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Factors contributing to work related low back pain among personal care workers in old age

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Abstract. This study aims to preliminary explore the work related and individual factors that contributed to the occurrence of low back pain (LBP) that affected work activities of Personal Care Workers (PCWs). A cross-sectional study was conducted to 36 PCWs in an old age home of Hong Kong. The study is divided into three parts: 1) a questionnaire to document the workload exposure factors and the musculoskeletal symptoms survey of the PCWs, 2) work posture evaluation; and 3) an evaluation of the physical fitness and lifting capacity of the PCWs. Univariate analyses were used to explore the risk factors associated with LBP that affected work activities. The results indicated that individual physical profile and lifting capacities did not contribute to occurrence of low back pain at work. For the work demand factors, the perceived physical demands in lifting and lowering heavy objects, awkward sustain neck and back postures, loading on the back, and perceived effort of cleaning task contributed to the occurrence of LBP. For the physical environment factors, thermal stress and improper ventilation were associated with the occurrence of LBP cases. For the individual factor, LBP cases were associated with workers' self perceived muscular effort, and perceived risk of mental illness in response to work requirements.

Keywords: Low back pain, risk factors, personal care workers

1. Introduction

Low back pain (LBP) constituted the major work related muscuoskeletal disorders in the health care professionals. According to the Statistics on Occupational Injuries compiled by the Labour Department of the Government of the Hong Kong Special Administrative Region (HKSAR), the most common occupational injuries in Health Care is "injured whilst lifting or carrying", which accounted for 31.9% for all the occupational injury in 2009 [1]. In old age homes (OAH), personal care workers (PCWs) share the workload of nurses in most of the transfer and manual handling tasks and it has been reported that nursing aids are more likely to suffer from LBP than registered nurses [2-4]. LBP is multifactorial in origin and may be associated with both occupational and non work-related factors, and multifactorial interventions has been suggested to the best approach in alleviating the problems of LBP at the workplace [5]. Thus, the purpose of this study is to use a multifactorial approach to identify the possible risk factors that might contribute to the occurrence of LBP among PCWs in an old age home. *

2. Method

Study design

The study is a cross sectional design applied to all the PCWs in a local Old Age Home. Workers with either disabling LBD symptoms (that required sick leave) during the last 7 days prior to the testing, or who have history of spinal surgery, diagnosed metabolic illness or cardiovascular disorders (such as rheumatoid arthritis, cardiovascular disease, diabetes, hypertension, malignancy, etc), or any severe pathology of prolapsed intervertebral disc were excluded from the study.

Measurement of risk factors

The interaction between the workload exposure and personal variables on the prevalence of LBD were evaluated. The study is divided into three parts: 1) a questionnaire to document the workload expo-

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sure factors and the musculoskeletal symptoms survey of the PCWs, 2) work posture evaluation; and 3) an evaluation of the physical fitness and lifting capacity of the PCWs.

Work load exposure questionnaire and musculoskeletal symptoms survey

The questionnaire consists of three parts: work demand evaluation, self-perceived work ability, PCWs demographic data, and a musculoskeletal-symptoms survey. The work demand factors consist of 55 items aimed to document the physical task requirements, mental task requirements, physical environment requirements, and socio-organisation environmental requirements. The self-perceived work ability consists of 32 items to evaluate the workers' self perceived work ability in dealing with commonly performed physically demanding tasks, and tolerance to various work environment and characteristics. Each items was assessed using a 7 point rating scale with linguistic descriptor anchored with each of the scale, ie. "very very low", "very low", "low", "moderate", "high", "very high", and "very very high". This measure has been used in our previous studies in the evaluation of manual lifting tasks [6,7]. The questionnaire also included individual characteristics: age, education level, marital status and years of working experience.

Posture evaluation

The Ovako Working posture Analysis System (OWAS), which was originally used for the documentation of the work postures in the Finnish Steel industry [8] was used to estimate the frequency and repetitiveness of the various body postures when performing the work tasks. Four PCWs were conveniently selected by the head nurse for the video recording of their work tasks during an eight-hour daytime shift. Nine basic work tasks (preparing meal, feeding, putting on / removing clothes, wheelchair pushing, cleaning, transfer, showering, turning in bed, changing diaper) were chosen for analysis.

