



Perceived Adverse Occupational Health Effects in Hospital Personnel: An Exploration of the Effects of the Workplace Environment

Jin-Ding Lin^{1*}, Ching-Hui Loh², Chao-Ying Lai³, Yuan-Ting Lo⁴, Hsueh-Lin Lu¹,
Chia-Feng Yen⁴, Shang-Wei Hsu⁵, Lan-Ping Lin⁴, and Cordia Chu⁶

¹*School of Public Health, National Defense Medical Center, Taipei,*

²*Department of Family and Community Medicine,*

Tri-Service General Hospital, National Defense Medical Center, Taipei,

³*Branch of Medical Affairs Management, Tri-Service General Hospital, Taipei,*

⁴*Graduate Institute of Life Sciences, National Defense Medical Center, Taipei,*

⁵*Graduate Institute of Healthcare Administration, Asia University, Taichung, Taiwan, Republic of China*

⁶*Center for Environment and Population Health, Griffith University, Brisbane, QLD, Australia*

Background: The aims of the analysis were to describe the prevalence and types of adverse effects on occupational health of hospital personnel, and to examine their relationship to the hospital working environment. **Methods:** Data were analyzed from a 2002 pilot project “*Taiwan Hospital Health Promotion Program: A Medical Center Initiative*”. The study sample consisted of 649 hospital personnel (response rate of 81.3%) in Taipei. The effects of three different health-affecting aspects of the working environment—physical environment, exposure to chemical agents, and usage of protective devices—were used as predictive variables for the perception of adverse health effects in hospital personnel. **Results:** 73.1% of hospital personnel reported adverse occupational health effects within one year. The main types of discomfort reported were (prevalence): neck/upper shoulder pain (39.9%), fatigue (38.9%), lower back pain (27.7%), headache (26.9%), eye discomfort (24.9%), throat irritation (22.3%), wrist discomfort (19.3%), nose discomfort (18.1%), and varicose veins (10.9%). A multiple logical regression model indicated that those personnel who perceived that they were exposed to health-affecting physical environments were more likely to perceive adverse health effects (OR = 3.11, 95% CI = 2.01-4.82) than those who did not consider that they were exposed to such physical environments. **Conclusions:** The hospital should adjust the provisional health and safety programs and strategies to the specific context and conditions of the physical environment of the hospital to improve the health and well-being of hospital personnel.

Key words: Occupational health discomfort, health and safety, physical environments, hospital personnel, health service management.

INTRODUCTION

The dramatic changes and improvements in technology that have taken place in the working environment during recent decades have resulted in emerging risks in the field of occupational health and safety¹. The Fourth European Working Conditions Survey showed that in 2005, 20% of workers from the 15 European member states believed that their health was at risk because of work-related stress and

reported muscular pains². In the Netherlands, statistics indicated that in 2001 psychological and musculoskeletal disorders each caused about 22% of the total costs of work-related sick leave and disability. In the same year, German data indicated that the estimated economic cost of these disorders was approximately €3,000 million³.

Health and safety at work is not only essential for employees' well-being but is a vital economic factor for enterprises and countries as a whole^{4,5}. Workers in healthcare settings comprise a vulnerable group for adverse health effects in the workplace and need to be protected. They usually perform the most stressful jobs, staying indoors in air conditioning all day with potential exposure to toxic chemical agents, and are also at risk from shift work and unpredictable working hours that will increase the risk of occupational fatigue and injuries⁶. Providing a risk assessment is one method for evaluating the circumstances of

Received: April 25, 2008; Revised: August 12, 2008;
Accepted: October 14, 2008

*Corresponding author: Jin-Ding Lin, School of Public Health, National Defense Medical Center, No.161, Section 6, Min-Chun E. Rd, Nei-Hu, Taipei 114, Taiwan, Republic of China Tel: +886-2-87923100#18447; Fax: +886-2-87923147; E-mail: a530706@ndmctsgh.edu.tw

employees working in healthcare settings. Although the concept of the need to identify and anticipate emerging risks related to occupational safety and health in healthcare settings has been emphasized recently by modern healthcare management, few studies focus on safety and health issues for hospital personnel, particularly in Taiwan. More research is needed to identify specific risk factors in these working environments.

