RESEARCH PROTOCOL

Nursing stress and patient care: real-time investigation of the effect of nursing tasks and demands on psychological stress, physiological stress, and job performance: study protocol

Barbara Farquharson, Cheryl Bell, Derek Johnston, Martyn Jones, Pat Schofield, Julia Allan, Ian Ricketts, Kenny Morrison & Marie Johnston

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Correspondence to B. Farquharson:
e-mail: barbara.farquharson1@stir.ac.uk

Barbara Farquharson MSc PhD RGN
Clinical Research Fellow
NMAHP Research Unit, University of Stirling, UK

Cheryl Bell MA
Research Assistant
Health Psychology Group, University of Aberdeen, UK

Derek Johnston MA PhD
Professor Emeritus
School of Psychology, University of Aberdeen, UK

Martyn Jones BSc PhD RMHN
Professor
School of Nursing and Midwifery, University of Dundee, UK

Pat Schofield PhD PGDipEd RGN
Professor
School of Health & Social Care, University of Greenwich, Eltham, UK

Julia Allan MSc PhD CPsychol
Lecturer
School of Psychology, University of Aberdeen, UK

Ian Ricketts BSc PhD
Professor Emeritus
School of Computing, University of Dundee, UK

Abstract

Aim. To examine the effects of nursing tasks (including their physiological and psychological demands, and the moderating effects of reward and control) on distress and job performance in real time.

Background. Nurses working in hospital settings report high levels of occupational stress. Stress in nurses has been linked to reduced physical and psychological health, reduced job satisfaction, increased sickness absence, increased staff turnover, and poorer job performance. In this study, we will investigate theoretical models of stress and use multiple methods, including real-time data collection, to assess the relationship between stress and different nursing tasks in general medical and surgical ward nurses.

Design. A real-time, repeated measures design.

Methods. During 2011/2012, 100 nurses from a large general teaching hospital in Scotland will: (a) complete self-reports of mood; (b) have their heart rate and activity monitored over two shifts to obtain physiological indices of stress and energy expenditure; (c) provide perceptions of the determinants of stress in complex ward environments; and (d) describe their main activities. All measures will be taken repeatedly in real time over two working shifts.

Discussion. Data obtained in this study will be analysed to examine the relationships between nursing tasks, self-reported and physiological measures of stress and to assess the effect of occupational stress on multiple work outcomes. The results will inform theoretical understanding of nurse stress and its determinants and suggest possible targets for intervention to reduce stress and associated harmful consequences.

Keywords: acute care, demand/control, ecological momentary assessment, effort/reward, energy expenditure, nurses, physiology, protocol, psychology, stress
Introduction

Stress in nurses has been linked to negative outcomes for both staff and patients. This protocol describes a study, which will use contemporary methodologies to explore the relationship between stress and particular nursing tasks in real time amongst hospital nurses. Results will be of international relevance to nurses and their managers and employers.

Background

Stress in nurses is an important issue as it can affect the nurse’s health (Gonge et al. 2002), the quality of the care they provide (Leveck & Jones 1996), and their desire to remain in nursing (Hasselhorn et al. 2008). In addition to the distress for individuals, the loss of highly trained staff from the clinical environment can increase the burden on remaining staff (Chang et al. 2007) and make it difficult to maintain patient safety, high quality of care, and to deliver evidence-based practice (Williams et al. 1998). The current global economic situation means many healthcare systems are undergoing major structural and financial changes.

