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ORIGINAL ARTICLE

Burnout symptoms in forensic mental health nurses: Results from a longitudinal study

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ABSTRACT: *Burnout in nursing staff is a major cause for turnover and absenteeism. Identifying risk and protective factors may be helpful in decreasing burnout symptoms. Moreover, research indicates that ambulatory assessments of the autonomic nervous system might be helpful in detecting long-term stress and burnout symptoms. One hundred and ten forensic nursing staff members completed questionnaires measuring experiences with aggressive behaviour, emotional intelligence, personality, and job stress during four waves of data collection across a 2-year period. Multilevel analyses were used to test the predicted associations and moderation effects with (the development of) burnout symptoms. Burnout was predicted by a combination of emotional intelligence, job stress, aggression, personality factors, and skin conductance, but no moderation effects over time were found. Over a period of 2 years, the model approximately predicts a change in one burnout category on the Maslach Burnout Inventory. The amount of burnout symptoms in nurses might be used as an indicator to predict turnover and absenteeism considering the increase in symptoms over time. Nursing staff who experience severe aggression and who have relatively low levels of emotional intelligence and altruism and high levels of neuroticism and job stress should be monitored and supported to decrease the risk of burnout. Staff members can be trained to increase their emotional intelligence and relieve stress to decrease their burnout symptoms and turnover and absenteeism on the long term. Ambulatory assessment might be helpful as a nonintrusive way to detect increasing levels of burnout.*

KEY WORDS: *burnout symptoms, forensic nursing, moderators, risk and protective factors, skin conductance.*

INTRODUCTION

Several definitions of and causes for burnout have been proposed in recent years. Burnout is often referred to as a psychological syndrome in response to long-term job stressors (Johnson *et al.* 2018; Leiter *et al.* 2014; Maslach *et al.* 2001; Schaufeli *et al.* 2017). The emotionally demanding interpersonal relationship of professional

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caregivers with their patients has been identified as a potential cause for burnout (Schaufeli *et al.* 2017). Also, in the earlier stages of research on burnout, it was noted that burnout is a response to overload, including fairly stable burnout scores over time, which indicated a potential influence of long-term job stressors (Maslach *et al.* 2001). Indeed, recent literature reviews identified three potential causes of burnout that interact with each other: long-term stress, career setbacks, and unbearable strain (Neckel *et al.* 2017). The most often used questionnaire to measure burnout is the Maslach Burnout Inventory (Grossi *et al.* 2015; Maslach *et al.* 2001) in which burnout is constructed of three subscales: Emotional Exhaustion, Depersonalization and Lowered Personal Accomplishment (Day & Leiter 2014).

One apparent risk factor for burnout in mental health nursing appears to be patient aggression as experienced by nursing staff (Nijman *et al.* 2005; Winstanley & Whittington 2002). Evers *et al.* (2002) found a significant association between interpersonal aggression and burnout. It appears that several types of aggression are associated with burnout symptoms. Indeed, reviews have indicated that both verbal aggression and physical aggression experienced by nurses lead to negative psychological outcomes (Edward *et al.* 2014, 2016). In general, being confronted with higher levels of aggression during work is associated with higher levels of burnout symptoms, whereby especially physical aggression seems to be relevant (Edward *et al.* 2014). Winstanley and Whittington (2002), for instance, reported that more frequently victimized nurses have higher levels of Emotional Exhaustion and Depersonalization compared to less frequently victimized nurses. This association between burnout and physical aggression was replicated for Emotional Exhaustion (Hensel *et al.* 2015).

Three protective factors seem important in the development of burnout: emotional intelligence (EI), personality and social support. First, the moderating role of EI on burnout has gained attention (Afsar *et al.* 2017; Shead *et al.* 2016; Zijlmans *et al.* 2011). EI seems to have a major protective influence on burnout (Antoniou & Koronaiou 2018; Beauvais *et al.* 2017; Görgens-Ekermans & Brand 2012; Zysberg *et al.* 2017). A study in South African nurses found that higher EI is significantly associated with lower levels of job stress and burnout symptoms and that EI moderated the stress–burnout association (Görgens-Ekermans & Brand 2012). However, Shead *et al.* (2016) investigated the moderating role of EI in the association between violence and burnout in a cross-sectional study and found that EI did not moderate the association. It seems warranted to investigate whether EI is a moderator over time in the development of burnout symptoms.

Second, personality has been an area of interest since the early stages of burnout research. Maslach *et al.* (2001) already pointed out that individuals with higher neuroticism scores were more vulnerable to burnout. A meta-analysis by Swider and Zimmerman (2010) confirmed this association, and several personality characteristics seem to predict burnout. Evidence was presented for a positive association between burnout and neuroticism, and for negative associations between burnout and agreeableness, conscientiousness, and extraversion. Although these associations have been established it is unclear whether there are moderating effects from personality over time (Schaufeli *et al.* 2017).