Evaluation of physical fitness, lifting capacity and anthropometric measurement

Among the thirty-six PCWs, thirty-two of them volunteered to perform a comprehensive physical fitness evaluation. These include cardiopulmonary fitness by Queens' College Step Test, Sit and reach test to document the joints flexibility, one minute sit up to represent muscle endurance, body composition, and three isometric lifting capacities (isometric arm lift, leg lift and back lift strength). The internal reliability of these tests has been reported to be high [9-12]. The body weight and height were measured for calculation of body mass index (BMI). All tests were performed with standard equipment and trained personnel. Rest period was given between each test.

Case definition

The LBP were assessed by a Chinese version of the Nordic Questionnaire, modified from the Nordic Musculoskeletal Symptom Survey [13] with body diagram to illustrate the respective body region as previously described [7].

Data management and statistical analysis

All analyses were performed using SPSS (Statistical Package for the Social Sciences) for window version 16.0 (Chicago, IL). Univariate logistic analyses were performed to identify variables that were significantly related to the occurrence of LBP.

3. Results

Prevalence of low back pain.

Table 1 shows the prevalence of LBP with various definitions. Ten (27.8%) of them reported to have LBP that limited their work activities in the past 12 months. For the purpose of this study, LBP was defined as the presence of any "aches, pains, or discomforts" in the lumbar or low back region in the past 12 months that limited their work activities at work but do not required any sick leave.

Physical fitness profile

Table 2 shows the physical fitness profile and the anthropometric measurement of the PCWs. Independent T-test reveals no significant different between the LBP cases and non-LBP cases.

Postural analysis

A total of 2,162 observations of the nine basic tasks were recorded. Table 3 shows the percentage of time spent in the recording of the nine basic activities. Among them, changing diaper (79.4 %), transfer (66.7%) and putting on / removing clothes (65.0 %) are the top three tasks with poor back posture.

Self perceived work demands factors

Table 4 shows the descriptive rating of the workers' perceived work demands and self perceived work capacity.

Table 1
Prevalence of low back pain (LBP)

LBP	n	percen-
1. Have you ever had trouble in lower back	34	94.4%
2. 12-month prevalence and duration:		
- 1-7 days	6	16.6%
- 8-30 days	7	19.4 %
- >30 days	8	22.2 %
- Everyday	13	36.1%
- N/A	2	5.5%
3. LBP reduced leisure in past 12-month	18	50.0%
4. LBP prevalence during the last 7 days	18	50.0%
5. LBP limited their work in past 12-month*	10	27.8%

Table 2
Physical fitness profile and the anthropmetric measurement of the PCWs (LBP vs non=LBP group

Variable	LBP	Mean	SD	t	p
Age	no	41.58	4.60	0.60	0.55
	yes	42.70	5.95		
Height (cm)	no	153.83	4.35	1.57	0.26
	yes	156.28	3.73		
Body weight (lb)	no	56.51	6.84	1.25	0.22
	yes	60.40	11.55		
Resting HR (beat/min)	no	79.14	10.18	0.60	0.55
	yes	76.75	11.81		
Recovery HR at post 1 min step test	no	123.80	19.46	0.48	0.63
	yes	120.88	15.79		
Sit and reach flexibility (cm)	no	27.52	7.34	1.10	0.28
	yes	30.54	7.34		
Sit up (repetition/min)	no	12.11	8.67	0.17	0.87
	yes	12.60	5.64		
Body fat composition (percentage)	no	25.31	4.20	0.81	0.42
	yes	26.80	6.55		
Left hand grip strength (kg)	no	27.90	4.69	1.27	0.21
	yes	25.87	2.96		
Right hand grip strength (kg)	no	28.41	4.46	0.32	0.75
	yes	27.92	2.76		
Left hand pinch grip strength (kg)	no	7.86	0.92	1.59	0.12
	yes	7.35	0.68		
Right hand pinch grip strength (kg)	no	8.11	0.99	0.12	0.91
	yes	8.07	0.63		
Isometric arm lift strength (kg)	no	21.67	6.47	0.79	0.43
	yes	19.92	4.09		
Isometric leg lift strength (kg)	no	55.35	20.00	0.94	0.35
	yes	62.00	15.94		
Isometric back lift strength (kg)	no	57.33	16.33	0.35	0.74
	yes	55.33	12.82		

P-value > 0.05 in independent t-test

Table 3
Percentage of time spent in the observation of the nine basic activities

Task	**% of observed time**
Preparing meal	19.4
Feeding	16.5
Putting on/ Remove clothes	6.4
Wheelchair pushing	6.2
Cleaning	5.7
Transfer	5.6
Showering	4.5
Turning in bed	3.9
Changing diaper	3.2
Other activities	28.5