Providing a comprehensive picture of perceived adverse health effects in hospital personnel and their risk factors will prompt healthcare organizations to examine the effects of the workplace environment on the health and safety of their employees. These data will allow the development of new solutions for occupational health and safety in hospitals in order to adequately manage the changes in the working environment. Therefore, the purpose of this paper is to provide a general picture of the perceived adverse health effects of the workplace for hospital personnel, particularly by describing the prevalence and types of occupational discomfort reported, and to examine their relationship to the hospital working environment.

METHODS

As part of a pilot project initiated by the first Taiwan Hospital Health Promotion Program in 2002, study participants were recruited from personnel records of the study hospital, a medical center in Taipei⁷. Subjects were stratified by job category selected systematically for the study according to the proportion of each category present in the hospital. A study sample of 798 employees was selected and data were collected by a structured questionnaire that was completed by each employee^{8,9}. The final analyzed sample consisted of 649 hospital personnel (response rate of 81.3%). We found that there was no statistical difference in job category between respondents and nonrespondents, suggesting that the responding subjects are a good representation of the population of the study hospital. Specifically, the sample included all categories of hospital personnel: physician, nurse, pharmacist, medical technician, administrative staff, and other staff. Self-report structured questionnaires were distributed to the study participants. To guarantee anonymity, the completed questionnaire could be returned by each working unit collectively instead of individually. For data analysis, the collected data were coded and analyzed using SPSS (version 10.0) for Windows. Demographic variables (i.e., age, sex, education, marital status, job category, and working experience) were included as control variables that could be expected to confound the relationship between working environment

Table 1. Perceived work health discomforts among hospital personnel

Characteristics of health discomforts	Number	Percent
Perceived work health discomforts (N=642)		
No	173	26.9
Yes	469	73.1
Types of perceived work health discomforts (N=642)		
Discomfort of neck, upper shoulder	256	39.9
Fatigue	250	38.9
Low back pain	178	27.7
Headache	173	26.9
Discomfort of eyes	160	24.9
Throat irritation	143	22.3
Wrist discomfort	124	19.3
Nose discomfort	116	18.1
Varicose vein	70	10.9
Difficult to concentrate at work	50	7.8
Ear itchy & discomfort	11	1.7
Other	44	6.9
Whom to report or discuss the work health discomfort (N=469)		
No one	98	20.9
Colleague	26	48.3
Family member	164	35.0
Friends	148	31.6
Professional within the hospital	136	29.1
Supervisor	49	10.5
Professional outside the hospital	14	3.0
Other	4	0.9
Solving status of the work health discomfort (N=469)		
Yes	200	44.9
No	245	55.1

and the outcome variable (perceived adverse health effects). We used three different health-affecting aspects of the working environment that were potentially modifiable by the health policy approach in the workplace — physical environment, exposure to chemical agents, and usage of protective devices — as predictive variables for the perceived adverse health effects among hospital personnel.

RESULTS

Perceived Adverse Occupational Health Effects among Hospital Personnel

Table 1 shows that 73.1% of hospital personnel perceived an adverse work-related health effect within one year. The main types of adverse effect were related to musculoskeletal disorders or sensory ailments such as (prevalence): neck/upper shoulder pain (39.9%), fatigue (38.9%), lower back pain (27.7%), headache (26.9%), eye discomfort (24.9%), throat irritation (22.3%), wrist discomfort (19.3%), nose discomfort (18.1%), and varicose veins (10.9%). More than one in five (20.9%) of those who perceived adverse health effects did not report or discuss their ailments with others. The remaining 79.1% chose to report or discuss the ailments with the following: colleague

Table 2. Perceived exposure to health-affected environments among hospital personnel

