Industrial Health 2011, **49**, 15–23 **Original Article**

An Integrated Model for the Assessment of Stress-related Risk Factors in Health Care Professionals

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Received February 21, 2008 and accepted March 11, 2010
Published online in J-STAGE September 1, 2010

Abstract: To assess the risk from exposure to occupational stress and burnout in health care workers (HCW), a cross-sectional study was planned to compare objective data that can represent potential job stressors in hospital wards and subjective symptoms reported by the workers. Medical doctors, nurses and ancillary workers of the Internal Medicine Wards of a large public hospital in Northern Italy participated in the study. Three subjective questionnaires were administered: the Job Content Questionnaire (JCQ), the State-Trait Anxiety Inventory (STAI), the Maslach Burnout Inventory (MBI). In addition, seven objective parameters were collected as average during the 3 months period prior to the study: a) working understaffed; b) ratio number of patients/HCW on service; c) ratio number of HCW on sick leave/ HCW on service; d) number of skipped days off after night shifts; e) days of sick leave; f) number of deceased patients; g) number of accidents at work. A total group of 230 HCW were examined, employed in six different sub-units of the Medical wards. The female workers were 67.8% and the male workers 32.2%, the mean age was 37.4 yr (SD 9.3) in the total group of HCW, 35.1 yr (SD 7.9) in females and 42.3 yr (SD 10.3) in males. The average scores of subjective and objective parameters resulted significantly higher in the same sub-units. The correlation analysis showed that the subjective questionnaires were highly inter-related. The multivariate analysis showed that the days of sick leave were significantly related to the subjective questionnaires, and the subjective subscales of emotional exhaustion (from MBI), job demand and decision latitude (from JCQ) and STAIt were significantly related to some of the objective parameters. These results support the integrated use of multiple subjective and objective assessment as the most appropriate approach for the evaluation of occupational stress.

Key words: Occupational stress, Health care workers, Subjective measures, Objective measures

Introduction

Growing interest is focusing on the exposure to stress and psycho-social factors at work. One of the most important aspects in this matter is how to define a proper methodology for the assessment of occupational stress. In fact, preventive approaches are based on risk characterization, which is the first step towards any intervention strategy. Differently from other types of risk factors represented by chemical, physical or biological agents, stress-related risk factors are more difficult to estimate with quantitative approaches. Various attempts are being applied and according to the most consistent literature the evaluation of health risks related to job stress involves three classes of variables: *job stressors, strains* and *health outcomes*. The term *job stressor* refers to a large number of work-related envi-

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ronmental conditions thought to impact on the workers' health and well-being (work overload, excess responsibility, time pressure, role conflict). *Strain* involves the worker's psychological and physiological reactions to such exposure (anxiety, depression, mood disorders, elevated blood pressure, increased production of stress hormones, including cortisol and catecholamine). The *health outcomes* refers to adverse health outcomes such as depression or hypertension possibly resulting from the exposure to job stressors. The literature on job stress measurement is quite extended. A review by Hurrell *et al.*[1] summarized three main approaches: the use of instruments developed for (a) self-reported measures, (b) "objective" observational measures of job stressors, (c) self-reported and physiological measures of strain. A large number of individual *self-reported scales* are available. They are designed to assess a wide range of job stressors, related to temporal aspects (amount of overtime, time pressure, time flexibility, shift work) work contents, work-group factors, leadership style and organizational conditions (work tasks administration, information quality). The most widely used are the Job Diagnostic Survey (JDS)[2, 3], the Job Characteristics Index (JCI)[4], the Occupational Stress Indicator (OSInd)[5]; the Work Environment Scale (WES)[6], the Occupational Stress Inventory (OSInv)[7], the Stress Diagnostic Survey (SDS)[8], the Job Content Questionnaire (JCQ)[9], the Generic Job Stress Questionnaire (GJSQ)[10], the Job Stress Survey (JSS)[11].

Limitations of self-reported instruments in job-stress research have been extensively reported[12–15]. These limitations are particularly evident in epidemiological research, where investigators have generally used self-reported measures of job stressors and strain, without objective observation.

