

Assessing and preventing low back pain in nurses. Implications for practice management

Gabriele d'Ettorre¹, Annamaria Vullo², Vincenza Pellicani³

¹Department of Occupational Medicine, Local Health Authority, Brindisi, Italy, Health Unit of Occupational Prevention and Protection, Brindisi, Italy; ²Department of Anatomical, Histological, Forensic and Orthopaedic Sciences, Sapienza University of Rome, Rome, Italy; ³Local Health Authority, Lecce, Department of Mental Health, Lecce, Italy

Abstract. *Background and aims:* The prevention of low back pain (LBP) among nurses employed in hospital departments represents a special concern for healthcare organizations globally. A growing literature evidences the need of workplace policy development related to organizational issues as strategic contribution to minimize the occurrence of LBP in healthcare sector. The purposes of this study were: 1) to analyze the relationship between shiftwork and acute LBP among female shift nurses; 2) to detect preventive interventions targeted on organizational issues. *Methods:* The authors conducted a cross-sectional nested case-control analysis of data concerning acute LBP and staffing data for 671 nurses employed in the Departments of General Practice and Elderly Care Medicine. The statistical analysis consisted of a logistic regression to calculate incidence odds ratios with 95% confidence intervals. Chi-square test and t-test were used to examine the relationship between categorical and continuous data, respectively. *Results:* The occurrence of acute LBP resulted significantly related to nightshift, extended shifts, obesity; the adoption of forward rotating schedules was found a protective factor in moderating the occupational risk of acute LBP in shift nurses. *Conclusions:* In this study the authors observed an association between shiftwork and acute LBP; improvement interventions should be aimed at: 1) moderating organizational risks linked with shiftwork schedules; 2) promoting healthy lifestyles. These interventions are suggested as a strategic way to effectively manage the phenomenon among female rotating shift nurses. (www.actabiomedica.it)

Key words: low back pain, safety, risk assessment, risk management., shift work, obesity

Introduction

The prevention of musculoskeletal disorders (MSDs) in healthcare workers (HCWs) is a major concern for both healthcare organizations and workers, globally. In fact, a growing literature reveals increased risk of MSDs in HCWs and the low back pain (LBP) has been proved the most common cause of work-related disabilities among nurses (1-4); increasing rates of LBP occurrence in nurses have been linked with the progressive aging of both healthcare workers and general population which significantly contribute

to higher risk for intervertebral disk degeneration in older workers (5-7).

The evidence based prevention of occupational diseases in healthcare sector points to the need for workplace policy development focused on organizational issues as strategic contribution to minimize the occurrence of LBP in HCWs. In fact, Rasmussen et al. (8) in a cluster randomised controlled trial found that participatory ergonomic interventions targeted to organizational risk factors (e.g. lack of communication or bad communication between supervisors and employees or colleagues in-between), and psychosocial risk

factors (e.g. low prioritization of staff wellbeing, conflicts with the person that needs care), were effective in moderating the occurrence rates of MSDs in nurses. In the past, many studies have shown the relationship between psychosocial risks, including the shiftwork, and the LBP in registered nurses (RNs) (9-11); in particular, Hopcia et al. (12) found an increased risk of injury in RNs with more consecutive work days and longer cumulative working hours, and demonstrated the need for organizational interventions targeted to shiftwork schedules with the aim to better protect the safety and health of HCWs.

Many authors revealed shiftwork also an independent variable associated to a greater risk of increased body mass index (BMI) and central obesity (13-15) and supposed the circadian rhythm disruption and unhealthy lifestyles (e.g. poor dietary habits, low recreational physical activity, sleep deprivation) being the major determinants of such metabolic disorders; according to these findings a growing literature showed the need for workplace health promotion programs which involve lifestyle behaviors (e.g. physical activity, healthy diet), aimed at the prevention of musculoskeletal and other non-communicable diseases (16-19). Despite these findings, to date there has been little evidence about the impact of shiftwork, including night shift, on the occurrence of acute LBP among shift-RNs working non-traditional shifts, including nights and 12-hour shifts. The purpose of the present research was to analyze the impact of shiftwork, physical activity and BMI on the occurrence of work-related acute-LBP (WRALBP) among female rotating shift-registered nurses (RNs) in Departments of General Practice and Elderly Care Medicine, with the aim of suggesting organizational interventions that would be effective in minimizing the occurrence of WRALBP.

