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Feature Article

Development, adaptation and psychometric assessment of the extended brisbane practice environment measure for nursing homes (B-PEM-NH) for use in the Norwegian setting

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ABSTRACT

Care workers' work environment is known to be associated with patient and nurse outcomes. To our knowledge no questionnaire is available for assessing this environment for all care workers in the Norwegian nursing-home setting. This paper describes the development, adaptation and assessment of such a questionnaire: the extended Norwegian version of the Brisbane Practice Environment Measure for Nursing Homes (B-PEM-NH). This version was developed and assessed using semistructured interviews, a reference group meeting, translation, adaptation, and pretesting, and psychometric assessment including exploratory and confirmatory factor analyses, and retest. We tested hypotheses to assess relations to other variables. The final factor solution comprised 41 items and 9 factors: interpersonal leadership, professional development, resources, professional leadership, input and acknowledgement, patient and next-of-kin focus, multidisciplinary collaboration, language misunderstandings, and feeling unsafe. The assessment showed that the B-PEM-NH had good psychometric properties, suggesting that the questionnaire is suitable for application in similar settings.

Background

Introduction

The pressure on the resources in long-term care settings is expected to increase as the proportion of older people with more-complex care needs increases. Meanwhile, the educational level of staff is generally lower in long-term care settings than in acute-care hospitals, while the workforce is ageing and has a low status.[1,2] Projections indicate an increasing global shortage of qualified personnel, with associated difficulties in recruiting and retaining the workforce.[3-5] This situation raises concerns about the quality of care and safety for both patients and care workers.

Factors in the work environment of nurses in hospital settings have been found to be associated with nurse assessments of the quality of care,[6] patient safety,[7] care left undone[8,9] and patient outcomes such as mortality,[10] falls and pressure ulcers.[11,12] This work environment is also associated with organizational outcomes such as the intention of nurses to leave,[13,14] nurse turnover[15] and health,[16] and sickness absences, overtime work and occupational injuries[17] among care workers. In addition, more-favourable nursing work environments are associated with patients reporting better experiences with care.[18] However, the evidence is scarcer for long-term care settings, while attention on nursing-home settings has increased the latest years. Associations have been found between work-environment factors and patient outcomes in nursing homes, such as pressure ulcers[19] and the use of antipsychotics in the last phase of life.[20] The perceptions of work-environment factors among nurses in nursing homes are also associated with their perceptions of the quality of care[21] and person-centred care.[22] Moreover, associations have been found between work-environment factors and the outcomes of care workers in nursing homes such as job satisfaction,[23-25] intention to leave and turnover.[26,27]

Abbreviations: B-PEM, Brisbane Practice Environment Measure; B-PEM-NH, Brisbane Practice Environment Measure for Nursing Homes; CFA, confirmatory factor analysis; CFI, comparative fit index; EFA, exploratory factor analysis; ICC, intraclass correlation coefficient; NA, nurse assistant; PN, practical nurse; RMSEA, root-mean-square error of approximation; RN, registered nurse; SRMR, standardized root-mean-square residual

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The care environment

Previous studies have used several terms interchangeably with "work environment" . In this article we use the term "care environment", which "*focuses on the context in which care is delivered*"[28] (p. 475), as distinguished from more generic work environments that concern all workers regardless of their occupations. We focus on the care environment characteristics, that are amenable to change, and facilitate or limit nursing practice.[29] The care environment is perceived multidimensional. Among hospital nurses, the following are among the domains generally perceived to be of importance: staffing, control over practice, autonomy and status of nursing, professional development, and collaborative relationships with managers, peers and physicians.[30,31] These domains also prevail in questionnaires measuring the care and work environment of nurses.[32]

Measuring the care environment

Monitoring the consequences of the decisions made in the setting of the present study requires a valid and reliable questionnaire that will make it possible to draw useful lessons and share knowledge. A widely used tool to measure nurses' work environment is The Nursing Work Index and its revised versions developed in 1989 for registered nurses (RNs) working in hospitals.[33] NWI has been evaluated for use in nursing homes in US, but only for RNs.[19] A recent review found that factors important to the job satisfaction of nurse assistants (NAs) were found to differ from those important to hospital nurses[34] Furthermore, the care workers in municipal health care (including nursing homes and home health care) in Norway in 2017 comprised approximately 35% RNs with a bachelor's degree, 40% practical nurses (PNs) with upper-secondary education and about 25% NAs and other personnel,[35] with no regulations concerning minimum staffing levels or skill mix.[36] This contrasts with hospital services, where most of the care personnel are RNs with a postgraduate education, and only a very small proportion of the care workers are NAs. This suggests that results from hospital settings cannot be directly applied to long-term care settings, nor can questionnaires developed and used in a hospital setting for RNs be applied directly to all care workers in the long-term care setting. This study formed part of a project intended to develop a questionnaire measuring the care-environment characteristics in nursing homes. In the first step, we conducted a literature search to identify questionnaires that fit the purpose of this study.[32] We identified several questionnaires measuring aspects of the work environment in nursing homes. For example person-centred climate,[37] patient safety culture[38-40] organizational context central to evidence-based practice,[41,42] work environment and perceived work effectiveness,[43] and nurses practice environment (person-centred practice framework). However, these tend to either be too lengthy (increasing respondent burden) or capture aspects other than general amendable care environment conditions within a nursing home context.

The Brisbane Practice Environment Measure (B-PEM) was found to be closest to meeting our requirements. The B-PEM was developed in Australia in 2009 as a contemporary tool designed to measure the nursing practice environment in all health-care settings.[44] However, since long-term care settings are specific in some areas, we extended the original B-PEM by adding items specific to nursing homes and tested their psychometric properties in the nursing-home setting.

This paper describes the development, adaptation and assessment of the psychometric properties of an extended Norwegian version of the Brisbane Practice Environment Measure for Nursing Homes (B-PEM-NH).

Brisbane practice environment measure (B-PEM)

The B-PEM was developed in Australia based on results from in-depth interviews with nurses resigning from a hospital. The B-PEM consists of 33 items worded as statements about the characteristics of the care environment. The responses are given on a 5-point scale ranging from 1 (never) to 5 (always), and six of the items are reverse scored.[44] The B-PEM was first assessed in a study conducted in a single hospital using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). A 26-item, 4-factor solution was extracted.[45] The B-PEM was tested again by applying EFA and CFA to data from a sample of nurses with different educational levels who were working in different settings in Australia. Of the original 33-items, 28 items were retained in a 5-factor solution.[46]

Methods

The development and assessment of the B-PEM-NH involved formulating research questions and hypotheses (Table 1) based on the American Educational Research Association[47] Standards for Educational and Psychological Testing which employs different sources of evidence (test content, response process, internal structure and relation to other variables) and provides accumulated validity evidence for the use of an questionnaire (test). Our two first questions concern initial translation, adaptation and assessment of feasibility, question three to twelve were assessed through statistical analyses in a cross-sectional survey. Background data were collected to explore whether there were differences among groups (age, occupation and mother tongue) on responding or not.

