

Perceived Job Stress and Health Complaints at a Bank Call Center: Comparison between Inbound and Outbound Services

Yen-Hui LIN^{1, 2*}, Chih-Yong CHEN³, Wei-Hsien HONG⁴ and Yu-Chao LIN⁵

¹School of Occupational Safety and Health, Chung Shan Medical University, No. 110, Sec.1 Jianguo North Rd., Taichung 402, Taiwan, R.O.C.

²Department of Occupational Medicine, Chung Shan Medical University Hospital, Taiwan, R.O.C.

³Institute of Occupational Safety and Health, Council of Labor Affairs, Taiwan, R.O.C.

⁴Department of Sports Medicine, China Medical University, Taiwan, R.O.C.

⁵Department of Business Management, National United University, Taiwan, R.O.C.

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Abstract: This study investigated how perceived job stress and health status differ, as well as the relationships to inbound (incoming calls) versus outbound (outgoing calls) calling activities, for call center workers in a bank in Taiwan. The sample bank employed 289 call center workers at the time of the survey, ranging in age from 19 to 54 yr old. Data were obtained on individual factors, health complaints, perceived level job stress, and major job stressors. Overall, 33.5% of outbound operators and 27.1% of inbound operators reported frequently or always experiencing high stress at work, however, the differences between inbound and outbound operators were insignificant. “Having to deal with difficult customers” was the most frequent job stressor for all workers. Musculoskeletal discomfort, eye strain, and hoarse or sore throat were the most prevalent complaints among call center workers. The relationship between perceived job stress and health complaints indicated that workers who perceived higher job stress had significantly increased risk of multiple health problems, including eye strain, tinnitus, hoarse or sore throat, chronic cough with phlegm, chest tightness, irritable stomach or peptic ulcers, and musculoskeletal discomfort (with odds ratios ranging from 2.13 to 8.24). These analytical results suggest that perceived job stress in the call center profoundly affected worker health. This study identified main types of job stressors requiring further investigation.

Key words: Health complaints, Call center, Perceived job stress, Incoming call, Outgoing call, Questionnaire

Introduction

Call centers are a rapidly growing industry in many countries. The call center industry experiences an annual growth of 30–35% in terms of call volumes and 20–25% in numbers of agents¹. Rocha *et al.*² reported a 30% increase in the number of call centers in Brazil during the last 20 yr. Moreover, an estimated 1–2% of the European work-force is employed in call centers, and

this proportion is expected to grow³. Call center operators spend most of their time transacting business via phones fitted with earpieces, usually supported by computers, and possibly using catalogue holders for ease of access of reference materials, calculators, and other accessories⁴. Call center services generally comprise one of the following two types. The first type deals with incoming customer calls (inbound services), with the workers providing customer services. The second type conducts simple sales activities or market surveys (outbound services) on prospecting for new clients. Ferreira and Saldiva⁵ indicated that computer-telephone interactive

*To whom correspondence should be addressed.
E-mail: yann@csmu.edu.tw

tasks, as performed for inbound or outbound services, are unique and thus require special study. Ferreira and Saldiva indicated that call centers working on outbound services faced higher productivity pressures and conflicts associated with supervisors than did those working on inbound services, but that work related to inbound services was more repetitive, and lacked autonomy and a structured work/rest schedule. Previous studies have demonstrated clear differences between the work loads of workers providing inbound and outbound services. However, no previous study has identified specific stressors for the two types of call center tasks.

Numerous studies have examined productivity, work-related stress, musculoskeletal disorders and caller quality service issues in call-center workers^{6–14}). For instance, Burton *et al.*¹²) indicated that productivity decreases as the health risks faced by call center operators increase. Furthermore, DiTecco *et al.*⁶) developed a questionnaire which contains measures of perceived stress, potential job stressors, management practices in feedback and monitoring, and worker monitoring preferences. Their questionnaire was distributed among 411 long-distance telephone operators and 396 directory-assistance telephone operators working in a large Canadian telecommunications company. They identified call-time pressures *i.e.*, having to process a customer call within a specific number of seconds has having the strongest relationship to job stress as perceived by workers, and furthermore over 50% of workers reported that call monitoring contributed to stress.

