Intensive & Critical Care Nursing 55 (2019) 102750

Contents lists available at ScienceDirect

Intensive & Critical Care Nursing

journal homepage: www.elsevier.com/iccn

Research article

The use of a pedometer to measure the physical activity during 12-hour shift of ICU and nurse anaesthetists in Poland

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ARTICLE INFO

Article history:
Received 29 December 2018
Revised 24 July 2019
Accepted 28 July 2019

Keywords:
Nurses
Physical exertion
Professional activities
Pedometer
Walking
Work environment

ABSTRACT

Background: Nurses are the largest group of employees in hospitals yet their working environment and conditions are not always optimal. Moreover, nurses may be convinced that the physical activity they perform during working hours is sufficient to maintain a healthy lifestyle.
Objectives: The study aimed to measure the number of steps, the distance and the energy expenditure during a 12-hour shift in the intensive care unit and for nurse anaesthetists in selected hospitals in Poland.
Methods: Data were collected via a pedometer and a socio-demographic interview. The project was multicentre, data were collected from 11.11.2013 to 04.05.2014.
Results: The median number of steps taken by nurse anaesthetists within the operating room was 7404 (IQR 4461–9443) while in the ICU it was 7358 (IQR 4705–9101). During the day in the operating and recovery room, both nurse anaesthetists (IQR 3.90–6.26) and ICU nurses (IQR 3.54–6.39) reached the median distance of five kilometres. There were significant differences in the distance covered during day and night between ICU ($p = 0.0003$) and anaesthetic staff ($p = 0.0001$) as well as the number of steps (ICU $p = 0.0002$; ANEST $p = 0.0001$) and energy expenditure (ICU $p = 0.0004$; ANEST $p = 0.0001$).
Conclusion: The professional activity of nurses alone is insufficient to meet the recommendation of taking 10,000 steps daily, which would contribute to improved quality of life.

Implications for clinical practice

- The assessment of both health and lifestyle for healthcare professionals may be helpful in the development of health plans and programmes aimed at the health situation of medical care providers.
- A pedometer as a simple tool, can very easily evaluate participants' physical activity and motivate them to increase the number of steps taken during the day (including working and non-working days).
- Physical activity at work very often does not reflect the real recommended activity of 10,000 steps per day.
- It would be recommended to prepare a special preventive training programme that would focus on health issues for the nursing staff.

Introduction

Many scientists have long been interested in the work environment of nursing staff. The existing publications pay particular attention to the relationship between the number of nursing staff and patient safety (Lang et al. 2004), between the working environment of nurses and the occurrence of adverse events (Aiken et al. 2011) and between physical load and the increased risk of the occurrence

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https://doi.org/10.1016/j.iccn.2019.07.009
0964-3397/

of osteoarticular disease (Menzel et al. 2004). Few of the existing studies have however drawn attention to the fact that the work of the nursing staff requires a lot of physical effort (Croteau, 2017).

The problem of significant physical overload of the nursing staff is extremely important, particularly in a situation where, according to statistics, the nursing profession is highly feminised (Chief Council of Nurses and Midwives, 2016). Another important issue raised while discussing the problems of workload is the rather broad definition of health of the healthcare professionals. It follows from multiple reports from the World Health Organization (WHO) that healthcare workers, like no other profession, are neglected in terms of health programmes promoting a healthy lifestyle and physical activity. Many healthcare professionals struggle with numerous health problems such as obesity, hypertension, osteoarticular diseases, depression and occupational burnout (Menzel et al. 2004; Croteau, 2017; Chief Council of Nurses and Midwives, 2016; Cho et al. 2006). Unfortunately, many of these problems particularly affect nursing staff (Chiou et al. 2014). The WHO recommends that each healthcare facility should be a special place, not only in terms of saving human lives but also of promoting a healthy lifestyle and physical activity, not only for the patients but also for their employees (WHO Report, 2004).