Test content

After reviewing the literature on possible questionnaires,[32] we conducted 16 semistructured interviews with care workers to explore the characteristics of the work environment that care workers consider to be important in enabling them to do a good job. The interviews were performed on an individual basis, and conducted both face to face or over the telephone in order to explore the phenomenon in diverse settings and locations in Norway. The characteristics of the interviewees varied in terms of their occupation, age and years of working experience.

Table 1
Guiding research questions and hypotheses.

Evidence for validity and reliability	Guiding hypothesis / question
Test content	1. Are the items relevant and appropriate for measuring the care environment in the Norwegian nursing-home setting?
Response process	2. Are the items and the questionnaire easy to respond to for all care workers of different language backgrounds as pre tested in cognitive interviews?
Acceptability	3. What percentage of respondents answer all questions? 4. Are there any patterns of missing values based on care workers occupation? 5. What is the distribution of the scores?
Internal structure	6. What is the factor structure identified in our sample? 7. Can the factor structure be confirmed in a CFA? 8. To what degree are the latent variables related to the exogenous care-environment construct?
Reliability	9. Is the B-PEM-NH internally consistent? 10. Do all items contribute to Cronbach's α value for the scale? 11. Are the scores stable over time?
Relations to other variables	12. We expect to find that the subscales are associated with the scores for (1) intention to leave, (2) job satisfaction, (3) would recommend the unit as a workplace, and (4) quality of care

Conventional content analysis was applied to the transcribed interviews,[48] and relevant questionnaires were identified based on the results from these interviews. We found that the B-PEM could serve as a basis for our questionnaire with the potential inclusion of more topics/themes specific to nursing homes. Permission was obtained from the author of the original 33-item measure[44] to translate and adapt the B-PEM.

The initial content and face validity of the B-PEM was assessed using a reference group meeting with experts experienced in nursing-home care in Norway. The original B-PEM was then translated following established procedures[49] with two independent forward–backward translation steps. The aim was to obtain an easy-to-understand version that accurately reflected the meaning of the original items but with cultural relevance to the Norwegian nursing-home setting.

We constructed additional items in order to customize the contents to the nursing-home setting. The contents was based on a review of the literature on work-environment questionnaires[32] and on the initial interviews with care workers.

Response process

All items in the extended B-PEM-NH were then pretested in cognitive interviews performed over two rounds, with the aim of further assessing the cultural and item equivalence, and evaluating the interpretation, relevance and ease of comprehension.[50] The first round of interviews was conducted with six care workers, and eight more interviews were conducted after the questionnaire had been revised. The interviews were performed face to face with care workers with differing occupations and language backgrounds who were working in different nursing homes of various sizes and locations.

The survey

Setting and sampling

Open invitations to participate were sent to the persons responsible for the nursing-home services in all municipalities in Norway. A total of 66 nursing homes consisting of 162 units located in urban and rural districts and varying in size from 16 to 120 beds agreed to participate. The individual inclusion criteria were being a care worker, working at least 50% of the time in providing direct patient care, and working in day and/or evening shifts. Based on the inclusion criteria, we received a list of 2,568 care workers names from the nursing homes that agreed to participate in the survey. In order to assess possible response bias, this list included age group (under/ 40 years and over), occupation (RN/PN/NA), and mother tongue (Nordic/non-Nordic) for each included care worker.

Data collection

Data were collected from September to December 2017. A contact person at each participating nursing home distributed invitation letters to the included care workers at their unit. The invitation letters were named and sealed, and provided information about the survey and privacy protection, a specific password, and the URL for completing the survey. The contact persons received three e-mail reminders during the survey, which included updates about the response rates of the units. The B-PEM-NH was administered as a web-based survey that also asked about the quality of care and patient safety as well as global ratings and demographic information. A retest was answered by 97 of the respondents at 1–3 months after their first response.

Statistical analyses

IBM SPSS Statistics for Windows (version 24, IBM Corporation, Armonk, NY, USA) was used for all statistical analyses except the CFA, for which the Lavaan package[51] in the R statistics software (version 3.4.1)[52] was used. For statistical analysis, all negatively worded single items were reversed in the analyses so that high scores consistently indicated a positive description. The subscale scores were transformed to a scale from 0 to 100, where a score of 100 indicated the best possible description of the care environment.

Chi-square (χ^2) statistics were used to examine whether there were differences between respondents and non-respondents based on the background information we received from the contact persons.

Acceptability

The acceptability were evaluated in terms of number of complete responses and the rate of item non-responses for both the questionnaire as a whole and single items. If the non-response rate exceeded 4% for a single item, that item was evaluated if the patterns of missing values varied by occupation and mother tongue. Response variability was assessed based on the score distribution for each item. Ceiling (or floor) effects were present when a large proportion of the respondents used the highest (or lowest) response category.

Internal structure

EFA was conducted in order to identify the internal structures in our data. Principal-axis factoring with an oblique rotation method (promax) was chosen based on the assumption that the factors were correlated. Missing data were handled using listwise deletion. All data were checked for assumptions related to performing factor analyses (correlations and sample size). The number of factors extracted was decided using an eigenvalue threshold of > 1. Items with factor loadings > 0.30 on a single factor (based on our sample size and a 0.05 significance level) was retained.[53] All items that loaded on two factors with a difference in loading of < 0.1 was removed so as to provide the best fit.

Finally, the internal structure was investigated using CFA. The objectives of applying CFA to our sample were (1) to test if the data fit our hypothesized model based on the EFA, and (2) to estimate the degree to which the endogenous latent standardized factor loadings were related to a second-order exogenous variable. The observed variables are set to load on only a single latent variable with uncorrelated errors.[53,54] The CFA was first conducted as a first-order analysis to evaluate the fit of the model. A second-order latent variable was then added that should not significantly decrease the overall fit of the model.[54] Maximum likelihood estimation with robust standard errors and the Satorra-Bentler scaled test statistic was chosen since it does not assume the presence of multivariate normality.[54] The factor loading estimates between the endogenous and exogenous constructs were required to be > 0.35, since the loadings should be somewhat higher in CFA than in EFA.[54] In CFA, the commonly reported χ^2 fit statistic should be non-significant for a good model fit. However, since our sample size was > 250 and there were ≥ 30 observed variables, a significant χ^2 was expected, and other fit indices should be seen as complementary.[53] The model fit was therefore assessed using the root-mean-square error of approximation (RMSEA), comparative fit index (CFI), and standardized root-mean-square residual (SRMR), with values < 0.06, > 0.90[53] and < 0.08,[55] respectively, considered to indicate a good fit.