Methods

The authors conducted a matched case-control study that involved all the female rotating shift-RNs, exactly 671 (mean age: 46,4±2,3; years of work: 20,9±2,1) employed in Departments of General Practice and Elderly Care Medicine, in Italy. The study was

performed in the period between December 2017 and November 2018 and was aimed at analyzing: 1) the relationship between cumulative hours, night shifts, and WRLBP 2) the relationship between forward-rotating shift schedules (morning-afternoon-night) and WRLBP occurrence 3) the relationship between BMI, physical activity, and WRLBP. The study of the work shift prior to the date of WRLBP analyzed: cumulative hours worked in the previous 7 and 28 days, cumulative nights worked in the previous 7 and 28 days, direction of rotating shift schedules in the previous 28 days prior to the date of NSI. A shift was categorized as a night shift if it included 1:00 am and 2:00 am as part of the shift. From the cohort of shift-RNs, the cases were selected according to the following case definition for WRLBP: activity-limiting LBP (± pain referred into one or both lower limbs) that lasts for at least one day; 'low back' was defined as the area on the posterior aspect of the body from the lower margin of the twelfth ribs to the lower gluteal folds [20]; the acute LBP occurred at work. If the cases reported more than one WRLBP incident, all the cases of WRLBP were included in the study. Controls were randomly selected by registry database of shift-RNs working in the same hospital, with similar demographic characteristics of the cases (unit type, job type, gender, age ± 5 year) and not already included in this study as cases. Each case was matched with two controls. All the cases and the controls were rotating shift-RNs employed in a Department of General Practice and Elderly Care Medicine in which the occupational risk assessment detected high levels of patient manual handling risk for shift-RNs (5). Cases and controls were divided according to: 1) number of night shifts worked 7 and 28 days prior to the day of WRLBP 2) total hours or shifts worked 7 and 28 days prior to the day of WRLBP 3) BMI 4) leisure physical activity 5) adoption of constant forward-rotating shift schedules 7 and 28 days prior to the day of WRLBP. BMI was categorized, according to the standard World Health Organization (WHO) definition (21), as normal if between 18.5 kg/m² and 24.99 kg/m², overweight if between 25kg/m² and 29.99 kg/m², and obese if 30 kg/m² or more. Leisure physical activity was defined as the equivalent of two and a half hours of moderate to vigorous physical activity each week, in leisure time; in fact, the WHO

recommended that all adults should get such activity to maintain good health (22-23). For the present research the author used the Occupational Prevention and Protection Service database consisting of all incident and safety reports (including the occurrence of WRLBP) and Human Resources information. The study population is reported in Table 1. The statistical analysis consisted of a logistic regression to calculate incidence odds ratios with 95% confidence intervals. Chi-square test and t-test were used to examine the relationship between categorical and continuous data, respectively. All analyses were performed using SPSS for windows. The study was performed as part of the obligatory evaluation of WRLBP, required by Italian Legislative Decree 81/08, and needed no formal approval by the local ethics committee.

Results

In the period investigated, 93 cases of WRLBP were reported among the 671 female RNs (annual incidence = 13.9%); 5 cases reported more than one episode of WRLBP. No significant differences were found among cases and controls compared by cumulative hours and total shifts worked in the 7 and 28 days prior to acute LBP date. A significant risk of LBP was found for nurses working for more than two 12-hours shifts in the previous 7 days, compared to working less than three 12-hours shifts in the previous 7 days. Cumulative night shifts were significant for 3 or more night shifts compared to working less