Objective measures of job stressors are generally difficult to obtain. Nevertheless, several attempts have been realized to develop observational methods. An observational approach does not rely on the job perception of the working environment and therefore is considered as more objective. One of the first measures of this type was developed by Elo and Vehvilaienen[16] at the Finnish Institute for Occupational Safety and Health. An other observational instrument was developed at the Tecnical University of Berlin[17]. Studies using these instruments showed an association between job stressors and psychosomatic complaints and objective outcomes such as accident rates among bus drivers[18–20]. Nevertheless, although very appealing because of their presumed objectivity, observational approach shows also a number of drawbacks. Gathering observational data on job stressors can be most reliably performed only by trained and experienced observers, otherwise also these "objective" assessment may be influenced by the observer's interpretation. Moreover, the observational methods require to adapt to the specific job being assessed.

Self-reported strain measures have been commonly used in the job-stress literature to assess anxiety, depression, general psychological and physiological distress and burnout. Many of these indicators were not specifically developed to address job-related strains. The limitations of self-reported strain measures are also documented: in addition to shared response bias, the contemporary use of self-reports of both job stressors and strains increases the potential for conceptual overlap in the measures. Such studies are subject to what Kasl[13] referred to as "trivial trap": a situation in which the independent and the dependent variable largely assess the same construct. Furthermore, stressors and strains, when measured together, can influence the person's attribution of a particular symptom.

Physiological measures of job strain may be categorized into three broad groups: a) cardiovascular variables, b) stress hormones, and c) measures of immune response. Cardiovascular indicators, including heart rate and blood pressure are the most studied physiological indicators.

Each of the above mentioned approaches show advantages and limitations. Therefore, the evaluation of job stress should result from an integration of subjective and objective measures of stressors, strain and health outcomes. An integrated assessment of job-stress was applied in this study to a group of hospital workers, and compared to similar experiences on health care workers[21–23] and workers from other sectors[19, 24–27].

Subjects and Methods

Target population

Medical doctors, nurses and ancillary staff from the three wards of General Medicine in a large public hospital in Northern Italy were recruited. Each of the three wards was subdivided in a male and a female section, yielding a total number of 6 sub-units, named A, B, C, D, E, F. The enrolment procedure took place within the health surveillance program of the hospital's Occupational Health Service. The survey is currently being extended to the other hospital wards of the hospital, with the objective of an overall evaluation of job stress in the entire employees population.

Study design

The study was a cross sectional observation with no exclusion criteria. The assessment procedure included meetings where workers were informed about the

study's objectives and methodology and invited to sign an informed consent upon acceptance. Personal data were treated with confidentiality by assigning an ID code to each participants and eliminating the names from the dataset. Participants were administered self reported questionnaires in groups of 20 individuals. A general questionnaire assessed socio-demographical and work-related variables: age, gender, school title, marital status, number of children, professional job title, work seniority, type of work shift. Three scales were administered to for the subjective assessment of work stressors and strain.

Self-reported subjective assessment

Standardized questionnaires were used for subjective assessment of perceived job stressors (a) and strain (b, c):

a. The JCQ is a well established and standardized instrument for the measurement of perceived stress in the workplace. The Italian version by Baldasseroni *et al*.[28] was used in this study: it includes 47 items for the assessment of the three dimensions of decision latitude (DL), job demand (JD) and social support (SS). Higher scores of JD and lower scores in the subscales of DL and SS indicate higher job stress.
b. The Maslach Burnout Inventory (MBI) was used to measure the perceived strain[29]. This scale has been designed to assess the "burnout" syndrome in human service professionals. The MBI evaluates Emotional Exhaustion (EE), De-Personalization (DP) and Personal Accomplishment (PA) through three different subscales. A burnout condition is given by high scores in EE and DP and by a reduced sense of PA.
c. The State-Trait Anxiety Inventory (STAI)[30] measures both state and trait anxiety with two subscales (STAIs and STAIt) and is one of the most widely used instruments in social sciences and medical research. The state anxiety subscale is particularly suitable for multiple administration in longitudinal studies. Higher scores in both subscales indicate higher anxiety level.