Third, a lack of social support, especially from supervisors, seems to increase the risk of burnout (Maslach *et al.* 2001). Social support has also been suggested as a moderator (Day & Leiter 2014; Devereux *et al.* 2009; Maslach *et al.* 2001). In a study by Devereux *et al.*(2009), social support moderated the effect of work demands on Personal Accomplishment. In this study, we investigated whether social support also moderates between demands and burnout symptoms.

Day and Leiter (2014) pointed out that numerous suggested associations and interactions with burnout symptoms can only be tested using a longitudinal design. However, much of the available research is cross-sectional in nature. For this reason, several authors (see Day & Leiter 2014; Gelsema *et al.* 2006; Hensel *et al.* 2015) call for longitudinal studies that investigate the mediators and moderators that are associated with burnout symptoms which might aid the development of theory or interventions targeted at burnout symptoms.

Lastly, the use of physiological indicators of burnout and long-term job stress is gaining attention (Grossi *et al.* 2015; Jarczok *et al.* 2013). Long-term and acute stress can have detrimental effects on the body (Kamath *et al.* 2016), and autonomic nervous system activity markers such as heart rate and skin conductance (SC) have been suggested as indicators of acute or long-term stress and fatigue (Khanade & Sasangohar 2017). Traditionally, burnout is measured with questionnaires, which are a time-intensive method to establish the level of burnout symptoms. The use of nonintrusive, ambulatory physiological measures might aid in the detection of rising levels of burnout symptoms. In addition, these recordings might be regarded as more objective measures without the option to answer in a socially desirable manner as is the case with questionnaires. Previous studies have linked burnout with heart rate and heart rate

variability (Henning *et al.* 2014; Jönsson *et al.* 2015; Lennartsson *et al.* 2016; Moya-Albiol *et al.* 2010), but no associations with SC have been studied (Boucsein 2012). This study aims to investigate the association between heart rate, skin conductance, and burnout in which the following research questions were investigated:

1. Are individual changes in burnout symptoms associated with job stress, EI, personality, and patient aggression over time? And, if so, do these variables moderate this association over time?
2. Are individual changes in burnout symptoms associated with SC and heart rate over time?

METHOD

Participants and setting

Participants were mental health nursing staff members of forensic psychiatric hospitals for clients with intellectual disabilities and severe challenging behaviour. Participants were included in four waves of data collection over a 2-year time period (June 2015–July 2017). We included 110 participants (59% female) between the ages of 21 and 59 years (mean = 35.5, SD = 10.0). On average, there were 12 clients residing on each ward (SD = 3.5) and staff members worked with five colleagues per shift (SD = 1.6). The mean number of years that staff members were employed on the wards was 4.4 (SD = 3.9). The characteristics of the main study variables can be found in Table 1 where two-tailed Pearson's correlations with 95% bias-corrected and accelerated bootstrap confidence intervals are presented. In the first wave, 110 participants participated in the study, 95 participated in the second, 74 in the third, and 68 in the fourth wave. As for the burnout measures, in total 337 burnout questionnaires were obtained during the four waves. It was tested whether dropout from the study was dependent on the time employed in health care and nursing. There was no difference in dropout rates for time employed on the unit, time employed with this employer, or time employed in health care. The difference in the sum of burnout symptoms for the dropouts is 0.46 (Fig. 1), but this is nonsignificant (dropout = 9.27 vs 8.81, $P = 0.14$). Some noteworthy correlations in Table 1 are those between burnout symptoms and EI ($r = -0.49$), neuroticism ($r = 0.42$), and job stress ($r = 0.37$). On the basis of the scores of the burnout questionnaire, 12 participants would qualify for a clinical burnout, and 28% reported a larger number of demands than support.

Procedure

The scientific committee and committee of ethics of the Faculty of Social Sciences of the Radboud University at Nijmegen (ECSW2015-1901-282) approved the study. The minimum number of participants necessary for this study was 98. The parameters of the power analysis were set to 95% power, and an effect size of 0.2 ($\alpha = 0.05$) on four predictor variables in a repeated-measures design with within- and between-subject interaction.

Nursing staff members were initially invited and informed about the aim of the study through email, posters, and flyers. First, participants were asked to complete a personality and an EI questionnaire after they gave informed consent. Next, staff wore a wristband called the Empatica E4, which measured SC and heart rate during a full day or evening shift (night shifts were excluded). Following ambulatory assessment, participants were invited to complete questionnaires on burnout symptoms, job stress, and frequency and intensity of patient aggression as experienced over the past 6 months.

