Personality factors predicting changes in shift work tolerance: A longitudinal study among nurses working rotating shifts

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Personality factors predicting changes in shift work tolerance: A longitudinal study among nurses working rotating shifts

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The aim of the present study was to investigate the relationship between personality factors (hardiness, morningness, flexibility, and languidity) and longitudinal changes on different measures of shift work tolerance (fatigue, sleepiness, anxiety and depression) over one year among nurses working rotating shifts. A total of 642 female Norwegian nurses working in a rotating three-shift schedule participated in the study. The cohort was established by age-stratified selection among members of the Norwegian Nurses Association in 2008. Questionnaires were administered in 2008/2009 (T1) and in 2009/2010 (T2). The results showed that hardiness was negatively related to fatigue, anxiety and depression at T2 when controlling for the scores on these constructs at T1. Morningness was not related to any indicators of shift work tolerance at T2 when controlling for shift work tolerance at T1. Flexibility was negatively related to anxiety at T2 when controlling for anxiety at T1. Languidity was positively related to sleepiness and fatigue at T2 when controlling for sleepiness and fatigue at T1. The findings indicate that personality factors, especially hardiness, can predict changes related to shift work tolerance over a period of one year.

Keywords: shift work tolerance; personality; hardiness; longitudinal; nurses

Introduction

Shift work can be defined as work taking place outside the standard hours of 8 am to 5 pm, Monday through Friday (Grosswald, 2004) that comprises different persons/teams working in succession to cover more than the standard hours of the work day (Costa, 2003). Studies have shown that shift work and night work can have major negative effects on sleep and alertness (Åkerstedt, 2003); health, for example, in terms of increased risk of cardiovascular disease (Puttonen, Hårmå, & Hublin, 2010); as well as accident rates and safety (Folkard & Tucker, 2003). Shift Work
Tolerance (SWT) was first described by Andlauer, Reinberg, Fourre, Battle, and Duverneuil (1979) as the ability to adapt to shift work without adverse impacts, especially in terms of resistance to digestive troubles, persisting fatigue and unusual nervousness and sleep alterations. Later, Reinberg and Ashkenazi (2008) added the following as indicators of shift work intolerance: regular use of sleep medication and changes in behaviour such as increased aggression and sensitivity. In line with Andlauer et al. (1979) and Reinberg and Ashckenazi's (2008) description of SWT, the following states can be seen as symptoms of poor SWT: high levels of daytime sleepiness, high levels of fatigue, and high levels of anxiety and depression.

These symptoms can often be seen among nurses who, due to the nature of their work, often have to work shifts (Burch et al., 2009). Rotating shift work is probably the most common shift schedule among nurses, and comprises a pattern of day, evening and night work. Nurses working rotating shifts are reported to get insufficient amounts of sleep compared to nurses not working shifts (Chan, 2009). Rotating shift work often leads to desynchronization of the circadian rhythm, which is, together with sleep deprivation, thought to be one of the main causes of many clinical complications associated with shift work (Chandrawanshi & Pati, 2000). It is also reported that working night shifts is the most important cause of long-term stress and fatigue among nurses (Winwood, Winefield, & Lushington, 2006). However, the stress, health and sleep problems that stem from shift work may be perceived differently across individuals. Hence, the personality of the shift worker can be of importance. Despite this, there are very few studies of a predictive nature that investigate the relation between SWT and personality among nurses. In the present study we examine whether personality factors can predict changes in measures of SWT over one year, in a sample of nurses working rotating shifts.

Bohle (1997) names shift work a “significant occupational stressor” (p. 369). Identifying factors related to better coping with shift work should therefore be of large interest for research and practice in the field of work and stress. Individual differences have been acknowledged as important in several theoretical models concerning stress in the work place (e.g. Karasek & Theorell, 1990; Siegrist, 2001). Individual characteristics have also been found to be highly relevant for the perception of stressors. In a recent cross-sectional study it was found that personality traits were related to perception of both positive and negative stress across different types of work arenas and occupations (Saksvik & Hetland, 2011). In a model summing up factors influencing tolerance to shift work specifically, individual characteristics are mentioned as one of four key aspects (Costa, 2004). The possible relation between personality and SWT can be seen as a measure of fit between the person and the environment or the job. The term “person-environment fit” can be defined as a congruence between norms, values or physical work conditions for an organization or work place and the individual (Furnham, 2005). Good person-environment fit seems to be related to better work satisfaction and better ways of coping with stress-related outcomes (Furnham, 2005; Judge & Kristof-Brown, 2004). Thus, identifying personality traits that can predict SWT could be important for person-environment fit research, and thereby help to improve (shift) work conditions for individuals.