Objective assessment of stressors

The identification of suitable objective indicators was based on a literature search focused on job-related stress in health care workers, and was discussed with the other occupational health professional of the hospital service. Seven parameters potentially related to job stress were identified:

1. the difference between the number of Health Care Workers (HCW) expected to be hired according to the official provisional needs for each sub-unit of the hospital wards and those effectively hired (working understaffed);
2. the ratio between the number of hospitalized patients and the number of HCW (patients/HCW) in each sub-unit. The number of patients was weighted according to three levels of patients collaboration: a) collaborative, b) partially collaborative, c) non collaborative;
3. the ratio between the number of HCW on sick leave and the number of HCW workers on service (HCW on sick leave/on service);
4. the number of skipped days-off, due to unexpectedly increased work demand (n. skipped days-off);
5. the days of absence from work due to sickness (n. of days on sick leave);
6. the number of patients deceased during or shortly after hospitalization (n. of deceased);
7. the number of work accidents causing exposure to biological agents in each sub-unit (n. of accidents).

These indicators were collected with the collaboration of the wards head nurses. Each parameter was averaged on the three months prior to the questionnaires administration and for each of the six sub-units in which the hospital wards were divided.

Statistical analysis

Descriptive analysis of the HCW population was performed with parametric tests to compare the subgroups of subjects working in the six sub-units. All variables were originally assessed for skewness and eventually transformed into logarithmic form to reach log-normal distribution. The analysis included the general questionnaire on socio-demographic variables, the subjective questionnaires and the objective job stressors.

A stepwise regression was used to assess the possible relation of socio-demographic variables with objective and subjective scores; each score was then adjusted for the socio-demographic variables that resulted significantly correlated, using the residuals from each regression analysis. Fisher's Protected Least Significant Difference (PLSD) was used to evaluate differences in regard to hospital sub-units and job rank. A model of multiple regression was used to assess the correlation among the different subjective methods and, finally, among objective and subjective scores.

Results

Socio-demographic and work-related variables

A total number of 230 workers agreed to participate in the survey out of 250 invited (92% participation rate). The 67.8% of the subjects were females, 32.2% males. Mean age was 37.4 yr (SD 9.3) in the total group, 35.1 yr (SD 7.9) in females and 42.3 yr

(SD 10.3) in males, with an average duration of service of 6.7 yr (SD 6.8) for the overall group. Considering work organization, 71% of the HCW worked on night shift, 18.2% on daily shift and 10.8% worked on part-time. Regarding the job title, 47.4% of the groups were nurses, 32.6% ancillary workers and 20% were medical doctors (Tables 1). The overall group was divided into six the different six sub-units of the hospital wards. No statistical differences were observed among the six sub-groups in respect of age, type of shift, job title, marital status, number of children, and education level. Gender distribution was similar in the various sub-units except for sub-unit A, where men's percentage resulted significantly higher (χ^2 p value<0.0001). Among the work characteristics, duration of service was significantly longer for the HCW of sub-unit A compared to B and F (respectively, mean difference 3.761, p=0.01; mean difference 3.451, p=0.04).

Table 1. socio-demographical data

(a)

Gender (%)	
Male	32.2
Female	67.8
Job title (%)	
Ancillary	32.6
Nurses	47.4
Doctors	20
Work shift (%)	
Part-time	10.9
Daily	18.2
Shift-worker	70.9
Educational level (%)	
Primary school	0.5
Lower secondary school	26
High school	43.5
Degree	30
Marital status (%)	
Unmarried	31.7
Married	58.7
Divorced/widow	10.6
N. of children (%)	
0	46.5
1	25.2
2	19.6
3	7.4
4	1.3

(b)

	Age (yr)		Duration of service (yr)	
	male	female	male	female
Mean ± DS	42.3 ± 10.3	35.1 ± 7.9	9.7 ± 8.9	5.3 ± 5.1
Range	22–67	22–59	0.4–30	0.1–29

The influence of potential confounders on the objective and subjective indicators of stress was assessed with stepwise regression, which showed a significant correlation between age and JD. Regarding the objective parameters, gender and age were related to the ratio "patients/HCW" and to the "n. of skipped days off", whereas age was related to the ratio "HCW on sick leave/on service" and to the "days on sick leave".