Materials and measures

The validated Dutch Maslach Burnout Inventory (Maslach *et al.* 1996) was used to assess burnout symptoms. This 20-item questionnaire has three subscales: Emotional Exhaustion (e.g. 'I feel tired when I get up in the morning'), Depersonalization (e.g. 'I can easily empathize with the feelings of patients/clients'), and Personal Accomplishment (e.g. 'I have accomplished a lot of valuable things in this job'). The items are rated on a 7-point Likert-type scale ranging from 0 (never) to 6 (every day). Clinical levels of burnout are established based on cut-off values: Emotional Exhaustion ≥ 2.2, Depersonalization ≥ 2, and Personal Accomplishment ≤ 3.66. The subscales get a value label of very low, low, medium, high, or very high based on normative data for mental health nurses (Schaufeli & Dierendonck 2000). To calculate burnout symptoms, the value label scores on Emotional Exhaustion, Depersonalization, and reverse-scored Personal Accomplishment were summed to indicate the number of burnout symptoms (i.e. a range of 3–15, all 'very low' or all 'very high'). Cronbach's alpha coefficients for the three subscales of the Dutch version are 0.86, 0.64, and 0.81, respectively (Schaufeli *et al.* 2001).

The Dutch Bar-On Emotional Quotient Inventory (Bar-On 2006) was used to assess emotional intelligence (EI). The Inventory consists of 133 items that

TABLE 1: *Correlations, intraclass correlations and descriptive statistics of study variable*

	Mean	SD	*N*	ICC	Gender[†]	1[‡]	2[§]	3[¶]	4[¶]	5[¶]	6[¶]	7[¶]	8	9[††]	10[‡‡]	11[‡‡]	12[‡‡]	13[‡‡]	14[f]	15[f]	16[f]	17	18
1. Burnout	9.24	1.67	337	0.67	0.05																		
2. Aggression	38.46	17.18	347	0.55	−0.04	0.17°°																	
3. Neuroticism	3.64	1.94	436		0.14°	0.42°°	0.02																
4. Extraversion	6.69	1.70	436		−0.08	−0.26°°	−0.11	−0.34°°															
5. Openness	5.54	2.12	436		0.02	0.02	0.04	0.14°	−0.01														
6. Altruism	6.23	1.70	436		−0.01	−0.34°°	−0.02	−0.33°°	−0.06	−0.09													
7. Conscientiousness	5.83	1.90	436		0.05	−0.19°°	−0.11	−0.10	0.18°°	−0.02	0.17°°												
8. EI	106.22	11.26	432		−0.05	−0.49°°	−0.03	−0.43°°	0.41°°	0.04	0.20°°	0.44°°											
9. Job stress	0.90	0.26	347	0.48	0.18°°	0.37°°	0.17°°	0.14°	−0.21°°	0.14°	−0.06	−0.12°	−0.21°°										
10. SCR	1.22	0.76	341	0.39	−0.12°	−0.05	0.00	0.08	−0.06	0.01	0.02	−0.04	−0.12°	−0.04									
11. SCL	1.16	1.79	341	0.50	−0.28°°	−0.04	0.05	−0.08	0.05	0.04	0.13°	−0.03	−0.02	−0.07	0.55°°								
12. RIS	1.88	0.15	341	0.35	0.02	0.01	0.15°	0.13°	0.01	0.02	−0.08	−0.12°	−0.08	−0.02	0.21°°	−0.01							
13. AMP	0.08	0.09	341	0.48	−0.27°°	−0.10	0.06	−0.04	0.02	0.03	0.09	−0.09	−0.05	−0.08	0.63°°	0.82°°	0.06						
14. DEC	0.87	0.13	341	0.15	−0.04	0.02	0.08	0.08	−0.10	0.00	−0.07	−0.08	−0.11	0.04	0.36°°	0.09	0.49°°	0.24°°					
15. WID	2.23	0.18	341	0.21	−0.03	0.00	0.12°	0.11	−0.07	0.02	−0.07	−0.12°	−0.13°	0.00	0.43°°	0.10	0.79°°	0.25°°	0.90°°				
16. AUC	0.21	0.23	341	0.51	−0.27°°	−0.10	0.05	−0.02	0.00	0.03	0.07	−0.09	−0.06	−0.08	0.66°°	0.77°°	0.09	0.99°°	0.30°°	0.31°°			
17. Temperature	35.97	3.39	336	0.02	−0.04	−0.09	−0.09	−0.02	−0.03	−0.04	−0.05	−0.05	0.01	−0.09	0.12°	0.12	−0.13°	0.16°°	0.10	0.02	0.16°°		
18. Movement	65.22	0.67	341	0.20	0.06	0.00	−0.05	0.00	0.04	−0.08	0.07	−0.05	−0.13°	0.05	0.14°	0.19°°	−0.03	0.21°°	0.01	0.00	0.20°°	0.23°°	
19. HR	84.12	5.76	319	0.61	0.27°°	−0.06	0.13°	0.05	0.03	−0.01	0.12°	−0.01	0.00	0.06	0.17°°	0.10	0.19°°	0.12°	−0.01	0.11	0.11	−0.07	0.28°°

*Correlation is significant at the 0.05 level (two-tailed); **Correlation is significant at the 0.01 level (two-tailed); Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples. [†]Gender in numeric variable 0 = male; [‡]Sum of EE, DP, and reverse-scored Personal Accomplishment; [§]Mean of the sum of product scores; [¶]Personality scores are stanine scores; [††]Demands divided by support above 1 is more demands than support; [‡‡]The Psychophysiological *N* is based on >2 hours of artefact-free data; *N* = 287 for the correlations; AMP, amplitude of an SCR; DEC, decay Time of an SCR; EI, emotional intelligence; HR, heart rate; RIS, rise time of an SCR; SCR, skin conductance response; SCL, skin conductance level; AUC, area under the curve of an SCR; WID, width of an SCR.