Table 1. Study population

Variable	Cases n=93	Controls n=186	p-Value
Age (SD)	45,8 (±2,3)	46,1 (±3,1)	p>0,05
Years of work (SD)	19,3 (± 2,4)	18,9 (±3,4)	p>0,05
Physical activity (%)	19 (25,3)	78 (52)	P<0.05
BMI:			
<18.5	12(12,9%)	29 (15,6%)	p>0,05
18.5-24.99	22 (23,7%)	55 (29,6%)	p>0,05
25-29.99	32 (34,4%)	78 (41,9%)	p>0,05
>30	27 (29%)	24 (12,9%)	P<0.05

than 8 night shifts in the previous 28 days (OR=3,73; 95% CI=1.96-7.11) (Table 2). The adoption of constant forward-rotating shift schedules proved effective in preventing acute LBP compared with shift schedules that did not follow the constant forward-rotating model in the preceding 28 days (0,44; 95% CI=0,26-0,72 p<0,05) (Table 5). Less leisure time physical activity was reported among cases than controls (p<0.05) and showed as a protective factor for WRLBP occurrence (OR=0,36; 95% CI=0,20-0,64 p<0,05). The cases were more often obese than controls (Table 1) and an increased OR for acute LBP was found among obese RNs (OR=2,60; 95% CI=1,21-5,50) (Table 4).

Discussion

The analysis showed the relationship between shiftwork and WRLBP, and, consequently, the need to strategize regarding the best way to approach the

Table 2. Odds Ratios for number of night shifts worked 7 and 28 days prior to the day of WRALBP

	Cases N. 93	Controls N. 186	O.R. (95% CI)	p-Value
Number of night-shifts in previous 7 days (length ≥4 hours)				
0	5	12	1*	
1-2	42	98	1,03 (0,34-3,10)	p>0,05
3-6	46	65	1,70(0,56-5,18)	p>0.05
Number of night-shifts in previous 28 days (length ≥4 hours)				
<4	20	67	1*	
4-8	24	75	1,07 (0,54-2,11)	p>0,05
>8	49	44	3,73 (1,96-7,11)	p<0.05

WRALBP, work-related acute low back pain.

*Referent category

Table 3. Odds Ratios for total hours or shifts worked 7 and 28 days prior to the day of WRALBP

	Cases N. 93	Controls N. 186	O.R. (95% CI)	p-Value
Total hours worked in previous 7 days				
<20	3	6	1*	
20-28	13	24	1,08 (0,23-5,06)	p>0,05
29-36	72	150	0,96 (0,23-3,95)	p>0,05
>36	8	16	1,0 (0,20-5,01)	p>0,05
Total shifts (any shift ≥4 hours) worked in previous 7 days				
0	4	7	1*	
1-2	18	95	0,33 (0,09-1,25)	p>0,05
3-6	71	84	1,48 (0,42-5,26)	p>0,05
Total 12-hr (or longer) shifts in previous 7 days				
0	3	15	1*	
1-2	84	167	2,51 (0,71-8,93)	p>0,05
3-6	6	4	7,50 (1,28-44,1)	P<0.05
Total hours worked in previous 28 days				
<80	6	13	1*	
80-115	7	9	1,69 (0,42-6,71)	p>0,05
116-144	30	65	1,00 (0,35-2,88)	p>0,05
>144	50	99	1,10 (0,39-3,05)	p>0,05
Total shifts (any shift ≥4 hours) worked in previous 28 days				
<6	3	8	1*	
6-12	19	50	1,01 (0,36-2,85)	p>0,05
>12	71	128	1,50 (0,38-5,75)	p>0,05
Total 12-hr (or longer) shifts in previous 28 days				
<6	4	10	1*	
6-12	83	166	1,25 (0,38-4,11)	p>0,05
>12	6	10	1,50 (0,32-6,99)	P>0,05

*Referent category

Table 4. Odds Ratios for BMI of cases and controls

Body Mass Index (BMI)	Cases	Controls	O.R. (95% CI)	p Value
< 18,5	11	31	1,13 (0,47-2,72)	p>0,05
18,5-24,99	24	52	1*	
25-29,99	34	83	0,89 (0,47-1,66)	p>0,05
≥30	24	20	2,60 (1,21-5,50)	P<0.05

