International Journal of Nursing Studies 75 (2017) 43–50

Contents lists available at ScienceDirect

International Journal of Nursing Studies

journal homepage: www.elsevier.com/locate/ijns

How does emotional exhaustion influence work stress? Relationships between stressor appraisals, hedonic tone, and fatigue in nurses' daily tasks: A longitudinal cohort study

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ARTICLE INFO

Keywords:
Burnout
Control
Demand
Ecological momentary assessment
Emotional exhaustion
Ward nurses

ABSTRACT

Background: Work-related stress is a prevalent condition in the nursing profession, and its influence may vary according to changeable individual and situational factors. It is, therefore, important to investigate the real-time momentary changes in these factors and their relationship to emotional exhaustion experienced by nurses.
Objectives: We aim to analyse how their perceptions of demand, control, effort and reward change according to the task performed through real-time assessment and interact with the emotional exhaustion level of ward nurses.
Design: The research design was longitudinal.
Method: A three-level hierarchical model with a repeated measures design was used to assess the momentary self-reports of 96 hospital ward nurses, completed using a smartphone programmed with random alarms.
Results: Findings show that demand, effort, and control appraisals depend on the task performed. The task appraised as most demanding, effortful, and controllable was direct care. Reward appraisal depends on the task performed and personal variables, i.e. emotional exhaustion. The situations perceived as more rewarding were rest and direct care. Momentary hedonic tone can be explained by the task performed, demand, reward, emotional exhaustion and by the interaction between emotional exhaustion and demand appraisal. Momentary fatigue can be explained by the task performed, demand, reward, and the emotional exhaustion.
Conclusions: This study highlights the importance of using momentary measures to understand complex and changeable inter-relationships. While also clarifying the targets of intervention programmes aimed at preventing burnout within the nursing profession.

What is already known about the topic?

- Stress, emotional states and fatigue in ward nurses depend on changes that occur from moment to moment along the shift.
- Studies using ecological momentary evaluation have shown that direct care tasks are the most stressing.
- Moreover, momentary emotional state can be predicted by the appraisals of demand, effort, control and reward of the task performed, and that fatigue can be predicted by the control and reward appraisals of the task performed.

What this paper adds

- The perceptions of demand, effort, control, and reward depend mainly on momentary task; however, the perception of reward is also negatively influenced by personal factors, as emotional exhaustion.
- Hedonic tone is influenced by momentary variables, such as appraisal of demand and reward, and by personal variables such as emotional exhaustion and years of experience. Furthermore, an interaction between personal and momentary variables has been found, since a high level of emotional exhaustion leads the appraisal

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http://dx.doi.org/10.1016/j.ijnurstu.2017.07.002
Received 27 February 2017; Received in revised form 30 May 2017; Accepted 2 July 2017

of demand to influence hedonic tone even more.
- Fatigue is influenced by momentary variables such as appraisal of task demand and reward and by personal variables as emotional exhaustion.

1. Introduction

Workplace stress is notoriously prevalent in the field of nursing and is associated with high levels of staff burnout (Greenglass et al., 2001; Estryn-Béhar et al., 2010), decreased job satisfaction (Zangaro and Soeken, 2007), decreased commitment to the institution (Cho et al., 2006), and safety violations (Aiken, 2002; Gerend et al., 2004; Fogarty and McKeon, 2006). To be exact, the term burnout is used to describe an individual condition related to chronic stress at work characterized by emotional exhaustion, depersonalization and a decline in personal accomplishment (Maslach et al., 2001). It has been claimed that workload is most directly related to emotional exhaustion defined as a feeling of excessive emotional stress and feeling drained from contact with other people (Maslach et al., 2001). Moreover, it has been stated that the core element of burnout is emotional exhaustion, and that it is the first dimension leading to burnout (Maslach et al., 2001; Kowalski et al., 2010; Günüşen et al., 2014).

The Job Demand-Resources model (Bakker et al., 2014) explains how burnout depends on the balance between job demand and the resources to cope with these demands. However, as Bakker et al. (2014) have pointed out, the challenge in researching workplace stress now lies in identifying daily fluctuations in stress levels in order to determine how far these changes depend on the nature of the task or on an individual's ability to cope with the situation.

Ecological Momentary Assessment can be thought of as a group of techniques that gather data regarding participants' behaviour and experience while in their natural environments and on a real-time basis (Shiffman et al., 2008; O'Connor and Ferguson, 2008). This method provides high ecological validity, and as assessments are completed in real-time, the risk of potential recall bias is reduced. It is also considered effective in gathering information regarding daily fluctuations in workplace stress; this is because, as Molenaar (2004) pointed out, the effective testing of psychological theories requires that not only should the variations between individuals be accounted for, but so should those within individuals, which Ecological Momentary Assessment is particularly effective for.