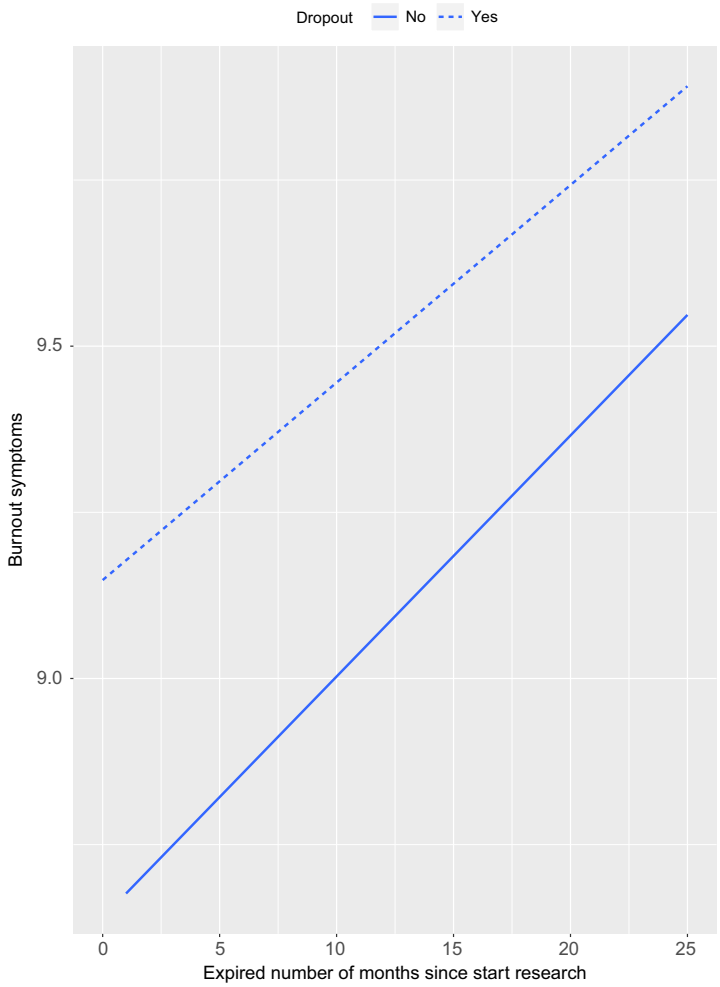

FIG. 1: *Regression slopes on the sum of burnout symptoms for dropouts vs nondropouts [Colour figure can be viewed at wileyonlinelibrary.com]*

are scored on a 5-point Likert scale ranging from 5 (very often true) to 1 (very seldom true). The Inventory results in one general Emotional Quotient score with a mean of 100 (SD = 15) and five subscales: Stress Management Skills, Interpersonal Skills, Amount of Adaptability, Intrapersonal Ability, and General Mood. The Cronbach's alpha coefficients for the five subscales ranged from 0.69 to 0.86 (Zijlmans *et al.* 2013).

The NEO Five-Factor Inventory (NEO-FFI) was used to assess personality. This 60-item validated Dutch version of the Big Five Personality Inventory (Costa & McCrae 1992) measures five personality traits: openness, conscientiousness, extraversion, agreeableness, and neuroticism. The items are scored on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). Each subscale is standardized to stanines with a mean of 5 (1 SD = 2). The Cronbach's alpha coefficients for the five subscales of the Dutch version ranged from 0.64 to 0.88 (Hoekstra *et al.* 1996).

The Demands and Support questionnaire was used to measure job stress (Rose 1999). The questionnaire was specifically designed to identify sources of job stress for people who work with clients with intellectual disabilities. The questions were rated on a 5-point Likert-type scale reflecting low (1) demands (and support) and high (5) levels of demand (and support). The demand questions and support questions were summed and divided by the total number of questions for each scale. The average demand was divided by the average support to obtain a fraction that reflected job stress. Scores above 1 indicate that a person experienced more demands than support. A score below 1 indicates that a participant experienced more support than demand. The score above 1 was used as an index of job stress. The demands over support were used as an

index of job stress. Cronbach's alpha's for the scales used in this study were 0.84 and 0.73, respectively.