Internal consistency

The internal consistency was assessed using Cronbach's α, with values of ≥ 0.7 and ≥ 0.8 generally considered acceptable, and good, respectively.[53,56] No item should cause a substantial increase in Cronbach's α if it is removed. The item-total correlation is less well established, with various cut-off scores adopted in the psychometric studies reported in the literature,

including > 0.30,[57] > 0.40,[58] > 0.50.[53] The test–retest reliability was assessed using the intraclass correlation coefficient (ICC), calculated based on absolute agreement with a two-way mixed-effects model and the average scores of raters. ICC values of < 0.5, 0.5–0.75, 0.75–0.90 and > 0.90 indicate poor, moderate, good and excellent stability, respectively.[59]

Relations to other variables

We hypothesized that B-PEM-NH subscale scores were inversely related to the care workers self-reported intention to leave[26,27] as measured with one item on intention to leave, with a dichotomized answer of yes or no. The hypothesis was tested using point-biserial correlation. Moreover, since previous studies have found associations between work-environment characteristics and the perceptions of the quality of care[21] and job satisfaction[23-25] among care workers, we hypothesized that the subscales would be positively associated with global ratings on general job satisfaction if the respondent recommended the unit as a workplace and the general quality of care. The latter three parameters were scored on a scale ranging from 1 to 10. The cut-off for the correlation coefficient depends on the context, and we considered correlations as being weak to moderate for coefficients of 0.3–0.5, and moderate to strong for coefficients > 0.5.

Results

Test content

14 new items were added to the questionnaire. In the translation of the B-PEM, metaphors (items 16 and 26) were explained with words since they can be difficult to understand by workers with different language backgrounds. The reference group meeting judged the content to be highly relevant and appropriate for our setting.

Response process

The entire questionnaire was pretested in cognitive interviews, which resulted in revisions in wording after the first round, and only minor revisions after the second round. The questionnaire was considered easy to answer, and the respondents regarded the contents as relevant. The terminology was customized. Item 7 (difficult to influence change in this unit) was changed to a positive statement in order to facilitate the interpretation. Three items (items 2, 5 and 30) were removed after the cognitive pretest interviews for following reasons: item 2 (performance and appraisal are completed in this area) was removed because of a problematic time frame, item 5 (I am able to change my roster if necessary) was removed because a change in roster is not always easy to fulfil due to competences differing among the care workers, and item 30 (our roster complies with roster regulations) was removed because a union representative routinely oversees that a developed roster complies with roster regulations.

The survey

The sample

After removing care workers reporting working mainly night ($N = 22$), the sample consisted of 931 care workers giving a 37.1% response rate. The characteristics of the respondents are provided in Table 2.

Geographic region and institution size are based on public data.

The background information differed significantly between respondents and non-respondents. The respondents comprised 42.1% RNs and 5.1% NAs, compared to 29% RNs and 12.8% NAs in the non-respondents group. There were 14.6% care workers with a non-Nordic mother tongue in the respondents group, compared to 22.1% in the non-respondents group. There were no significant differences between age groups (results in Appendix A).

Table 2
Respondent characteristics ($N = 931$) based on survey data.

		N	%
Age (years)	Mean = 45.4, SD = 11.9		
Gender	Female	875	95
	Male	46	5
Occupation	NAs	47	5
	PNs	490	52.6
	RNs	394	42.3
Mother tongue	Nordic	782	84.9
	Non-Nordic	139	15.1
Employment (%)	100	360	39
	75–99	370	40.1
	<74	193	20.9
Tenure at present nursing home (years)	<1	99	10.8
	1–2	114	12.4
	3–5	162	17.7
	6–9	168	18.3
	>10	374	40.8
Tenure in current occupation (years)	<1	35	3.8
	1–2	63	6.8
	3–5	126	13.8
	6–9	114	12.4
	>10	578	63.1
Type of care unit	Regular long term	563	56.4
	Short term	101	10.1
	Palliative, rehabilitation	43	4.3
	Dementia special care	263	26.4
	Other	28	2.8
Geographic region in Norway	South-east	605	65
	West	130	14
	Central	98	10.5
	North	98	10.5
Institution size	Small (< 40 beds)	302	32.4
	Moderate (41–80 beds)	458	49.2
	Large (> 81 beds)	171	18.4

Acceptability

All 44 items were answered by 69.8% of the respondents, 15.1% left only a single item out and 15 respondents left out 10 or more items. All of the items were answered by 301 (76.4%) of the RNs, 327 (66.7%) of the PNs and 22 (46.8%) of the NAs.

The item non-response rate was generally low, and was highest for item 20 (There is equity in rostering in this unit; 5% omitted responses), followed by item 33 (Opportunities for advancement are available in this organisation; 4.3% omitted responses). The non-response rate for these items varied with the type of care worker: item 33 was omitted by 12.8% of the NAs, 5.3% of the PNs and 2% of the RNs; the corresponding proportions for item 20 were 12.8%, 6.1% and 2.8%. The proportion of highest scores was highest for item 44 (About how often must patients wait unjustifiably long to be seen by a doctor; 69.2% with the highest score), followed by item 43 (About how often is there a lack of consumables; 55% with the highest score) (Table 3).

Internal structure

Our data met the assumptions for performing a factor analysis, with the correlation being strongest between items 40 and 41 ($r = 0.809$), and the sample size was adequate, with 658 complete cases (14 cases per variable). Three items (items 4, 23 and 32) was removed in the EFA due to the presence of cross-loadings. The final factor solution comprised 41 items and 9 factors that explained 49% of the total variance. The model was easy interpretable, and

Table 3
Score distribution ($N = 931$).