Ecological Momentary Assessment is specifically suitable for evaluating nurses with respect to how far changes in task demand or resources result in differences in work stress, modelling together within and between individual influences, which can lead to a more complete explanation of the process, as well as a more ecological understanding of what happens in the real world. Through this effective method using diaries and traditional questionnaires, Johnston et al. (2006) assessed trained nurses' momentary self-report of perceived task demand, control, effort and reward. This study, therefore, demonstrates how momentary diaries could be a powerful and flexible way of assessing work related stress and its putative determinants in a real life work setting due to their sensitivity to short-term changes in the variables chosen for the study.

Shively et al. (2011) applied Ecological Momentary Assessment data collection to 119 registered nurses over a timescale of one week. The nurses were required to report their work activity, perceived workload and subsequent stress level at 90 min intervals. Results revealed that as the number of patients assigned to an individual nurse increases, so does the nurse's reported stress level. Interestingly, it was found that nurses' age and gender along with their familiarity with the patients, proportion of direct care tasks, and whether the facility was adult or paediatric did not significantly predict nurses' momentary stress. Johnston et al. (2013) used the same methodology in order to study the relationship between task demand/effort, control and reward together with nurses' changeable positive and negative mood. Their main findings were that negative affect in nurses was highest at moments of high task demand/effort together with low control and low reward; in addition control and reward moderated the effects of demand/effort. In contrast, high positive affect was linked to moments of high task demand/effort and also high control and reward. This study was based on both Karasek's Demand – Control model (Karasek et al., 1998), and on Siegrist (1996) Effort – Reward imbalance model. These occupational stress models have been widely tested for comparison between individuals (Gilbert-Ouimet et al., 2014). The study by Johnston et al. (2013) reached the conclusion that they can also be applied to explain variations within the individual over the working day. Johnston et al. (2016) made a real-time comparison between nurses of the psychological and physiological effects of workplace stressors in each individual nurse and the nurses' appraisals of these stressors. Physiological measures included changes in heart rate and the psychological measures perceived were tense-arousal, hedonic tone and fatigue. As well as that, the task being performed at the time was also measured as it was considered a momentary stressor. Findings suggested that heart rate was associated with both demand and effort, while perceived tense arousal was related to demand, control, effort and reward. Hedonic tone was also linked to demand and control, and finally, fatigue was shown to be related with control and reward. Surprisingly in this study, task demand and perceived task effort had no fatigue effect. However, decreases in fatigue and increases in the nurses' positive affect were evident when appraisals of self-control were high. In terms of Job Demand – Resources model, fatigue appeared related to resources, whereas hedonic tone depended on job demand; and perceived tense arousal was related to both kinds of variables. It was found that some nursing tasks are perceived as more stressful than others, with nurses reporting more stress during episodes of direct care than with any other task type.

Nevertheless, in a systematic review of research about the relationships between work-related stress, workplace burnout, job satisfaction and the general health of nurses, Khamisa et al. (2013) identified contradictory evidence of the causality between these measures, which indicates that there is a need for further investigation. The data reviewed above can open up a new way to analyse causality of work-related stress in nurses. Returning to the concept of emotional exhaustion, presented at the beginning, information provided by self-report questionnaires in cross-sectional studies shows that emotional exhaustion could be a state that links workload stress and burnout and low job satisfaction. However, it has very little information about how emotional exhaustion influences everyday activities in nurses. Although emotional exhaustion is a general condition which prevails over time when it is measured by questionnaires, we believe that it does not have the same influence in all situations. Emotionally exhausted nurses could be more reactive to situations related specifically to demand, showing more fatigue and more negative hedonic tone.

2. Aim

The aim of this study was to explore the relationship between emotional exhaustion and the momentary events occurring during the daily shift.

Firstly, we hypothesized that nurses with higher emotional exhaustion should appreciate: (1) more demand, (2) more effort, (3) less control, and (4) less reward than nurses with low levels of emotional exhaustion under equal conditions. This influence would be stronger in direct care tasks, as illustrated by Johnston et al. (2016), who found that this was the most stressful task for nurses.

Secondly, we also hypothesized that hedonic tone would be more negative through the shift and would be influenced by demand and effort momentary appraisals, emotional exhaustion and its interaction, which is consistent with the results by Johnston et al. (2016) that related hedonic tone with job demand factors.

Thirdly, we hypothesized that fatigue would increase through the

shift and would be influenced by reward, control momentary appraisals, emotional exhaustion, and its interaction, consequently with the results by Johnston et al. (2016) that related fatigue with resources factors.