*Referent category

concern; in fact, increased OR for WRLBP was found for RNs working night-shifts more than 8 nights in 28 days. This finding confirmed the evidence in the literature regarding the harmful effect of shift work, including night shift, on workers' safety; in the past,

many studies demonstrated the link between shiftwork and occupational stress, burnout, fatigue, sleeping difficulties, reduced work efficiency, poor performance, decreased job satisfaction, increased rates of absenteeism and turnover and increased accident and injury

Table 5. Odds Ratios for adoption of constant forward-rotating shift schedules worked 7 and 28 days prior to the day of WRLBP

	Cases N. 93	Controls N. 186	O.R. (95% CI)	p-Value
Constant forward-rotating shift schedules in previous 7 days (%)	31 (33,3)	81 (43,5)	0,65 (0,39-1,10)	p>0,05
Constant forward-rotating shift schedules in previous 28 days (%)	38 (40,9)	114 (61,3)	0,44 (0,26-0,72)	p<0,05

rates (24-26). In the present study, night shift work was confirmed as a workplace stressor for shift-RNs working frequent night shifts – a stressor that could be minimized through organizational interventions aimed at reducing the number of night shift per RN to be no more than 8 nights every 28 days. The risk of WRLBP resulted increased among RNs working three or more 12-hour shifts a week or working more than six 12-hour shifts every 28 days; this finding demonstrated the unhealthy impact of extended shifts on the workers' safety, in accordance with many authors (12, 24-27) who have pinpointed such extended shifts as major risk for the occurrence injuries. This finding may be due to increased fatigue, poor mood, poor recovery from work between work periods, all of which have been linked to long work hours (26-30, 31). Extended shifts followed by several days off allow workers to better manage schedules outside of work, but represent an risk for occupational acute-LBP.

In accordance with HSE recommendations (32), the adoption of forward-rotating schedule for rotating shifts proved effective at better protecting the workers' safety than a backward-rotating schedule or other rotating schedules; in fact, we observed a trend of increasing OR for acute-LBP in RNs adopting rotating schedules other than forward rotating shift-work.

These findings showed that RNs with a heavy night work load and frequent extended shifts may incur a greater risk of WRLBP; organizational interventions targeted at reducing the shift load (e.g. number of night shifts less than nine monthly, limitation of extended shifts, adoption of forward-rotating schedule) are required to moderate the shift workload and, consequently, to minimize the occurrence of WRLBP among RNs in Departments of General Practice and Elderly Care Medicine.

The analysis of BMI revealed that cases were more frequently obese than controls, and obesity was asso-

ciated with a high risk of WRLBP (OR=2,60; I.C.= 1,21-5,50); these findings confirmed the evidence reported by many authors (18, 19) in reference to the relationship between shiftwork and increased BMI, and showed that obesity is a risk for the occurrence of WRLBP among female RNs.

This study supported the need to prioritize interventions aimed at promoting healthy lifestyle choices and targeting modifiable lifestyle factors (e.g. alcohol consumption, smoking habit, physical activity), with the aim of preventing non-communicable diseases and, particularly, the occurrence of WRLBP among rotating shiftwork RNs.

Conclusion

Shiftwork and WRLBP were found to be interconnected. Improvement interventions should be aimed at: 1) moderating the organizational risks linked with shiftwork schedules; 2) promoting healthy lifestyles. These interventions are suggested as a strategic way to effectively manage the phenomenon among female rotating shift-RNs in Departments of General Practice and Elderly Care Medicine. According to the World Health Organization, constructing healthy workplaces, including in the healthcare sector, is a goal that may be reached through collaboration between workers and managers, with the aim of promoting and protecting the health, safety and well-being of all workers and the sustainability of the workplace (33).