Characteristics of work environments	Number	Percent
Exposure to health-affected physical environments (N=642)		
Yes	512	79.8
No	130	20.2
Types of health-affected physical environments (N=512)		
Poor air ventilation	191	37.3
Biological or infectious agent	178	34.8
Inadequate working space	118	23.0
X ray and radiation	115	22.5
Noise & vibration	111	21.7
Cool temperature	109	21.3
Poor ergonomic design	99	19.3
Poor lighting	75	14.6
Hot temperature	72	14.1
Fall & slippery	46	9.0
Dust	37	7.2
Unsanitary environment	21	4.1
Other	42	8.2
Exposure to health-affected chemical environments (N=642)		
Yes	224	34.9
No	418	65.1
Types of health-affected chemical environments (N=224)		
Anti-cancer drug	66	29.5
Toxic chemicals	57	25.4
Toxic gas	38	17.0
Anesthetic gas	37	16.5
Second hand smoke	29	12.9
Formaldehyde	19	8.5
Explosive agents	15	6.7
Ethylene oxide	11	4.9
Asbestos	4	1.8
Heavy metal	3	1.3
Other	31	13.8
Working under the inadequate safety protection for health (N=642)		
Yes	159	24.8
No	483	75.2
Types of inadequate safety protection (N=159)		
Inadequate safety training	60	37.7
Inadequate protective devices	60	37.7
Other	39	24.6

(48.3%), family member (35.0%), friend (31.6%), professional within or outside the hospital (29.1 and 3.0%), or his/her supervisor (10.5%). Generally, more than one half (55.1%) of the employees continued to experience occupational discomfort during the study period.

Perceived Exposure to Health-Affecting Environments

To evaluate the perceived exposure of hospital personnel to health-affecting environments, the potential risks were divided into three categories: health-affecting physical environments, exposure to chemical agents, and the usage of protective safety devices. Table 2 illustrates that 79.8% of personnel expressed that they were currently exposed to health-affecting physical environments. The most commonly reported health-affecting aspects of the physical environment were poor air ventilation (37.3%),

Table 3. Relationship of demographic factors and perceived health discomforts

Variable	Perceived discomforts		χ^2	p
	No N (%)	Yes N (%)		
Gender (N=639)			35.1	<0.001
Female	105 (21.2)	390 (78.8)		
Male	67 (46.5)	7 (53.5)		
Job category (N=642)			21.9	<0.001
Admin staff	41 (32.5)	85 (67.5)		
Doctor	36 (45.6)	43 (54.4)		
Nurse	65 (21.3)	240 (78.7)		
Pharmacist & technician	24 (24.7)	73 (75.3)		
Other	7 (20.0)	28 (80.0)		
Job-affiliated status (N=636)			8.2	0.043
I group	44 (21.6)	160 (78.4)		
II group	56 (25.8)	161 (74.2)		
III group	55 (34.6)	104 (65.4)		
IV group	17 (30.7)	39 (69.6)		
Educational level (N=637)			2.6	0.273
High school and less	20 (25.0)	60 (75.0)		
Bachelor or college diploma	126 (26.0)	359 (74.0)		
Master and doctoral	25 (34.7)	47 (65.3)		
Marital status (N=629)			11.9	0.001
Unmarried	67 (21.0)	252 (79.0)		
Married	104 (33.5)	206 (66.5)		
Age (N=619)			7.0	0.031
19-30	77 (22.7)	262 (77.3)		
31-40	58 (32.4)	121 (67.6)		
>40	35 (31.5)	76 (68.5)		
Length of working years (N=610)			2.3	0.320
<5	86 (25.1)	257 (74.9)		
5-10	32 (27.8)	83 (72.2)		
>10	48 (31.6)	104 (68.4)		
Working hours per week (N=608)			3.7	0.160
<40	2 (11.8)	15 (88.2)		
40-49	119 (26.0)	339 (74.0)		
≥ 50	42 (31.6)	91 (68.4)		

exposure to biological or infectious agents (34.8%), inadequate working space (23.0%), X-ray and medical radiation (22.5%), noise and vibration (21.7%), cold and hot temperatures (21.3 and 14.1%), poor ergonomic design (19.3%), and poor lighting (14.6%).

Over one-third (34.9%) of personnel perceived that they were exposed to health-affecting chemicals, with the most frequently reported agents being anti-cancer drugs (29.5%), toxic chemicals (25.4%), toxic gases (17.0%), anesthetic gas (16.5%), and second-hand smoke (12.9%). Nearly one-quarter of staff (24.8%) expressed that they were currently working under inadequate safety and health protection. The main reasons given by these employees for this were inadequate safety training (37.7%) and inadequate use of protective devices (37.7%).