However, few studies have examined the multiple health risks that call center workers face in relation to job stress in the workplace, particularly in banks, which are currently facing intense market competition. This study thus employed a cross-sectional questionnaire survey dealing with individual factors, health status, perceived job stress levels, and main job stressors to examine rates of subjective physical discomfort, prevalence of job stress and patterns of major job stressors among two main groups of call center workers at a bank, *i.e.* those dealing with inbound and outbound services. Additionally, this study examined the associations between job stress and self-perceived health status, as well as, and how they differed between inbound and outbound services.

Subjects and Methods

Subjects and job description

The call center in this study was established in 2001 by a commercial bank to provide telecommunication and information-related services, for example handling questions related to commercial bank products and services, including information on product promotions, customer

account status and service fees. The center employs 308 operators (188 inbound operators and 120 outbound operators, aged 19 to 54 yr old, with a mean of 33.6 yr), supervised by one director and two assistant supervisors. For inbound services, the pace of work is machine-controlled *i.e.*, calls are computer-routed to available operators, and operators handle approximately 120 to 150 calls each 8 h day. Outbound operators comprise the first link between customers and the commercial bank regarding business matters. Outbound operators are primarily responsible for sales (explaining bank services and costs to customers), and handle approximately 120 calls daily. All staff required a high school diploma and proficient communication skills, including the ability to express themselves clearly. Among them, only general employees belonging to the two major concerned groups of inbound and outbound services were considered for further study. Overall, 308 call center operators agreed to participate. Nineteen operators were excluded for being at their current job less than six months, leaving a final sample of 289 operators. Inbound operators provided 171 usable returns, while outbound operators provided 118 usable returns, representing response rates of 91% and 98%, respectively, for the two groups.

Questionnaire design

The self-administered questionnaires were accompanied by a letter encouraging participation, signed by both the managers and supervisors of the call centers and delivered to each subject by a trained interviewer in May 2006. All subjects were informed of the study objectives prior to participation, and participated voluntarily. Subjects completed the questionnaires during their leisure time, with the process taking between 15 and 20 min. To protect the confidentiality of individual worker data against managerial or employer access, subjects completed the questionnaires anonymously and returned them directly to the interviewers. On completing the questionnaire, the interviewer performed an on-site check for completeness. The questionnaire obtained data on the following main areas: (1) Individual factors: age, sex, marital status, length of employment in current company, full/part time work, and weekly hours spent on physical exercise. (2) Health status: participants were asked if over the past 12 months they had experienced the following symptoms at least weekly, and were further asked to rank the severity on a scale ranging from moderate to severe (yes/no): “itchy skin”, “eye strain”, “tinnitus”, “hoarse or sore throat”, “chronic coughing with phlegm”, “chest tightness”, “irritable stomach or peptic ulcers”, and “musculoskeletal discomfort”. (3) Perceived job stress and major job stressors. Psychological stress and potential job stressors were gathered via a series of questions translated

from DiTecco *et al*⁶). Perceived stress was measured using self-reported responses to the question “How frequently do you feel very stressed at work?”, with responses being recorded on a five-point scale, comprising 1=never, 2=seldom, 3=sometimes, 4=frequently, and 5=always. Regarding job stressors, participants were asked to rank the main stressors contributing to their work stress referring to a list of possible job stressors. Ten job stressors believed to capture the main sources of job stress among workers were described, including: (1) being monitored by a manager without being informed; (2) having to deal with difficult customers; (3) system monitoring of operator call activities; (4) calls that take a long time to process; (5) difficulties in talking to co-workers while sitting at their workstations; (6) difficulty in providing good customer service while simultaneously meeting time targets; (7) devices for controlling call time; (8) insufficient rest breaks; (9) being expected to remain constantly at ones workstation; and (10) being distracted by other workers.