Table 4
Self-perceived work demands and work capabilities

Questions	Mean	SD
PART I		
A. Self-perceived working ability		
1. Heavy objects in upright position	5.74	1.00
2. moderately heavy objects continuously in upright position	5.71	0.96
3. maintaining the lower extremity in continuous standing and sitting	***6.11**	**0.83**
4. maintaining the lower extremity in continuous walking	6.05	0.80
5. repetitive and continuous upper extremity activities	5.61	0.86
6. repetitive and continuous head and neck activities	5.08	0.85
7. repetitive and continuous low back activities	5.11	0.89
8. repetitive and continuous lower extremity activities	5.58	0.86
9. continuous , awkward upper extremity fixed positions	4.11	1.13
10. continuous , awkward head fixed positions	3.76	1.32
11. continuous , awkward low back fixed positions	3.84	1.65
12. large fixed forces using the upper extremity	5.21	0.91
13. large fixed forces using the lower extremity	5.26	0.89
14. continuous, moderate fixed forces using the upper extremity	4.95	1.01
15. moderate fixed forces using the lower extremity	5.16	0.97
16. self-perceived ability to handle mental demand per day	4.87	1.21
B. Self-perceived working tolerance		
17. extreme physical factors e.g. noise, vibration, improper lighting	***5.00**	**1.36**
18. physical hazards e.g. kinetic, mechanical, fall	3.50	1.80
19. extreme non-toxic chemical factors e.g. dust, fumes	4.42	1.45
20. toxic chemical hazards e.g. solvents, carcinogens	2.84	1.90
21. non-supportive social environment	4.63	1.40
22. non-supportive organizational environment	4.89	1.62
23. non-supportive technical environment	4.18	1.33
24. muscular effort	***6.55**	**0.69**
25. mental effort	5.53	1.13
26. perceived risk of physical illness or injury	6.29	0.98
27. perceived risk of mental illness	5.74	1.16
D. Self-perceived ability status		
28. muscular fatigue	6.37	0.67
29. mental fatigue	5.89	0.92
30. boredom	2.68	1.66
31. freshness to perform muscular work	6.50	0.73
32. freshness to perform mental work	6.16	0.86

PART II

A. Work factors analysis: physical demand

1. lifting and lowering heavy objects	***6.32**	0.96
2. carrying heavy objects	4.61	1.10
3. pushing and pulling heavy objects	5.11	1.07
4. lifting and lowering moderately heavy objects continuously	4.79	1.12
5. carrying moderately heavy objects	3.50	1.43
6. pushing and pulling moderately objects continuously	5.16	1.08
7. standing	***6.89**	**0.39**
8. sitting	1.03	1.13
9. squatting and crouching	5.58	1.22
10. walking	***6.89**	**0.39**
11. climbing stairs, ladders, and ramps	3.13	1.09
12. crawling	0.89	1.20
13. repetitive activities: upper limbs	6.71	0.69
14. repetitive activities: neck	4.97	1.82
15. repetitive activities: back	***6.74**	**0.64**
16. repetitive activities: lower limbs	***6.74**	**0.60**
17. awkward fixed position: upper limbs	5.55	1.08
18. awkward fixed position: neck	3.95	1.56
19. awkward fixed position: back	***6.21**	**1.32**
20. awkward fixed position: lower limbs	6.00	1.04
21. fixed force or load on: upper limbs	***6.55**	**0.76**
22. fixed force or load on: neck	4.03	1.84
23. fixed force or load on: back	6.34	0.94
24. fixed force or load on: lower limbs	6.47	0.65
25. physical task demand: in and out bed	***6.53**	**1.29**
26. physical task demand: turning the patient	5.82	1.49
27. physical task demand: walk the patient	5.05	1.39
28. physical task demand: showering	6.39	1.31
29. physical task demand: bedding	4.03	1.24
30. physical task demand: cleaning	4.05	1.25
31. physical task demand: feeding patient	3.92	1.05

B. Work factors analysis: mental demand

32. mental task demands	***6.32**	**0.99**

C. Work environment evaluation: environmental factor

33. physical environment condition: noise	5.18	1.37
34. physical environment condition: vibration	1.87	1.74
35. physical environment condition: thermal stress	***6.08**	**1.08**
36. physical environment condition: improper lighting	5.18	1.09
37. physical environment condition: improper ventilation	4.79	1.09
38. physical environment condition: mechanical hazards	2.18	2.12
39. physical environment condition: fall hazards	3.26	1.69
40. physical environment condition: immediate danger to life and death	5.92	1.34
41. physical environment condition: non-toxic chemical factors	4.74	1.88
42. physical environment condition: toxic chemical hazards	2.11	1.98