In Poland, in accordance with the regulation of the Ministry of Health, a nurse anaesthetist is a nurse who has completed a specialisation or has received a qualification in the field of anaesthesiology and intensive care nursing (Regulation of Minister of Health, 2016).

The work of a nurse anaesthetist in an operating room (OR) or intensive care unit (ICU) is regarded as very burdensome. This is associated with the need for constant attention, systematic assessment of a patient's condition, the need for making numerous and sudden decisions, frequent contact with death and the inability to alleviate patients' suffering. Their workload does not only result from the nature of their duties but also from working conditions (Cudak and Dyk, 2007; Cudak and Dyk, 2010).

In the ICU, the nurse-patient ratio is of key importance to ensure the appropriate quality of care and reduce patients' mortality (Cudak and Dyk, 2010) as well as to counter nurse fatigue. Daily patients' care and transport to diagnostic departments often involve coverage of significant distances which may lead to an increased level of fatigue, overload of joints and exposure to injuries and other ailments (Yip 2004; Welton et al. 2006).

The aim of the study was to measure the number of steps, the distance and the energy expenditure in a 12-hour shift of ICU nurses in selected hospitals in Poland.

Methods

Design and collection

The research project was multi-centre. Data were collected from 11.11.2013 to 04.05.2014. The study was quantitative and comparative in nature with no participation of a control group. Consents were obtained from the directors of particular facilities. Two hundred nurse anaesthetists working a 12 – hour shift system (day or night) in operating rooms, post-anaesthesiology recovery rooms and the ICU participated in the project. The day shift began at 07:00 and lasted until 19:00hrs; the night shift lasted from 19.00 to 07:00hrs. Prior to starting duty, the nurse participating in the study was given a socio-demographic questionnaire and a pedometer set to zero. Each new user was instructed by the researcher on how to attach the device. At the beginning of the study, each participant was asked to take 10 steps to calibrate the pedometer in accordance with the assumptions of study conducted by Welton et al. (2006). At the end of the shift, the researcher in the presence of a respondent entered all data into the final column of the completed survey questionnaire.

The ICU at the University Hospital had the biggest number of intensive care beds (12), other medical facilities had from 5 to 8 intensive care beds. The wards had a mixed structure. The size of ICU, recovery rooms and anaesthesiology stations are specified in detail by regulations and the guidelines of the Polish Society of Anaesthesiology and Intensive Care (Regulation of Minister of Health 2016; Kusza et al. 2012). In the ICU a single bed room should be at least 25 m^2, while for multi-bed rooms it should be at least 20 m^2. All facilities participating in the project met the above requirements. According to the regulations, the number of nursing staff in the ICU should fall within a range of one nurse per 1.2–1.5 beds. When it comes to the hospitals that participated in the research project, one intensive care nurse was assigned to 1.5 to 2 intensive care beds in every hospital unit.

The number of operating rooms ranged from 5 to 10. The University Hospital had the biggest number of them (10). Considerable intensity of work associated with the functioning of operating rooms was from 07:00 to 19:00hrs, when both planned and emergency surgery were performed. The night shift, i.e. from 19:00 to 07:00hrs, was dedicated to urgent surgery only and to medicine and equipment supply. In accordance with national regulations, the surface area of a patient's room in a post-anaesthesia recovery unit should be at least 18 m^2 for a single-bed room or at least 16 m^2 for a multi-bed room. In the participating hospitals the number of beds ranged from 5 to 8. All stations met the organisational standards. In accordance with the applicable laws, one anaesthesiology nurse cared for four patients. Both the guidelines of the Polish Society of Anaesthesiology and Intensive Care and separate provisions of law clearly indicate that any transport of a patient within the operating room and outside the intensive care unit requires the constant presence of an anaesthesiologist and a nurse anaesthetist.

Participants

Nurses from the anaesthesiology wards and ICUs from Pomorskie and Warminsko-Mazurskie areas were invited to be involved in the study. Each participant was informed that the research was anonymous, and that its results would o be used only for scientific purposes. It was planned to conduct the study including 200 respondents.