Psychosocial job characteristics were assessed using a 22-item Job Content Questionnaire (C-JCQ), revised from the Job Content Questionnaire (JCQ) of Karasek *et al.* and translated into Chinese¹⁵). These analyses employed the job control dimension by summing two subscales: skill discretion, comprising six measurement items, and decision authority, comprising three measurement items. The job demand scale comprised five items. The work-related social support scale was the sum of two subscales, namely support from supervisors and support from co-workers, each measured using four items. The response to each item was recorded using a four-point Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree). The C-JCQ was designed for domestic workers in Taiwan and was tested and validated¹⁶). Briefly, psychosocial job constraint was measured with a twenty-two-item scale with internal consistency reliability (Cronbach’s alpha) of 0.85.

Data analysis

A comparison was made of demographic characteristics between inbound and outbound workers, including such characteristics as age, sex, length of employment in their current company, weekly time spent on physical exercise, marital status, full time versus part time work, and frequency of health problems based on the Student’s *t*-test or Pearson χ^2 test. Multivariate logistic regression models were used to assess the associations between perceived levels of job stress and various health complaints. The odds ratio (OR) and its 95% confidence interval (CI) were calculated for each independent variable. All statistical analyses were performed using SPSS release 11.5 for Windows, with a significance level of 5%.

Results

Prevalence of individual and health complaints

Table 1 lists the self-reported demographic data for both groups. Inbound and outbound services displayed no significant difference for age, sex, length of employment, weekly time spent on physical exercise, marital status, and full-time versus part-time work (Table 1). Table 1 also lists reports of health complaints occurring in the current job differences between the inbound and outbound services. For inbound services, “musculoskeletal discomfort” (88%) was the most prevalent health complaint, followed by “hoarse or sore throat” (85%), “eye strain” (84%), “tinnitus” (59%), “chronic cough with phlegm” (50%), “irritable stomach or peptic ulcers” (42%), “chest tightness” (35%), and “itchy skin” (29%). Meanwhile, “musculoskeletal discomfort” (85%) was found to be the most frequent health complaint across all body areas in outbound services, but the rankings of other health complaints differed between inbound and outbound services. Furthermore, for all body areas, inbound services displayed higher prevalence of “itchy skin” (29% vs. 22%), “eye strain” (84% vs. 79%), “tinnitus” (59% vs. 32%), “hoarse or sore throat” (85% vs. 70%), and “musculoskeletal discomfort” (88% vs. 85%) than did outbound services. Significant differences existed for “tinnitus” ($p<0.01$), “hoarse or sore throat” ($p<0.01$), and “irritable stomach or peptic ulcers” ($p<0.05$) between inbound and outbound services (Table 1).

Perceived job stress and major job stressors

To compare the association between perceived job stress and the two call center tasks, the authors choose to describe level of job stress at work frequently or always as a high-stress. The observed results revealed that outbound services (33.5%) displayed a higher prevalence of high-stress than inbound services (27.1%), but the difference was insignificant ($p=0.247$). This study also examined patterns of major job stressors. For inbound services, the most significant source of job stress was ‘having to deal with difficult customers’, identified by 54.0% of subjects. ‘Devices for controlling call time’ (46.3%) were the second-most-frequent source of job stress, followed by ‘being monitored by a manager without being informed’ (44.1%), ‘system monitoring of operator call activities’ (36.8%), ‘calls that take a long time to process’ (32.9%), ‘difficulty in providing good customer service while simultaneously meeting time targets’ (31.3%), ‘insufficient rest breaks’ (23.9%), ‘being expected to remain constantly at ones workstation’ (23.1%), ‘difficulty in talking to co-workers while sitting at their workstations’ (12.9%), and ‘being distracted by other workers’ (0.9%). On the other hand, ‘having to deal with difficult

Table 1. Comparison of mean and percentage distribution of demographic characteristics and health complaints for inbound and outbound services

Variables	Inbound operators (N=171)	Outbound operators (N=118)	<i>p</i>
Age (yr), Mean ± SD	32.9 ± 7.7	33.9 ± 8.5	ns
Length of employment (yr), Mean ± SD	3.8 ± 2.1	4.2 ± 2.3	ns
Weekly physical exercise time (h), Mean ± SD	2.1 ± 2.0	2.3 ± 2.2	ns
Gender: Female (%)	96%	99%	ns
Marital status: Married (%)	47%	49%	ns
Full-time worker (%)	88%	86%	ns
Body discomfort area (prevalence)			
Itchy skin (%)	29%	22%	ns
Eye strain (%)	84%	79%	ns
Tinnitus (%)	59%	32%	**
Hoarse or sore throat (%)	85%	70%	**
Chronic cough with phlegm (%)	50%	52%	ns
Chest tightness (%)	35%	43%	ns
Irritable stomach or peptic ulcers (%)	42%	57%	*
Musculoskeletal discomfort (%)	88%	85%	ns

p*<0.05, *p*<0.01, ns: insignificant.