3. Materials and methods

3.1. Design

We used Ecological Momentary Assessment methods with multilevel statistical analysis to identify relationships within each participant and between participants. Each momentary measure (labelled *moment*) was randomly taken at intervals of between 60 and 90 min within each 5 working days (labelled *shifts*), which represents a mean of 5 measures in a shift of 7 working hours, and 25–30 observations for each nurse (labelled *participant*). The structure of the multi-level model is a three-level design with repeated measures (Ato et al., 2013): Level 1 (within person) is represented by all the *moments* when Ecological Momentary Assessment measures were taken, nested into *shifts* (level 2, within person), nested into *participants* (level 3, between persons). The socio-demographic and professional variables, as well as emotional exhaustion, measured by the Maslach Burnout Inventory (Maslach et al., 2001), belong to level 3. It should be noted that this study is part of a larger project of mixed methods to investigate the working conditions of nurses in two university hospitals with data collected at different times, using questionnaires, interviews and Ecological Momentary Assessment records. However, in this paper we only present data related to the purpose outlined above.

3.2. Participants and procedure

A random sample of 113 nurses was recruited from two Spanish University general care hospitals, from the following wards: internal medicine, surgery, traumatology, oncology, cardiology, neurology, nephrology, pneumology, rheumatology, digestive, gynaecology, geriatrics, palliative care, paediatrics and psychiatry. Critical care services and emergency services were excluded from the sample because of their distinctive features. The nurse-patient ratio in these hospitals ranges from 10 patients in the day shift to 30 patients in the night shift. Seventeen nurses refused to participate in the study, so 96 nurses comprised the final sample, with a response rate of 85.47%.

First, the Human Resources Departments provided a list of all the nurses working in the hospital wards, maintaining their anonymity. The inclusion criteria required nurses to have a full-time, ongoing contract, so nurses who were not currently working were excluded. A random sample of 80% of the nurses was selected from each ward, and the nurses were asked to participate voluntarily. A research team member explained the purpose of the study and its execution to each nurse individually, and also gave them written instructions. After accepting to participate, the nurses signed the informed consent, basic demographics and professional details were collected, and the questionnaire was provided in a sealed envelope. They were also provided with a smartphone programmed at the time to schedule the next five shifts. They were then shown how the smartphone worked, and were asked to repeat the process to make sure they had understood it clearly. They were also given a contact phone number to report their completion of the evaluation or any mishap that may occur. Research assistants collected both the completed questionnaires and the smartphones through the ward secretary, where nurses had been instructed to hand in the materials after completing the procedure. Data were collected between January 2015 and December 2015, except for holiday periods.

3.3. Measures

3.3.1. Ecological momentary assessment measures

These measures, corresponding to level 1 variables (*moment* level), were obtained using a Samsung Galaxy Mini Smartphone, with Android software specially developed for this study. Data entry was prompted by a vibration or buzzing alarm, and if nurses were busy they could postpone the answer for 10 min, which meant that if the task that they were doing was direct care, it could be completed and the nurses could wash their hands before touching the screen. However, if the question remained unanswered for 20 min then this moment was registered as missing data. Answers were presented on analogue scales and 'tips' to select, so participants could choose their answers to the questions. The software was designed with a help menu for answering any queries just by touching the screen. Measures taken at each evaluation moment are listed below.

3.3.1.1. Hedonic tone and fatigue. Hedonic tone was measured by a single-item visual analogue scale of five points from a happy face to a sad face, and fatigue was measured by a single-item visual analogue visual scale of five points from a full battery to an empty battery.

3.3.1.2. Nursing task. The task the nurse was involved in was coded according to an adaptation of the WOMBAT classification (Westbrook and Ampt, 2009). Nursing tasks were classified into five broad work categories: direct care, medication tasks, documentation, other professional tasks, and resting.

3.3.1.3. Demand, effort, control, reward. Four questions were designed to evaluate different characteristics of work stress appraisal: demand, control (labelled as autonomy and skills development), effort and reward. Each question consisted of the label of the term to be evaluated, followed by a simple question about how far each concept could be applied to the characteristics of the task performed at the time. The four questions were answered on a wide screen visual analogue scale from 0 to 10 in order to evaluate the intensity of the response, which is one of the most usual response formats for single-item questions (Patrician, 2004).

The order number of each record into a shift (level 1, moment) and order number of each shift (level 2, shift) were automatically recorded by the device.

3.3.2. Questionnaires

3.3.2.1. Maslach Burnout Inventory (MBI) (Maslach and Jackson, 1986). Spanish translation and adaptation by Gil-Monte and Peiró (1999). The MBI is a 22-item questionnaire with a Likert response scale and measures the frequency and intensity of burnout in three subscales: emotional exhaustion, depersonalization, and personal accomplishment. An overall score for burnout can be obtained from these three scales. This inventory has shown high levels of reliability (from 0.75 to 0.90) for the evaluation of the construct (Maslach and Jackson, 1986; Gil-Monte and Peiró, 1999; Moreno-Jimenez et al., 2001). The emotional exhaustion scale was the only scale considered in the analyses, as a level 3 variable (*participant* level). Table 1 shows the list of measures used.

