SUBJECTIVE EVALUATION OF THE WORKLOAD OF NURSES CAUSED BY THEIR PROFESSIONAL WORK

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Abstract

The study background: Nursing workload is discussed within the literature as an important factor, which influenced nurses' job satisfaction and the quality of health care they provide. Aims: The aim of the study was to determine which groups of nursing activities cause the subjective feeling of fatigue in nurses, to which category of workload they belong, and which of the following factors: system of work, speciality of the ward, age, state of health, commutation to work, housing conditions, may contribute to the degree of fatigue felt.

Methods: In order to evaluate nurses' tiredness and workload caused by their occupational work Borg's scale was used. Three hundred and seven nurses employed with wards of different specialties were invited to participate in the study. The nurses' task was, after they had finished their work, to determine in points the degree of workload for the particular groups of activities performed. The attained results were then analysed statistically by the STATA computer program. Results: Generally, in the nurses' views, the work of a nurse was regarded as a light job. With regard to the particular activity groups, the heaviest ones were found to be those connected with transporting and moving of the patients and participation in resuscitation of patients. The evaluation of the workload for the particular groups of nursing activities was dependent upon age, ward specialty, type of work shift as well as the housing conditions and time spent on commuting to work. Subjective evaluation of the workload was depended neither upon duration of the work shift nor upon the state of health. Conclusion: This study confirms an important role of the psychic element in the subjective evaluation of the workload by nurses. It is suggested to undertake further studies regarding the matter, which would simultaneously investigate physical and psychical workload related to the nurses' professional activities.

Key words: Borg's scale - workload - nurse

Introduction

Fatigue is a diminished ability to work, which occurs during work and as a result of work. It is a phenomenon, which signals the necessity to refrain from further work. It manifests itself by tachycardia [1-3], tachypnoea (Syabbalo,1994), elevated body temperature and excessive sweating (Kondo,2001). It has been found that the threshold at which fatigue starts is dependent upon one's physiological adaptability, emotional state, and work conditions.

The evaluation of workload is conducted in order to determine the kind and duration of work as well as breaks from work, which diminishes the amount of workload at a work post, for the purposes of diagnosing work organisation, job evaluation, job division and work coordination.

Among the methods that evaluate the absolute physical workload are estimation methods (tabular and chronometric-tabular) (Belova, 1999) and measurement methods (indirect calorimetry (Brun, 1992; Melanson, 1996; Jakicic, 1999), measurement of the heart rate (Backs 1995)). The most convenient method to determine the workload for a particular job is the chronometric-tabular one. It is easy to apply and it does not interfere with the very process of work. It requires, however, the presence at the work post of a highly qualified specialist in ergonomics, who will perform the analysis in question.

A slightly less popular seems to be the method developed by Gunnar Borg (Engels, 1994, 1998). He developed a 15-point scale of subjective evaluation of workload (Borg 1962). Using this scale consist in selecting, after having done a particular activity, a specific number of points to define its workload. The value of the points multiplied by 10 quite closely corresponds with the heart rate at the time of performance of the particular activity (Kozłowski, 1986). The main advantages of Borg's scale are: (a) its simplicity and (b) the possibility of measuring simultaneously both physical and mental workload caused by certain professional activities. Because of these reasons the Borg's scale was used as a tool in our study.

Fig1. Borg's scale representing subjective evaluation of workload (Kozlowski, 1986;17)

6, 7 very, very light
8, 9 very light
10, 11 rather light
12, 13 rather heavy
14, 15 heavy
16, 17 very heavy
18, 19, 20 extremely heavy

Within the literature which is known about the topic, the workload of nursing is studied in three main ways, i.e. in relation to:

(1) retention and job satisfaction,

(2) patients acuity and their outcomes

(3) "use of either nurse activity or dependency system to predict nursing cost from workload assessments" (Hegney et all, 2003,308; Adomat, 2003; Mäkinen, 2003; Sasichay-Akkadechanunt, 2003; Yaktin, 2003; Yang, 2003).

The aim of the study was to determine which groups of nursing activities cause the subjective feeling of fatigue in nurses, to which category of workload they belong, and which of the following factors: system of work, speciality of the ward, age, state of health, commutation to work, housing conditions, may contribute to the

Activities	x	SD
nursing-hygienic	12.V	4.0
nursing-medical	12.II	3.VI
care	11.VII	3.VIII
nourishing	10.IV	3.VIII
assisting in medical procedures	10.V	4.VII
moving, transporting, lifting of patients	14.0	4.VIII
preparation of rooms, appliances, equipment	11.II	3.V
documentation, registration	10.VI	2.IX
giving instructions, health education	10.II	5.VII
communication with patients, conversation with patients, taking history, passing on information	10.V	3.I
self-study	9.VIII	4.0
patient's resuscitation, participation in resuscitation of patients.	13.IV	7.0
others	1.III	4.V

Table No. 1. The mean point values of the workload for the particular activities

degree of fatigue felt.