The study has some limitations: 1) the period investigated is too short to draw strong conclusions about the relationship between shift work schedules and occurrence of WRLBP; 2) the analysis is conducted on a small sample; 3) the study is targeted to the relationship between WRLBP and cumulative hours, night shifts, forward-rotating shift schedules, BMI,

physical activity, and does not take into account other types of determinants for WRLBP; 4) the disadvantage of case-control studies is that they do not indicate absolute risk, but, rather, the risk of the category worked related to another lower or referent category.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

References

- Freimann T, Pääsuke M, Merisalu E. Work-Related Psychosocial Factors and Mental Health Problems Associated with Musculoskeletal Pain in Nurses: A Cross-Sectional Study. *Pain Research and Management*. 2016; <http://dx.doi.org/10.1155/2016/9361016>.
- Duthey B. Background Paper 6.24 Low back pain. World Health Organization. 2013. Available from: www.who.int/medicines/areas/priority.../BP6_24LBP.
- Sadeghian F, Hosseinzadeh S, Aliyari R. Do Psychological Factors Increase the Risk for Low Back Pain Among Nurses? A Comparing According to Cross-sectional and Prospective Analysis. *Saf Health Work* 2014; 5: 13-16.
- Lin PH, Tsai YA, Chen WC, Huang SF. Prevalence, characteristics, and workrelated risk factors of low back pain among hospital nurses in Taiwan: a cross sectional survey. *Int J Occup Med Environ Health* 2012; 25: 41e50.
- Battevi N, Menoni O, Alvarez-Casado E. Screening of patient manual handling risk using the MAPO method. *Med Lav* 2012 Jan-Feb; 103(1): 37-48.
- Sharma S, Shrestha N, Jensen MP. Pain-related factors associated with lost work days in nurses with low back pain: cross-sectional study. *Scand J Pain* 2016; 11: 36-41.
- Lorusso A, Bruno S, L'Abbate N. A review of low back pain and musculoskeletal disorders among Italian nursing personnel. *Ind Health* 2007; 45: 637e44.
- Rasmussen CD, Holtermann A, Jørgensen MB, Ørberg A, Mortensen OS, Søgaard K. A multi-faceted workplace intervention targeting low back pain was effective for physical work demands and maladaptive pain behaviours, but not for work ability and sickness absence: Stepped wedge cluster randomised trial. *Scand J Public Health* 2016 Aug; 44(6): 560-70.
- Wagstaff AS, Sigstad Lie JA. Shift and night work and long working hours--a systematic review of safety implications. *Scand J Work Environ Health* 2011 May; 37(3): 173-85. doi: 10.5271/sjweh.3146. Epub 2011 Feb 3.
- Stimpfel AW, Brewer CS, Kovner CT. Scheduling and shift work characteristics associated with risk for occupational injury in newly licensed registered nurses: An observational study. *Int J Nurs Stud* 2015 Nov; 52(11): 1686-93.
- Attarchi M, Raeisi S, Namvar M, Golabadi M. Association between shift working and musculoskeletal symptoms among nursing personnel. *Iran J Nurs Midwifery Res* 2014 May; 19(3): 309-14.
- Hopcia K, Dennerlein JT, Hashimoto D, Orechia T, Sorensen G. A Case-Control Study of Occupational Injuries for Consecutive and Cumulative Shifts Among Hospital Registered Nurses and Patient Care Associates. *Workplace Health Saf* 2012 October; 60(10): 437-444.
- Peplonska B, Bukowska A, Sobala W. Association of Rotating Night Shift Work with BMI and Abdominal Obesity among Nurses and Midwives. *PLoS ONE* 2015; 10(7): e0133761.
- Peplonska B, Bukowska A, Sobala W. Rotating night shift work and physical activity of nurses and midwives in the cross-sectional study in Lodz, Poland. *Chronobiol Int* 2014; 31: 1152-1159.
- Peplonska B, Burdelak W, Krysicka J, Bukowska A, Marcinkiewicz A, Sobala W, et al. Night shift work and modifiable lifestyle factors. *Int J Occup Med Environ Health* 2014; 27: 693-706.
- Zhao I, Bogossian F, Turner C. The effects of shift work and interaction between shift work and overweight/obesity on low back pain in nurses: results from a longitudinal study. *J Occup Environ Med* 2012 Jul; 54(7): 820-5.
- Peplonska B, Burdelak W, Krysicka J, Bukowska A, Marcinkiewicz A, Sobala W, Klimecka-Muszyńska D, Rybacki M. Night shift work and modifiable lifestyle factors. *Int J Occup Med Environ Health* 2014 Oct; 27(5): 693-706.
- Buchvold HV, Pallesen S, Øyane NM, Bjorvatn B. Associations between night work and BMI, alcohol, smoking, caffeine and exercise--a cross-sectional study. *BMC Public Health* 2015 Nov 12; 15: 1112.
- Tada Y, Kawano Y, Maeda I, Yoshizaki T, Sunami A, Yokoyama Y, Matsumoto H, Hida A, Komatsu T, Togo F. Association of body mass index with lifestyle and rotating shift work in Japanese female nurses. *Obesity (Silver Spring)* 2014 Dec; 22(12): 2489-93.
- Weaver MD, Patterson PD, Fabio A, Moore CG, Freiberg MS, Songer TJ. The association between weekly work hours, crew familiarity, and occupational injury and illness in emergency medical services workers. *Am J Ind Med* 2015 Dec; 58(12): 1270-7.
- WHO. Physical status: the use and interpretation of anthropometry: report of a WHO expert committee. WHO Technical Report Series 1995; 854: 1-452. PMID: 8594834.
- Harvard T.H. Chan. School of Public Health. Obesity Prevention Source. [Internet] [cited 2016 Oct 21] <https://www.hsph.harvard.edu/obesity-prevention-source/obesity-causes/physical-activity-and-obesity/#references>.
- World Health Organization. Global recommendations on physical activity for health; 2011. Accessed Gen 25, 2017.
- Caruso CC, Condon ME. Night shifts and fatigue: coping skills for the working nurse. *Am J of Nursing* 2006; 106: 88.
- Caruso CC, Waters TR. A review of work schedule issues