Severity of patients' aggression as experienced by mental health staff was assessed with items on intensity and frequency of aggression. The nursing staff were asked how many times (frequency, ranging from never to very often) and how intense (intensity, ranging from not fierce to very fierce) aggression were experienced at work during the past 6 months resulting in a number between 1 and 10 for five types of aggression (see below). The severity of each type of aggression was calculated as the product of frequency and intensity. Severity was then summed into one total aggression score. The items are part of the Modified Overt Aggression Scale+ (Crocker *et al.* 2006) and the Modified Overt Aggression Scale (Oliver *et al.* 2007). The items addressed verbal aggression, physical aggression, aggression against objects, auto-aggression, and sexual aggression. In this study, Cronbach's alpha coefficients for both frequency and intensity scales were 0.75 and 0.72, respectively.

Physiological assessments

The Empatica E4 wristband was used to obtain the physiological data (Garbarino *et al.* 2014). For all four waves of data collection, the participants were instructed to wear the E4 on their nondominant hand for one-eight-hour shift. The E4 measures skin conductance (in μSiemens), temperature (in degrees Celsius), movement (the magnitude of acceleration), and heart rate (in beats per minute, which is based on the blood volume pulse). Boucsein (2012) describes several parameters to extract from the skin conductance signal. The average of the following parameters were extracted: skin conductance level (SCL), skin conductance peaks per minute (PPM), area under the curve (AUC) of these peaks, amplitude (AMP) of these peaks, width (WID) of these peaks, rise time (RIS) of the peaks, and decay time (DEC) of the peaks. The threshold for a skin conductance peak was set at 0.005 μSiemens. In addition, we controlled for movement and temperature as these are known to influence both heart rate (Kamath *et al.* 2016) and SC (Boucsein 2012).

Sample attrition

Only recordings with over 2 hours of artefact-free data were used in the analyses. The recordings on the wrist are artefact-prone as a result of movement or not wearing the wristband tightly enough. As a result, the quality of the recordings might be affected (Boucsein 2012). Therefore, all recordings were visually inspected and automatically checked with automated recognition software as is standard practice (Kleckner *et al.* 2017; Taylor *et al.* 2015) with the use of a batch Python 2.7 script, called 'eda explorer', developed by the Massachusetts Institute of Technology (Taylor *et al.* 2015). The amount of artefact-free data ranged from 4.91% to 99.71% (M = 83.1 SD = 17.8). The physiological data were obtained on a total of 347 recording days. At least 2 hours of clean artefact-free data were available for 341 of the 347 recording days. The temperature sensor was broken for five participants and set to missing.

Design and statistical analyses

The first research question regarding the individual change in burnout symptoms over time as a function of the four predictors (i.e. EI, personality, job stress, and patient aggression) was assessed with a longitudinal multilevel model (Hox *et al.* 2017) where the repeated measures (level 1) were nested within individuals (level 2). The multilevel model is especially useful in case there are missing data (see Table 1 for the main study variables). First, the time-varying predictor aggression and job stress were added to the model followed by the time-invariant predictors EI and personality. All predictors were tested as possible moderators over time. The second research question regarding the individual change in burnout symptoms over time as a function of physiological parameters was assessed using a similar multilevel model with physiological parameters as predictors while controlling for possible confounders such as movement and temperature. The analyses were performed with SPSS 24 and the nlme package in R (Pinheiro *et al.* 2018), to check the residuals as they are not given in SPSS. MLwiN version 2.36 was used to check for assumptions of normally distributed residuals on all levels of the model.

RESULTS

Burnout symptoms and moderators

Model 1 (Table 2) shows the empty model for burnout, which is estimated with a mean of 9.28 (SD = 1.67, range = 5–14). The repeated-measures variance is estimated at 0.93, with the subject-level variance at 1.88, which results in an ICC of 0.67 indicating that about two-thirds of the variance is explained at the subject level and one-third at the repeated-measures level. Model 2 predicts a value of 8.89, which increases with 0.035 each month. Considering that each interval of 1

TABLE 2: *Multilevel regression models for predictors of burnout*

	Model 1: Random intercept		Model 2: Random intercept with time		Model 3: Fixed level 1		Model 4: Fixed level 2		Model 5: Random Slope time		Model 6 Standardized model 4
	Parameter	SE	Parameter	SE	Parameter	SE	Parameter	SE	Parameter	SE	Parameter
FIXED											
Mean/intercept	9.28**	0.14	8.89**	0.17	6.90**	0.32	12.61**	1.31	12.69**	1.32	
Time			0.04**	0.01	0.03**	0.01	0.03**	0.01	0.03**	0.01	0.12
Job stress					1.88**	0.28	1.66**	0.27	1.70**	0.27	0.26
Aggression					0.01*	0.00	0.01*	0.00	0.01*	0.00	0.11
EI							−0.05**	0.01	−0.05**	0.01	−0.33
Neuroticism							0.16**	0.06	0.16*	0.06	0.19
Altruism							−0.14*	0.06	−0.14*	0.07	−0.14
RANDOM											
VAR(e(ij))§	0.93	0.10	0.84	0.08	0.72	0.07	0.72	0.07	0.62	0.07	
VAR(u(0j))§	1.88	0.30	1.94	0.31	1.61	0.26	0.89	0.16	1.06	0.26	
VAR(u(1j))§									0.00	0.00	
COVAR									−0.01	0.01	
FIT (par)											
Deviance	1141.11	3.00	1120.80	4.00	1060.87	6.00	990.30	9.00	986.18	11.00	
Diff Dev†				1.00	59.92	2.00	130.49	3.00	134.62	3.00	
AIC‡	1147.11		1128.80		1072.87		1008.30		1008.18		
Explained variance											
R2 level 1					0.14		0.15		0.27		
R2 level 2					0.17		0.54		0.46		