Instruments

Socio-demographic data were collected based on an original interview questionnaire.

In order to measure the distance covered during a 12-hour duty and to estimate the energy (caloric) expenditure, an indirect calorimetry device (a pedometer) was used, a simple device measuring the number of steps and the distance covered (Turner et al. 2012). The pedometer used in the study was adjusted to the calculation of energy (caloric) expenditure based on the covered distance T-Dista (model no: 03A09). The T-Dista pedometer used in the study was a readily available device in Poland. The equipment registered similar results to Yamax pedometer used in research of Welton and Schneider. (Schneider et al.2004; Welton et al. 2006). The measurement of the distance covered was possible thanks to the presence of sensors recording the movement. The distance covered [km], the number of steps taken during the duty and the energy expenditure value [kcal] were measured.

In order to properly estimate the energy expenditure based on the covered distance, each participant's body weight had to be entered into the device prior to the beginning of the study. The weight was measured before the start of the research. After all data

Fig. 1. Pedometer.

were confirmed, the pedometer was horizontally attached to a belt (of a nurse's uniform, trousers or skirt) (Fig. 1). After correctly affixing the device, the pedometer automatically recorded movement.

Ethical considerations

The study was approved by the Institutional Ethics Committee at the Medical University of Gdansk (NKEBN/45/2009). Each respondent gave consent to the involvement in the project. Participation was voluntary and anonymous and every nurse had the right to withdraw from the study at any stage.

Statistical analysis

All analysis was performed using the StatSoft, Inc. statistical package (2013) STATISTICA version 13 www.statsoft.com and the Excel (Microsoft Office® Professional Plus 2016). Quantitative variables are reported as a median, interquartile range [IQR]. Variables of the qualitative type are presented as quantity and percentages. To check if a quantitative variable originated from a population with normal distribution, a Shapiro-Wilk test was applied, Student's test and Welchs's test were performed in the absence of homogeneity of variance. The Mann-Whitney-*U* test was used for not normally distributed variables. The significance of differences between more than two groups was checked using ANOVA test, or by Kruskal-Wallis test in case of non-fulfilment of ANOVA applicability conditions. Where statistically significant differences between groups were obtained, post hoc tests were applied (Tukey's test for R, Dunn's test for Kruskal-Wallis).

A significance level of $p < 0,05$ was adopted for all calculations.

Results

Socio-demographic characteristics of the study group

A total number of 160 nurses eventually participated in the study of which 158 were included in the further analysis. The study group was internally divided in terms of the place of work into anaesthesiology (n = 65; 41%) and intensive care (n = 93; 59%). Most participants (n = 150, 95%) were female. The participants' sociodemographic characteristics are presented in Table 1. The median work experience of the anaesthesiology ward nurses was 21 years (IQR 15–27) while for the ICU staff it was 16 years (IQR 10–21; p = 0.0001).

A test using a pedometer and a questionnaire for fatigue assessment

The median number of steps of all nurses (n = 158) was 7369 (interquartile range, IQR 4674–9292), distance covered 4.04 km (IQR 2.64–5.48) and energy expenditure 248.5 kcal (IQR 151–340) (Table 2). A detailed analysis suggested that 12 out of 65 anaesthesiology nurses (18.5%) exceeded 10,000 steps during their duties. Very similar results were demonstrated for the intensive care nurses 16.1% (n = 15). The calculation presents that about 26.2% (n = 17) of anaesthesiology nurses reached from 6001 to

Table 1
Socio-demographic characteristics of the nursing staff in anaesthesiology and intensive care units – sex, place of living, education, type of duty (n = 158).