An ad-hoc questionnaire recorded gender, age, marital status, number of children, years of experience, and professional status.

3.4. Data analyses

Descriptive statistics were obtained using the SPSS Statistical Package v.22 (IBM, 2015). Data were analysed using multilevel univariate linear regression modelling, with quantitative dependent variables, and with full maximum likelihood estimation, implemented by HLM 6 (Raudenbush et al., 2004). Data contained a three level hierarchical structure: level 1 – data from moments, level 2 – data from shifts, and level 3 – data from participants. Quantitative explanatory variables for level 1 and 2 were centred around the group mean. The intercepts and slopes were treated as random effects at level 3. No missing data imputation was done due to the inherent tolerance of

Table 1
Design levels, variables, instruments, measurement scales, and type of measures of the study.

Level	Variable	Instrument	Measurement Scale	Type
1: Moment	Hedonic Tone	Electronic device	Analog Scale: 0–10 points	Single-item
	Fatigue	Electronic device	Icon Scale: 5 points	Single-item
	Task	Electronic device: WOMBAT	Nominal	Check list
	Demand	Electronic device	Analog Scale 0–10 points	Single-item
	Effort	Electronic device	Analog Scale 0–10 points	Single-item
	Control	Electronic device	Analog Scale 0–10 points	Single-item
	Reward	Electronic device	Analog Scale 0–10 points	Single-item
2: Shift	Order number	Electronic device		Automatic
3:Participant	Emotional exhaustion	Maslach Burnout Inventory (MBI)	Likert	Inventory
	Socio-Demographic and Professional Data	Ad hoc questionnaire		

multilevel analyses to handle with missing data. Six modelling analyses were conducted, and the fit process for all of these modelling analyses started with the simplest regression model (random intercept model without explanatory variables), going from parsimonious to more complex models as recommended by Hox (2010). The choice of the final model for each modelling analysis was made according to the last significant change in deviance value.

Four separate analyses were made with each of the task appraisal variables as dependent variable (demand, effort, control, and reward). For each analysis, the explanatory variables were the task performed at each evaluation moment (level 1 variable), and emotional exhaustion (level 3 variable); no level 1 and 2 control variables were included, and level 3 control variables were hospital of origin and years of professional experience. After the random intercept model (Model 1), level 1 explanatory variables were introduced in a first step (Model 2), then level 3 explanatory variables were introduced (Model 3), and finally level 3 control variables were tested (Model 4). Task performed was introduced in the equation as 4 dummy variables (direct care, medication, documentation and other professional tasks), with resting as the reference. Task to task comparisons were carried out to establish their order of influence on each of the four dependent variables. Four task to task comparisons were needed for each model, so Bonferroni correction for multiple comparisons was applied, being significance criteria established at $p = 0.013$.

Hedonic tone and fatigue were used as separate dependent variables. Explanatory variables were demand, control, and reward at level 1, and emotional exhaustion at level 3. Effort was excluded from the analysis because in previous additional analyses, it was found that demand and effort were fully redundant variables. The moment when the measure was taken within the shift (from 1 to 7) was introduced as a level 1 control variable. Hospital of origin and years of experience were considered as level 3 control variables. First, a basic model without any explanatory variables was tested (Model 1, random intercept model), secondly the model with level 1 control and explanatory variables was tested (Model 2). A third model (Model 3) included level 3 control and explanatory variables. When random slopes for quantitative level 1 explanatory variables were significant, meaning that, beyond the general effect of these explanatory variables on hedonic tone and/or fatigue, there are individual differences among participants that should be explained, a fourth model (Model 4) was added. This model tested cross-level interactions of significant level 3 explanatory variables (e.g. emotional exhaustion) on variance slope, in order to see if some of them could account for these differences in the influence of level 1 explanatory variables (e.g. demand or reward) on hedonic tone and/or fatigue.

4. Results

4.1. Sample description

89.90% of the sample were female with a mean age of 40.22 years (SD = 8.50). The shift patterns of the sample were as follows: 45.45% worked rotating shifts, and the remaining worked fixed shifts – either mornings, evenings or nights, and 5.20% had an additional job. The distribution between hospitals was 47.42%/52.58%. The mean years working at their current job was 9.86 (SD = 7.99) and as a nurse 17.40 years, (SD = 8.36). 77.31% of the nurses were tenured staff and 52.53% have a speciality in nursing beyond their university degree. Additionally, 50.51% were in a relationship, 16.16% were single and the remaining were separated, divorced or widowed.

4.2. Demand

Intra-class correlation coefficients of demand showed that 51.2% of the variation was at moment level (level 1), 6.7% was at shift level (level 2), and 42.1% was at participant level (level 3). The multi-level analysis demonstrated that model 2 (D = 8299.04), including task variable, showed a significant change in deviance (772.55**), and models 3 and 4, which added emotional exhaustion and control variables, did not show a significant change in deviance (1.06 and 1.66 respectively).