Research organisation and method

A questionnaire developed by authors here of was used in order to investigate the nurses' workload. The questionnaire contained questions concerning: age, work experience, place of work, system of work, housing conditions, subjective evaluation of health state, time spent on commuting to work; and, in its main part: thirteen groups of nursing activities to be evaluated according to Borg's scale.

The study was conducted in the years 2001 to 2002. The study population consists of 2531 nurses working in public hospitals in Katowice, Sosnowiec and Mysłowice - three towns of the Upper Silesian region (Poland). Using a simple random sampling design 379 nurses were chosen to participate in the study (15% of the whole population). As a sampling frame were used lists of nurses employed in a certain hospital and obtained form the hospital's administration. Each potential nurse was provided with written introduction on the purpose and procedures of the research. Twelve nurses refused to participate in the research and 60 were excluded from sampling because of their permanent (more than one week) absence from the work place (43 were on leave and 17 were absent due to illness). Three hundred and seven nurses from 10 public hospitals took part in the research. The nurses were to evaluate, after having finished their duties, the workload for the particular groups of activities, using the points on the scale. The information obtained in this way was then analysed statistically by the STATA program. Ethical approval of the study was obtained from the Local Bioethics Committee.

Characteristics of the study group

The nurses participating in the study were employed in wards concerned with different specialities. Their age ranged from 23 to 53 years. The average age was 33.6 years, standard deviation s = + 6.8 years; work experience from 0 to 36 years; average 12.9 years; s= + 7.1. The most numerous group 73.3% consisted of married nurses. Sixty-one (19.9%) nurses commuted to work more than for one hour. 56.1% nurses described their housing conditions as good. Among the study group, 203 (66.6%) persons regarded themselves as healthy, in 69 (22.6%) nurses periodically various ailments occurred, without the medical certification of the illness felt. A chronic disease occurred in 25 (8.2%) nurses, but it was not a contraindication for work in the nursing profession. The study nurses worked within different systems of shift work; the most numerous group (63.2%) consisted of persons employed within the 12-hour system; 18.6% were employed within the three-shift system with an unequal distribution of shift duration.

Study results and discussion

The mean value for the workload is 10.6 points, which places the nurses' work in the light work category. However, rather high standard deviation s=+5.0 suggests high differentiation between the individual evaluation results. The activities connected with lifting, moving, and transporting the patients, and those connected with patient's resuscitation are regarded by nurses as rather heavy and heavy.

The nurses' age was statistically significant in the e-valuation of the groups of activities, which were connected with assisting in medical procedures (p=0.0319) and activities performed during resuscitation (p= 0.0138). It should be emphasised that we were taken into account only chronological age of nurses. However, one ought to be aware that according to the results obtained by Iskra-Golec (2002) nurses feeling older then their chronological age indicates, and the subjective experience of aging process influences powerfully on evaluation of nurses tiredness after the workday.

Assisting in medical procedures consists mainly in working in the upright or stooping positions, quite often forced ones, with the accompanying emotional strain. Resuscitation, in turn, beside considerable physical exertion, involves heavy emotional strain and the pressure of time (Ball, 2003).

Another factor contributing to the evaluation of the

Scale	Age	
Activities:	Correlation coefficient r	Significance level p
nursing-hygienic	-0.01843	NS
nursing-medical	-0.00014	NS
care	-0.03151	NS
nourishing	0.02239	NS
assisting in medical procedures	-0.12251	**0.0319**
moving, transporting, lifting of patients	0.01182	NS
preparation of rooms, appliances, equipment	-0.09122	NS
documentation, registration	0.01825	NS
giving instructions, health education	-0.03211	NS
communication with patients, conversation with patients, taking history, passing on information	0.05084	NS
self-study	-0.08603	NS
patient's resuscitation, participation in resuscitation of patients.	-0.14044	**0.0138**
Others	-0.00017	NS

Table 2. The correlation analysis of subjective evaluation of the workload depending on age

workload was ward speciality. The nurses from the medical wards for adults evaluated their nursing and hygienic duties (p=0.0045) along with the activities connected with moving and transporting patients (p= 0.0001) higher than in the case of the nurses from the other wards. On the other hand, the nurses from the children's wards evaluated assistance in medical procedures (p=0.0420) higher than the other nurses did. Table No.3.