Variable	Anaesthesiology		ICU		p-value
	n	%	n	%	
Sex					
F	59	90.8	91	97.7	0.1‡
M	6	9.2	2	2.2	
Age (years)					
24–30	3	4.5	17	18.3	
31–35	8	12.2	24	25.8	<0.001*,†
36–40	18	27.7	24	25.8	
>41	36	55.4	28	30.1	
Education					
medical secondary school	24	36.8	42	45.2	
post-secondary school of nursing	15	23.1	21	22.6	0.7*
bachelor's degree nursing college	14	21.4	18	19.4	
master's degree nursing college	12	18.5	12	12.9	
Supplementary course					
None	58	89.3	78	83.8	
qualification course in anaesthesiology and intensive care	2	3.1	8	8.6	0.2*
specialization in anaesthesiology and intensive care	3	4.5	1	1.1	
other	2	3.1	6	6.5	
Type of duty					
12-hour day shift	41	63.1	58	62.4	
12-hour night shift	24	36.8	35	37.6	0.9*

Source: Q 1–3 of the survey questionnaire (part one).
* Chi-square (x^2) test, significance level $p < 0.05$.
† Significance of differences between the study groups.
‡ Test chi-square with Yates correction.

Table 2
Energy expenditure (kcal), the number of steps, the distance (medians, IQRs) – anesthesiology versus ICU nurses.

	Anaesthesiology (n = 65)	ICU (n = 93)	All nurses (n = 158)
Energy expenditure (kcal)			
IQR	165–317	149.0–347	151–340
median	249	239	248.5
Number of steps			
IQR	4461–9443	4705–9101	4674–9292
median	7404	7358	7369
Distance (km)			
IQR	2.73–5.38	2.61–5.52	2.64–5.48
median	4.22	3.94	4.04

9001 steps per shift (Table 3). A detailed analysis showed that 24.2% (n = 24) of all nurses took 10,000 to 15,000 steps during their day shift (Fig. 2).

A post hoc Dunn's test indicated that in the group of anaesthesiology staff working in the operating room during the day, the median values of number of steps (8891) during day shifts were significantly greater than for nurses working night shifts (4041; p = 0.0001).

During a day shift in the operating and the recovery room, nurse anaesthetists reached the median distance of 5.0 kms (IQR 3.90–6.26). The intensive care unit nurses also covered 5.0 km (IQR 3.54–6.39). During a night shift these values decreased to 2.4 (IQR 1.2–2.9) and 2.7 kms (IQR 2.1–3.9) respectively. The distances covered during the day shift were significantly longer for both nurses anaesthetists working in the operating room (p = 0.0001) and in ICUs (p = 0.0003).

The median energy expenditure during the day shift was 239 kcal (IQR 243–389) in the ICUs and 249 kcal (IQR 165–317) in anaesthesiology wards. During the night shift, these values decreased to 135 kcal (IQR 67–180) and 156 kcal (IQR 119–252). More than 75% of respondents burned 340.75 kcal during a 12-hour work. Median and energy expenditure ranges (IQR) for the day and night shifts of all the participants together with the number of steps and distance covered are reported in Table 4.

Discussion

The aim of the study was to measure the number of steps, the distance and the energy expenditure in a 12-hour shift of ICU nurses in selected hospitals in Poland. Our study showed that the number of steps taken during a 12-hour shift depends on many factors including the type of shift. Nevertheless, the physical activity of the nursing staff was still inadequate. Only a small group of nurses reached the recommended 10,000 steps during their shift.

The sociodemographic characteristics of the respondents were another important issue raised during the study. As confirmed by scientific reports on the age and sex structure of nursing staff both in Poland and in other European countries (Chief Council of Nurses and Midwives, 2016) and as demonstrated by the sample in the current study, the nursing staff is highly feminised profession. This means that they are also at high risk of physical inactivity. The latest WHO data published in The Lancet Global Health showed that

Table 3
Percentage distribution of the number of steeps – anaesthesiology vs ICU nurses.