In the UK, radical changes associated with the modernization of the National Health Service (NHS) (Department of Health 2012), accompanied by demographic changes in the population seem likely to increase pressure on nursing services and may contribute additional stress. For example, the downsizing of hospital services has been shown to have a detrimental effect on workplace environment (Aiken et al. 2000) (e.g. resource adequacy and nurse-manager support) and in turn is a potential source of stress and burnout amongst care professionals (Aiken & Sloane 1997). Nurses’ work burden may be increased as they struggle to balance potentially conflicting goals such as decreasing length of patient stay whilst attempting to maintain quality of care (Aiken et al. 2001). It is also anticipated that there will be an amplified demand for nursing care as the population ages and experiences more chronic disease and physical incapacity (Karlsson et al. 2006), but current figures suggest that there may be a shortfall of appropriately qualified nurses to deal with this demand. In the UK, the nursing workforce is predominantly composed of middle-aged nurses, many of whom will soon retire (Nursing Midwifery Council (NMC) 2008). In this existing workforce, 30% of nurses report experiencing work-related stress in the past year, 31% often think about leaving their job, and 16% say that they will leave their organization as soon as they can find another job (Department of Health 2011). This pattern echoes the conclusions of a recent major European survey and systematic review, which found that stress and burnout in nurses are associated with increased intentions to leave the profession (Coomber & Barriball 2007, Estryn-Behar et al. 2007). In addition to the increasing number of nurses wishing to leave the profession, the number of UK school leavers wish to train as nurses has decreased sharply – from 70% of nursing entrants in 1986 (Hanson & Patchett 1986) to only 37.5% in 2005/2006 (CATCH 2006). A quarter of student nurses do not complete their training (Waters 2006), with stress a likely contributory factor (Last & Fulbrook 2003). Ten per cent of nurses in Scotland leave the profession every year (Nursing & Other Health Professions’ Review Body (NOHPRB) 2006) leading some to predict a shortfall of entrants into nursing (RCN 2003). It is, therefore, crucial to examine and understand any factors that might lead to the premature loss of qualified nurses from the NHS or indeed deter potential future nurses from entering the profession.

In addition to potentially reducing the number of qualified nurses in practice, high levels of stress and burnout may contribute to sub-optimal patient care, increased rates of safety breaches, and more frequent errors (cognitive failures) (Aiken et al. 2002, Van der Linden et al. 2005, Elfering et al. 2006). It is therefore important to understand the sources of stress to minimize these detrimental effects. We plan to investigate how the psychological and physiological experience of stress and the theoretical determinants of stress (demand, control, effort, and reward) are associated with particular nursing tasks and with nursing performance outcomes.

Studies of nurse stress to date have been limited by the methods available. Recent advances in: (a) methods of measuring fluctuations in perceived stress; (b) tracking ambulatory changes in physiological functioning and effort; and (c) reliable categorization of nursing tasks make it possible to investigate nursing stress in real, working time, and in some detail. While retrospective questionnaire methods have given some account of stress and its sources, they are prone to systematic error and bias due to the many factors that influence memory, such as time from events and the respondents’ current emotional state. In addition, it is not possible to identify the events or tasks that precipitate the stress as the remembered account cannot give accurate
timings of these events and the experience of stress. This can be dealt with by measuring behaviour, physiological changes, and distress in real time, as the events of interest actually take place, using ecological momentary assessment (EMA) (Stone & Shiffman 1994).

Ecological momentary assessment uses computerized diaries to collect data in real time and has been used to examine the effects and potential sources of work stress on emotional and physical well-being and behaviour in the general public (Kamarck et al. 2002) and with healthcare staff (Johnston et al. 2006, Rutledge et al. 2009). However, EMA approaches to date have typically focused on either the theoretical determinants of nurse stress or the occurrence of specific incidents that are expected to be stressful. For example, in a series of studies (Johnston et al. 2006, Mckee et al. 2010), we obtained support for the two dominant models of work stress, Karasek’s demand-control model (Karasek 1979) and Siegrist’s effort-reward imbalance model (Siegrist 1996): specifically, that high demand/effort leads to more distress, but this can be offset by increases in control or reward. Furthermore, in a study of 250 ward nurses, serious critical incidents were found to have a persistent negative effect on the real-time measures of nurses’ mood for the remainder of their work shift and this was associated with a self-reported deterioration in the adequacy of their nursing performance (Jones & Johnston 2012). While the latter study provided valuable insights into the effects of serious critical incidents, such incidents are rare and there may be more to be gained from studying more common nursing tasks.

A comprehensive classification of clinical tasks [Work Observation Method by Activity Timing (WOMBAT)] has recently been developed and tested in observational and self-report studies of nurses and doctors (Ampt et al. 2007, Westbrook et al. 2008, Westbrook & Ampt 2009) and shown to be reliable and to successfully classify 99% of nursing tasks. The WOMBAT is a sophisticated scheme that describes nursing tasks in 10 categories: direct care, indirect care, medication tasks, documentation, professional communication, ward-related activities, in transit, supervision, social, and other and thus captures the physical, cognitive, and organizational aspects of nursing. To date, it has been implemented on Personal Digital Assistant devices (PDAs) for use by observers classifying nursing tasks. However, we have adapted it for use by the nurses themselves. Using the PDAs, we also measure self-rated adequacy of performance. In addition, by utilizing discrete, self-contained combined heart rate and activity monitors (Cambridge Neurotechnolog, Cambridge, UK), we are able to estimate physical energy demands objectively, from heart rate activity and energy expenditure measures (Brage et al. 2005). Together, these tools allow us to build on earlier studies to examine both the determinants and consequences of stress in real time and to relate them to potentially modifiable factors, including particular tasks, in the nursing environment.