This, therefore, indicated that tasks significantly influenced demand appraisal. Direct care was perceived as the most demanding, with an estimated demand level of 6.53 points (CI[6.10,6.95]) followed by medication ($t(95, 0.05) = -6.11$, $p < 0.001$), documentation ($t(95, 0.05) = -3.16$, $p = 0.002$) and other professional tasks ($t(95, 0.05) = 0.240$, ns), with no significant differences between them, and resting as the least demanding ($t(95, 0.05) = -11.95$, $p < 0.001$).

4.3. Effort

Intra-class correlation coefficients of effort showed that 54.5% of the variation was at moment level (level 1), 5.6% was at shift level (level 2), and 39.9% was at participant level (level 3). The multi-level analysis demonstrated that model 2 (D = 8161.78), including task variable, showed a significant change in deviance (840.09**), and models 3 and 4, which added emotional exhaustion and control variables, did not show a significant change in deviance (0.73 and 3.18 respectively).

This, therefore, indicated that tasks significantly influenced effort appraisal. Direct care was perceived as having the highest level of effort, with an estimated level of 6.24 points (CI[5.82,6.65]), followed by medication ($t(95, 0.05) = -7.15$, $p < 0.001$), documentation ($t(95, 0.05) = 1.54$, ns), and other professional tasks ($t(95, 0.05) = -0.45$, ns), with no significant differences between them, and finally resting as the one that requires the least effort ($t(95, 0.05) = -13.86$, $p < 0.001$).

4.4. Control

Intra-class correlation coefficients of demand showed a 45.4% variation was at moment level (level 1), 9.1% was at shift level (level 2),

and 45.5% was at participant level (level 3). The multi-level analysis demonstrated that model 2 (D = 8318.55), including task variable, showed a significant change in deviance (452.38**), and models 3 and 4, which added emotional exhaustion and control variables, did not show a significant change in deviance (1.89 and 0.78 respectively).

This, therefore, indicated that tasks significantly influenced control perception. Direct care was perceived as the most controllable task, with an estimated level of 7.4 points (CI[7.02,7.78]), then documentation (t(95, 0.05) = −2.46, $p = 0.016$) and medication (t(95, 0.05) = 0.8; ns), with no significant differences between them, followed by other professional tasks (t(95, 0.05) = −2.89, $p = 0.005$), and finally, resting, which was the least controllable (t(95, 0.05) = −5.067; $p < 0.001$).

4.5. Reward

Intra-class correlation coefficients of demand showed 35.1% variation was at moment level (level 1), 5.5% was at shift level (level 2), and 59.4% was at participant level (level 3). The multi-level analysis demonstrated that model 3 (D = 8275.56), including task variable and emotional exhaustion, showed the lowest deviance a significant change in deviance (14.44**), and model 4, which added control variables, did not show a significant change in deviance (2.85).

Therefore, tasks had a significant influence on reward appraisal. Resting was perceived as the most rewarding task, with an estimated level of 5.60 points (CI[5.35,6.66]), but not significantly different from perceived reward of direct care (t(95, 0.05) = −0.65, ns). No significant differences were found between tasks in the task to task comparison according to the descending level of reward (resting, direct care, medication, other professional tasks, and documentation), but there was a significant change in reward level between direct care and documentation, with the perceived level of reward for documentation task being 0.51 points lower (CI[, −0.81, −0.22]) than that of direct care (t(95, 0.05) = −3.44; $p < 0.001$). The effect of emotional exhaustion on reward showed that for each increasing point of emotional exhaustion level, perceived reward decreases by 0.09 points (CI [−0.13, −0.05]). If we consider that the estimated level of emotional exhaustion in the nursing population with the same characteristics as the nurses from this study (with a risk of 5%) ranges from 2.77 to 41.96 points (39.19 points of difference), it can be estimated that a difference of 3.35 points (CI[−5.12, −2.01) will be perceived in task reward between nurses with a lower and higher level of emotional exhaustion.

4.6. Hedonic tone

Intra-class correlation coefficients of demand showed 53.7% variation between moments (level 1), 12% between shifts (level 2), and 34.3% between nurses (level 3). The multi-level analysis (see Table 2) demonstrated that the saturated model (model 4) showed the lowest deviance, even though its deviance change does not reach a significant level.

Among the fixed effects, influence of moment was significant, so hedonic tone becomes more negative throughout the day. The influences of demand and reward appraisals, emotional exhaustion and years of experience were, therefore, significant. Among the random effects, the demand slope at level 3 was found to be significant, which was not the case for control and reward appraisals. Moreover, in model 4, a cross-level interaction between emotional exhaustion and demand appraisal was found, which explains demand random effects (see Fig. 1).