In the following analysis, the scores of subjective and objective variables were adjusted for the confounders that resulted specifically correlated.

Subjective evaluations

Table 2 shows the mean values, median and ranges of JCQ subscales in the sub-units of the medical wards. The ANOVA showed statistical differences for JD (F=3.511; p=0.0045) and SS (F=3.046; p=0.0112) among the six subunits. Post hoc comparison showed higher scores of JD in unit E compared to unit A and to unit D. The DL score was higher in unit B compared to C; a lower SS was found in department E compared to department B and D (p=0.001) and in F compared to B and D (Table 3). The analysis of subjective evaluations according to job rank showed lowest scores for DL and SS in ancillary workers; no significant differences were found regarding JD. Medical doctors showed the highest levels of PA.

Table 4 shows the mean values, median and ranges of MBI in the sub-units of the medical wards. The ANOVA analysis showed statistical differences of the subscale of EE among the sub-units (F=8.740; p<0.0001). Post hoc comparison (Table 5) indicated

Table 2. Mean scores, median and ranges of JCQ subscales in the 6 subunits of the medical wards

Sub Unit	Decision latitude			Job demand			Social support		
	Mean	Median	Range	Mean	Median	Range	Mean	Median	Range
A	67.8	70	46–94	37.5	37	28–49	22.7	23	17–28
B	68.4	68	44–84	39.7	40	27–51	23.7	24	18–29
C	63.5	63	30–90	40.0	38	29–52	22.7	22	13–44
D	68.1	69	50–78	38.0	38	25–45	24.0	24	17–29
E	66.5	70	30–90	42.3	42	29–56	21.6	23	13–38
F	66.8	66	48–82	40.4	40	31–54	22.1	23	15–28

Table 3. Significant differences of JCQ scores among the subunits of the medical wards

Fisher's PLSD	Mean difference	*p* value
Jod Demand		
Subunit A vs E	–5.151	0.0253
Subunit D vs E	–6.054	0.0100
Decision Latitude		
Subunit B vs C	4.910	0.0426
Social Support		
Subunit B vs E	2.125	0.0042
Subunit B vs F	1.587	0.0487
Subunit D vs E	2.453	0.0011
Subunit D vs F	1.915	0.0189

Table 6. Mean scores, median and ranges of STAI-trait and STAI-state subscales in the 6 subunits of the medical wards

Sub Unit	STAIt			STAIs		
	Mean	Range	Median	Mean	Range	Median
A	48.0	2–99	50	40.1	4–88	41
B	38.4	1–97	30	38.1	1–89	34.5
C	45.3	12–99	42	39.9	4–89	38.0
D	36.4	1–96	32	33.3	1–89	34.0
E	57.4	3–99	61	51.2	1–99	50.5
F	61.3	5–97	64	48.3	3–90	44.0

Table 4. Mean scores, median and ranges of MBI subscales in the 6 subunits of the medical wards

Sub Unit	Emotional Exhaustion			De-Personalization			Personal Accomplishment		
	Mean	Range	Median	Mean	Range	Median	Mean	Range	Median
A	16.7	1–49	14	5.0	0–21	3	39.1	13–48	41
B	16.2	1–41	13	4.2	0–17	2.5	37.3	15–48	39
C	21.1	0–52	17	6.9	0–28	5.0	36.8	7–46	39
D	15.0	0–35	12	4.1	0–17	2.5	39.9	22–48	41
E	29.1	1–54	27	7.3	0–29	6.0	37.2	10–47	41
F	26.4	4–48	28	6.7	0–19	6.0	36.0	27–48	36

Table 5. Significant differences of MBI scores among the subunits of the medical wards