Item	N	Non-response (%)	bMean (SD)	Lowest score (%)	Highest score (%)
1a. I feel supported by my line manager	926	0.5	4.06 (0.88)	0.5	34.9
3a. In this unit staff get away with bad behavior[a]	901	3.2	3.41 (0.96)	2.3	12.2
4a. I feel respected in the way people speak to me	918	1.4	4.33 (0.73)	0.4	45.2
6a. There is time for staff development	924	0.8	3.15 (0.96)	3.2	7.9
7a. It is easy to influence change in this unit (original: It is difficult to influence change in this area)	911	2.1	3.07 (0.85)	2.6	4.4
8a. There is a great team spirit in my unit	919	1.3	4.03 (0.78)	0.7	27.9
9a. My line manager is responsive to emergent leave requirements	906	2.7	3.98 (0.90)	0.8	32.0
10a. I am treated as an individual	901	3.2	4.34 (0.84)	1.0	52.9
11a. There is equity in staff development opportunities	903	3.0	3.57 (1.04)	2.9	20.5
12a. My skills are acknowledged	919	1.3	3.94 (0.87)	0.3	27.6
13a. I participate in roster development	895	3.9	3.34 (1.17)	7.8	18.1
14a. My line manager is approachable	914	1.8	4.26 (0.91)	0.9	51.2
15a. Offline time is offered for professional development	913	1.9	3.11 (0.99)	3.8	8.8
16a. I am given tasks that I doubt I am capable of resolving or managing [a] (original: I am thrown in at the deep end)	914	1.8	3.82 (0.83)	1.6	18.1
17a. The workload is overwhelming in this unit [a]	910	2.3	2.59 (0.89)	11.5	1.4
18a. I have access to the information I need to do my job	916	1.6	4.18 (0.67)	0.1	31.9
19a. I feel insecure/unsafe among colleagues in this unit [a] (original: I feel intimidated when working in this area)	915	1.7	4.07 (0.90)	1.9	36.0
20a. There is equity in rostering in this unit	884	5.0	3.72 (0.95)	2.8	19.1
21a. I am acknowledged when I put in extra effort	905	2.8	3.34 (1.05)	5.2	13.5
22a. The skill mix is about right in this unit	915	1.7	3.71 (0.84)	0.9	15.2
23a. In this unit, clinical resources are adequate	912	2.0	3.88 (0.73)	0.2	16.1
24a. I am asked to operate outside my scope of practice [a]	912	2.0	4.23 (0.78)	0.9	39.9
25a. I can contact and talk to a nurse/doctor when needed (original: There is a high level of clinical expertise I can access)	920	1.2	4.43 (0.72)	0.4	54.3
26a. I feel I am seen and heard (org: I feel just like a number)	920	1.2	4.03 (0.84)	0.9	30.5
27a. There is support for professional development in my unit	899	3.4	3.59 (0.97)	1.6	18.5
28a. Continuity of care is considered in this unit	898	3.5	3.78 (0.83)	1.0	18.4
29a. I enjoy coming to work	923	0.9	4.25 (0.75)	0.4	40.3
31a. My line manager is ready to help out in the care work (original: My line manager is ready to help out in the clinical area)	909	2.4	3.02 (1.42)	20.5	20.9
32a. Staff workloads are equal	912	2.0	3.50 (0.91)	2.7	10.3
33a. Opportunities for advancement are available in this organisation	891	4.3	3.31 (0.99)	4.0	11.0
34b. Patients participate in important decisions about themselves (as far as possible) in my unit	923	0.9	3.83 (0.92)	0,9	24.6
35b. Patients can make choices about their help and care (as far as possible) in my unit	926	0.5	3.95 (0.75)	0.5	20,2
36b. The next of kin of a patient are included in decisions when the patient is unable to participate in my unit	922	1.0	4.17 (0.80)	0.3	37.7
37c. When needed, joint discussions are conducted on how patient's challenges can be resolved	908	2.5	4.15 (1.09)	3.9	49.0
38c. At my workplace, the management will take action if I report concerns about patient care	905	2.8	3.99 (1.14)	3.2	41.9
39c. The staff adhere to joint decisions (e.g. decided in staff meetings) in my unit	909	2.4	3.94 (1.09)	2.5	36.1
40d About how often do language differences cause misunderstandings between staff (e.g. in handovers or messages)?[a]	915	1.7	3.90 (1.11)	4.2	35.1
41d About how often do language differences cause misunderstandings between staff and patients?[a]	919	1.3	3.67 (1.20)	7.5	28.0
42d About how often is there a lack of equipment (e.g. pressure ulcer mattress, bed rails or patient lifts)?[a]	919	1.3	4.18 (1.06)	4.0	49.1
43d About how often is there a lack of consumables (e.g. gloves, disposable bed pads or other hygiene products)?[a]	922	1.0	4.31 (0.94)	1.8	55.0
44d About how often must patients wait unjustifiably long to be seen by a doctor (in your opinion)?[a]	905	2.8	4.59 (0.71)	0.8	69.2
45d About how often must you wait for necessary maintenance (e.g. janitor services or equipment repair)?[a]	927	0.4	3.84 (0.98)	4.2	22.3
46d About how often does it happen that you experience problems when using PCs for routine tasks (e.g. waiting for an available computer, or software or network problems)?[a]	927	0.4	3.70 (1.14)	5.7	25.5
47d About how often do you not have time to take meal breaks?[a]	917	1.5	3.83 (1.09)	4.3	29.2

[a] Negative items are reversed.
[b] High scores indicate favourable descriptions: range = 1–5.Response categories: Items with numbers appended with "a" (original B-PEM) and "b": 1 = never, 2 = rarely, 3 = sometimes, 4 = frequently and 5 = always. Items with "c": 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree and 5 = strongly agree. Items with "d": 1 = never/seldom, 2 = sometimes/monthly, 3 = weekly, 4 = several times weekly and 5 = once daily. In adapted B-PEM items original wording is provided in paranthesis.

comprised several aspects of the care environment. The nine subscales comprised interpersonal leadership, professional development, recourses, professional leadership, input and acknowledgement, patient and next-of-kin focus, multidisciplinary collaboration, language misunderstandings, and feeling unsafe. Scale descriptives and psychometric properties and the items comprising the scales are provided in Table 4. All rotated loadings from the EFA are presented in Appendix B.

The CFA was first performed as a first-order analysis based on the hypothesized model obtained from the EFA. The findings of the χ^2 test were, as expected, statistically significant [$\chi^2 = 1436.35$, degrees of freedom (df) = 743, $p < 0.001$], but the alternative fit measures indicated a good fit: RMSEA = 0.041 [90% confidence interval (CI) = 0.037–0.044], SRMR = 0.050, and CFI = 0.925 . Each observed variable had a standardized factor loading of > 0.4 on its endogenous latent variable, with the values varying from 0.46 to 0.95. The correlation coefficients for the latent variables ranged between 0.20 and 0.88 (data for the first-order model are not presented). The overall fit was similar in the second-order model (Fig. 1), with fit statistics of $\chi^2 = 1566.93$, df = 770 and $p < 0.001$, and RMSEA = 0.043 (90% CI = 0.040–0.046), SRMR = 0.055, and CFI = 0.913. The endogenous latent variables all had loadings of > 0.35 on the exogenous variable. The associations between latent variables and exogenous latent variables were in the following order: multidisciplinary collaboration

Table 4
Scale descriptives and psychometric properties ($N = 931$).