In previous reviews, primarily based on cross-sectional studies, it has been concluded that low scores on the personality factors morningness, “languidity” (languor) and neuroticism and high scores on the personality factors flexibility,
extraversion and internal locus of control are associated with better shift work tolerance (Saksvik, Bjorvatn, Hetland, Sandal, & Pallesen, 2011). However, contradictory findings have been reported in both experimental and questionnaire-based studies (Burch et al., 2009; Folkard & Hunt, 2000; Reinberg & Ashkenazi, 2008; Willis, O’Connor, & Smith, 2008). Generally, various different results have been obtained for the relation between personality and SWT in cross-sectional studies. Accordingly, in the present study we sought to clarify the relations between SWT and the personality variables hardiness, morningness, flexibility and languidity, using a longitudinal design. These traits have been selected for investigation in relation to SWT because they are assumed to be especially important. Hardiness was chosen because it has in several studies been associated with coping with stress and thus is a core construct in contemporary stress research. Shift work has in many studies been related to poor health and diseases (Pati, Chandrawanshi, & Reinberg, 2001), and hardiness is, in particular, assumed to protect against stress and illness (Kobasa, 1979). Morningness, flexibility and languidity were chosen because of their relation to sleep and circadian rhythms. Sleep problems are found to be the most common health complaint among shift workers (Åkerstedt, 2003). Although it is a matter for debate whether morningness, flexibility and languidity actually represent personality factors, they are still regarded as important individual differences (e.g. Di Milia, Smith, & Folkard, 2005; Natale & Cicogna, 2002). In the present study, “personality factors” will be used as a common term for these constructs.

Hardiness is regarded as a resilience resource that can be applied in stressful situations and which is assumed to prevent the person from falling ill during stress (Kobasa, 1979). Hardiness is defined by a high sense of life and work commitment, high belief in control, and high openness to change and challenges, as well as a more positive perception of stress. There seem to have been few studies investigating the relationship between hardiness and SWT, especially over the last decade. However, a newly published cross-sectional study showed that hardiness was negatively associated with sleepiness, insomnia, anxiety and depression (Natvik et al., 2011). Furthermore, in a longitudinal study published in 1997, it was established that two of the three sub-facets of the hardiness trait (commitment and challenge) could predict adaptation to shift work among nurses after six months (Bohle, 1997). Still, hardiness as an overall trait (including all the three sub-facets) could not predict adaptation to shift work after six months and 15 months. Consequently, Bohle (1997) concluded that hardiness seems to be a poor predictor of shift workers’ perception of stress related to working shifts. Due to these conflicting results, one goal of this paper was to re-examine the relation between hardiness and SWT longitudinally.

Morningness/eveningness is a dimension describing individual differences in circadian typology. This dimension is also often described as a trait that reflects individual’s diurnal preference (Roberts & Kylönen, 1999). Individuals with high scores on morningness (morning types) have their peak of alertness earlier in the day relative to individuals with low scores on morningness (evening types) (Natale & Cicogna, 2002). Although a handful of studies published in the last decade suggest that low scores on morningness are positively related to SWT (Saksvik et al., 2011), the results concerning this trait are overall inconclusive (Härmä, 1993). This pertains also to rotating shift workers. Some studies on this group report that morningness is positively related to SWT (Härmä, Partinen, Repo, Sorsa, & Siivonen, 2008; Willis et al., 2008), whereas others the opposite (Khaleque, 1999;
McLaughlin, Bowman, Bradley, & Mistlberger, 2008; Ognianova, Dalbokova, & Stanchev, 1998; Seo, Matsumoto, Park, Shinkoda, & Noh, 2000; Smith, Tanigawa, et al., 2005; Takahashi et al., 2005). One problem with many of these studies is the heavy preponderance of males in the samples (e.g. Khaleque, 1999; Ognianova et al., 1998; Seo et al., 2000; Smith, Tanigawa, et al., 2005; Takahashi et al., 2005). Thus, findings from these studies may have limited generalizability in terms of gender.