Neither, duration of the particular shift nor health state influenced the subjective evaluation of the workload caused by the particular groups of activities. Our results seems to be consistent with study carried out by Makowiec-Dąbrowska et all (2000).

The impact of family type and unwaged domestic

	Workplace						**Sig. level p**
Activities	1	2	3	4	6	7	
	n=129	n=19	n=119	n=30	n=5	n=5	
nursing-hygienic	12,2±4,5	**10,7±4,1**	13,6±3,5	11,5±2,5	10,0±1,6	12,2±1,8	0,0045
nursing-medical	11,9±3,9	11,4±4,4	12,8±3,2	11,9±2,5	10,8±1,9	13,0±1,4	**NS**
Care	11,4±4,3	10,9±4,4	12,2±3,4	11,8±2,0	10,2±0,8	12,6±0,9	**NS**
nourishing	9,6±4,4	10,2±4,2	11,1±3,4	10,9±1,6	11,0±1,4	11,0±0,0	**NS**
Assisting in medical procedures	10,4±4,9	11,6±4,7	10,5±4,7	11,5±1,8	12,0±2,2	4,4±6,0	0,042
moving, transporting, lifting of patients	14,7±4,2	12,3±5,1	14,4±5,1	12,5±3,2	13,6±2,6	5,6±7,9	0,0001
preparation of rooms, appliances, equipment	11,1±3,7	11,6±3,4	11,1±3,4	11,9±2,1	11,4±1,1	9,0±5,1	**NS**
documentation, registration	10,6±3,1	11,4±3,6	10,5±2,6	10,3±1,7	10,2±1,1	11,2±1,1	**NS**
giving instructions, health education	10,5±7,9	10,3±4,2	10,1±3,0	10,6±1,7	9,8±1,1	4,4±6,0	**NS**
communication with patients, conversation with patients, taking history, passing on information	10,4±3,1	10,8±3,9	10,8±2,9	9,8±2,9	9,2±0,4	12,0±2,0	**NS**
self-study	9,5±4,1	10,3±4,2	9,9±3,4	10,5±3,2	11,6±3,3	8,2±7,5	**NS**
patient??´s resuscitation, participation in resuscitation of patients	13,1±7,4	14,0±6,6	14,1±6,5	12,5±6,6	15,0±2,0	7,0±9,6	**NS**
Others	1,7±5,2	0,0±0,0	1,2±4,3	1,4±4,5	0,0±0,0	0,0±0,0	**NS**

Table 3. Subjective evaluation of workload depending on the workplace

Activities:	Housing conditions 1	2	3	4	5	Sig. level p
	n=23	n=55	n=98	n=67	n=63	
Nursing-hygienic	13,3±2,7	**12,4±4,8**	13,3±3,3	12,2±4,5	11,8±3,6	**NS**
Nursing-medical	13,2±2,4	12,6±3,6	12,9±2,9	11,3±4,4	11,9±3,3	0,0246
Care	13,4±2,6	11,6±4,5	11,8±3,5	10,9±3,9	11,9±3,0	**NS**
Nourishing	11,6±3,5	10,6±4,1	10,7±3,1	9,7±4,3	10,3±3,6	**NS**
Assisting In medical procedures	10,8±4,7	11,7±4,3	10,2±4,7	9,7±5,3	11,0±3,8	**NS**
Moving, transporting, lifting of patients	14,5±4,1	15,0±4,5	14,4±4,7	13,4±5,3	13,4±4,4	**NS**
Preparation of room, appliances, equipment	12,2±2,7	10,9±2,8	10,7±2,8	10,1±3,3	10,2±2,8	**NS**
Documentation, registration	11,4±2,7	10,6±2,5	10,5±2,9	10,7±2,8	10,5±2,8	**NS**
Giving instructions, health education	10,6±3,7	10,2±3,2	9,7±3,5	9,9±3,3	11,5±10,4	**NS**
Communication with patients, conversation with patients, taking history, passing on information	11,6±3,6	10,9±2,8	10,7±2,8	10,1±3,3	10,2±2,8	**NS**
Self-study	9,9±3,6	10,0±3,8	9,8±3,6	9,3±4,5	10,3±4,0	**NS**
Patient´s resuscitation, participation In resuscitation of patients	14,8±6,2	14,8±6,5	13,9±6,5	11,6±8,1	12,9±6,4	**NS**
Others	2,1±5,7	1,4±4,6	1,7±5,3	0,8±3,8	0,9±3,6	**NS**

Table 4. Subjective assessment (Borg´s scale) depending on housing conditions

work of nurses on their duration and timing of sleeping (resting) and professional work was proved by Clissold et all (2000). According to the data obtained in our study it could be added that such factors as housing conditions and time spent on commuting to work, which determine the duration and quality of rest after work, did affect the evaluation of the workload by the surveyed nurses with reference to the nursing-medical activities (p=0.0246); (p=0.0142). Tables 4 and 5.

