)	*P*-value
BMI	Hands/wrists	1.07(1.02–1.12)	0.0052
	Hips/thighs	1.05(1.00–1.09)	0.0405
	Knees/lower legs	1.07(1.03–1.12)	0.0013
	Ankles/feet	1.11(1.06–1.16)	<0.0001
	Lower back/elbows&forearms	1.04(1.00–1.08)	0.0462
	Lower back/hips&thighs	1.04(1.00–1.08)	0.0409
	Lower back/knees & lower legs	1.05(1.01–1.10)	0.0153
	Lower back/ankles & feet	1.06(1.01–1.10)	0.0124
	Lower back/elbows&forearms/ hands&wrists	1.04(1.00–4.80)	0.0332
	Lower back/hips&thighs/ knees&lower legs	1.06(1.01–1.10)	0.0087
	Lower back/hips&thighs/ ankles&feet	1.06(1.01–1.10)	0.0101
	Lower back/hips&thighs/ knees&lower legs/ankles&feet	1.06(1.01–1.11)	0.0093
Heavy Smoking[a]	Hands/wrists	2.67(1.19–5.98)	0.0052
	Lower back	2.33(1.08–5.00)	0.0304
	Lower back/elbows&forearms	2.17(1.01–4.66)	0.0475
	Lower back/hands&wrists	2.32(1.06–5.06)	0.0356
	Lower back/fingers	2.44(1.12–5.35)	0.0253
	Lower back/hips&thighs	2.40(1.10–5.25)	0.0285
	Lower back/knees&lower legs	2.41(1.08–5.39)	0.0326
	Lower back/elbows&forearms/ hands&wrists	2.19(1.00–4.80)	0.0492
	Lower back/hands &wrists/fingers	2.68(1.20–5.99)	0.0165
	Lower back/hips&thighs/ knees&lower legs	2.24(1.00–5.02)	0.0499
Heavy Alcohol Consumption[a]	Hands&wrists	5.28(1.46–19.07)	0.0112
Work Experience	Lower back	0.97(0.94–0.99)	0.0259
	Lower back/knees &lower legs	0.97(0.95–0.99)	0.0458

[a] The variables 'Heavy smoking', 'Heavy alcohol consumption' indicate a score of ≥4 ('fairly often' and 'very often').

4.2. Associations

Significant associations found between the lower back and multiple body regions lend credence to the thought that symptoms in one area may often be accompanied by symptoms in other body regions. Atypical behavioral mechanisms may occur due to altered coordination or concentration due to pain (Natvig et al., 2000). Indeed, in a study by Engkvist (Engkvist, 2004) the single most prominent factor directly contributing to an accident process was whether the nurse worked in an awkward position. If a nurse is suffering from pain or injury to the lower back and required to engage in patient handling, he/she may attempt to direct some, if not all, of the patient's weight on the arms using the knees and lower legs (not the lower back) for stabilization, causing undue stress on those areas. A solution may be to provide substitute work or ensure availability of lifting/moving devices supported with strong policies and training designed to ensure their use (de Castro, 2004).

Although a thorough understanding of the pathological (biological) process of lower back pain has yet to be defined, the root of the pain may be due to excessive strain on the muscles, tendons, ligaments, joints or discs. Nonetheless, in many cases, if left untreated, the pain may radiate to adjacent areas of the body leading to symptoms in those regions by the actual spread of inflammation or the result of nerve damage.

Perceived risk (psychological) may also play an important role. In a study involving nurses, Karwowski et al. (Karwowski et al., 2005) found that fixed low back postures were a significant predictor for perceived risk of musculoskeletal injury or illness. In addition, the impact of having severe lower back pain on a nurse's quality of personal and work life may increase the risk of psychological stress possibly leading to symptoms in other body areas (Hagen et al., 2006; Josephson and Vingard, 1998; Layer et al., 2009; Daraiseh et al., 2003; Hoogendoorn et al., 2000; Violente et al., 2004).

4.3. Lifestyle/individual factors

Studies have been inconsistent concerning lifestyle/individual factors and their association with MSS. Kamaleri et al. (Kamaleri et al., 2008a) reported the overall number of pain sites (1–10) and their associations with lifestyle factors. This study builds upon this knowledge by specifying the particular pain sites. Results here found that a greater number of pain sites were reported by heavy smokers and individuals with high BMI. It is of concern that the mean BMI is 27.9 and 37.6% of participants reported a BMI of ≥30; considered overweight and obese (respectively) by the National Institutes of Health (National Institutes of Health, 2000). However, according to the National Health Statistics Report (McDowell et al., 2008) the mean BMI for this sample is below the mean (28.4) for females in the U.S. over 20 years of age.