The study

Aims

The aim of the study was to examine the effects of nursing tasks (including their physiological and psychological demands and the moderating effects of perceived reward and control) on distress and job performance in real nursing time. Specifically, we aimed to answer the following research questions:

- Are periods of psychologically and physically demanding work, combined with low control and reward, related to poorer outcomes (poorer mood, increased physiological arousal, and lowered self-ratings of the adequacy of nursing performance)?
- To what extent do nursing tasks (a) differ in their effects on physical and psychological demand, control, reward, and mood; and (b) explain the effects of demand, control, and mood on stress?
- Do the real-time measures of stress, mood, and their determinants relate to general measures of job content, job satisfaction, perceived stress, work-specific cognitive failures?

Design

A real-time, repeated-measures design conducted amongst ward-based hospital nurses.

Participants and setting

We aimed to recruit 100 nurses (50 medical, 50 surgical) from randomly selected wards in a large UK teaching hospital. Sample size was determined by multilevel power analysis using the programme MLPowSim (available at http://www.bristol.ac.uk/cmm/software/mlpowsim/). On the basis of Westbrook and Ampt’s (2009) information on the frequency of different types of nursing activities and information from our earlier studies on the between- and within-participant correlation of our main measures, we calculate that to detect a difference of 0.2 SD on hedonic tone (a moderate effect size) between a neutral reference category (social activities) and the most important frequent nursing tasks, such as direct patient care and medication-related tasks, requires 100 nurses assessed 12 times for a
power of 80% and \( P < 0.05 \). Our studies generate approximately six observations per shift, so we need to study the nurses over two shifts. A study of this size will have considerably greater power to detect differences in more directly work-related measures, such as demand or control, where the within-participant correlation is very substantial.

**Inclusion criteria**
Registered nurses working in medical and surgical inpatient wards (>20 beds).

**Exclusion criteria**
Nurses working in specialist units and outpatient areas will not be eligible to take part in this study. There are no other exclusion criteria.

**Procedures.** All eligible wards will be identified and a random sample identified (Figure 1). We will then advertise the study on the wards, providing a contact email and telephone number so that any potential participants can make contact. Nurses who express an interest will receive an information pack and be offered the opportunity to contact the research team for further information. Those who choose to participate will be asked to return a signed consent form and to indicate suitable shifts for participation. On receipt of the consent form, the relevant member of the research team will then make arrangements (using email or telephone depending on participants’ preference as indicated on consent form) for data collection. Only one nurse will be recruited from any ward on each shift to minimize disruption.

**Data collection**
Data collection will occur during 2011/2012.

**Measures**

**Questionnaires.** Firstly, participants will be asked to complete several validated questionnaire measures relating to workplace stress. The Job Content Questionnaire (measuring demand and control) (Karasek et al. 1985), Effort Reward Imbalance Scale (measuring effort, reward, and over commitment) (Siegrist et al. 2004), Work-specific Cognitive Failures scale (Wallace & Chen 2005), and the Perceived Stress Scale (Cohen et al. 1983). These are widely used scales, which we have used in the past and take about 15 minutes to complete. Participants will also be asked to complete a quick ‘errorless’ training manual on how to use the self-report WOMBAT (see Supporting Information). General information including age, gender, nursing grade, and time in nursing will be obtained in relation to all nurses working on the randomly selected wards to allow assessments for any bias in participation to be made later.

![Figure 1: Data collection process.](image-url)
**Real time.** Over two working shifts, PDAs (Dell Axim 51, Round Rock, TX, USA) will be used to collect repeated measures of mood, perceived stress, theoretical determinants of stress (effort, reward, demand, control), current task and perceived performance and Actiheart monitors (Cambridge Neurotechnology, Cambridge, UK) used to record heart rate and energy expenditure in real time (see Figure S1 for example screenshots).