Table 2. Rankings of major job stressors and reporting percentages of study subjects for inbound operators (n=171) and outbound operators (n=118)

Stressors at work	Inbound operators		Outbound operators	
	Rank	N (%)	Rank	N (%)
Having to deal with difficult customers	1	92 (54.0%)	1	64 (54.4%)
Being monitored by a manager without being informed	3	75 (44.1%)	2	63 (53.2%)
System monitoring of operator call activities	4	63 (36.8%)	3	53 (44.9%)
Devices for controlling call time	2	79 (46.3%)	5	29 (24.9%)
Calls that take a long time to process	5	56 (32.9%)	4	41 (35.0%)
Difficulties in talking to co-workers while sitting at their workstations	9	22 (12.9%)	6	29 (24.9%)
Difficulty in providing good customer service while simultaneously meeting time targets	6	54 (31.3%)	7	27 (23.0%)
Insufficient rest breaks	7	41 (23.9%)	9	14 (11.9%)
Being expected to remain constantly at ones workstation	8	40 (23.1%)	8	22 (19.0%)
Being distracted by other workers	10	2 (0.9%)	10	6 (4.8%)

customers' (54.4%) was also found to be the most frequent job stressor for outbound services, while the ranks of the other major OR main job stressors differed between inbound and outbound services (Table 2).

Ratings for psychosocial factors differed significantly between the inbound and outbound operators (Table 3). Outbound operators significantly outscored inbound operators in skill discretion, decision authority, job control, supervision support, and work-related support. In contrast, inbound operators scored slightly higher in job demands. Thus, outbound operators reported high job

control and low work demands in this study. Ratings on C-JCQ for the psychosocial factors of outbound workers were compared with those obtained from the survey of Taiwanese workers conducted by Cheng *et al*¹⁶). Table 3 clearly shows that outbound operators scored slightly lower than male operators in skill discretion, decision authority, job control, and job demands. However, outbound operators scored slightly higher than male telecommunication company call center operators in skill discretion, decision authority, job control. Conversely, outbound operators displayed low job demands and high

Table 3. Distributions of the C-JCQ scores of the study sample vs. those of Taiwanese workers in general

JCQ Subscale (# of items)	Inbound services (N=171)			Outbound services (N=118)			<i>p</i> ^a	
	Mean	SD	Range	Mean	SD	Range		
Skill discretion	27.9	4.9	14–42	30.8	4.2	18–48	<0.01	
Decision authority	26.2	6.9	12–44	32.4	5.2	16–48	<0.01	
Job control	54.1	10.6	26–86	63.2	8.2	34–96	<0.01	
(Skill discretion + Decision authority)								
Job demands	30.0	4.0	21–42	29.8	4.9	12–43	0.684	
Supervision support	10.8	2.2	4–16	12.5	1.9	4–16	<0.01	
Coworker support	12.8	2.7	7–41	12.9	1.6	10–16	0.569	
Work-related support	23.6	3.5	16–50	25.4	3.2	16–32	<0.01	
(Supervision support + Coworker support)								
	Men (n=551) ^b		Women (n=648) ^b		Men (N=155) ^c		Women (N=868) ^c	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Skill discretion	32.3	4.7	28.8	5.1	30.4	4.6	29.9	4.4
Decision authority	32.6	5.9	28.9	6.3	30.4	5.9	29.7	6.1
Job control	64.9	9.2	57.7	10.3	60.8	9.1	59.6	9.1
(Skill discretion + Decision authority)								
Job demands	33.5	4.4	33.6	4.6	31.0	5.0	31.7	4.5
Supervision support	11.2	2.2	10.9	2.2	12.2	1.8	12.0	2.1
Coworker support	12.1	1.6	12.3	1.7	12.6	1.9	12.9	2.1
Work-related support	23.4	3.1	23.2	3.2	24.8	3.4	24.9	3.5
(Supervision support + Coworker support)								

^aStudent *t*-test.