Fisher's PLSD	Mean difference	*p* value
Emotional Exhaustion		
Subunit A vs E	–12.462	<0.0001
Subunit A vs F	–9.556	0.0012
Subunit B vs E	–12.776	<0.0001
Subunit B vs F	–9.871	0.0009
Subunit C vs D	5.856	0.0381
Subunit C vs E	–8.250	0.0034
Subunit D vs E	–14.105	<0.0001
Subunit D vs F	–11.200	0.0002
Depersonalization		
Subunit B vs E	–3.083	0.0237
Subunit D vs E	–3.123	0.0236
Personal accomplishment		
Subunit D vs F	3.913	0.0378

Table 7. Significant differences of STAI-trait and STAI-state scores among the 6 subunits of the medical wards

Fisher's PLSD	Mean difference	*p* value
STAIs		
Subunit A/E	–5.166	0.0048
Subunit A/F	–3.937	0.0451
Subunit B/E	–4.488	0.0146
Subunit C/E	–4.374	0.0204
Subunit D/E	–6.211	0.0009
Subunit D/F	–4.982	0.0128
STAIt		
Subunit A/E	–8.225	0.0001
Subunit A/F	–10.938	<0.0001
Subunit B/E	–7.482	0.0005
Subunit B/F	–10.195	<0.0001
Subunit C/E	–6.657	0.0026
Subunit C/F	–9.370	0.0001
Subunit D/E	–7.822	0.0004
Subunit D/F	–10.535	<0.0001

significantly higher levels of EE in subunit E and F vs. all the others. DP resulted higher in subunit E compared to subunits B and D, and PA was significantly higher in subunit D compared to F.

Table 6 shows the mean values, median and range of STAIt and STAIs tests. Post-hoc analysis showed significantly higher levels of anxiety among the HCW of subunits E and F compared to the others (Table 7).

The correlation analysis between the different subjective questionnaires showed that these instruments were highly inter-related (Table 8).

Objective parameters

Table 9 shows the mean scores of the objective parameters assessed in the subunits of the medical wards. Parameter #1 is higher in unit E than in others. Worce scores were observed in post-hoc comparison (Table 10) in subunit F compared to subunits A, C, D

Table 8. Correlation analysis between the questionnaires scores

Correlation		Coeff.	*p* value
MBI-EE	STAIs	0.223	<0.0267
	STAIt	0.408	<0.0001
	JCQ-JD	0.255	<0.0001
	MBI-DP	0.573	<0.0001
MBI-DP	STAIt	0.153	0.0022
	MBI-PA	–0.132	0.0180
MBI-PA	STAIs	–0.163	0.0265
	JCQ-DL	0.228	<0.0001
	STAIt	–0.136	0.0255
STAIs	JCQ-SS	–0.294	0.0348
	STAIt	0.510	<0.0001
STAIt	JCQ-DL	–0.147	0.0287
	JCQ-JD	0.216	0.0006
	JCQ-SS	–0.749	0.0004
JCQ-DL	JCQ-SS	1.217	<0.0001

Table 9. Mean scores of the objective parameters in each of the 6 subunits of the medical wards

Sub Unit	Objective parameters						
	#1	#2	#3	#4	#5	#6	#7
A	1	20.176	1.352	1.025	4.512	0.166	0.044
B	1	19.998	1.428	1.513	5.192	0.176	0
C	1	21.013	3.611	1.879	4.853	0.063	0
D	1.016	20.497	3.047	1.466	1.606	0.204	0
E	1.059	21.750	2.891	0.482	7.919	0.115	0.096
F	1	22.344	0	2.135	7.519	0.293	0

Table 10. Comparison of objective parameters in the 6 subunits of the medical wards