Number of steps	Anaesthesiology (n = 65)		ICU (n = 93)	
	N	%	N	%
<1000–3000	8	12.3	7	7.5
3001–6000	19	29.2	30	32.3
6001–9000	17	26.2	31	33.3
90001–10000	8	12.3	7	7.5
10001–15000	12	18.5	15	16.1
>15000	1	1.5	3	3.2
Total	65	100	93	100

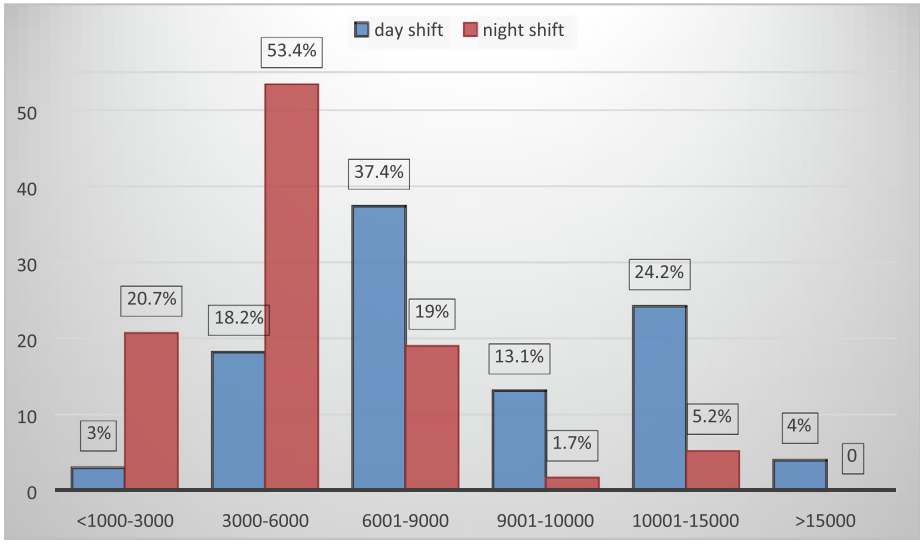

Fig. 2. Percentage distribution of the number of steeps – day vs night shift.

Table 4
Energy expenditure (kcal), the number of steps, the distance covered during the day and night duty (medians, IQRs).

	Anaesthesiology		ICU		P-value
	D	N	D	N	
Energy expenditure (kcal)					
IQR	243–389	67–184	200–366	119–252	0.0001*
median	297	136.5	287.5	156	0.0004*
Number of steps					
IQR	996–10651	2313–4674	6007–10625	3784–6735	0.0001*
median	8891	4041	8169	4947	0.0002*
Distance (km)					
IQR	3.90–6.26	1.22–2.94	3.54–6.39	2.11–3.9	0.0001*
median	5.0	2.4	5.0	2.8	0.0003*

Legend: D – day shift N – night duty.
†Statistically significant p-value.
* Kruskal–Wallis test by ranks, $p < 0.05$.

women are less active (32%) compared with men (23%). This observation confirmed that physical inactivity is also strongly correlated with age and country income (Guthold et al., 2018).

The analysis of the level of education of respondents showed that the vast majority of nurses (89.3%, n = 53) have not completed the required courses and specialisations in the field of anaesthesia and intensive care required by law. According to Polish regulations, nursing staff should have aligned their professional qualifications by 31 December 2018 (Regulation of Minister of Health, 2016). Another issue is the fact that to undertake specialist education in the field of anaesthesia and intensive care, a nurse should have an appropriate length of work experience in the profession of nursing. In case of a qualification course, six months of experience are required and for a specialisation at least two years (The Nurses and Midwife Professions Act, 2011). Undoubtedly, it can have an impact on the results obtained at work. A significant part of nursing staff could have been during the specialisation or course, In case of nursing graduates they have to achieve legal requirements to undertake such education.