The terms flexibility/rigidity and languidity/vigourosity are concerned with the stability and amplitude of the circadian rhythm (Di Milia et al., 2005). Flexibility is a term used to describe the stability of the circadian rhythm of individuals. High scores are associated with the ability to sleep and work at unusual times whereas individuals with low scores on this dimension are classified as more rigid. Languidity/vigourosity describes the amplitude of the circadian rhythm. Individuals with high scores on languidity will have a lower rhythm amplitude, and will consequently be less alert and have a higher sleep need (Di Milia et al., 2005). The opposite, vigorous types, will have a higher circadian rhythm amplitude. There are not many studies investigating the relation between circadian amplitude/rhythm and SWT. Moreover, the few studies conducted in the last decade have been cross-sectional and have indicated that high scores on flexibility and low scores on languidity are related to higher SWT (Di Milia et al., 2005; Ognianova et al., 1998).

All reviews investigating the relation between personality and SWT, consistently and urgently call for studies investigating the predictive role of individual differences in SWT, as the great majority of previous studies have been cross-sectional (Härmä, 1993; Nachreiner, 1998; Saksvik et al., 2011). In fact, not one single longitudinal study investigating the relation between personality factors and SWT published within the last decade was identified in a systematic review recently conducted by our research group (Saksvik et al., 2011).

In line with the theory of person-environment fit, research concerning the relation between shift work tolerance and personality among nurses working rotating shifts may add to knowledge about personnel selection and vocational counselling in shift work. Also, this kind of research may give input to guidelines for designing and tailoring interventions promoting adaptation to shift work.

In this longitudinal study we investigated how the personality traits morningness, flexibility, languidity and hardiness measured at T1 predicted changes in SWT (measured in terms of sleepiness, fatigue, anxiety and depression one year later: T2) over the course of one year in a sample of nurses on a rotating three-shift schedule. Specifically, we investigated the following hypotheses:

**Hypothesis 1:** Hardiness will positively predict a decrease in sleepiness, fatigue, anxiety and depression at T2 when controlling for the scores on these variables at T1.

**Hypothesis 2:** Morningness will positively predict an increase in sleepiness, fatigue, anxiety and depression at T2 when controlling for the scores on these variables at T1.

**Hypothesis 3:** Flexibility will positively predict a decrease in sleepiness, fatigue, anxiety and depression at T2 when controlling for the scores on these variables at T1.

**Hypothesis 4:** Languidity will positively predict an increase in sleepiness, fatigue, anxiety and depression at T2 when controlling for the scores on these variables at T1.
Methods

Sample

A cohort of 2059 nurses was established in 2008 (T1). They were all registered members of the Norwegian Nurses Association, and originally 6000 nurses were invited. This population comprised almost all employed nurses in Norway educated since 1996. The sample was stratified by how long it was since they completed their nursing education. Five strata of 1200 nurses were applied; 0–1 years since completion of degree, 1.1–3 years, 3.1–6 years, 6.1–9 years and 9.1–12 years. Stratification was performed to ensure an equal distribution of nurses with different times since completion of their nursing degree. The response rate was 38.1%. In the second part of the study (T2), the same 2059 nurses were asked to complete new questionnaires. A total of 1586 responded (response rate 77%). Out of all the participants, 707 worked a rotating three-shift schedule on both T1 and T2. There were 642 (90.8%) women and 62 (8.8%) men. Three persons did not answer the question about gender. Because there were so few men, these were excluded from the analysis. Thus, only female nurses working in a rotating three-shift schedule both at T1 and T2 were included in the present study, giving a sample size of 642. The rotating three-shift schedule was comprised of day work, evening work, and night work. The amount of day, evening and night shifts per week differed among the nurses, but usually they worked fewer night shifts than day and evening shifts. Furthermore, the direction as well as the speed of the rotating three-shift schedules differed among the nurses included in the present study.