Fisher's PLSD	Mean difference	*p* value
#3		
Subunit A vs F	5.547	0.0099
Subunit B vs C	–4.721	0.0210
Subunit B vs D	–4.510	0.0254
Subunit C vs F	8.022	0.0003
Subunit D vs F	7.810	0.0004
Subunit E vs F	6.502	0.0027
#4		
Subunit A vs E	4.816	0.0084
Subunit B vs E	4.876	0.0084
Subunit C vs E	5.636	0.0029
Subunit D vs E	5.259	0.0048
Subunit E vs F	–7.699	0.0001
#5		
Subunit A vs D	6.988	0.0012
Subunit B vs D	5.659	0.0093
Subunit B vs E	–4.378	0.0410
Subunit C vs D	4.532	0.0407
Subunit C vs E	–5.505	0.0120
Subunit C vs F	–5.260	0.0269
Subunit D vs E	–10.037	<0.0001
Subunit D vs F	–9.792	<0.0001

Table 11. Mean scores of the five objective parameters according to the different job categories

Job rank	Objective parameters						
	#1	#2	#3	#4	#5	#6	#7
Ancillary	1.032	25.031	1.667	0.945	7.170	0.194	0.048
Nurses	1.009	17.661	3.307	2.267	5.768	0.135	0.021
Doctors	0.992	21.714	0.109	0	0.721	0.187	0

and E. Parameter #4 (n. of skipped days off) resulted lower in unit E compared to all the other units, and parameter #5 (days on sick leave) was significantly higher in unit E and F compared to the other units. The last two parameters, #6 (number of deceased) and #7 (number of accidents), were not further considered in the analyses because the values were too low and not significant.

The analysis of the objective parameters according to job rank are reported in Table 11. The ratio Patients/HCW, quantitative expression of workload, was higher in ancillary vs. nurses and doctors. The ratio HCW on sick leave/on service resulted higher in doctors; the number of skipped days off is higher in nurses. The lowest average number of sick leave days was observed among doctors.

Relationship between subjective questionnaires and the objective parameters

Table 12 shows the correlations between subjective and objective parameters. A significant correlation resulted between EE and parameter #1 "working understaffed", #2 "patient/HCW" and #4 "n. of skipped days off". STAIt and DL correlated to #1 "working understaffed"; JD correlated to #2 "patients/HCW", #4 "n. of skipped days off" and #5 "days on sick leave".

Table 12. Significant results of correlation analysis between objective parameters and the questionnaires' subscales

	Objective parameters											
	#1			#2			#4			#5		
	R	coeff.	*p*	R	coeff.	*p*	R	coeff.	*p*	R	coeff.	*p*
MBI-EE	0.38	2.597	<0.0001	0.38	2.597	<0.0001	0.38	0.357	0.0422			
JCQ-JD				0.54	0.263	0.0368	0.53	0.295	0.0206	0.55	0.534	<0.0001
JCQ-DL	0.23	1.238	0.0041									
STAIt	0.30	1.642	<0.0001									

Discussion

In our study subjective evaluations of strain, obtained with MBI and STAI strongly agreed in identifying the sub-units E and F oh the medical wards as the most critical. The subjective evaluation of stressors obtained with JCQ indicated also the same sub-units as characterized by higher JD and lower SS. This implies that the two approaches investigate similar aspects, as supposed by Kasl[13–15]: in fact, a good correlations resulted in our study between subjective evaluations of stressors and strain.

The objective evaluation of stressors indicated also more critical conditions in the same two subunits E and F regarding to the number of days on sick leave. This can be interpreted as the only objective index of effect, while the other objective parameters can be considered as objective indicators of exposure to stress. Therefore, the number of days on sick leave results as the objective index that better reflects the subjective evaluation of stress and strain in the different subunits.

Nevertheless, objective and subjective indicators were related in various correlations. EE was positively associated with the "n. of skipped days off", the ratio "patients/HCW" (which is an objective index of JD) and "working understaffed". The subjective perception of JD was positively correlated to the objective index ("patients/HCW") and to the loss of recovery time ("n. of skipped days off"). The parameter "working understaffed" reflected the adequacy of the staff: an inadequate staff was correlated to higher levels of EE and anxiety measured with STAI. There was also a positive correlation to DL, possibly because if the workers are fewer, they must make more decisions.