Physical activity, distance covered and energy expenditure of nursing staff during their professional duties

Research shows that regular and appropriate physical activity (PA) is the main factor in the prevention of the growing global burden of chronic and non-communicable diseases (NCDs). According to the WHO, the recommended level of sufficient PA for adults aged 18–64 years old is at least 150 min with aerobic PA of moderate intensity throughout the week, or at least 75 min of energetic aerobic PA during a week, or an equivalent combination of moderate activity and energetic intensity. This recommendation is equivalent to the broadly applied pedometer of 10,000 walking steps per day (World Health Organization, 2010; Tudor-Locke and Bassett, 2004; Tudor-Locke et al. 2008; Tudor-Locke et al 2011). The health benefits of the PA include a reduced risk of NCDs, premature death, obesity, cardiovascular diseases, insulin dependent diabetes and osteoporosis. As a result of improved mood PA also contributes to enhancing quality of life and to longevity. Physical inactivity is an increasingly serious worldwide health problem and has been attributed to an increase in the risk of the global occurrence of non-communicable diseases. The WHO report (World Health Organization, 2019) states that at least 80% of people worldwide do not reach the minimum recommendation for sufficient PA. Lack of physical activity is now the fourth main risk factor for global mortality. The rapid progress of civilisation has nearly completely eliminated all forms of PA and simple physical effort from everyday work, and only leaves monotonous actions which put uneven strain on particular parts and systems of the human body. Previous studies demonstrated that healthcare professionals (HCPs) are at high risk of NCDs, sedentary lifestyle, overweight, obesity, musculoskeletal disorders related to work and working conditions that lead to physical inactivity (World Health Organization, 2010). Healthcare professionals are perceived as pioneers and statutory advocates for a healthy lifestyle. They are expected to support PA through leadership, so that their patients, customers and the society will follow. This is why communities expect them to set a good example, and assume that such behaviour should be common among them. However, this perception remains questionable, as there is no good empirical evidence to confirm it. The analyses showed that professional activity connected with the physical effort of nursing staff does not meet the recommendations for daily physical activity, which can significantly affect health and well-being.

The data obtained using pedometers clearly show that the number of steps taken during a 12-hour shift, both within the operating room and in the intensive care unit, is below the recommended value. The results have shown that only small groups of nurses reached the minimum, recommended amount of physical effort of 10,000 steps per day. The results of previous studies using a pedometer indicate that undertaking a physical activity at a level exceeding 12,913 steps per day may contribute to an improvement in the quality of sleep and rest and to a more efficient dealing with stressors, including in the work environment (Lavoie-Tremblay et al., 2004). Moreover, increasing physical activity, particularly in the context of women suffering from hypertension, can significantly contribute to reducing and regulating blood pressure (Moreau et al. 2001).

In the present study, the median energy expenditure of nurses in the ICU was 239 kcal (IQR 243–389) during the 12-hour duty and 249 kcal (IQR 165–317) in the anaesthesia ward with post-anaesthesia room. There were significant differences in the energy expenditure according to the type of shift (day shift vs night shift). The energy expenditure incurred by the nursing staff of anaesthesiology departments, as well as ICUs was greater during the daytime than the night shift. These results differ from the results of Irimagawa and Imamiya (1993), who conducted a study among a small group of 12 nurses from various hospital departments using a pedometer and electrocardiograph during an 8-hour working day and after the end of the shift for another 8 h (total time of 16 h). It showed that the average value of energy expenditure during the 16-hour observation was 341.2 kcal (SD ± 110.9). A different research model from the one used in our study was implemented, which may explain such divergent results. Another method was used in a study conducted by Ksykiewicz-Dorota et al. (1992). There, the energy expenditure of nursing staff was measured by the tabular-timing method, during the 8-hour duty period. The

average energy expenditure in the surgery ward reached 857.7 kcal and 770.7 kcal in the internal ward. Thereby, these results which by far exceed the energy expenditure measured in our study.

The work of nursing staff is extremely demanding in terms of the physical effort. This was confirmed by many studies, both qualitative and quantitative (Croteau, 2017; Geiger-Brown et al. 2004). Although general physical exhaustion and joint pain occurring after the end of a shift (Geiger-Brown et al. 2004) could indicate excessive physical activity, the results of the conducted research indicate that physical activity connected with nursing profession is still insufficient in terms of the recommended number of steps. Without doubts, nurses have a physically demanding work which requires them to spend a lot of time on their feet. The research led by Welton et al. (2006) proved that the distance reached by nurses during a shift mainly depends on patient's needs and the unit design. All surgical nurses who took part in the Welton's research project reached between 4.1 and 4.6 miles per the 12-hour shift. These results differ from the results of our study but the characteristics of the ICU and post – operative care units are more complex and require more advanced and specialist medical treatment.