The mean age at T1 was 32.3 years (SD = 7.7) and the mean years of work experience as a nurse (working either day, evenings, night and rotating shift schedules) was 4.9 years (SD = 3.8). The nurses worked in somatic and psychiatric hospital departments, out-patient clinics, nursing homes, homecare services and public health centres. A total of 294 (45.8%) reported that they had children living at home. Ten (1.6%) nurses reported that they had a position under 50% of full time, 183 (28.5%) a position between 50 and 70% of full time, 88 (13.7%) held a position between 76–90% of full time and 359 (55.9%) nurses had a position higher than 90% of full time, respectively.

Procedure

At Time 1 (T1) the data collection took place from November 2008 to March 2009. For Time 2 (T2) the questionnaires were collected approximately one year after T1, from January 2010 to May 2010. The participants received an information letter explaining the purpose of the study at T1, and a letter of recommendation of the study from the Norwegian Nurses Association. The participants received the questionnaires along with a prepaid envelope for return of the completed questionnaire. For each time of data collection two reminders, one with a new questionnaire, were sent to nurses who did not answer after the first data collection. Participation in the study was voluntarily. As an incentive, gift cards worth 500 NOK (about 64 Euros or 85 USD) were given as a reward to 25 random respondents through a lottery. The project was approved by the Regional Committee for Medical and Health Research Ethics in Western Norway.
Instruments

The instruments relevant for this study administered at T1 were: Questions about age and gender, as well as instruments measuring personality and SWT. The instruments administered at T2 were: Questions about number of nights worked last year, whether or not the respondents had children living at home and percentage of full-time position as well as instruments measuring SWT. Norwegian language versions of all the instruments were applied.

Instruments measuring individual differences were included only at T1. These were: The Dispositional Resilience (Hardiness) Scale (Bartone, 1989) to measure hardiness, The Diurnal Scale (Torsvall & Åkerstedt, 1980) to measure morningness, and the Circadian Type Inventory (Di Milia et al., 2005) to measure flexibility and languidity.

The Dispositional Resilience (Hardiness) Scale – Revised (DRS-15-R). The DRS-15-R consists of 15 statements that represent different attitudes and thoughts. The respondents are asked to answer on a four-point scale, ranging from “not at all true” to “completely true”, how true the statements are for them. This instrument measures hardiness, and has three sub-dimensions: commitment, control and challenge, and was first presented by Bartone (1989). A study investigating the psychometric properties of the Norwegian version of the DRS-15-R was recently published (Hystad, Eid, Johnsen, Laberg, & Bartone, 2010). The Cronbach’s alpha for this instrument in the present study was .70.

Diurnal Scale (DS). The DS consists of seven questions about preferences and habits concerning sleep time and wake time. Four response alternatives are provided for each question with different ratings. This instrument measures diurnal types and differentiate between morning, evening and intermediate types in sleep/wake habits. The instrument was constructed by Torsvall and Åkerstedt (1980), who also confirmed the scale’s validity and consistency among shift workers. The Cronbach’s alpha for the Diurnal Scale was .64 in the present study.

Circadian Type Inventory (CTI). The CTI is composed of eleven questions concerning the respondents’ daily sleep, wake and activity habits and preferences. The respondents apply their answers on a five-point scale ranging from “almost never” to “almost always”. This instrument measures the respondents’ circadian rhythm stability and amplitude in the form of vigourosity/languidity and flexibility/rigidity. The instrument has been validated in a sample of workers (Di Milia et al., 2005). In the present study, the Cronbach’s alpha for the languidity subscale was .66, and for flexibility it was .77.

Instruments measuring important parts of SWT were administered at both T1 and T2. These were: the Epworth Sleepiness Scale (Johns, 1991), the Fatigue Questionnaire (Chalder et al., 1993), and the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983).

Epworth Sleepiness Scale (ESS). The ESS measures daytime sleepiness and consists of eight items that represent specific situations. The respondents are asked to rate how likely they are to doze off on a scale from 0 to 3 in the situation. The Norwegian
version of the ESS has been validated (Pallesen et al., 2007) and is found to have high reliability (Beiske, Kjelsberg, Ruud, & Stavem, 2009). In the present study the Cronbach’s alpha of the scale was calculated to be .76.