*Correlation is significant at the 0.05 level (two-tailed); **Correlation is significant at the 0.01 level (two-tailed); †cut-off value for test with 1 df is 3.84; cut-off value for test with 2 df is 5.99; ‡lowest AIC is best model; §In test of random parameters (both Wald and difference of deviances), *P* has to be divided by 2.

is a category change in Emotional Exhaustion, Depersonalization, or Personal Accomplishment, the model approximately predicts a change in category each 2 years. Multiple polynomials for the effect of time were fitted, but none of the higher order polynomial terms were significant. Both the time-varying predictors, job stress and aggression in model 3, have a significant positive effect, meaning that burnout symptoms increase with increasing job stress and aggression. It was also tested whether years working on the unit, with this employer or in health care, was a predictor, but neither three had a significant effect. Next, a model with three time-invariant predictors was fitted: EI, personality, and sex. Only EI and two personality traits (neuroticism and altruism) had a significant effect and were added to model 4. In line with what could be expected on the basis of earlier research, EI and altruism turned out to have a negative association with burnout symptoms, while neuroticism has a positive association. In model 5, a random slope for time was added, which did not result in a significant improvement compared to model 4 ($Dev = -4.12$, $df = 3$). This conclusion remained after adding an autoregressive covariance structure as burnout is known to have high autoregressive regression coefficients (Maslach *et al.* 2001). This means that participants do not vary significantly in their rate of change, and therefore, model 4 was the model of choice (Fig. 2). All predictor variables were also added to the models as interactions with time. However, none of the variables significantly moderated the effect of time within the multilevel model. In addition, it was tested whether the effect of time was moderated by social support, but this turned out not to be the case. The standardized coefficients (model 6) indicate that EI has the largest effect, followed by job stress and neuroticism. The effects for altruism, time, and aggression are approximately equal.

Burnout symptoms and psychophysiology

The empty model 1 and model 2 are identical to those in the previous analyses. Adding the time-varying predictors of psychophysiology in model 3 resulted in a significant negative effect for both AMP and AUC of the skin conductance assessments. Only the effects of the AMP are reported (Table 3) as there is a high correlation between AUC and AMP (0.988). Movement,

temperature, and heart rate which are also measured by the Empatica E4 did not have a significant effect in model 4. A random slope for time was added in model 5 as well as an autoregressive covariance structure, but this did not result in a significant improvement compared to model 4. Thus, participants do not vary significantly in their rate of change.

The models with EI, personality, job stress, and aggression might be considered as a psychological model, while the model with AMP of the skin conductance assessments can be considered as a physiological model. To test the relative influence of the physiological part of the model, it was checked whether the effect of AMP would still be significant in model 4 of the psychological variables. Indeed, the AMP remained significant in model 4 of the psychological variables (standardized beta = −0.093). Finally, the residuals at each level were tested for normality and multicollinearity, and all indices were good (i.e. were normally distributed and had a VIF < 10).

DISCUSSION

Main findings

The present study investigated individual changes in, and moderators of, burnout symptoms of mental health nurses as a function of EI, personality, patient aggression as experienced by nursing staff, and job stress. In addition, individual changes in burnout scores as a function of skin conductance and heart rate were investigated, which resulted in four main findings. First, the proposed predictors EI, personality, aggression, and job stress are associated with burnout over time. Second, none of these predictors moderated the association over time. Third, the AMP of the SC assessments was associated with burnout symptoms over time and this physiological effect remained after controlling for the psychological predictor variables. Fourth, social support did not moderate the development of burnout symptoms over time.

Considering the first research question, associations were found between burnout and EI, personality, patient aggression, and job stress. However, no moderation effects were found. In line with earlier research (Beauvais *et al.* 2017; Görgens-Ekermans & Brand 2012; Zysberg *et al.* 2017), the results suggest that EI has a protective influence on the development of burnout symptoms. Moreover, standardized parameters suggest it has the largest influence of all four predictors. Training staff members' EI may be helpful to prevent burnout (Zijlmans *et al.* 2011). As for the moderation, the results suggest no moderation effects of EI, which means that the development of burnout is not different at differing levels of EI. These results are in line with the Shead *et al.* (2016) study. However, a study by Görgens-Ekermans and Brand (2012) found a moderating effect of EI in the job stress–burnout association. The difference with these studies is that in our study, moderation was investigated over time while other