D. Work environmental evaluation: non-environmental factor

43. non-physical environment condition: social support provided by supervisor	3.95	1.11
44. non-physical environment condition: social support provided by peers	***5.47**	**1.31**
45. non-physical environment condition: praise	2.61	1.03
46. non-physical environment condition: nurturing	3.63	1.20
47. non-physical environment condition: participation in decision-making	2.00	1.29
48. non-physical environment condition: relevant, accurate and timely feedback information	3.79	1.51
49. non-physical environment condition: adequacy of work benefits	3.76	1.20
50. non-physical environment condition: income and employment security	4.13	1.09
51. non-physical environment condition: time available to do the work	3.29	1.23
52. non-physical environment condition: staff support	5.11	1.45
53. non-physical environment condition: availability and functionality of tools/ equipment/ supplies	3.39	1.17
54. non-physical environment condition: technical information and training	4.05	1.04
55. non-physical environment condition: technical supervision	4.11	1.03

* highest mean value among the sub-groups of self-perceived capacity and work demand

Univariate logistic regression

Table 5 shows the summary of the univariate logistic regression analyses. The results indicated that individual physical profile and lifting capacities did not contribute to occurrence of low back pain at work. For the work demand factors, the perceived physical demands in lifting and lowering heavy objects, demands of awkward sustain neck and back postures, demands of loading on the back, and perceived effort of cleaning task contributed to the occurrence of LBP. For the physical environment factors, thermal stress and improper ventilation were associated with the occurrence of LBP cases. For the individual factor, LBP cases were associated with workers' self perceived muscular effort, and perceived risk of mental illness in response to work requirements.

4. Discussion

Prevalence of LBP

The muscuoskeletal symptoms survey revealed a very high prevalence of LBP in this group of PCWs. Among all the PCWs, only two of them did not have any symptoms of LBP in the past 12 months. This figure is similar to the one that we conducted to a group of female nurses working in hospital setting [14].

Physical fitness and lifting capacity

Result of this study did not indicate any association between physical fitness and LBP. This corroborated with our earlier study in non-emergency ambulance workers that personal fitness is not a core factor contributed to work-related LBP [15].

Work posture

It was noticed that 50% of the 2,162 observed posture were identified as harmful back postures according to OWAS. Meal feeding to clients and preparation of meal constituted the two most frequently performed harmful task (14 and 9% respectively). For these two tasks, the PCWs normally adopted a bend, twisted or prolonged stooping postures. Our recent study on the association between back pain and trunk posture of workers in a special school for the severe handicaps also revealed subjects with LBP spent significantly longer percentage of time in static trunk posture when compared to normal [16]. Thus, analysis of workers' posture throughout the entire working shift is essential when assessing the risk factors associated with the LBP.

Self-perceived work demand and work capacity

The results of this investigation indicated that workers' perceived physical demands in lifting and lowering heavy objects, demands of awkward sustain neck and back postures, demands of loading on the back, and perceived effort of cleaning task contributed to the occurrence of LBP. For the physical environment factors, thermal stress and improper ventilation were associated with the occurrence of LBP cases. These all are related to the work environment. Indeed, environmental work constraints will stress the PCWs lower back when they have to assist the client to get up from bed as they have to sustain the back in flexed position when performing this task. The study also indicated that workers' perceived exertion at work is a strong indication of musculoskeletal complaints. Our previous study also showed an increase in risk (OR=7.95) of developing LBP among non-emergency ambulance transfer workers when workers' perceived high effort exertion at work [15]. Nonetheless, it has to take note that in the present investigation, both the exposure (perceived work load) and outcome variables (LBP) were assessed by self-reports, workers with negative affectivity may have perceived their work load more negatively. Thus, there was potential of bias from the workers' evaluation and reporting of symptoms.

5. Conclusion

The findings of the risk factors for LBP among PCWs should be interpreted with caution as causality cannot be established from this cross-sectional study. Also, the inclusion of PCWs only in one nursing home must be considered when interpreting the data. Nonetheless, the results of the current study corroborated with many studies that indicated work environment contributed to the LBP at work. While ergonomics design and workers' training might serve a role in the prevention of LBP at work, workers' perceived exertion at his workplace might has an invaluable role in assessing the risk that contributed to the work-related LBP. To avoid progression of LBP at the workplace, work adjustment or modification should be considered when workers reported high level of perceived exertion at work.