**Fatigue Questionnaire (FQ).** The FQ asks 11 questions about feelings of fatigue over the last month. Respondents are asked to state how often, or to what degree, these problems have occurred during the last month, on a four-point scale from “less than usual” to “much more than usual” or “better than usual” to “much worse than usual”. The instrument is validated in a general population and has good psychometric properties (Chalder et al., 1993). The Norwegian version of the scale is validated in a large study of a representative sample of the general Norwegian population (Loge, Ekeberg, & Kaasa, 1998). Cronbach’s alpha was .89 in the present study.

**Hospital Anxiety and Depression Scale (HADS).** The HADS consists of 14 statements, of which seven measure non-vegetative anxiety symptoms, and seven measure non-vegetative depression symptoms. The response rate is from zero to three, with different response options. The HADS is found to be reliable in the setting of a hospital medical outpatient clinic (Zigmond & Snaith, 1983), and a non-clinical sample (Crawford, Henry, Crombie, & Taylor, 2002). The validity of the instrument in both the clinical and general population is confirmed in a literature review (Bjelland, Cahl, Haug, & Neckelmann, 2002). The Norwegian version is validated in a large sample of the general population (Mykletun, Stordal, & Dahl, 2001). For anxiety the Cronbach’s alpha was 82, while for depression the Cronbach’s alpha was .80 in the present study.

The amount of missing data in the entire dataset was 2.3%. No missing substitution was performed, except for in the Fatigue Questionnaire, where standard procedure was used.

**Statistical analysis**

Hierarchal regression analyses were performed to investigate the relationship between personality factors at T1 and measures of SWT at T2, controlling for the measure of SWT at T1. Controlling for SWT at T1 makes it possible to see how much of the changes in the scores of SWT from T1 to T2 can be explained by personality.

The statistical program PASW version 17 (SPSS/PASW, Inc., Chicago, IL) was applied to conduct the analyses. The dependent variables comprised the four indicators of SWT administered at T2: sleepiness, fatigue, anxiety and depression. Hence, four separate hierarchical regression analyses were performed. All the four hierarchical regression analyses were conducted in three steps. Step 1 included age, children living at home, percentage of working hours per week and number of nights worked at T2. In step 2 the measure of SWT applied in each of the specific analyses for T1 was entered. For example, in the analysis of sleepiness at T2, sleepiness at T1 was entered in step 2. Lastly, in step 3 (the final model), the four measures of personality (hardiness, morningness, flexibility, and languidity hardiness) were entered.
Results

Changes in mean scores of sleepiness, fatigue, anxiety and depression from T1 to T2 were minimal (see Table 1). The correlation matrix shows that there were many significant correlations between the independent variables and the dependent variables (see Table 2). However the correlations were generally small to moderate. Most of the personality variables correlated significantly with all the dependent variables: sleepiness, fatigue, anxiety and depression at T2. Hardiness at T1 had a negative, significant correlation with anxiety and depression at T2 at above .3. Languidity at T1 showed a positive, significant correlation above .3 with sleepiness at T2. All the other correlations between the personality variables at T1 and sleepiness, fatigue, anxiety and depression at T2 were below .3.

Prior to performing the regression analysis, the data were checked for multicollinearity, normality, linearity, homoscedasticity, independence of residuals and outliers. No major violations of the assumptions of the regression analysis were found. A few outliers were seen in the analyses: two in the fatigue analysis, and one each in the anxiety and depression analyses. Additional analyses were performed without the respondents causing the outliers, to see if they strongly affected the results, which they did not. Accordingly we decided to keep the original analyses, including the outliers.