The activities in question included: taking specimens for investigations, drug administration, both oral and by giving injections, drip application, making and changing dressings, catheterization, etc. They require concentration and precision and they are accompanied by fears of making a mistake and its consequences.

Nurses working at night evaluated the activities connected with the preparation of rooms, appliances, and equipment for work (p=0.0130) higher, compared to the nurses working during the day. The results were statistically significant. Table 6.

Conclusion

The results of the evaluation of the workload, conducted according to Borg's scale, show that the evaluation results are affected by such variables as age, specificity of ward, type of shift, and factors outside the pro-

activities:	Commuting to work 1	2	3	4	Sig. level p
	n=74	n=88	n=81	n=61	
Nursing-hygienic	13,4±3,3	**12,3±4,2**	12,3±4,0	12,4±4,1	**NS**
Nursing-medical	13,1±2,9	12,5±2,8	11,4±4,4	12,3±3,4	0,0142
Care	12,4±3,4	11,6±3,7	11,2±3,8	12,1±3,7	**NS**
Nourishing	11,3±3,4	10,4±3,9	10,8±3,8	11,4±3,8	**NS**
Assisting in medical procedures	10,9±4,7	10,6±4,7	9,8±4,6	11,2±4,3	**NS**
Moving, transporting, lifting of patients	14,7±4,6	14,5±4,6	13,5±4,8	13,9±4,6	**NS**
Preparation of room, appliances, equipment	11,5±3,0	11,4±3,1	10,8±3,8	11,4±3,8	**NS**
Documentation, registration	10,9±2,2	10,6±2,6	10,4±2,8	10,6±3,5	**NS**
Giving instructions, health education	9,9±3,5	9,9±3,1	9,7±3,4	11,9±10,7	**NS**
Communication with patients, conversation with patients, taking history, passing on information	11,0±2,4	10,4±3,0	9,9±2,9	11,0±3,5	**NS**
Self-study	9,9±4,0	9,7±3,9	9,4±4,1	10,7±3,5	**NS**
Patient´s resuscitation, participation in resuscitation of patients	13,6±6,6	12,9±7,5	13,5±6,8	14,4±6,3	**NS**
Others	1,1±4,2	1,6±5,1	1,4±4,8	1,1±3,8	**NS**

Table 5. Subjective assessment (Borg´s scale) depending on commuting work

ime spent on commuting to work-up to 15 minutes, 2. 15-30 minutes, 3. 30 mi-nutes - 1 hour, 4.over 1 hour.

Scale	shift			Significance level p
	Day-time		Night-time	
activities:	morning	afternoon	n=21	
	n=263	n=21		
Nursing-hygienic	12,6±3,9	**13,1±4,2**	13,0±2,1	**NS**
Nursing-medical	12,3±3,6	12,6±1,7	12,8±1,8	**NS**
care	11,7±3,6	12,5±3,6	12,1±3,2	**NS**
nourishing	10,6±3,6	10,3±2,8	8,7±5,2	**NS**
Assisting in medical procedures	10,8±4,5	9,1±4,7	9,8±5,9	**NS**
Moving, transporting, lifting of patients	14,3±4,4	13,1±6,0	13,0±5,9	**NS**
Preparation of rooms, appliances, equipment	11,4±3,3	9,4±4,4	12,3±2,4	**0,013**
Documentation, registration	10,6±2,8	10,3±1,5	11,6±2,1	**NS**
Giving instructions, health education	10,4±5.8	9,8±3,7	9,4±4,3	**NS**
Communication with patients, conversation with patients, taking history, passing on information	10,5±3,0	10,9±1,6	11,8±2,0	**NS**
Self-study	10,0±3,7	9,2±3,9	8,9±5,4	**NS**
patient´s resuscitation, participation in resuscitation of patients	13,8±6,6	11,1±8,3	11,8±7,9	**NS**
others				