Subscale/items	Rotated factor loadings	Item-total correlation coefficients	†Mean (SD)	Cronbach's α	Test–retest ($N = 97$) ICC (95% CI)
Interpersonal leadership			70.85 (20.65)	0.823	0.920 (0.874–0.948)
14a. My line manager is approachable	0.930	0.725			
1a. I feel supported by my line manager	0.683	0.695			
9a. My line manager is responsive to emergent leave requirements	0.575	0.591			
31a. My line manager is ready to help out in care work if needed	0.534	0.518			
Professional development			58.77 (20.60)	0.852	0.891 (0.838–0.927)
15a. Offline time is offered for professional development	0.818	0.653			
6a. There is time for staff development	0.761	0.694			
27a. There is support for professional development in my unit	0.724	0.738			
11a. There is equity in staff development opportunities	0.538	0.681			
Recourses			71.58 (15.35)	0.747	0.911 (0.868–0.941)
42d About how often is there a lack of equipment (e.g. pressure ulcer mattress, bed rails or patient lifts)?	0.751	0.553			
43d About how often is there a lack of consumables (e.g. gloves, disposable bed pads or other hygiene products)?	0.533	0.466			
44d About how often must patients wait unjustifiably long to be seen by a doctor (in your opinion)?	0.527	0.480			
45d About how often must you wait for necessary maintenance (e.g. janitor services or equipment repair)?	0.514	0.458			
46d About how often does it happen that you experience problems when using PCs for routine tasks (e.g. waiting for an available computer, or software or network problems)?	0.509	0.409			
47d About how often do you not have time to take meal breaks?	0.491	0.423			
17a. The workload is overwhelming in this unit	0.329	0.432			
Professional leadership			67.89 (19.46)	0.808	0.890 (0.834–0.927)
37c. When needed, joint discussions are conducted on how patient's challenges can be resolved	0.838	0.711			
38c. At my workplace, the management will take action if I report concerns about patient care	0.708	0.684			
39c. The staff adhere to joint decisions (e.g. decided in staff meetings) in my unit in my unit	0.662	0.595			
3a. In this unit staff get away with bad behavior	0.435	0.423			
7a. It is easy to influence change in this unit	0.380	0.584			
Input and acknowledgement			68.01 (16.52)	0.823	0.906 (0.859–0.937)
13a. I participate in roster development	0.697	0.488			
12a. My skills are acknowledged	0.547	0.647			
26a. I feel I am seen and heard	0.546	0.668			
33a. Opportunities for advancement are available in this organisation	0.483	0.515			
21a. I am acknowledged when I put in extra effort	0.466	0.597			
20a. There is equity in rostering in this unit	0.446	0.477			
10a. I am treated as an individual	0.351	0.543			
Patient and next-of-kin focus			74.60 (16.88)	0.753	0.806 (0.709–0.871)
34b. Patients participate in important decisions about themselves (as far as possible) in my unit	0.805	0.659			
35b. Patients can make choices about their help and care (as far as possible) in my unit	0.659	0.602			
36b. The next of kin of a patient are included in decisions when the patient is unable to participate in my unit	0.525	0.501			
Multidisciplinary collaboration			76.63 (13.71)	0.803	0.918 (0.877–0.945)
8a. There is a great team spirit in my unit	0.729	0.586			
18a. I have access to the information I need to do my job.	0.714	0.525			
22a. The skill mix is about right in this unit	0.447	0.597			
29a. I enjoy coming to work	0.416	0.593			
25a. I can contact and talk to a nurse/doctor when needed	0.410	0.454			
28a. Continuity of care is considered in this unit	0.357	0.611			
Language misunderstandings			69.59 (27.74)	0.902	0.858 (0.787–0.905)
40d About how often do language differences cause misunderstandings between staff (e.g. in hand-overs or messages)?	0.887	0.821			
41d About how often do language differences cause misunderstandings between staff and patients?	0.878	0.821			
Feeling unsafe			76.00 (15.62)	0.602	0.821 (0.732–0.880)
16a. I am given tasks that I doubt I am capable of resolving or managing	0.696	0.412			
24a. I am asked to operate outside my scope of practice	0.667	0.467			
19a. I feel insecure/unsafe among colleagues in this unit	0.319	0.342			

See footnote of Table 3 for explanations of symbols and response categories. ICC values are for absolute agreement, two-way mixed-effects model and average scores of raters.

(0.93), input and acknowledgement (0.93), professional leadership (0.85), professional development (0.82), interpersonal leadership (0.78) and resources (0.64). The latent variables of feeling unsafe (0.45) and patient and next-of-kin focus (0.46) were moderately related to the exogenous variable. The weakest relation was with the latent variable of language misunderstandings (0.35). However, the estimates and fit statistics overall indicate a significant relationship between the endogenous latent variables and the overall exogenous variable.

Internal consistency

The Cronbach's α, was satisfactory for all except one scale, and varied from 0.602 to 0.902 (mean = 0.790). The item-total