The results of the hierarchical regression analyses for sleepiness show that 48% of the variance in sleepiness at T2 was explained by the final model including all the variables ($F(9583) = 58.91, p < .001$; see Table 2). The demographic variables age, children at home, percentage of full-time position and number of nights worked in the last year explained 4% of the variance in sleepiness at T2 (see Table 2). When also entering sleepiness at T1 in the model, the model explained an additional 43% of the variance in sleepiness at T2. Step 3 with the demographic variables, sleepiness at T1 and the personality factors explained an additional 1% of the variance in sleepiness at T2. Children living at home, age and sleepiness at T1 had a significant positive relation to sleepiness at T2 in the final model. Of the personality variables, only languidity showed a significant relation to sleepiness at T2, this relationship was positive.

For fatigue at T2, the final model explained 27% of the variance in fatigue at T2 ($F(9583) = 23.46, p < .001$). The demographic variables alone entered in step 1 explained 0.1% of the variance, step 2 explained an additional 22% of the variance, while step 3 including the personality factors explained additionally 3% of the variance in fatigue at T2. Children living at home and fatigue at T1 was significantly, positively related to fatigue at T2 in the final model. The same was the case for languidity. Hardiness was significantly, negatively related to fatigue at T2.

The multiple regression analyses for symptoms of anxiety and depression showed that concerning anxiety, the final model explained a total of 44% of the variance in anxiety at T2 ($F(9583) = 51.49, p < .001$; see Table 2). Step 1 did not explain any of the variance in anxiety at T2. Step 2 explained 43%, while step 3 including all the variables explained an additional 2% of the variance in anxiety at T2. Having children at home was significantly, negatively related to anxiety at T2. Anxiety at T1 was significantly, positively related to anxiety at T2 in the final model. For the personality variables, both hardness and flexibility were significantly, negatively related to anxiety at T2.
Table 1. Means, standard deviations and correlations for all study variables except dichotomous variables ($N = 614–642$).

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<thead>
<tr>
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<th>Mean (SD)</th>
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<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
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</thead>
<tbody>
<tr>
<td>1. Age</td>
<td>32.3 (7.7)</td>
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<td>2. Nights worked last year T2</td>
<td>30.7 (19.0)</td>
<td>−0.03</td>
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<tr>
<td>3. Percentage of full-time position</td>
<td>3.26 (0.91)</td>
<td>−0.01</td>
<td>0.06</td>
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<tr>
<td>4. Sleepiness T1</td>
<td>8.7 (3.8)</td>
<td>−0.11**</td>
<td>0.09*</td>
<td>0.06</td>
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<tr>
<td>5. Fatigue T1</td>
<td>13.5 (4.3)</td>
<td>−0.00</td>
<td>0.01</td>
<td>−0.02</td>
<td>0.29**</td>
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<tr>
<td>6. Anxiety T1</td>
<td>4.5 (3.8)</td>
<td>−0.03</td>
<td>0.06</td>
<td>0.01</td>
<td>0.27**</td>
<td>0.46**</td>
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<tr>
<td>7. Depression T1</td>
<td>2.6 (2.7)</td>
<td>0.06</td>
<td>−0.01</td>
<td>0.01</td>
<td>0.25**</td>
<td>0.58**</td>
<td>0.66**</td>
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<tr>
<td>8. Hardiness</td>
<td>31.7 (4.1)</td>
<td>0.01</td>
<td>−0.03</td>
<td>0.04</td>
<td>−0.17**</td>
<td>−0.27**</td>
<td>−0.34**</td>
<td>−0.38**</td>
<td>–</td>
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<tr>
<td>9. Morningness</td>
<td>17.9 (3.3)</td>
<td>0.09*</td>
<td>−0.04</td>
<td>−0.13**</td>
<td>−0.13**</td>
<td>−0.19**</td>
<td>−0.15**</td>
<td>−0.14**</td>
<td>0.07</td>
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<tr>
<td>10. Flexibility</td>
<td>12.2 (3.7)</td>
<td>−0.04</td>
<td>0.08</td>
<td>0.17**</td>
<td>−0.04</td>
<td>−0.09*</td>
<td>−0.04</td>
<td>−0.09*</td>
<td>0.10</td>
<td>−0.31**</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>11. Languidity</td>
<td>20.8 (3.5)</td>
<td>−0.20**</td>
<td>0.04</td>
<td>0.06</td>
<td>0.32**</td>
<td>0.33**</td>
<td>0.24**</td>
<td>0.23**</td>
<td>−0.16**</td>
<td>−0.44*</td>
<td>−0.09*</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>12. Sleepiness T2</td>
<td>8.6 (3.8)</td>
<td>−0.03</td>
<td>0.12**</td>
<td>0.09*</td>
<td>0.67**</td>
<td>0.30**</td>
<td>0.29**</td>
<td>0.26**</td>
<td>−0.13**</td>
<td>−0.13**</td>
<td>−0.02</td>
<td>0.32**</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>13. Fatigue T2</td>
<td>13.0 (4.3)</td>
<td>0.01</td>
<td>0.06</td>
<td>−0.06</td>
<td>0.33**</td>
<td>0.48**</td>
<td>0.39**</td>
<td>0.44**</td>
<td>−0.23**</td>
<td>−0.14**</td>
<td>−0.12**</td>
<td>0.27**</td>
<td>0.35**</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>14. Anxiety T2</td>
<td>4.4 (3.6)</td>
<td>0.01</td>
<td>0.01</td>
<td>−0.03</td>
<td>0.24**</td>
<td>0.33**</td>
<td>0.65**</td>
<td>0.49**</td>
<td>−0.31**</td>
<td>−0.09*</td>
<td>−0.12**</td>
<td>0.14**</td>
<td>0.29**</td>
<td>0.51**</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>15. Depression T2</td>
<td>2.5 (2.8)</td>
<td>0.12**</td>
<td>−0.01</td>
<td>−0.03</td>
<td>0.25**</td>
<td>0.39**</td>
<td>0.46**</td>
<td>0.60**</td>
<td>−0.32**</td>
<td>−0.05</td>
<td>−0.12**</td>
<td>0.12**</td>
<td>0.30**</td>
<td>0.63**</td>
<td>0.69**</td>
<td>–</td>
</tr>
</tbody>
</table>