Relationship between Demographic Factors, Working Environment, and Perceived Adverse Health Effects We investigated the relationship between the demographic profile of participants, their working environment, and

Table 4. Relationship of working environments and perceived health discomforts

Variable	Perceived discomforts		χ^2	p
	No N (%)	Yes N (%)		
Exposure to health-affected physical environments (N=636)			35.3	<0.001
No	62 (47.7)	68 (52.3)		
Yes	108 (21.3)	398 (78.7)		
Exposure to health-affected chemical agents (N=636)			1.7	0.199
No	118 (28.5)	296 (71.5)		
Yes	52 (23.4)	170 (76.6)		
Working in inadequate safety protection for health (N=636)			3.3	0.070
No	137 (28.7)	341 (71.3)		
Yes	33 (20.9)	125 (79.1)		

their perception of adverse health effects. Table 3 shows that sex, age, job category, job affiliation (categorized by wage source and job contract), and marital status of personnel were significantly associated with perceived adverse health effects (chi-square test; $p < 0.05$). Those personnel who were female, nurses, unmarried, and aged 19-30 were more likely to perceive discomfort than were other participants. Other factors such as educational level, number of working years, and working hours per week in the hospital were not significantly associated with the perception of discomfort ($p > 0.05$).

In terms of the relationship between the working environment and the perception of adverse health effects, Table 4 shows that those personnel who felt that they were exposed to health-affecting physical environments were more likely to report perceived adverse health outcomes than were those who did not work in these environments ($p < 0.0001$). The chemical environment and the usage of protective devices were not significantly associated with the perception of adverse effects on health in hospital personnel ($p > 0.05$).

Prediction of Perception of Adverse Effects on Health by Hospital Personnel

A multivariate logistic regression model was used to assess the variation in perceived adverse health effects across different demographic groups and to measure its association with the person's working environment. The regression model used the chi-square test to analyze the possible confounding (demographic) and predicting (working environment) variables that were significantly related to perceptions of adverse health effects. The results are shown in Tables 2-4. The factors that were significantly associated included sex, age, job category, job affiliation, and marital status of the personnel, and exposure to health-affecting physical environments. The results shown in

Table 5. Multiple logistic regression of perceived occupational health discomforts of hospital personnel (N=606)

Predictive variables	β	p	OR	95% CI for OR
Constant	0.784	0.045	2.19	0.98-0.21
Age				
19-30			1	
31-40	-0.048	0.863	0.95	0.55-1.64
>40	-0.076	0.824	0.93	0.47-1.81
Gender				
Female			1	
Male	-1.195	<0.001	0.30	0.16-0.58
Marital status				
Unmarried			1	
Married	-0.386	0.134	0.68	0.41-1.13
Job category				
Admin staff			1	
Doctor	0.293	0.450	1.30	0.63-2.87
Nurse	0.043	0.885	1.04	0.58-1.87
Pharmacist & technician	0.307	0.381	1.36	0.69-2.70
Other	0.732	0.172	2.08	0.73-5.95
Job-affiliated identification				
I group			1	
II group	-0.432	0.090	0.65	0.39-1.07
III group	-0.128	0.687	0.88	0.47-1.64
IV group	-0.710	0.076	0.49	0.22-1.08
Exposure to health-affected physical environment				
No			1	
Yes	1.136	<0.001	3.11	2.01-4.82

Table 5 indicate that only one factor—"exposure to health-affecting physical environments"—was significantly correlated with the perception by hospital personnel of adverse health effects at work ($p < 0.0001$). The model indicated that those personnel who reported that they were exposed to health-affecting physical environments were more likely to perceive adverse health effects (OR = 3.11, 95% CI = 2.01-4.82) than those who thought they were not exposed to that kind of physical environment at work.

DISCUSSION

The identification of emerging occupational health risks is aimed at early intervention to prevent any possible negative effects of these risks on workers' health and safety. From the perspective of hospital personnel, the results of the present survey on emerging risks for occupational discomfort, as well as the effects of physical and chemical environments and the usage of safety devices, should be seen as a basis for discussion among hospital stakeholders to set health policy priorities for further workplace health and safety planning.