Several studies on the general population do not agree with results found for MSS and smoking, obesity and alcohol consumption (Leboeuf-Yde, 1999, 2000a, 2000b; Björkstén et al., 2001). Others have found increased risk of MSS with increased BMI (Kamaleri et al., 2008a; Rodacki et al., 2005; Thomas et al., 1999; Thorbjörnsson et al., 2000; Vieira et al., 2008): smoking (McDowell et al., 2008; Thomas et al., 1999; Thorbjörnsson et al., 2000; Vieira et al., 2008; Karahan et al., 2009): and alcohol (Thomas et al., 1999; Nathan et al., 1996; Smith et al., 2006). Surprisingly, in this study, BMI had only a minor increase in risk whereas heavy smoking and heavy alcohol consumption resulted in much higher risks of MSS. Even though BMI may have only a slight risk it is associated with 4 of 10 single body regions as well as multiple body regions; many regions include the lower back. The cumulative impact of BMI and its established associations with other debilitating conditions (i.e. heart disease, diabetes, and high blood pressure) underscore the importance of addressing high BMI/obesity in this population.

Smoking can affect the musculoskeletal system through: i) blood flow reduction (Brage and Bjerkedal, 1996); hypoxia (Leboeuf-Yde, 2004); or chemical changes leading to muscle, joint and disc degeneration and/or ii) excitatory effects of nicotine may alter the perception/threshold of pain, increasing self-reporting among smokers (Brage and Bjerkedal, 1996). Obesity places pressure on disc endplates and facet joints and can also place excessive force on other joints in the body. In addition, stature loss caused by increased and chronic loading; and a greater stature recovery period in obese individuals can be considered a risk factor for low back pain (Rodacki et al., 2005).

Excessive alcohol consumption may impact fine-motor skills and dexterity and decrease the body's ability to fight repetitive strain (Ingram-Rice, 1997) (hand movements that are highly prevalent in nursing activities). Furthermore, entrapment of the peripheral nerves due to excessive alcohol consumption (Bracker and Ralph, 1995) and deficiencies of calcium and vitamin D due to malabsorption may also explain the increased risk for MSS in hands/wrists (Bikle et al., 1985; Laitinen and Välimäki, 1991). However, since moderate levels of alcohol have shown to have a beneficial effect on bone (Zhang et al., 2008); the relevant question is "How much alcohol is too much in regards to MSS?"

Notable, work experience showed to be a protective factor indicating possible coping strategies among experienced nurses, which needs to be examined in future studies.

4.4. Limitations

Due to the cross-sectional nature of this study, the investigators cannot conclude on a causal relationship between multiple MSS. The authors' intent is to lay the groundwork for future studies, possibly longitudinal in nature, to investigate this hypothesis further.

In this study, the frequency and intensity categories were stated in linguistic terms (i.e. never, rare, very rare) and not defined numerically (i.e. once per week or once per month). This may be considered a limitation; however, the investigators' focus was not on pinpointing the actual frequency/intensity of symptoms, but to gain a broad understanding due to the subjective nature of MSS. Thus, interpretation of the various scales was left to the participants since their perception of frequency was of more interest to the authors than actual number of times a symptom occurred. Yeung et al. (Yeung et al., 2003) utilized linguistic terms in assessing MSS among manual handling workers in Hong Kong (low, moderate, high, and very high) since humans tend to think and act in linguistic terms.

Since participation was voluntary, respondents may not represent the entire range of nursing personnel, as they may have been more receptive to participating because they suffered from MSS. The results may also be affected by recall bias since all data collected were self-reported using questionnaires.

5. Conclusions

The possibility of preventing symptoms in some body areas by alleviating or treating symptoms in another may have considerable impact on the occurrences and potential chronicity of MSS. In a two-year prospective study conducted on nurses, Smedley et al. (Smedley et al., 1997) found that the strongest predictor of new lower back pain was earlier history of the symptom and later found that prior lower back symptoms were the strongest predictor for pain in the neck/shoulder (Smedley et al., 2003). Significant associations found here lead to serious consideration that problems in the lower back may lead to problems in other body areas.

Results emphasize the importance of interventionists conducting periodic assessments on nursing personnel rather than wait for annual evaluations (IJzelenberg and Burdorf, 2004). In fact, Natvig et al. (Natvig et al., 2001, 2000) and Kamaleri et al. (Kamaleri et al., 2008b) found a near linear increase in functional limitation by increasing number of areas with MSS. Symptom reporting at the time of initial back pain can identify individuals at higher risk for developing chronic musculoskeletal disorders in multiple body areas (Leboeuf-Yde, 2000b; IJzelenberg and Burdorf, 2004; Carnes et al., 2007).

Future studies should address the chronological order of symptom development to fully demonstrate if the onset of symptoms in various body regions is triggered by preexisting symptoms in another region. Also, detailed studies with a 'dose–response' emphasis should be conducted to fully examine individual/lifestyle factors and MSS. This is an area rich with implications for possible future research involving prevention and treatment for MSS.

Acknowledgements

This research was supported (in part) by a pilot project research training grant from the University of Cincinnati. The University of Cincinnati, an Education and Research Center, is supported by Training Grant No. T42/CCT510420 from the Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health. The contents are solely the responsibility of the authors and do not necessarily represent the official views of the National Institute for Occupational Safety and Health.

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