Table 6. Subjective assessment of workload depending on shift

fession such as housing conditions and time of commutation to work. The heaviest duties include the lifting, moving, and transporting of the patients. In children's wards, these activities give priority to assisting in medical procedures, in terms of the strain experienced. The nurses had a possibility to provide and evaluate activities other than those provided in the questionnaire. Five persons noted down and included in the group of heavy duties the activities performed with regard to alcohol intoxicated, excited, or unconscious patients. Physically, the activities performed with regard to the above mentioned types of patients did not differ from the activities performed with regard to other patients; the fact that they were mentioned separately resulted probably from the psychological strain which is normally felt while working with such patients. Similarly, psychological strain of a higher degree was experienced by the nurses who were assisting in the medical procedures in children's wards and by those participating in the resuscitation of patients. It is probably because the physical strain is superimposed on the psychological one, or viceversa.

The current Polish regulations regarding limitations on performance by women of the physical work adopt as the criterion the value of the workload measured as the net energetic (calorific) output. The physical jobs for which the energetic output exceeds 5000 KJ (1200 kcal) are forbidden to women. The legal regulation does not take into consideration the psychological and mental strain. Work-related emotional exhaustion still seems to be underestimated not only among the nurse staff but also among other groups of health care professionals (Biaggi, 2003; Visser, 2003). The data obtained in our study suggest that evaluation of workload based only on measurement of energetic output could be highly misleading, especially when applied to professions - like the nursing - which an essential element of workload was caused by psychical component of the work.

There are some methodological limitations to discuss in this study. One is the size of sample of nurses in the study. If there had been more nurses involved, of course, same of them would have experienced their work in a different way. Another possible objection concerns the sampling process. Only nurses employed in the public hospitals were chosen to participate in the research. Taking into account differences between public and private sector of health care it could be assumed that sample is not representative for all nurses. It should be emphasised also that the research was conducted in Upper Silesia region, which is the highly industrialised region of Poland (the population density in this region is about 385 pers/km2, and average in Poland - 122 pers./km2) (http://www.stat.gov.pl). Industrialization is obviously related to the living conditions (housing condition, time spent on commuting to work etc.) of nurses who took part in the study.

The attained study results suggest that with regard to all types, of analyses of the nurses' work strain, methods which take into consideration the said two types, i. e. physical and psychological-mental, of strain should be used, especially, when the results of the analyses are to serve the purposes of job evaluation and establishing the duration of the breaks from work for a particular work shift. The study confirms that it is necessary to continue researching the influence of stress-related workload on the nurses' job satisfaction, the quality of health care provision and, taking into account that stress-related illness are increasing in the contemporary society, on the health status of nurses (Olofsson, 2003).

The method of a subjective evaluation of the workload with the use of Borg's scale, is simple and easy to apply, without the necessity to employ specialists, especially with regard to provisional, diagnostic studies. Taking into account that stability (test-retest reliability) of a measure using Borg's scale in study conducted by Capodaglio (2001) was found to be good, it seems rationale to promote using of this tool for measurement of workload. Modification and expansion in the questionnaire of the list of activities could help specify the study results, point at the activities which are particularly strenuous, requiring deeper analysis, including evaluation of the kind of physical workload (static or dynamic) and the accompanying psychological strain.