Our results revealed that more than 70% of hospital personnel perceived work-related adverse effects on their health within one year. The main types of discomfort were

related to musculoskeletal or sensory ailments such as neck/upper shoulder pain, fatigue, lower back pain, headache, eye discomfort, throat irritation, wrist discomfort, nose discomfort, and varicose veins. These ailments have a huge national and economic cost. In France, the cost of work-related lower back pain was estimated at €1,300 million in 2002¹⁰. Therefore, the challenge for healthcare management in the future will be the prevention of such work-related discomfort.

Although our findings did not show a significant relationship between working hours and perceived discomfort, this may be because the average age of the participants was low and because of the healthy worker effect in the study hospital. Many studies have reported a strong relationship between long working hours and the health of workers. The report "Time and Work: Duration of Work in Europe" showed that employees clearly perceived increased working time as being linked to health and safety risks¹¹, particularly in hospital doctors who are also at risk from a combination of shift work and long and unpredictable hours during on-call work. This causes poor mental health as a result of extreme fatigue and stress^{6,12}. Similarly, White and Beswick reviewed the literature and found that working long hours (more than 48 hours per week on a regular basis) is an important occupational stressor that reduces job satisfaction, multiplies the effects of other stressors and increases the risk of health problems¹³. This relationship between working hours and perceived adverse health effects suggests the need to examine the phenomenon of long working hours in the healthcare industry.

Health and well-being can be influenced both positively and negatively by work. Work can provide a goal and meaning in life, but can also cause ill health, accelerate its course, or trigger its symptoms¹⁴. Our results show that the physical working environment was mentioned as a potential emerging risk for adverse occupational health by the respondents. To solve this problem, hospital authorities should examine the components of the physical environment such as the ventilation systems, exposure to biological or infectious agents, working space, X-ray and medical radiation, noise and vibration, working temperature, ergonomic design, and workplace lighting. To improve the workplace health and safety of workers in every aspect related to their work, the hospital should adopt the EU framework directive based on the following general principles of prevention: avoiding risks, combating the risks at source, and adapting the work to the individual¹⁴.

With regard to the influence of personal characteristics on the health of staff, gender has a significant effect on the perception of work-related discomfort. The study found in

a multiple logistic regression analysis that female staff members were more likely than males to perceive work-related discomfort. Nurses were the main female participants in the study, and many studies have reported that nurses have a high prevalence of lower back problems or musculoskeletal complaints¹⁵⁻¹⁷. The risk factors for this have been documented as job stress, monotonous tasks, high perceived workload, and time pressure^{18,19}.

Our results showed that more than one half of the employees remained under the conditions perceived as causing the adverse occupational health effects. The persistence of discomfort is likely to cause further disease or stress and will affect the individual's quality of life. Based on these results, there is a need for proper health and safety prevention and early intervention strategies to combat these adverse health effects in hospital personnel. Work-related discomfort may be prevented or counteracted by improving the workplace environment by examining the physical and chemical environments and adjusting occupational physical settings, by job redesign (e.g., changing the shift work schedule), training (e.g., in use of protective devices), by strengthening social support (e.g., caring about a colleague's discomfort), and by reorienting health promotion activities within healthcare settings. Therefore, the hospital should adjust the provisional health and safety programs and strategies to fit the specific context and conditions of its physical environment to improve the health and well-being of hospital personnel. Future research could analyze the relationship between an employee's health profile and workplace environment, extending the analysis to broad environmental factors such as biological agents to scrutinize the factors influencing the employee's health.

ACKNOWLEDGMENT

Research funded by Bureau of Health Promotion, Taiwan Department of Health (Grant number 91-02-98) and the authors acknowledge all the hospital participants in the study.