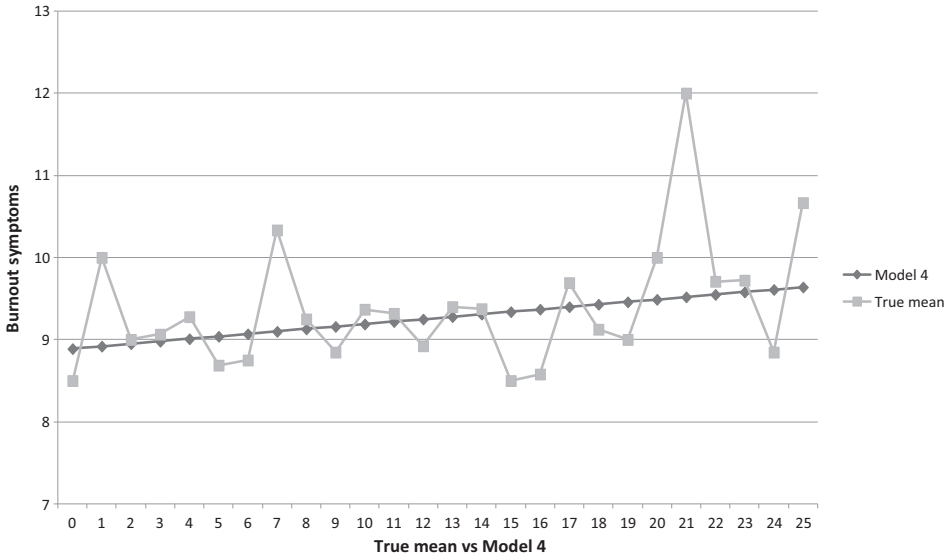

FIG. 2: *Mean sum of burnout scores vs estimated mean burnout scores in model 4*

studies used job stress and violence as moderators with EI. We tested for a moderation effect of EI between job stress and burnout (not reported), but did not find a significant effect. Future research should focus on specific combinations of moderators or mediation effects in the development of burnout symptoms.

For the association between burnout symptoms and personality, the association was significant for neuroticism (Maslach *et al.* 2001; Winstanley & Whittington 2002) and altruism (Swider & Zimmerman 2010). Staff members with a high level of neuroticism experience more burnout symptoms, whereas high altruism scores are associated with lower burnout levels. These findings can be useful in allocating mental health nursing staff to psychiatric wards with high job stress demands. The expected negative association with conscientiousness and extraversion (see Swider & Zimmerman 2010) was confirmed only for the bivariate correlations. However, the associations were nonsignificant controlling for the other predictors. In this study, personality factors of neuroticism and altruism seem to play a larger role than the other three personality factors and are the only significant effects when considering the longitudinal multilevel structure of the data set. The strength of the associations of EI and personality with burnout thus seems to change somewhat when we examine these associations over time and in a multilevel framework. It is, therefore, essential to take into account both the longitudinal and individual differences in levels of burnout symptoms.

The association between job stress and burnout is the second strongest association and in line with other studies focussing on the influence of long-term job stressors (Leiter *et al.* 2014; Schaufeli *et al.* 2017) and the autoregressive nature of burnout (Maslach *et al.* 2001). Again, no moderation effects over time were found, which also indicates that there are no differences in rate of burnout development at differing levels of job stress. Nevertheless, this result clearly indicates that lowering job stressors and demands may decrease burnout symptoms in mental health staff members. A way to decrease job stress is increasing the number of nurses per shift (Johnson *et al.* 2018), while larger complements of staff could potentially decrease the amount of aggression (Brandt *et al.* 2016).

The association between burnout and patient aggression as experienced by staff is consistent with earlier research. The correlations between aggression and burnout symptoms were not as high as those in the Winstanley and Whittington (2002) investigation, but

TABLE 3: *Multilevel regression models for physiological predictors of burnout*

	Model 1: Random intercept		Model 2: Random intercept with time		Model 3: Fixed level 1		Model 4: Fixed level 1 control		Model 5: Random Slope time	
	Parameter	*SE*	*Parameter*	*SE*	*Parameter*	*SE*	*Parameter*	*SE*	*Parameter*	*SE*
FIXED										
mean/intercept	9.28**	0.14	8.89**	0.17	9.04**	0.18	7.91	6.97	9.03**	0.19
time			0.04**	0.01	0.04**	0.01	0.03**	0.01	0.04**	0.01
AMP					−1.86*	0.88	−1.82*	0.91	−1.79*	0.88
Temperature							−0.03	0.02		
Movement							0.03	0.11		
RANDOM										
VAR(e(ij))[§]	0.93	0.09	0.84	0.08	0.87	0.09	0.88	0.09	0.75	0.09
VAR(u(0j))[§]	1.88	0.30	1.94	0.31	1.86	0.30	1.86	0.30	2.31	0.45
VAR(u(1j))[§]									0.00	0.00
AutoCor									−0.45	0.18
FIT (par)										
Deviance	1141.11	3.00	1120.80	4.00	1064.39	5.00	1051.76	7.00	1060.56	7.00
Diff Dev[†]				1.00	56.40	1.00	69.04	3.00	60.24	2.00
AIC[‡]	1147.11		1128.80		1074.39		1065.76		1074.56	
Explained variance										
R2 level 1					−0.03		−0.04		0.11	
R2 level 2					0.04		0.04		0.74	
R2 cross-level interaction										