Note: *p < .05; **p < .01.
Table 2. Hierarchical regression analysis for variables predicting sleepiness and fatigue at T2 (N = 614–642).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sleepiness</th>
<th></th>
<th>Fatigue</th>
<th></th>
<th>Anxiety</th>
<th></th>
<th>Depression</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE B</td>
<td>β</td>
<td>B</td>
<td>SE B</td>
<td>β</td>
<td>B</td>
<td>SE B</td>
</tr>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.01</td>
<td>0.02</td>
<td>0.02</td>
<td>-0.01</td>
<td>0.02</td>
<td>-0.01</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Children at home</td>
<td>1.01</td>
<td>0.34</td>
<td>0.13**</td>
<td>-0.67</td>
<td>0.39</td>
<td>-0.08</td>
<td>-0.01</td>
<td>0.33</td>
</tr>
<tr>
<td>Percentage of full-time position</td>
<td>0.35</td>
<td>0.17</td>
<td>0.09*</td>
<td>0.35</td>
<td>0.20</td>
<td>0.07</td>
<td>0.05</td>
<td>0.16</td>
</tr>
<tr>
<td>Nights worked last year</td>
<td>0.01</td>
<td>0.01</td>
<td>0.06</td>
<td>-0.01</td>
<td>0.01</td>
<td>-0.05</td>
<td>-0.00</td>
<td>0.01</td>
</tr>
<tr>
<td>Sleepiness/Fatigue T1</td>
<td>0.66</td>
<td>0.03</td>
<td>0.66**</td>
<td>0.47</td>
<td>0.04</td>
<td>0.47**</td>
<td>0.67</td>
<td>0.03</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.04</td>
<td>0.02</td>
<td>0.08**</td>
<td>-0.01</td>
<td>0.02</td>
<td>-0.01</td>
<td>0.00</td>
<td>0.02</td>
</tr>
<tr>
<td>Children at home</td>
<td>0.89</td>
<td>0.26</td>
<td>0.12**</td>
<td>-0.59</td>
<td>0.35</td>
<td>-0.07</td>
<td>-0.58</td>
<td>0.25</td>
</tr>
<tr>
<td>Percentage of full position</td>
<td>0.14</td>
<td>0.13</td>
<td>0.03</td>
<td>0.30</td>
<td>0.17</td>
<td>0.07</td>
<td>-0.04</td>
<td>0.12</td>
</tr>
<tr>
<td>Nights worked last year</td>
<td>0.01</td>
<td>0.01</td>
<td>0.03</td>
<td>-0.01</td>
<td>0.01</td>
<td>-0.04</td>
<td>-0.00</td>
<td>0.01</td>
</tr>
<tr>
<td>Sleepiness/Fatigue T1</td>
<td>0.66</td>
<td>0.03</td>
<td>0.66**</td>
<td>0.47</td>
<td>0.04</td>
<td>0.47**</td>
<td>0.67</td>
<td>0.03</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.05</td>
<td>0.02</td>
<td>0.10**</td>
<td>0.00</td>
<td>0.02</td>
<td>0.01</td>
<td>-0.00</td>
<td>0.02</td>
</tr>
<tr>
<td>Children at home</td>
<td>0.88</td>