- and musculoskeletal disorders with an emphasis on the healthcare sector. *Ind Health* 2008; 46: 523-34.
26. Caruso CC. Negative Impacts of Shiftwork and Long Work Hours. *Rehabil Nurs* 2014; 39(1): 16-25.
 27. Dwyer T, Jamieson L, Moxham L, Austen D, Smith K. Evaluation of the 12-hour shift trial in a regional intensive care unit. *Nurs Manag* 2007 Oct; 15(7): 711-20.
 28. van der Hulst M, van Veldhoven M, Beckers D. Overtime and need for recovery in relation to job demands and job control. *J Occup Health* 2006 Jan; 48(1): 11-9.
 29. van der Starre RE, Coffeng JK, Hendriksen IJ, van Mechelen W, Boot CR. Associations between overweight, obesity, health measures and need for recovery in office employees: a cross-sectional analysis. *BMC Public Health* 2013 Dec 20; 13: 1207.
 30. d'Ettorre G. Needlestick and Sharp Injuries Among Registered Nurses: A Case-Control Study. *Ann Work Expo Health* 2017; 61 (5): 596-599. doi: 10.1093/annweh/wxx027.
 31. d'Ettorre G, Vullo AM, Pellicani V, Ceccarelli G. Acute low back pain among registered nurses. Organizational implications for practice management. *Ann Ig* 2018; 30: 482-489 doi:10.7416/ai.2018.2248.
 32. Health and Safety Executive (UK). Managing shiftwork - Health and safety guidance. London: HSE. 2006. Available from: www.hse.gov.uk/pubns/books/hsg256.htm.
 33. World Health Organization (Geneva). Healthy workplaces: a model for action: for employers, workers, policymakers and practitioners. 2010. Available from: [ww.who.int/.../healthy_workplaces_model.pdf](http://www.who.int/health/.../healthy_workplaces_model.pdf)

Received: 22 February 2019

Accepted: 13 May 2019

Correspondence:

Gabriele d'Ettorre, Medical Doctor,

Local Health Authority of Brindisi (ASL BR)

Director of the Health Unit of Occupational Prevention and Protection

Piazza Di Summa - 72100 Brindisi, Italy

Tel. +390831510433

Fax +390831510438.

E-mail: gabriele.det@libero.it