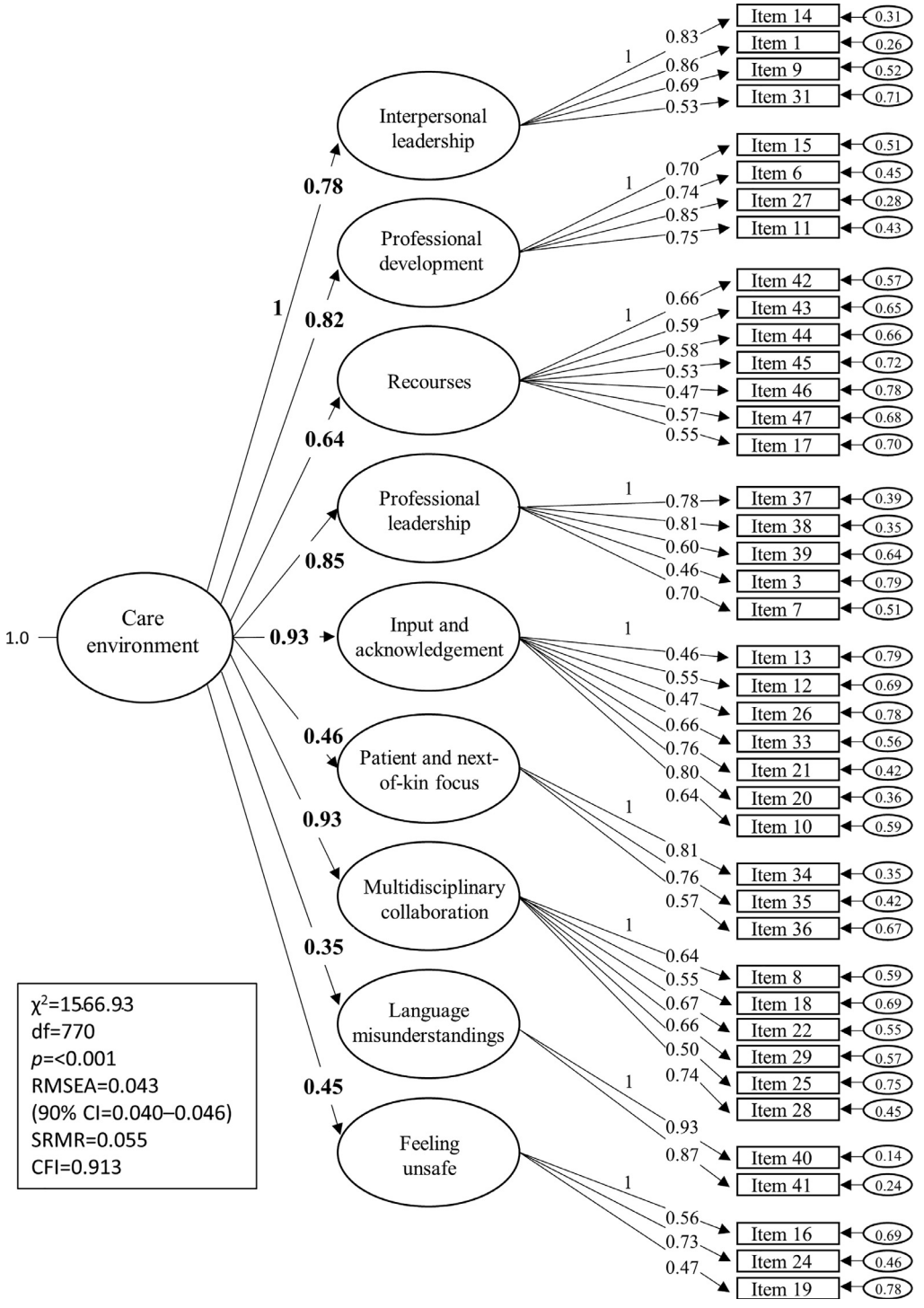

Fig. 1. Path diagram of the CFA model (the full text of each item is provided in Table 4). Values are reported as complete standardized estimates.

correlation coefficients were all > 0.4 except for item 19 (I feel insecure/unsafe among colleagues in this unit), which had an item-total correlation coefficient of 0.342. All items contributed to Cronbach's α for the respective scale except for item 3 (staff in this unit get away with bad behavior), but the change in Cronbach's α was small, so we chose to keep that item. The ICC varied from 0.806 to 0.920 (mean = 0.880) indicating good to excellent retest stability (Table 4).

Relations to other variables

All correlations were significant, and in the expected direction. The correlation with the global rating was strongest for multidisciplinary collaboration ($r = -0.482$ to 0.643, $p < 0.001$), followed by professional leadership ($r = -0.450$ to 0.558, $p < 0.001$), and was weakest for patient and next-of-kin focus ($r = -0.171$ to 0.283, $p < 0.001$) and language misunderstandings ($r = 0.201$ to 0.262, $p < 0.001$) (Table 5). Very similar estimates were found for the Spearman rank correlation.

Table 5
Associations between subscales and global rating items ($N = 888–926$).

	Intention to leave	Job satisfaction	Would recommend the unit as a workplace	Quality of care
Interpersonal leadership	−0.338*	0.427*	0.469*	0.391*
Professional development	−0.343*	0.477*	0.438*	0.399*
Recourses	−0.399*	0.418*	0.432*	0.397*
Professional leadership	−0.450*	0.541*	0.558*	0.529*
Input and acknowledgement	−0.410*	0.493*	0.526*	0.414*
Patient and next-of-kin focus	−0.171*	0.248*	0.283*	0.281*
Multidisciplinary collaboration	−0.482*	0.628*	0.643*	0.579*
Language misunderstandings	−0.227*	0.201*	0.253*	0.262*
Feeling unsafe	−0.288*	0.327*	0.315*	0.264*

* Significant at the < 0.001 level (two-tailed test). Point-biserial correlation for the intention to leave; Pearson's r for continuous variables with pairwise deletion.

Discussion

This paper has described the development, adaptation and assessment of the psychometric properties of the extended Norwegian version of the B-PEM-NH. The assessment was guided by research questions and hypotheses formulated based on the American Educational Research Association[47] Standards for Educational and Psychological Testing. The EFA yielded a nine-factor model with easily interpretable subscales and promising psychometric properties. The suggested model was supported in the CFA, with acceptable fit statistics in a second-order model, demonstrating that the first-order latent variables are indicators of a second-order construct.

Norway consists of many small municipalities, and B-PEM-NH can be a tool for measuring aspects of the care work, the scores can be used as an indicator for detecting or monitoring the care environment, across- or within nursing homes, units or municipalities. The results suggest that the questionnaire can be used in similar health care systems after investigation of the contents appropriateness.

Test content

The B-PEM was developed in a hospital setting for RNs in Australia. Using surveys in settings and geographic areas different from where they have been developed can be challenging due to differences in how care is organized, health-care policies, reforms and financial systems.[60] Nevertheless, questions related to care environments may have similarities at a cross-national level. The translation and adaptation of the B-PEM and the development of new complementary nursing-home items was conducted in a thorough process that included semistructured interviews, a reference group meeting and cognitive pretesting. This approach ensured that the items were understandable and adequately reflected the breadth of the care environment for care workers in the Norwegian nursing-home setting. Nevertheless, even though the adapted the B-PEM-NH addresses relevant topics, this does not guarantee that the content of the B-PEM-NH will be relevant to all nursing homes. Consequently, the content and items in the subscales and the model itself may need to be refined in order to measure contemporary and relevant issues with the highest accuracy.

Response processes

We did not include care workers who worked mainly night shifts, since such subjects more frequently work in multiple units, and may be less involved in organizational or unit projects. Both of these aspects may have impaired the ability to rate the items accurately. However, night-shift workers are an important part of the care environment, and so the relevance of the present items should be explored in this population.