**Mood measures.** Mood will be measured using items from all three scales of the widely used UWIST Mood Adjective Checklist (Matthews et al. 1990): hedonic tone (cheerful, happy, sad, angry); tense arousal (stressed, nervous, calm, relaxed); and energetic arousal (energetic, alert, sluggish, tired).

**Theoretical determinants of stress measures.** Measures of the perception of work will use four general visual analogue scales (VAS) supplemented by specific binary (yes/no) questions. Demand will be assessed by a general (VAS) rating of demand: ‘rate the last 10 minutes. Think about mental and physical activity in the past 10 minutes. Work has been demanding no (0) – yes (100) and three yes/no items on ‘working hard’, ‘working fast’, having ‘too much to do’ plus whether there were any interruptions and enough time and resources available. In addition to VAS ratings of Effort (‘put in a lot of effort’), binary yes/no questions will be used with three items: ‘being under constant pressure’, ‘having a lot of responsibility’, and ‘a lot of physical demand’ from the Effort Reward Imbalance Scale (Siegrist et al. 2004). Control will be assessed by a VAS on control: ‘had control over my work’ plus three yes/no questions on using ‘a high level of skill’, making the ‘main decisions’ about actions and having a ‘lot of say’ in actions. The VAS of reward (‘work has been rewarding’) will be supplemented by yes/no questions on being ‘appreciated’, ‘valued’, and ‘respected’. We will also include two additional yes/no items assess how ‘challenged’ nurses have been and whether they would have liked ‘more control’.

**Nursing task measures.** The measure of nursing tasks is based on the Australian WOMBAT classification (Amp et al. 2007). This has been used extensively in observational studies of nurses and other health professions, but has not been used before in a self-report format. Nursing tasks are divided into 10 categories (direct patient care, indirect care, medication, etc.) and further questions are asked about who else is involved (doctors, nurses, patients, relatives, etc.); whether the respondent is multi-tasking; has been interrupted; is satisfied with performance; has the resources necessary for executing the task; and has sufficient time available. Nurses will be asked to complete a WOMBAT diary entry with respect to their major activity during the previous 10 minutes.

**Performance measures.** As in our previous studies, at the end of the shift, nurses will record details of the most significant event during the shift (positive or negative), their mood at the time and whether it affected their subsequent work performance (Figure S1, bottom right screenshot). Finally, they will record how many errors or ‘near misses’ they observed during the shift that could put patients or staff at risk.

**Heart rate and activity measures.** Heart rate and activity level will be recorded continuously using Actiheart monitors to provide measures of both non-metabolic changes in heart rate (as an indicator of stress) and energy expenditure (as an indicator of physical demand). The Actiheart monitor weighs <10 g and is attached to two adhesive chest electrodes. The unit is self-contained and does not require the participant to wear a bulky battery pack or data recorder and as such is discreet and comfortable to wear. Mean acceleration, heart rate, inter-beat intervals, and heart rate variability are stored in 15 seconds epochs. The recordings are date and time ‘stamped’ and so can be readily related to the other real-time study variables. The validity and reliability of the Actiheart monitor have been established in ambulatory participants (Brage et al. 2005) and was used successfully by our team in a previous study of stress in nurses working in a telephone health advice service (Allan et al. 2009).

**Procedure**

Nurses who agree to participate in the study will be asked to complete the questionnaires, demographic information, and training manual detailed above in their own time. Prior to the two, normal working shifts nominated for participation, a research assistant will meet the participating nurse to issue the PDA and provide instruction on its use, attach the Actiheart monitor and ensure a satisfactory signal is received, and to ensure that participants are clear about how to complete the WOMBAT satisfactorily.

The PDA will prompt participants to make a diary entry every 90 minutes (plus or minus up to 15 minutes randomly determined by the software). The time for a diary entry is signalled by the PDA beping. If nurses are not in a position to make an entry, they can ‘snooze’ the device for up to 60 minutes. Each diary entry contains the questions on mood, theoretical determinants of stress, and current task detailed above. Participants can also make additional diary entries at any time if they consider that an
important event has occurred. The questions on work performance are completed once at the end of each participation shift. Nurses record details of the most significant event during the shift (positive or negative), their mood at the time, and whether it affected their subsequent work performance. Finally, they record how many ‘errors or near misses’ they observed during the whole shift that could put patients or staff at risk.