Limitations

This study has its limitations. The most important one is that nurses carried the pedometer only during a single shift. The method of choosing the convenience sampling might be another important barrier. Nurses who have participated in the study were recruited from only two regions of Poland. Therefore, the nurse sample might have been too homogeneous to draw general conclusions regarding the whole population. Research in a more diverse group of respondents would be recommended.

Conclusions

During a 12-hour day shift, nurses anaesthetists, both in the anaesthesiology ward and intensive care unit, take more steps than during night shifts, which is related to the increase of distance and energy expenditure. The effort incurred by nurses is quite large, however, from the perspective of a healthy lifestyle, it is not a recommended form of a physical activity. Although nurses have reached the number of steps close to the recommended quantity, it should be emphasized that the workload is not a beneficial physical exercise.

Occupational activity of the nursing staff is not related to the physical activity that contributes to the improvement of health or the quality of life of nurses. Taking into account the decreasing number of the nursing staff, it is crucial to introduce programmes that would promote a healthy lifestyle, particularly physical activity. For this reason, nursing manager should consider creating an environment that supports healthy lifestyle choices, especially non – work related physical activity.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We would like to acknowledge Doctor Agnieszka Młynarczykowska and Magdalena Antoń for their statistic and language support. The researchers are also grateful to all nurses who agreed to participate in the study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.iccn.2019.07.009.

References

Aiken, L.H., Sloane, D.M., Clark, E.S., Poghosyan, L., Cho, E., You, L., et al., 2011. Importance of work environments on hospital outcomes in nine countries. Int. J. Qual. Health Care 23 (4), 357–364.

Chief Council of Nurses and Midwives. Preliminary assessment of human resources of nurses and midwives in Poland until 2020. http://www.izbapiel.org.pl/upload/Wstepna.ocena.zasobow.kadrowych.pdf. [accessed 01.01.2016].

Chiou, S.T., Jen-Huai, Ch., Huang, N., Li-Yin, Ch., 2014. Health behaviors and participation in health promotion activities among hospital staff: which occupational group performs better? BMC Health Serv. Res. 14 (22), 474.

Cho, J., Laschinger, H.K.S., Wong, C., 2006. Workplace empowerment, work engagement and organizational commitment of new graduate nurses. Nurs. Leadersh. 19 (3), 43–60.

Croteau, K.A., 2017. Using pedometers to increase the non-workday steps of hospital nursing and support staff: a pilot study. Workplace Health Saf. 65 (10), 452–456.

Cudak, E.K., Dyk, D., 2010. The need for nursing care in the intensive care units. Anaesthesiol. Intensive Ther. XLII, 23–27 [in Polish].

Cudak, E.K., Dyk, D., 2007. The assessment of nursing workload in Intensive Care Unit based on the scale "Nine equivalents of nursing manpower use score" (NEMS). Nursing Topics 15, 1–10 [in Polish].

Geiger-Brown, J., Trinkoff, A., Nielsen, K., Lirtmunlikaporn, S., Brady, B., Vasquez, E., 2004. Nurses' perception of their work environment, health, and well-being. AAOHN J. 52 (1), 16–22.

Guthold, R., Stevens, G.A., Riley, L.M., Bull, F.C., 2018. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9 million participants. The Lancet Global Health 6, e1077–e1086.

Irimagawa, S., Imamiya, S., 1993. Industrial hygienic study on nursing activities comparison of energy expenditure between pedometer and holter electrocardiograph. Kitasato Arch. Exp. Med. 65 (Suppl.), 99–105.