Acceptability

There were an overall low rate of item non-responses, which indicates that the items are relevant and suggests good acceptability in the current setting. On the other hand, the rate of missing data differed significantly with the occupation of the care workers, with items 33 and 20 being omitted more by NAs than by PNs and RNs. Moreover, only 5% of the respondents in our sample were NAs, compared to a proportion of approximately 25% across the entire Norwegian municipal healthcare workforce.[35] This means that the relevance of B-PEM-NH items among NAs should be explored further. Furthermore, there were some substantial concentrations of answers in the highest response category for some of the items, which may reduce the ability of the questionnaire to detect changes in small-scale surveys or distinguish differences over time.[61]

Internal structure

The EFA yielded nine easy interpretable subscales that cover diverse aspects of the care environment. The subscales can be used independently to detect specific problems related to the care environment. The first subscale was called interpersonal leadership, and comprised items related to the closest leader, and how responsive the leader is to subordinates. Nevertheless, a leader can be accommodating at an individual level (i.e. items in the interpersonal leadership scale), but less able to provide professional leadership. This aspect was added to the questionnaire by the items in the professional leadership subscale, which comprises items related to the leader supporting subordinates in providing high quality care at the unit level. There is little consensus in the published literature about the definition of leadership.[62] However, the present subscales consist of themes that the care workers in the interviews emphasized as being important for the leader to provide at their unit. The interpersonal leadership and professional leadership subscales were both strongly correlated with the global ratings, and there were high loadings on the exogenous variable in the CFA, with somewhat higher estimates for the professional leadership subscale. These findings are consistent with previous studies of the impact of leadership on job satisfaction and the quality of care.[24,62,63] The professional development subscale consists of items related to different aspects of opportunities and support for increasing capabilities. The recourses subscale comprised new items plus one from the B-PEM. Almost all of the interviewees commented on the importance of enough resources providing good care and supporting a good care environment. The interviewees explained that there were aspects of resources that simply should always be provided, without which optimal care cannot be delivered. The input and acknowledgement subscale comprises items related to the way that care worker can have a say and are acknowledged for the work they do. The patient and next-of-kin focus subscale comprises three new items related to the way patients and relatives are involved in care. Maintaining a personal relationship with patients and their next of kin is a vital part of long-term care.[64] The multidisciplinary collaboration subscale comprises items related to collaboration and teamwork between care workers. The scale associations with the overall rating variables was also strong, in line with previous studies of how the team climate and multidisciplinary collaborations impact on the perceived quality of care and job satisfaction.[65] The language misunderstandings subscale consists of two new items. There was general agreement in the interviews that language misunderstandings will

increase the workload. Language misunderstandings are also related to leadership and can threaten patient safety. Finally, the feeling unsafe subscale consists of three items related to unpleasant feelings towards the work situation.

We did not modify the CFA in order to increase the level of fitness since the aim of the CFA was to test the suitability of the hypothesized model identified in the EFAs, when the observed variables were set to load on a single latent variable with uncorrelated errors. Our primary intention was to assess the strength of the loadings to the overall exogenous latent variable, rather than to find a perfect fit of the model in the CFA. Furthermore, the CFA was performed based on results of a thorough EFA. Modifications that are not strictly theoretically grounded—based mainly on the CFA findings, such as by adding constraints or accepting cross-loadings—should be avoided.[53,54]

Internal consistency

Cronbach's α was only 0.602 for the feeling unsafe subscale. However, it has been argued that in research on new developed scales, Cronbach's α as low as 0.600 are still acceptable. There are also few items in the subscale that will reduce Cronbach's α.[53]

Relations to other variables

The results showed associations between the subscale scores and global ratings, with weaker associations with the language misunderstandings and the patient and next-of-kin focus subscales. The same subscales also had lower factor loadings to the overall construct in the second-order CFA.

Strengths and limitations

The strengths of the study are the thorough procedure that included a literature review, semistructured interviews, a reference group meeting, translation and adaptation following established procedures, pretesting with cognitive interviews, and the large sample, which gives the internal structure a solid basis. Moreover, the factor structure was evaluated using a systematic process with good psychometric properties, and the stability was assessed in a test–retest analysis. The participating units were diverse, both in terms of facility size and geographical location, while special-care units and more traditional long-term care units were represented, which makes us believe that the questionnaire can be applied in such settings. We have not found other questionnaires specifically developed and adapted for nursing home settings which can be used to measuring different areas of amendable care environment characteristics.[32] The developed questionnaire fulfils this purpose, and addresses the increasing need to evaluate care environments, which have had low priorities in Norwegian nursing homes.

One limitation of this study was the low response rate, with only 37.1% of the potential respondents answering the survey. Low response rates are often reported for surveys targeting nurses, with web-based methods being less effective than postal and telephone-based surveys.[66] Some of the present respondents reported that the web-based survey tool was slightly difficult to use. During the survey we found some of the potential respondents entered the survey link into the Google search engine, which resulted in them not finding the survey. Moreover, the use of web-based data collection meant that we were not able to send personalized reminders to the participants, and communication was through a contact person. We therefore had no control over the information and motivation that was provided to potential respondents.

The analysis of the background information showed that fewer NAs and care workers with a non-Nordic mother tongue answered the questionnaire compared to RNs and those with a Nordic mother tongue, which meant that the results may have been influenced by the presence of non-response bias.

We correlated only self-reported data obtained from health-care workers. It would have been preferable to assess the sensitivity of the questionnaire and the subscales using other sources of observable behaviors or data on outcomes, because self-report measures can be subject to social-desirability response bias and common-methods bias.[67]

Conclusions

This study assessed different sources of evidence including semi-structured interviews, a reference group meeting, cognitive pretesting and psychometric assessment using data from a survey and a retest. The developed B-PEM-NH showed good measurement properties, and based on the collected evidence we propose that the questionnaire can be used in nursing homes in Norway and also in other countries with similar health systems. However, the questionnaire should be further assessed for relevance among NAs and night-shift workers.

Acknowledgements

We thank the participating nursing homes, contact persons and care workers who contributed to collecting data, helping in the interviews and responding to the survey. We also thank our colleagues who helped in translating the instrument and collecting data.

Ethics approval and consent to participate

The study was notified to the Data Protection Official for Research in the Norwegian Institute of Public Health (Ref. No. 17/11981/). Informed consent was considered to have been given when the respondent received information and submitted their response.

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Availability of data and materials

The data sets are not publicly available since they form part of an ongoing PhD project at the Norwegian Institute of Public Health and the University of Oslo.

Declarations of interest

None.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.gerinurse.2018.11.007.

Appendix A. Respondents and non-respondents

Table A
Respondents and non-respondents.

		Respondents (N = 953)[a]		Non-respondents (N = 1615)		Total (N = 2568)		Difference
		N	%	N	%	N	%	p[b]
Age	Over 40 years	635	66.6	1060	65.6	1695	66	
	Under 40 years	318	33.4	555	34.4	873	34	0.606
Occupation	NA	49	5.1	207	12.8	256	10	
	PN	503	52.8	940	58.2	1443	56.2	
	RN	401	42.1	468	29	869	33.8	<0.001
Mother tongue	Nordic	814	85.4	1245	77.1	2059	80.2	
	Non-Nordic	139	14.6	370	22.9	509	19.8	<0.001

[a] Night shift workers (N = 22) were excluded in analysis.
[b] χ2-test.