*Correlation is significant at the 0.05 level (two-tailed); **Correlation is significant at the 0.01 level (two-tailed); [†]cut-off value for test with 1 df is 3.84; cut-off value for test with 2 df is 5.99; [‡]lowest AIC is best model; [§]In test of random parameters (both Wald and difference of deviances), *P* has to be divided by 2.

similar to those reported by Hensel *et al.* (2015). One reason for this finding might be that we considered the entire burnout scale as well as the entire aggression scale as opposed to using subscales. The use of the entire scales does strengthen our confidence in the association between the constructs. Therefore, what is added in this study is that the association is not only evident with physical aggression (Hensel *et al.* 2015) or interpersonal aggression (Evers *et al.* 2002), but for a broader construct of aggression as we included several types of aggression. We were unable to test for mediation effects in a structural equation model over time as our sample was too small. This is an interesting area of research as Winstanley and Whittington (2002) already posed the question whether aggression causes burnout or vice versa. Future research on this topic is warranted as there is a growing literature on longitudinal mediation analysis (VanderWeele & Tchetgen 2017; Zheng & van der Laan 2017).

The second research question, regarding the association between burnout symptoms and physiology, was partially confirmed as only the effects of AUC and AMP of the skin conductance assessments were significant, but no significant effects of heart rate were found. We found that the AMP and AUC get smaller as burnout symptoms increase. The confidence of this result was strengthened because this association remained significant after controlling for the psychological predictors. However, the relative influence of amplitude is smaller than that of EI, for example, as the standardized beta points out. Nevertheless, early detection of changing levels of AMP could indicate rising levels of burnout symptoms and subsequently help prevent staff turnover and absenteeism, although it remains to be seen if staff members would accept this 'surveillance' where it to be adopted routinely.

Two particular strengths of this study can be identified. First, the nature of this study partially fulfils the need for longitudinal studies (Schaufeli *et al.* 2017) with which the changes in burnout symptoms can be studied. In addition, specific predictors and moderators can be studied that might aid the development of theory and intervention targeted at burnout. Second, the findings related to particular risk and protective factors are identified in earlier research, and their association with burnout symptoms is important as replication of psychological science is not self-evident (Makel *et al.* 2012).

However, there are also some limitations. First, we were unable to study causal connections because of the relatively small sample size. Second, the time interval between the physiological measures was large and there is great variation in physiology on a day-to-day basis. Careful 24/7 monitoring is needed to establish the exact nature of the associations. Also, the intervals were 6 months to test whether there were longitudinal changes in burnout symptoms. To increase the likelihood of early detection of increasing levels of burnout symptoms, shorter time intervals are needed. The third limitation is the amount of data loss of the physiology sensors. This poses a problem for real-time measures, although statistical techniques such as the multilevel framework take into account incomplete data sets. The sensors seem useful for the detection of long-term heart rate and skin conductance, but not for more sensitive measures such as heart rate variability, as they strongly depend on the correct registration of beats per minute. However, efforts should be made to increase the accuracy of these wrist-worn devices.

Relevance for clinical practice

There are at least four implications for practice, which might also be of interest to employers and organizations. First, it is important to monitor nursing staff regularly, especially nursing staff with relatively higher levels of neuroticism, lower EI, and higher levels of job stress as they are at a higher risk of turnover or absenteeism. Although the focus of this study was targeted at psychological variables, there is arguably a balance between considering individual characteristics of staff members and attempting to alter the working conditions as well to increase the person–job fit.

Second, physiological monitoring might be a feasible and objective and unobtrusive monitoring tool to signal rising levels of burnout symptoms. Specifically, AMP and AUC may be useful indicators. Recognizing the variation between and within persons in physiology (Boucsein 2012; Kamath *et al.* 2016) underlines the need for more personalized models to predict burnout symptoms. Third, on the short term it is recommendable to monitor nursing staff after they encountered severe aggressive behaviour and provide social support. Fourth, long-term interventions focussing on increasing EI in mental health nurses are promising (Zijlmans *et al.* 2011), which may potentially result in higher levels of resilience against job stress and burnout. Through the advanced knowledge to inform organizational practice, this study might be helpful in keeping that what starts out as pleasant, energetic, meaningful work stays that way and does not change into unpleasant, exhausting, and meaningless work (Maslach *et al.* 2001).

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ETHICAL STATEMENT

All research with participants was conducted in line with the Helsinki declaration for studies on human subjects.

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