Ksykiewicz-Dorota, A., Gerasim, B., Zagorski, J., Sadlo, A., 1992. The evaluation of the nursing staff physical workload. Public Health 103, 514–519.

Kusza, K., Kübler, A., Maciejewski, D., Mikstacki, A., Owczuk, R., Wujtewicz, Piechota, M., 2012. Guidelines of the Polish Society of Anaesthesiology and Intensive Therapy determining principles, conditions and organisational aspects of anaesthesiology and intensive therapy services. Anaesthesiol. Intensive Ther. 44 (4), 201–212.

Lang, T., Hodge, M., Olson, V., Romano, P.S., Kravitz, R.L., 2004. Nurse-patient ratios. A systematic review on the effects of nurse staffing on patient, nurse employee, and hospital outcomes. J. Nurs. Adm. 34, 326–337.

Lavoie-Tremblay, M., Sounan, C., Trudel, J.G., Lavigne, G.L., Martin, K., Lowensteyn, I., 2004. Impact of a pedometer program on nurses working in a health-promoting hospital. Health Care Manage. (Frederick) 33 (2), 172–180.

Menzel, N., Brooks, S.M., Bernard, T., Nelson, A., 2004. The physical workload of nursing personnel: association with musculoskeletal discomfort. Int. J. Nurs. Stud. 41 (8), 859–867.

Moreau, K.L., Degarmo, R., Langley, J., McMahon, C., Howley, E.T., Bassett, D.R., 2001. Increasing daily walking lowers blood pressure in postmenopausal women. Med. Sci. Sports Exerc. 33 (11), 1825–1831.

Regulation of Minister of Health of 29 December 2016 on the organisational standard of healthcare in the field of anaesthesiology and intensive care. file:///C:/Users/kasia/AppData/Local/Temp/D20162218-1.pdf. [accessed: 08.07.2017].

Schneider, P.L., Crouter, S.E., Bassett, D.R., 2004. Pedometer measures of free-living physical activity: comparison of 13 models. Med. Sci. Sports Exerc. 36 (2), 331–335.

The Nurses and Midwife Professions Act from July 15, 2011 Articles 67 and 71. http://prawo.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=wdu20111741039 [accessed: 05.05.2019].

Tudor-Locke, C., Bassett Jr., D.R., 2004. How many steps/day are enough? Preliminary pedometer indices for public health. Sports Med. 34 (1), 1–8.

Tudor-Locke, C., Craig, C.L., Brown, W.J., Clemes, S.A., De Cocker, K., Giles-Corti, B., Hatano, Y., et al., 2011. How many steps/day are enough? For adults. Int. J. Behav. Nutr. Phys. Act 28 (8), 79.

Tudor-Locke, C., Hatano, Y., Pangrazi, R.P., Kang, M., 2008. Revisiting "how many steps are enough?". Med. Sci. Sports Exerc. 40 (7 Suppl.), S537–S543.
Turner, L.J., Huchen, L., Williams, J., 2012. Reliability of pedometers to measure step counts in patients with chronic respiratory disease. J. Cardiopulm. Rehabil. Prev. 32 (5), 284–291.
Welton, J., Decke, r.M., Adam, J., Zone-Smith, L., 2006. How far do nurses walk? Medsurg. Nurs. 15 (4), 213–216.
WHO Report. Regional Office for Europe. Standards for health promotion in hospitals: Development of indicators for a self-assessment tool. 2004. http://www.euro.who.int/__data/assets/pdf_file/0010/99775/E84988.pdf. [accessed 08.01.2018].
World Health Organization. World Health Organization Report. Global Recommendations for Physical Activity for Health. Geneva, Switzerland 2010.
World Health Organization. Newsroom/Factsheet/Detail: Physical activity. https://www.who.int/news-room/fact-sheets/detail/physical-activity. [accessed 20.07.2019].
Yip, Y., 2004. New low back pain in nurses: work activities, work stress and sedentary lifestyle. J. Adv. Nurs. 46 (4), 430–440.