^bThe mean value and standard deviation of C-JCQ scores for Taiwanese workers in Cheng, Luh, & Guo¹⁶.

^cThe mean value and standard deviation of C-JCQ scores for call center operators in Lin *et al*⁸.

work-related support⁸).

Association between perceived levels of job stress and health complaints

Table 4 summarizes the results of the multivariate logistic regression analyses. Subjects who reported “always” or “frequently” feeling very stressed at work were classified as the High-Stress group, those who reported only “sometimes” feeling very stressed were classed as the Intermediate-Stress group, and those who reported “never” or “seldom” feeling very stressed were assigned to the Low-Stress group. Since the prevalence of high stress did not differ significantly between inbound and outbound services (*p*=0.247), these two service groups were combined for the purposes of this investigation. Compared with the Low-Stress group, The High-Stress group had significantly increased risks of various health problems. Table 3 showed that higher levels of job stress were associated with “eye strain” (odds ratio [OR]=2.50, 95%CI=1.07–5.87), “tinnitus” (OR=4.53, 95%CI=2.05–9.98), “hoarse or sore throat” (OR=2.96, 95%CI=1.16–7.54), “chronic cough with phlegm” (OR=2.13, 95%CI=1.02–4.44), “chest tightness” (OR=3.85, 95%CI=1.73–8.57), “irritable stomach or peptic ulcers” (OR=8.24, 95%CI=3.56–19.09) and “musculoskeletal dis-

comfort” (OR=6.46, 95%CI=2.27–18.33).

Discussion

Health complaints and job stress survey

Call center workers displayed a significantly raised prevalence of “musculoskeletal discomfort” (inbound: 88% vs. outbound: 85%), as listed in Table 1. The prevalence of “musculoskeletal discomfort” was compared with data obtained by the Institute of Occupational Safety and Health of Taiwan¹⁷) for all industries, as part of its periodic survey of physical discomfort. The analytical results indicated that the prevalence of “musculoskeletal discomfort” for workers in this call center significantly exceeded the industry average (63.3% for “musculoskeletal discomfort”). Self-reported “musculoskeletal discomfort” is associated with activities such as heavy physical work, and with psychosocial and environmental stress. In call center work, the main influences besides non-dynamic sitting are psychosocial factors⁵). In this investigation, 33.5% of outbound service call center workers and 27.1% of inbound service call center workers were classified as suffering high stress, considerably higher than figures from a wider survey of the working population in Taiwan, which identified high stress in just 7.6%

Table 4. Multivariable odds ratio (OR) with 95% confidence intervals (CI) for health complaints and stress levels among call center operators

Health complaints	Stress level ^a	Total population (N=289)	
		OR	(95%CI)
Itchy skin	Low	1	–
	Intermediate	1.23	(0.69–2.20)
	High	1.40	(0.61–3.25)
Eye strain	Low	1	–
	Intermediate	1.27	(0.48–2.01)
	High	2.50*	(1.07–5.87)
Tinnitus	Low	1	–
	Intermediate	2.25*	(1.08–4.70)
	High	4.53**	(2.05–9.98)
Hoarse or sore throat	Low	1	–
	Intermediate	2.75*	(1.30–5.82)
	High	2.96**	(1.16–7.54)
Chronic cough with phlegm	Low	1	–
	Intermediate	1.53	(0.90–2.59)
	High	2.13*	(1.02–4.44)
Chest tightness	Low	1	–
	Intermediate	1.60	(0.75–3.42)
	High	3.85**	(1.73–8.57)
Irritable stomach or peptic ulcers	Low	1	–
	Intermediate	3.03**	(1.40–6.55)
	High	8.24**	(3.56–19.09)
Musculoskeletal discomfort	Low	1	–
	Intermediate	1.82	(0.69–4.76)
	High	6.46**	(2.27–18.33)

* $p < 0.05$, ** $p < 0.01$.