Appendix B. Results from the factor analyses

Table B
Results from the factor analyses.

		1	2	3	4	5	6	7	8	9
14	My line manager is approachable	**0.930**	−0.051	−0.049	0.062	−0.013	−0.034	−0.064	−0.036	0.024
1	I feel supported by my line manager	**0.683**	−0.074	−0.016	0.203	0.138	−0.030	−0.039	−0.008	−0.016
9	My line manager is responsive to emergent leave requirements	**0.575**	0.088	0.018	−0.163	0.161	0.032	0.047	0.014	0.052
31	My line manager is ready to help out in the care work	**0.534**	0.104	−0.042	−0.070	−0.100	0.025	0.101	0.098	−0.025
15	Offline time is offered for professional development	0.031	**0.818**	−0.096	−0.007	−0.042	−0.001	−0.043	0.027	−0.017
6	There is time for staff development	0.014	**0.761**	0.019	0.072	−0.076	−0.004	0.009	−0.055	0.003
27	There is support for professional development in my unit	−0.101	**0.724**	−0.001	−0.012	0.258	−0.004	0.004	−0.012	0.017
11	There is equity in staff development opportunities	0.094	**0.538**	−0.019	0.039	0.107	−0.008	0.052	−0.054	0.092
42	About how often is there a lack of equipment	0.015	−0.005	**0.751**	−0.095	0.059	0.058	−0.023	−0.001	−0.055
43	About how often is there a lack of consumables	0.005	−0.034	**0.533**	0.074	0.124	−0.006	−0.133	0.014	0.074
44	About how often must patients wait unjustifiably long to be seen by a doctor	−0.001	−0.133	**0.527**	0.111	0.041	−0.023	0.105	0.030	−0.031
45	About how often must you wait for necessary maintenance	−0.149	−0.031	**0.514**	0.106	0.090	0.009	−0.035	0.012	0.032
46	About how often does it happen that you experience problems when using PCs for routine tasks	0.033	−0.032	**0.509**	−0.063	−0.023	−0.026	0.071	0.028	−0.036
47	About how often do you not have time to take meal breaks	−0.038	0.060	**0.491**	0.208	−0.043	−0.093	0.032	−0.102	−0.016
17	The workload is overwhelming in this unit	0.002	0.148	**0.329**	0.096	−0.008	−0.058	0.049	−0.006	0.098
37	When needed, joint discussions are conducted on how patient's challenges can be resolved	0.085	0.016	0.065	**0.838**	−0.142	0.098	−0.083	0.000	−0.072
38	At my workplace, the management will take action if I report concerns about patient care	0.228	0.104	0.104	**0.708**	−0.086	0.034	−0.181	−0.017	−0.012
39	The staff adhere to joint decisions (e.g. decided in staff meetings) in my unit	−0.113	0.026	0.026	**0.662**	−0.242	0.056	0.228	0.064	−0.093
3	In this unit staff get away with bad behavior	−0.096	−0.037	−0.012	**0.435**	0.134	0.006	−0.063	0.088	0.208
7	It is easy to influence change in this unit	0.055	0.228	−0.004	**0.380**	0.006	−0.033	0.184	0.013	−0.042
13	I participate in roster development.	0.063	0.024	0.088	−0.242	**0.697**	0.078	−0.120	0.018	−0.074
12	My skills are acknowledged	0.052	0.051	−0.057	0.130	**0.547**	−0.009	0.121	−0.047	−0.039
26	I feel I am seen and heard	0.052	−0.031	−0.011	0.161	**0.546**	−0.050	0.170	−0.005	−0.015
33	Opportunities for advancement are available in this organisation	−0.055	**0.355**	0.069	−0.068	**0.483**	−0.019	−0.089	0.063	−0.103
21	I am acknowledged when I put in extra effort	0.102	0.175	−0.042	0.035	**0.466**	−0.048	−0.003	−0.015	−0.002
20	There is equity in rostering in this unit	0.141	0.056	0.080	−0.206	**0.446**	0.099	−0.035	0.045	0.036
10	I am treated as an individual	0.283	−0.087	0.016	0.039	**0.351**	0.028	0.121	−0.060	0.059
34	Patients participate in important decisions about themselves (as far as possible) in my unit	0.023	−0.010	−0.034	0.088	0.062	**0.805**	−0.082	−0.018	0.025
35	Patients can make choices about their help and care (as far as possible) in my unit	−0.058	0.072	0.013	0.112	−0.017	**0.659**	0.040	−0.013	0.073
36	The next of kin of a patient are included in decisions when the patient is unable to participate in my unit	0.013	−0.097	−0.037	0.028	0.115	**0.525**	0.185	−0.006	−0.088
8	There is a great team spirit in my unit	−0.083	−0.072	−0.143	0.159	0.070	0.025	**0.729**	−0.043	−0.003
18	I have access to the information I need to do my job	0.070	0.117	0.194	−0.164	−0.288	0.010	**0.714**	−0.042	0.089
22	The skill mix is about right in this unit	0.074	0.126	−0.038	0.061	0.019	0.045	**0.447**	0.063	−0.032
29	I enjoy coming to work	0.225	−0.061	0.021	0.047	0.145	−0.083	**0.416**	−0.002	0.023
25	I can contact and talk to a nurse/doctor when needed	0.090	−0.061	0.176	−0.170	0.132	0.096	**0.410**	0.024	−0.041
28	Continuity of care is considered in this unit	0.002	0.200	0.028	0.146	0.092	0.008	**0.357**	0.094	−0.051
40	About how often do language differences cause misunderstandings between staff	0.016	−0.018	0.014	0.090	−0.024	−0.055	−0.011	**0.887**	0.047
41	About how often do language differences cause misunderstandings between staff and patients?	0.012	−0.008	−0.008	0.016	0.050	0.025	−0.029	**0.878**	−0.009
16	I am given tasks that I doubt I am capable of resolving or managing	0.042	−0.042	−0.029	−0.082	−0.081	−0.028	0.025	0.028	**0.696**
24	I am asked to operate outside my scope of practice	0.036	0.091	0.041	−0.021	−0.096	0.066	0.002	0.020	**0.667**
19	I feel insecure/unsafe among colleagues in this unit	−0.140	−0.128	−0.012	0.198	0.200	−0.023	0.196	−0.052	**0.319**

Factor loadings > 0.30 are in boldface. Promax rotation was used.

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