Pilot tests have shown that nurses found the PDA acceptable, the bleeping was audible, but not intrusive, and the diary was not found to significantly increase work burden or cause any other problems. Nurses spent on average 67 seconds on mood and job perceptions and 45 seconds making WOMBAT diary entries. The Actiheart requires no input from participating nurses and, once attached, records heart rate and activity continuously until removed.

**Data analysis**

The main data gathered in this study are complex repeated multilevel observations obtained from individuals operating in different work environments. On the basis of our previous studies, we anticipate recording approximately 16 PDA entries per nurse (over two shifts) for each of 100 nurses and that each entry will include approximately 40 responses. The multilevel modelling programme, MLwiN, will be used to analyse the data modelled with three levels, repeated observations on the diary and Actiheart (level 1) nested within shifts (level 2) which are further nested within participants (level 3).

**Ethical considerations**

**Sensitive data**

The study is designed to ensure that it does not interrupt essential nursing tasks and the pilot work confirmed that this was so. Very little of the data that will be collected are of a sensitive nature. However, participants are asked to identify potential errors and near misses in medical practice that might have put patients or staff at risk. The questions are designed so that the participant is not invited to incriminate themselves and the questions do not identify the nature of the error or the perpetrator. The research team has used these questions extensively, without an issue. Participants are instructed that entering information on errors in this way is not an alternative to hospital safety procedures and that they should also carry out their normal practice regarding reporting safety violations. Participants can also enter a text description of any critical incidents during the shift. They are told not to enter information that identifies an individual and no one has ever done so.

**Participant burden**

As the project includes multiple measures, the protocol is relatively demanding for participants. Nurses in both pilot studies, however, were happy with these demands and maintained that the measures did not interfere with work practice. On average, nurses in the pilot study took only 112 seconds to complete all PDA measures. Participation rates have been uniformly high in pilot studies and the data have been acceptable despite the need for researchers to work quickly when attaching heart rate monitors and administering PDAs.

**Confidentiality**

All personally identifiable data relating to participants are kept separate from study data. Study data are identified by means of a unique participant number. Only members of the research team can link the two sources of data, so it will not be possible to link study data with any individual participant. Individuals will not be identifiable in any publication or report that stems from this study. Research Ethics Committee approval was obtained from the relevant NHS Research Ethics Committee on 12 August 2011 and NHS R&D approval was obtained on 26 September 2011.

**Validity and reliability**

In the study, we have used previously validated questionnaires to measure possible determinants of stress [the Job Content Questionnaire (Karasek et al. 1985) and the Effort Reward Imbalance Scale (Siegrist et al. 2004)], Work-specific Cognitive Failures (Wallace & Chen 2005) and perceived stress (Perceived Stress Scale; Cohen et al. 1983). Furthermore, we have used a validated tool for the classification of nursing tasks (the WOMBAT; Ampt et al. 2007) and the Actiheart provides an objective measure of energy expenditure. Cronbach’s alpha will be used to assess the internal reliability of the subscales of each of the validated measures.

**Limitations**

Participants will be ward-based nurses in a large teaching hospital – results may not generalize to nurses in other hospital environments such as specialist units or clinics. The study is focused on occupational factors relating to stress and may fail to account for non-work factors (e.g. family/ home commitments). However, as the aim is to inform future strategies to reduce workplace stress, this is considered justifiable.
Obtaining real-time psychological and physiological data makes this study potentially revealing in several ways. In particular, it is anticipated that the study will provide unique insights into the relationship between stress and specific nursing tasks. Results may suggest possible routes towards stress reduction (e.g. environmental changes such as alterations to the structural components of nursing or psychological interventions such as stress management training). This will be particularly important if there is evidence that the stress experienced by ward nurses is detrimental to overall patient care.

Conclusion

Examining the effects of nursing tasks and their physiological and psychological demands on distress and job performance in real nursing time will inform theoretical understanding of nurse stress and its determinants. The results of the study may suggest possible changes to the NHS to reduce nurse distress, improve patient care, and develop improved methods of investigating work-related stress, retention, and patient care.

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Conflict of interest

No conflict of interest has been declared by the author(s).

Author contributions

All authors have agreed on the final version and meet at least one of the following criteria [recommended by the ICMJE (http://www.icmje.org/ethical_1author.html)]:
- substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data;
- drafting the article or revising it critically for important intellectual content.

Supporting Information

Additional Supporting Information may be found in the online version of this article:
- Data S1 Training manual for self-report WOMBAT.
- Figure S1. Example screenshots from PDAs.

References


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