4.7. Fatigue

Intra-class correlation coefficients of demand showed 55.6% variation between moments (level 1), 8.4% between shifts (level 2), and 35% between nurses (level 3). The multi-level analysis (see Table 3) indicated that the most complex model (model 4) showed the lowest deviance, but it is not significantly different from Model 3. Among the fixed effects, the influence of moment was significant so fatigue increases throughout the day. Therefore, demand and reward appraisals and emotional exhaustion showed a significant influence.

Among the random effects, the demand slope was found to be significant at level 3, but this was not the case for control and reward appraisals. In model 4, no cross-level interactions were found between emotional exhaustion and demand appraisals (see Fig. 2).

5. Discussion

This paper presents findings from a study using ecological momentary evaluations in which professional task, task appraisal, momentary hedonic tone and fatigue are recorded from a sample of hospital ward nurses. As seen in previous studies (Johnston et al., 2006, 2013), this paper confirms that the assessment of demand, effort, reward and control varies from moment to moment and depends on the task being performed. This study, nevertheless, adds to previous knowledge that emotional exhaustion interacts with daily activity, and furthermore, it demonstrates that aspects depending on contextual and momentary factors are also influenced by stable personal factors.

The first hypothesis was partially confirmed. Only reward appraisals of the momentary task were influenced by emotional exhaustion. It seems that appraisals of demand, effort, and control are more related to momentary factors and the appraisal of reward is related to personal factors. Direct care tasks were perceived as the most demanding, effortful, controllable and rewarding; which indicates that direct care contains both factors of demand and resources (i.e. control and reward), and may explain contradictory findings; for example, while Shively et al. (2011) did not find a relationship between the proportion of direct care and stress, Johnston et al. (2016) observed more work stress during direct care.

The second hypothesis was confirmed. Appraisal of demand worsened hedonic tone and appraisal of reward improved it. Also, emotional exhaustion influences hedonic tone, so these results showed the contribution of momentary and personal factors. Furthermore, a cross-level interaction was found, so when emotional exhaustion was high the effect of appraisal of demand on hedonic tone was higher. But it should be noted that it had not been hypothesized that the reward had any effect on hedonic tone.

The third hypothesis was partially confirmed. Fatigue is decreased by reward appraisal and increased by level of emotional exhaustion and is also increased by momentary demand appraisal. It was expected that fatigue could be influenced by control and reward, but not by demand. In our opinion, the results for fatigue are important because while emotional exhaustion directly affects hedonic tone and the relationship between demand and hedonic tone, it has also a direct effect at fatigue level. Although, on their part, Johnston et al. (2016) did not find a relation between demand and fatigue; findings in this study show a relationship between fatigue and demand and emotional exhaustion. This discrepancy is difficult to explain and further studies will be required to determine whether it is due to differences in measurement instruments or other reasons.

These findings are consistent with the Job Demand – Resources model (Bakker et al., 2014) because they show that momentary hedonic tone and fatigue could be explained by the balance between demand appraisal and reward appraisal. Furthermore, the fact that reward appraisal depends more onpersonal predisposition than momentary events can explain the relationship between burnout and low job satisfaction (Zangaro and Soeken, 2007).

Our study also points out and helps to understand some aspects studied by Khamisa et al. (2013). This paper explains the fatigue produced by the task performed in conjunction with emotional exhaustion, so it is not enough to be emotionally exhausted to have fatigue, depending also on the task performed. In the case of hedonic tone, there is

Table 2
Fixed Effects Estimates (top) and Variance-Covariance Estimates (bottom) for Models of the Predictors of Hedonic Tone.

Parameter		Model 1	Model 2	Model 3	Model 4
		Fixed effects			
Intercept		2.26** (0.07)	2.25** (0.07)	2.25** (0.07)	2.25** (0.07)
Level 1 (Moment)	Moment		0.10** (0.02)	0.10** (0.02)	0.10** (0.02)
	Demand		0.09** (0.01)	0.09** (0.01)	0.09** (0.01)
	Control		0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
	Reward		−0.07** (0.01)	−0.07** (0.01)	−0.07** (0.01)
Level 2 (Shift)					
Level 3 (Person)	Emotional exhaustion			0.03** (0.01)	0.03** (0.01)
	Hospital			0.10 (0.11)	0.10 (0.11)
	Work Experience			−0.01** (0.01)	−0.01** (0.01)
Emotional exhaustion *Demand					0.01** (0.01)
		Random effects			
Level 1 (Moment)	Intercept σ2ε	0.56** (0.02)	0.32** (0.01)	0.32** (0.01)	0.32** (0.01)
Level 2 (Shift)	Intercept σ2e	0.12** (0.02)	0.18** (0.02)	0.18** (0.02)	0.18** (0.02)
Moment	random slope σ2e1		0.02** (0.01)	0.02**(0.01)	0.02**(0.01)
Level 3 (Person)	Intercept τp	0.36** (0.06)	0.36** (0.06)	0.25** (0.04)	0.25** (0.04)
Moment	random slope ττ1		0.02** (0.01)	0.02** (0.01)	0.02** (0.01)
Demand	random slope ττ2		0.01** (0.01)	0.01** (0.01)	0.01** (0.01)
Control	random slope ττ3		< 0.01 (0.01)	< 0.01 (0.01)	< 0.01 (0.01)
Reward	random slope ττ4		< 0.01 (0.01)	< 0.01 (0.01)	< 0.01 (0.01)
Deviance		4954.79	4466.01	4439.14	4425.94
Deviance Change			223.50**	26.86**	13.2