^a“Low”: never or seldom felt stressed at work, “Intermediate”: felt very stressed at work sometimes, “High”: often or always felt very stressed at work.

of male workers and 6.5% of female workers¹⁸). Furthermore, this study observed that inbound services may be associated with higher prevalence of “musculoskeletal discomfort” than outbound services. Differences in task loads should be compared between inbound and outbound services. Unfortunately, this study did not use self-reporting or observation to identify differences, for example differences related to mental, emotional, psychosocial, and environmental loads.

Nearly one-third of the workers (inbound: 27.1% vs. outbound: 33.5%) were classified as belonging to the high stress group, significantly lower than in the study of DiTecco *et al.*⁶ (57%). One explanation for this phenomenon was that inbound service call-center workers handled between 120 and 150 calls daily, each averaging 120–150 s, representing a reasonably manageable workload. Supervisors paid attention to workers who underperformed the office average but did not penalize them. Furthermore, the finding that outbound services were

associated with higher job stress than inbound services was consistent with the finding of Ferreira and Saldiva⁵ that outbound services faced greater productivity pressure and supervisor-related conflicts than did inbound services. The association between high levels of job stress and health complaints in this study suggests that call center work is characterized by job stress, in turn possibly resulting in high levels of health problems. Several studies have identified job stress as an important risk factor for health-related quality of life^{19, 20}. Consistent with previous studies, dose-response associations were observed between levels of job stress and increased risks of multiple self-reported health complaints in bank call center workers.

Comparison of job stressors

This study identified differences in sources of job stressors between call center workers providing inbound and outbound services (Table 2). Notably, most of the study

subjects, namely 54.0% for inbound services and 54.4% for outbound services, considered “having to deal with difficult customers” to be the top job stressor. This finding differed from that of DiTecco *et al.*⁶⁾, namely that the main job stressor was “difficulty in providing good customer service while simultaneously meeting time targets”. This study and that of DiTecco *et al.*⁶⁾ examined all the main job stressors, and operators of both studies reported similar specific stressors contributing to their feelings of job stress, for example “difficulty in providing good customer service while simultaneously meeting time targets”, “system monitoring of operator call activities”, and “being monitored by a manager without being informed”. However, this investigation asked workers to rank the main stressors, which was a forced choice task. Possibly, subjects would have preferred to indicate no, or just one or two major stressors; in which case the forced choice task would lead to unrealistically high percentages and overestimations of the importance of stressors. Additionally, information on minor stressors, with potential to differentiate between groups, is lost in this situation.

Study limitations and future research

Various improvements could refine the current investigation. For example, the investigation focuses on a single banking call center, it would be interesting to analyze call centers of firms engaged in different businesses. Additionally, both self-recording and observation methods could be used to identify differences, such as those involving mental, emotional, psychosocial, and environmental load. Possible (semi-) quantitative parameters could also be obtained, including call number and duration, number of conflicting calls, number of calls categorized according to difficulty, and computer workstation parameters. A further limitation of this study is that the sample size of subjects (171 inbound and 118 outbound operators) could be considered too small to clearly identify relationships between stress and health complaints, preventing the generalization of the results to all studies involving call center tasks, however, they represent almost all workers in current activity in those departments, thus helping avoid selection bias⁵⁾. Another limitation of this investigation is that health complaints were self-reported and based on symptoms rather than on detailed medical examinations. Meanwhile, the study adopted a transversal design, and data on stress and medical conditions were collected simultaneously. Thus it is impossible to conclude to a causal relationship between stress and medical conditions subjects with bad medical conditions are possible to describe a high level of perceived stress.

Conclusion

This study identified “musculoskeletal discomfort”, “eye strain”, and “hoarse or sore throat” as the most prevalent health complaints at a bank call center. Additionally, call center workers providing outbound services were more likely than those providing inbound services to report frequently or always feeling very stressed at work. Furthermore, “having to deal with difficult customers” was the most frequent job stressor facing operators. Finally, the association between perceived job stress and health complaints indicated that workers who perceived high job stress had significantly increased risks of multiple health problems.