References

1. ADOMAT, R., HICKS, C. Measuring nursing workload in intensive care: an observational study using closed circuit video cameras. In *J Adv Nurse*, 2003; 42(4): 402-412
2. BACKS, R.W. Going beyond heart rate: autonomic space and cardiovascular assessment of mental workload. In *Int J Aviat Psycho*,l 1995; 5(1):25-48
3. BALL, C., MCELLIGOT, M. "Realising the potential of critical care nurses": an exploratory study of the factors that affect and comprise the nursing contribution to the recovery of critically ill patients. In *Intensive Crit Care Nurs*, 2003; 19(4):226-238
4. BELOVA, L.V., MISHKICH, I.A., KRESOVA, G.A, LIUBOMUDROVA, T.A. Assessment of working conditions in a modern Russian milk processing plant from the aspect of occupational medicine. In *Croat Med J,* 1999; 40(1):93-98
5. BIAGGI, P., PETER, S., ULICH, E. Stressors, emotional exhaustion and aversion to patients in residents and chief residents - what can be done? In *Swiss Med Wkly,* 2003; 133(23-24): 339-346
6. BORG, G. Physical performance and perceived exertion. *Studia psychologica et paedagogica* 1962. Series altera. Investigationes, 11
7. BRUN, T. The assessment of total energy expenditure of famle farmers under field conditions. In *J Biosoc Sci,* 1992; 24(3):325-333
8. CAPODAGLIO, E.M. Comparison between the CR10 Borg's scale and VAS (Visual analogue scale) du-ring an arm-cranking exercise. In *J Occup Rehabil,* 2001; 11(2):69-74
9. CLISSOLD, G., SMITH, P., ACUTT, B. The impact of unwaged domestic work on the duration and timing of sleep of famle nurses working full-time on rotating 3-shift rosters. In *J Hum Ergol* (Tokyo), 2001; 30(1-2) 345-349
10. ENGELS, J.A., van der GULDEN, J.W., SENDEN, T.F., HERTOG, C.A., KOLK, J.J., BINKHORST, R.A. Physical work load and its assessment among nursing staff in nursing homes. In *J Occup Med,* 1994; 36(3): 338-345
11. ENGELS, J.A., van der GULDEN, J.W., SENDEN, T.F., KOLK, J.J., BINKHORST, R.A. The effects of an ergonomic-educational course. Postural load, perceived physical exertion, and biomechanical errors in nursing. In *Int Arch Occup Environ Health,* 1998;71(5): 336-342
12. HEGNEY, D., PLANK, A., PARKER, V. Nursing workloads: the results of a study of Queensland Nurses. In *J Nurs Manag*, 2003;11: 307-314
13. ISKRA-GOLEC, I. Personal age and assessment of work stress in Polish nurses. In *Exp Aging Res*, 2002; 28(1):51-8
14. JAKICIC, J.M., WINTERS, C., LAGALLY, K., HO, J., ROBERTSON, R.J., WING, R.R. The accuracy of the TriTrac-R3D accelerometer to estimate energy expenditure. In *Med Sci Sports Exerc*, 1999; 31(5):747-754
15. KONDO, N., SHIBASAKI, M., AOKI, K., KOGA, S., INOUE, Y., CRANDALL, C.G. Function of human eccrine sweat glands during dynamic exercise and passive heat stress. In *J Appl Physiol*, 2001; 90)5):1877-1881
16. KOZŁOWSKI, S. *Granice Przystosowania* [Limits of Adaptation]. Warszawa : Wiedza Powszechna; 1986
17. MÄKINEN, A., KIVIMÄKI, M., ELOVAINIO, M., VIRTANEN, M., BOND, S. Organization of nursing care as a determinant of job satisfaction among hospital nurses. In *J Nurs Manag,* 2003; 11: 299-306
18. MAKOWIEC-DABROWSKA, T., KRAWCZYK-ADAMUS, P., SPRUSINSKA, E., JOZWIAK, Z.W. Can nurses be employed in 12-hour shift systems? In *Int J Occup Saf Ergon*, 2000; 6(3):393-403
19. MELANSON, E.L., FREEDSON, P.S., HENDELMAN, D., DEBOLD, E. Reliability and validity of a portable metabolic measurement system. In *Can J Appl Physiol*, 1996; 21(2):109-119
20. OLOFSSON, B., BENGTSSON, C., BRINK, E. Absence of response: a study of nurses' experience of stress in the workplace. In *J Nurs Manag*, 2003; 11 : 351-358, Polish Official Statistics, available at: http: //www.stat.gov.pl
21. ROACH, D., HAENNEL, R., KOSHMAN, M.L., SHELDON, R. Origins of heart rat variability: relationship of heart rate burst morphology to work duration and load. In *Am J Physiol,* 1999; 2777(4 pt 2): H1491-H1497
22. SASICHAY-AKKADECHANUNT, T., SCALZI, C.C., JAWAD, A.F. The relationship between nurse staffing and patient outcomes. In *J Nurs Adm*, 2003; 33(7-8):384-390
23. SYABBALO, N.C., KRISHNAN, B., ZINTEL, T., GALLAGHER, C.G. Differential ventilatory during constant work rate and incremental exercise, *Respir Physiol,* 1994; 97(2):175-187
24. TERZIOTTI, P., SCHENA, F., GULLI, G., CEVESE, A. Post-exercise recovery of automatic cardiovascular control: a study by spectrum and cross-spectrum analysis in humans. In *Eur J Appl Physiol*, 2001; 84(3):187-194
25. VISSER, M.R., SMETS, E.M., OORT, F.J, DE HAES, H.C. Stress, satisfaction and burnout among Duch medical specialist. In *CMAJ*, 2003; 168(3): 271-275