Note: Standard errors are in brackets.
* $p < 0.05$.
** $p < 0.01$.

also an interaction between these two elements.

This work uses ecological momentary assessment along with traditional retrospective measures, thereby improving the way participants are evaluated. Also, a random sample with a very low reject rate ensures the representativeness of the data. The use of multilevel modelling makes it possible to study more complex relationships, also measured over time, and to estimate causality, in a way that the variables related to a person show predispositions that influence daily events that in turn influence the general welfare of the nurses.

However, this study has some limitations. One important limitation of this study is that it was performed in only certain hospital wards and data are not generalizable for all types of nurses. It is necessary to develop similar studies in other contexts such as emergency wards or outpatient nursing. Although the percentage of rejections was low, it is important to know why they refused to participate and how this missing data would have influenced the results. Most of the nurses who refused to participate complained about the high number of evaluations and surveys which they are currently undergoing. Moreover, although the use of single-items is almost mandatory in ecological momentary assessment, the representativeness of these items in relation to the construct of measurement could be questionable. We are developing a later study with the purpose of studying the psychometric properties of these single-items.

Future research should clarify the evolution of fatigue and the resources that can facilitate recovery from work, especially coping. Finally, these findings can help to clarify the objectives of intervention programs to prevent burnout in nurses, and the importance of differentiating between personal factors and organizational factors related to burnout.

6. Conclusions

To sum up, we have been able to show the importance of studying the changes that occur from moment to moment throughout the day in ward nurses, depending on the tasks performed.

The findings add five main points to existing literature. First, the appraisal of work demand is far from consistent over time; on the contrary, it depends on little more than half of the factors changing at each moment. The changes in perceptions of work demand are especially apparent when the nurses consider the task being performed, with direct care being considered the most demanding, followed by medication and then documentation.

Second, the appraisal of work control also depends on around half the factors changing at each time, especially the task being performed, with the most demanding task being direct care followed by documentation and medication.

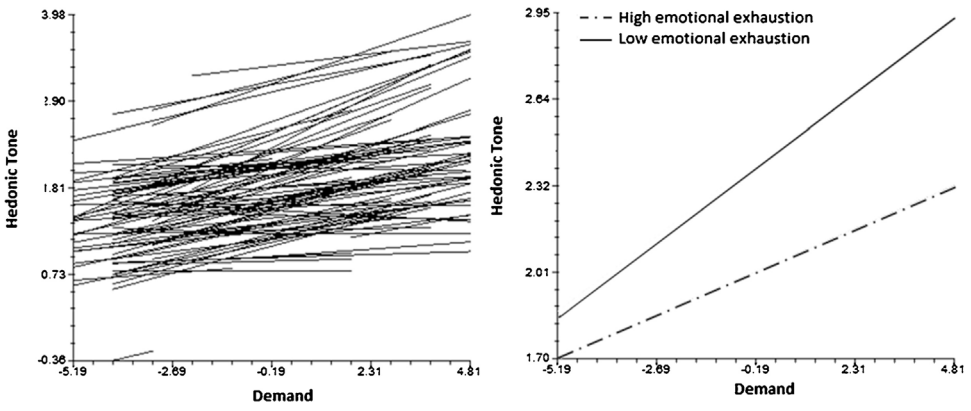

Fig. 1. Nurses' individual slopes of hedonic tone level as a function of Demand (left panel) and plot of interaction between the predictors on hedonic tone: demand – emotional exhaustion (right panel).

Table 3
Fixed Effects Estimates (top) and Variance-Covariance Estimates (bottom) for Models of the Predictors of Level of Fatigue.