References

- 1) Norling P (2001) Call centre companies and new patterns of organization. *Economic and Industrial Democracy* **22**, 155–68.
- 2) Rocha LE, Glina DMR, Marinho MF, Nakasato D (2005) Risk factors for musculoskeletal symptoms among call center operators of a bank in São Paulo, Brazil. *Ind Health* **43**, 637–46.
- 3) Sprigg CA, Smith PR, Jackson PR (2003) Psychosocial risk factors in call centers: an evaluation of work design and well-being. Health and Safety Executive, research report 169.
- 4) Smith MJ, Bayehi AD (2003) Do ergonomics improvements increase computer workers’ productivity?: an intervention study in a call centre. *Ergonomics* **46**, 3–18.
- 5) Ferreira Jr. M, Saldiva PHN (2002) Computer-telephone interactive tasks: predictors of musculoskeletal disorders according to work analysis and workers’ perception. *Appl Ergon* **33**, 147–53.
- 6) DiTecco D, Cwitco G, Arsenault A, Andre M (1992) Operator stress and monitoring practices. *Appl Ergon* **23**, 29–34.
- 7) Smith MJ, Carayon P, Sanders KJ, Lim SY, LeGrande D (1992) Employee stress and health complaints in jobs with and without electronic performance monitoring. *Appl Ergon* **23**, 17–27.
- 8) Lin YH, Chen CY, Lu SY (2008) Physical discomfort and psychosocial job stress among male and female operators at telecommunication call centers in Taiwan. *Appl Ergon* **40**, 561–8.
- 9) Charbotel B, Croidieu S, Vohito M, Guerin AC, Renaud L, Jaussaud J, Bourboul C, Imbard I, Ardiet D, Bergeret A (2009) Working conditions in call-centers, the impact on employee health: a transversal study. Part II. *Int Arch Occup Environ Health* **82**, 747–56.
- 10) Croidieu S, Charbotel B, Vohito M, Renaud L, Jaussaud J, Bourboul C, Ardiet D, Imbard I, Guerin AC, Bergeret A (2008) Call-handlers’ working conditions and their subjective experience of work: a transversal study. *Int Arch Occup Environ Health* **82**, 67–77.

- 11) Sprigg CA, Stride CB, Wall TD, Holman DJ, Smith PR (2007) Work characteristics, musculoskeletal disorders, and the mediating role of psychological strain: a study of call center employees. *J Appl Psychol* **92**, 1456–66.
- 12) Burton WN, Conti DJ, Chen CY, Schultz AB, Edington DW (1999) The role of health risk factors and disease on worker productivity. *J Occup Environ Med* **41**, 863–77.
- 13) Burton WN, Conti DJ, Chen CY, Schultz AB, Edington DW (2001) The impact of allergies and allergy treatment on worker productivity. *J Occup Environ Med* **43**, 64–71.
- 14) Halford V, Cohen HH (2003) Technology use and psychosocial factors in the self-reporting of musculoskeletal disorder symptoms in call center workers. *J Safety Res* **34**, 167–73.
- 15) Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B (1998) The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol* **3**, 322–55.
- 16) Cheng YW, Luh WM, Guo YL (2003) Reliability and validity of the Chinese version of the job content questionnaire in Taiwanese workers. *Int J Behav Med* **10**, 15–30.
- 17) Institute of Occupational Safety and Health (IOSH) of Taiwan (2001) Survey of employees' perceptions of safety and health in the work environment in 2001 Taiwan (IOSH90-H304). IOSH, Taipei.
- 18) Cheng YW, Guo YL, Yeh WY (2001) A national survey of psychosocial job stressors and their implications for health among working people in Taiwan. *Int Arch Occup Environ Health* **74**, 495–504.
- 19) Lerner D, Levine S, Malspeis S, D'Agostino R (1994) Job strain and health-related quality of life in a national sample. *Am J Public Health* **84**, 1580–5.
- 20) Amick BC, Kawachi I, Coakley EH, Lerner D, Levine S, Colditz GA (1998) Relationship of job strain and iso-strain to health status in a cohort of women in the United States. *Scand J Work Environ Health* **24**, 54–61.