Table 5
Univariate analyses of the associations of LBP cases with the risk factors

		95% CI	
Variables	OR	Lower	Upper
Physical task demands in lifting and lowering heavy objects *	3.24	0.824	12.73
Perceived demands of awkward sustain neck postures*	0.66	0.40	1.09
Perceived demands of awkward sustain back postures*	2.31	0.68	7.85
Perceived demands of loading to back*	2.98	0.78	11.28
Perceived effort in cleaning task**	2.57	1.15	5.71
Perceived thermal stress at work**	3.22	1.03	10.06
Perceived improper ventilation at work*	2.03	0.98	4.20
Perceived muscular effort exerted in response to work requirements*	6.31	0.79	47.49
Perceived risk of mental illness in response to work* requirements	2.32	0.97	5.54

*p <0.1

**p <0.05

Variables not associated with LBP cases: age (p=0.54), muscle strength (p=0.11), cardiovascular fitness (p=0.50), flexibility (p=0.34), years of work experience in manual handling (p=0.21)

References

[1] Department of Labour. (2010). Statistics on Occupational Injuries Compiled by the Labour Department of Government Hong Kong Special Administration Region. 2010: http://www.labour.gov.hk/eng/osh/content10.htm

[2] Guo, HR. (2002). Working hours spent on repeated activities and prevalence of back pain. *Occup Environ Med 59*, 680-688.

[3] Eriksen, W. (2003). The prevalence of musculoskeletal pain in Norwegian nurses' aides. *International Archives Occupational Environmental Health 76*, 625-30.

[4] Trinkoff, A.M., Johantgen, M., Muntaner, C., & Le R. (2005). Staffing and worker injury in nursing homes. *Am J Public Health, 95,*1220–1225.

[5] Dawson, A.P., McLennan, S.N., Schiller, S.D., Jull, G.A., Hodges, P.W., & Stewart. S. (2007). Interventions to prevent back pain and back injury in nurses: a systematic review. *Occup Environ Med, 64*, 642-650.

[6] Yeung, S., Genaidy, A., Deddens, J., Alhemood, A., & Leung, P.C. (2002). Prevalence of musculoskeletal symptoms in single and multiple body regions and effects of perceived risk of injury among manual handling workers. *Spine 27(*19), 2166-2172.

[7] Yeung, S.S., Genaidy, A.M., Karwowski, W., & Leung, P.C. (2002). Reliability and validity of self-reported assessment of exposure and outcome variables for manual lifting tasks: a Preliminary investigation. *Applied Ergonomics 33*, 463-469.

[8] Karhu, O., Kansi, P,. & Kurinka, I. (1977). Correcting working posture in industry: a practical method for analysis. *Applied Ergonomics 8*, 199-201.

[9] Jackson, A.S., Pollock, M.L., Graves, J.E., & Mahar, M.T. (1988). Reliability and validity of bioelectrical impedance in determining body composition. *Journal of Applied Physiology 64,* 529-534.

[10] Morrow, J.R,, & Jackson, A.W. (1995). Disch JG, Mood D. Measurement and evaluation in human performance, 1st ed., Champaign, IL: Human Kinetics Publishers Inc.

[11] Safrit, M.J., & Wood, T.M. (1995). Introduction to measurement in physical education and exercise science, 3rd ed., St. Louis, MO: Mosby-Year Book Inc.

[12] Heyward, VH. (1998). Advanced fitness assessment and exercise prescription, 3rd ed., Champaign, IL: Human Kinetics Publishers Inc.

[13] Kuorinka, I., Jonsson, B., Kilborm, A., Vinterberg, H., Biering-Soremsen, F., Andersson, G., & Jorgensen, K. (1987). Standardized Nordic questionnaires for the analysis of musculoskeletal symptoms. *Applied Ergonomics 18* (3), 233-237.

[14] Yeung, S.S., Genaidy, A., & Levin, L. (2004). Prevalence of musculoskeletal symptoms among Hong Kong nurses in single and multiple body regions. *Occupational Ergonomics 4*(3), 199-208.

[15] Tam, G.Y.T., Yeung, S.S. (2006), Perceived effort and low back pain in non-emergency ambulance workers: Implications for rehabilitation. *Journal of Occupational Rehabilitation 16,* 231-240.

[16] Wong, K.C., Lee, R.Y., & Yeung, S.S. (2009) The association between back pain and trunk posture of workers in a special school for severe handicaps. *BMC Musculoskeletal Disorders, 10.* 43 doi:10.1186/1471-2474-10-43