Parameter		Model 1	Model 2	Model 3	Model 4
		Fixed effects			
Intercept		2.39** (0.07)	2.38** (0.07)	2.39** (0.06)	2.39** (0.06)
Level 1 (Moment)	Moment		0.28** (0.02)	0.28** (0,02)	0.28** (0,02)
	Demand		0.02* (0.01)	0.02* (0.01)	0.02* (0.01)
	Control		0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
	Reward		−0.04** (0.02)	−0.04** (0.02)	−0.04* (0.02)
Level 2 (Shift)					
Level 3 (Person)	Emotional exhaustion			0.03** (0.01)	0.03** (0.01)
	Hospital			0.06 (0.12)	0.06 (0.12)
	Work Experience			−0.01 (0.01)	−0.01 (0.01)
Emotional exhaustion*Demand					0.001 (0.01)
		Random effects			
Level 1 (Moment)	Intercept σ2ε	0.65** (0.02)	0.21** (0.01)	0.21** (0.01)	0.21** (0.01)
Level 2 (Shift)	Intercept σ2e	0.09** (0.02)	0.19** (0.02)	0.19** (0.02)	0.19** (0.02)
Moment	random slope σ2e1		0.02** (0.01)	0.02** (0.01)	0.02** (0.01)
Level 3 (Person)	Intercept ττ	0.40** (0.06)	0.40** (0.06)	0.30** (0.05)	0.30** (0.05)
Moment	random slope ττ1		0.04** (0.01)	0.04** (0.01)	0.04** (0.01)
Demand	random slope ττ2		0.01** (0.01)	0.01** (0.01)	0.01** (0.01)
Control	random slope ττ3		< 0.01 (0.01)	< 0.01 (0.01)	< 0.01 (0.01)
Reward	random slope ττ4		< 0.01 (0.01)	< 0.01 (0.01)	< 0.01 (0.01)
Deviance		5147.79	3895.17	3871.99	3869.47
Deviance Change			794.33**	23.17**	2.52

Note: Standard errors are in brackets.
* $p < 0.05$.
** $p < 0.01$.

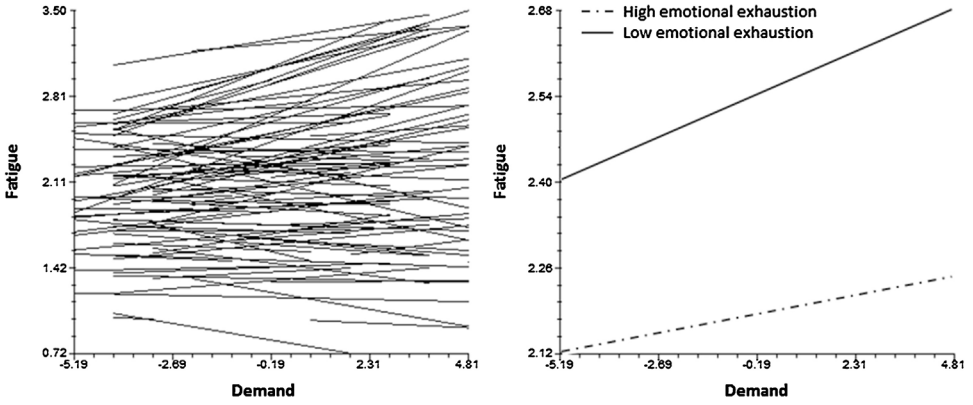

Fig. 2. Nurses' individual slopes of fatigue as a function of demand (left panel) and plot of interaction between the predictors on fatigue: demand – emotional exhaustion (right panel).

Third, reward appraisal depends mainly on personal factors, especially the level of emotional exhaustion. Among the momentary factors, documentation has been found to be the least rewarding task for nurses.

Fourth, hedonic tone does not improve throughout the day and instead becomes more negative as perceived demand increases, but more positive as perceived reward increases. In addition, the level of emotional exhaustion exacerbates hedonic tone, while work experience improves hedonic tone. An interaction between emotional exhaustion and demand has also been found; when emotional exhaustion is high, the influence of demand on hedonic tone is more acute.

Fifth, fatigue increases throughout the day, it is higher at times when greater demand is perceived, and lower when greater reward is perceived. The level of emotional exhaustion predicts increased fatigue.

Regarding tasks, direct care is the task that is experienced as both the most demanding and the most controllable. On the other hand, documentation is viewed as undemanding, but also as the least rewarding.

With respect to the influence of burnout on daily nursing work, emotional exhaustion is found to make all work tasks less rewarding, and is related to a more negative hedonic tone and greater fatigue. Moreover, emotional exhaustion is shown to increase the negative effect of demand appraisal on hedonic tone.

Conflicts of interest

None. The authors declare no conflicts of interest exist.

Funding

This work was supported by the Ministry of Science and Innovation (Spain) and FEDER (EU) [grant number PSI2010-18397 and PSI2016-76411-R].

Ethical approval

Approval was granted by CEIC (Ethics and Clinical Research Committee) at the University Hospital of Elche, Spain, on 23/01/2013 and CEIC (Ethics and Clinical Research Committee) Hospital of Terrassa, Spain, on 18/06/2013

The participants were informed about the purpose of the study and signed an informed consent. Their participation was voluntary, and data confidentiality was guaranteed.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the

online version, at http://dx.doi.org/10.1016/j.ijnurstu.2017.07.002.

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