REFERENCES

1. European Agency for Safety and Health at Work. Expert Forecast on Emerging Psychosocial Risks Related to Occupational Safety and Health. Luxembourg: Office for Official Publications of the European Communities; 2007.
2. European Foundation for the Improvement of Living and Working Conditions. Fourth European Working

- Conditions Survey. Office for Official Publications of the European Communities, Luxembourg, 2006. <http://www.eurofound.eu.int/ewco/surveys/EWCS2005/index.htm>.
3. European Foundation for the Improvement of Living and Working Conditions. Work-Related Stress. Office for Official Publications of the European Communities, Luxembourg; 2006. <http://www.eurofound.eu.int/ewco/reports/TN0502TR01/TN0502TR01.htm>.
4. European Agency for Safety and Health at Work. The Changing World of Work. Conference hosted jointly by the Austrian Presidency of the European Union and the European Agency for Safety and Health at Work, Bilbao, 19-21 October 1998. <http://osha.europa.eu/publications/conference/19981019/index.htm#2>.
5. Commission of the European Communities. Adapting to Change in Work and Society: A New Community Strategy on Health and Safety at Work 2002-2006. Commission of the European Communities, Brussels; 2002. http://ec.europa.eu/employment_social/news/2002/mar/new_strategy_en.html.
6. Leduc E. Physician on call frequency: Society of Rural Physicians of Canada discussion paper. *Canadian Journal of Rural Medicine* 1998;3:139-141.
7. Lin JD, Loh CH, Lu SL, Lo YT, Yen CF, Lai CI. The Development of Health Promoting Hospital Programme in Taiwan: A Pilot Initiative in a Medical Center. Report to Bureau of Health Promotion, Department of Health, Taiwan, Grant Number: 91-02-98; 2003.
8. Lu HL, Loh CH, Lo YT, Yen CF, Hsu SW, Lai CI, Chien WC, Lin JD. Self-perceived work stress and stressors of hospital personnel: a cross-sectional survey in Taipei. *J Med Sci (Revised)*.
9. Lo YT, Loh CH, Lin JD, Hsu SW, Lu HL, Yen CF, Chu CM, Lin YW, Lai CI, Chen HI. The development of health promoting hospitals in Tri-Service General Hospital: profile of staff's health, smoking status and the determinations. *J Med Quality* 2006;3:10-19. (in Chinese)
10. Aptel M, Aublet-Cuvelier A, Cnockaert JC. Work-related musculoskeletal disorders of the upper limb. *Joint Bone Spine* 2002;69:546-555.
11. Boisard P, Cartron DC, Gollac M, Valeyre A. European Foundation for the Improvement of Living and Working Conditions, Time and Work: Duration of Work. Office for Official Publications of the European Communities, Luxembourg; 2003. <http://www.eurofound.eu.int/publications/htmlfiles/ef0211.htm>
12. Spurgeon A, Harrington JM. Work performance and health of junior hospital doctors: a review of the literature. *Work and Stress* 1989;3:117-128.
13. White J, Beswick J. Working Long Hours. Health and Safety Laboratory, Sheffield; 2003. http://www.hse.gov.uk/research/hsl_pdf/2003/hsl03-02.pdf.
14. European Commission. Guidance on Work-Related Stress: Spice of Life or Kiss of Death? Luxembourg: Office for Official Publications of the European Communities; 2002.
15. Burton AK, Symonds TL, Zinzen E, Tillotson KM, Caboor D., Van Roy P, Clarys. Is ergonomic intervention alone sufficient to limit musculoskeletal problems in nurses? *Occup Med* 1997;47:25-32.
16. Yassi A, Khokhar J, Tate R, Cooper J, Snow C, Vallentyne S. The epidemiology of back injuries in nurses at a large Canadian tertiary care hospital: implications for prevention. *Occup Med* 1995;45:215-220.
17. Smith DR, Wei N, Zhao L, Wang RS. Musculoskeletal complaints and psychosocial risk factors among Chinese hospital nurses. *Occup Med* 2004;54:579-582.
18. Bongers PM, Kremer AM, ter Laak J. Are psychosocial factors, risk factors for symptoms and signs of the shoulders, elbow, or hand/wrist?: a review of the epidemiological literature. *Am J Ind Med* 2002;41: 315-342.
19. Langerstrom M, Wenemark M, Hagberg M, Hjelm EW. Occupational and individual factors related to musculoskeletal symptoms in five body regions among Swedish nursing personnel. *Int Arch Occup Environ Health* 1995;68:27-35.