Several studies on occupational stress adopted both subjective and objective methods to evaluate job stressors and strain[19, 21–27]. All the studies found some correlation between subjective and objective measures. Each study adopted different methods, both for subjective and objective evaluations; the indicators chosen for the objective evaluations were generally context- and job-specific. The number of days on sick leave has been one of the mostly evaluated objective parameter[22–24], but the high specificity of the other objective indices and the wide number of subjective questionnaires make the comparison among the studies very difficult. For this reason, we focused on studies conducted on HCW to compare our results.

Objective and subjective indicators of psychosocial hazards among HCW were measured by Fox *et al*.[21] with objective indexes and perceptual measures of demands. Objective evaluation included patient load, the percentage of hours spent for direct patients care out of the total work schedule, and the average number of deaths witnessed by the nurses in the last year. Subjective evaluation of JD was performed by a seven-item scale[31] and by a 45-items inventory of stressful events[32]; the subjective perception of the control the workers experienced in that work was measured with a 22-items scale[33]. Among the affective outcomes, the overall job satisfaction was assessed with a version of the "faces" scale[34]; illness and somatic complains using a 17-items scale measuring several symptoms. Physiological indicators were also measured including arterial blood pressure and salivary cortisol sampled at work and at home. The last instrument was a measure of the overall job performance. The instrument contained six major responsibility areas with rating assigned by an assessor (usually the head nurse). The authors (Fox *et al*.[21]) observed a convergence of subjective and objective assessment of JDs: the scale of quantitative work load correlated significantly with two objective indicators, patient load and direct patients care. The same two indicators correlated also with physiological outcomes. Subjective workload did not correlate with any of the outcome variables. Somatic complains outcomes was positively correlated with the frequency of stressful events, negatively with beliefs in high control levels. Overall job performance resulted significantly related (with a negative correlation) with the percentage of time in contact with patients and with other strain variables (blood pressure at work).

Objective measurement of occupational stress factors were also assessed by Bourbonnais *et al*.[22], to

determine if nurses exposed to job strain (measured by JCQ) reported a higher incidence of sick leave than non-exposed nurses. Objective parameters of stress were represented by data on sick leave, both short-term (1–5 d) and longer sick leave (>3 or 5 d). Results indicated that short-term sick leaves were associated with job strain and with lower SS at work; longer sick leaves were associated with lower SS.

Rahuala *et al*.[23] measured objective parameters in nurses; the aims of this study were to examine whether work overload was related to sickness absenteeism and to quantify potential loss of working days. Workload was measured by the RAFAELA patient classification system[35], sickness absence was measured as short (1–3 d) and long-term (>3 d). Results showed a positive association between score of workload and both measures of short and long-term sick leave.

Conclusions

In summary, the use of subjective an objective parameters of work stress showed two positive associations: a) between subjective and objective indicators of job stressors and strain, and b) between subjective measures of strain and the objective indicators of stress. These results further support the use of integrated methods in occupational stress studies, that allow to take full advantage of all the scales and evaluation instruments. A limitation of the studies already published on this topic is that they generally do not adopt widely validated instruments, especially for the subjective measurements. Therefore a strength of our study is the use of validated instruments for subjective measurement. Nevertheless, although subjective instruments are useful to identify the most critical organizational areas and the effects related to occupational stress, they do not identify the sources of work stress. Therefore they cannot be used to program preventive intervention and they must integrate with objective measurement. Our model is suitable for this purpose, although it may be further implemented with other objective indicators of effect, such as increased turnover, errors and mistakes in various job tasks. The index that measures days on sick leave could also be divided in short and long term absences.

Risk assessment and risk characterization are essential steps for the implementation of preventive and protective policies. Job-related stress is an emerging risk factor in occupational setting, therefore it should be assessed with an adequate approach. The use of objective measures can contribute to a clearer linkage between subjective perception and the environmental conditions and can indicate what aspects should be modified by preventive intervention. On the other hand, subjective measures are needed because the impact of exposure varies substantially among individuals; moreover, they examine cognitive and emotional processing. Therefore, the best approach to measure occupational stress is an integrated one, which involves the use of multiple subjective and objective assessment modalities.

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