<td>0.26</td>
<td>0.12**</td>
<td>-0.74</td>
<td>0.35</td>
<td>-0.09*</td>
<td>-0.58</td>
<td>0.25</td>
</tr>
<tr>
<td>Percentage of full position</td>
<td>0.14</td>
<td>0.13</td>
<td>0.03</td>
<td>0.31</td>
<td>0.17</td>
<td>0.07</td>
<td>-0.02</td>
<td>0.12</td>
</tr>
<tr>
<td>Nights worked last year</td>
<td>0.00</td>
<td>0.01</td>
<td>0.03</td>
<td>-0.01</td>
<td>0.01</td>
<td>-0.03</td>
<td>0.00</td>
<td>0.01</td>
</tr>
<tr>
<td>Sleepiness/Fatigue T1</td>
<td>0.63</td>
<td>0.03</td>
<td>0.63**</td>
<td>0.40</td>
<td>0.04</td>
<td>0.40**</td>
<td>0.64</td>
<td>0.04</td>
</tr>
<tr>
<td>Hardiness</td>
<td>-0.00</td>
<td>0.03</td>
<td>-0.00</td>
<td>-0.10</td>
<td>0.04</td>
<td>-0.10**</td>
<td>-0.08</td>
<td>0.03</td>
</tr>
<tr>
<td>Morningness</td>
<td>0.05</td>
<td>0.04</td>
<td>0.04</td>
<td>-0.07</td>
<td>0.06</td>
<td>-0.05</td>
<td>-0.06</td>
<td>0.04</td>
</tr>
<tr>
<td>Flexibility</td>
<td>0.01</td>
<td>0.03</td>
<td>0.01</td>
<td>-0.08</td>
<td>0.05</td>
<td>-0.07</td>
<td>-0.09</td>
<td>0.03</td>
</tr>
<tr>
<td>Languidity</td>
<td>0.15</td>
<td>0.04</td>
<td>0.14**</td>
<td>0.13</td>
<td>0.05</td>
<td>0.11*</td>
<td>-0.05</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Notes: Sleepiness: $R^2$ Step 1 = .04; $\Delta R^2$ Step 2 = .43; $\Delta R^2$ Step 3 = .01; Fatigue: $R^2$ Step 1 = .01; $\Delta R^2$ Step 2 = .22; $\Delta R^2$ Step 3 = .03. *p < .05; **p < .01; Anxiety: $R^2$ Step 1 = .00; $\Delta R^2$ Step 2 = .43; $\Delta R^2$ Step 3 = .02; Depression: $R^2$ Step 1 = .02; $\Delta R^2$ Step 2 = .35; $\Delta R^2$ Step 3 = .01. *p < .05; **p < .01.
With regards to symptoms of depression, the final model explained 39% of the variance in depression at T2 ($F (9, 583) = 41.69, p < .001$). Step 1 explained 2%, step 2 explained an additional 35% and step 3 explained additionally 1% of the variance in depression at T2. Children at home was the only demographic variable that showed a significant relation to depression at T2 in the final model; this relation was negative. Furthermore, depression at T1 was significantly and positively related to depression at T2. Of the personality variables, only hardiness was significantly related to depression at T2, this relation was negative.

**Discussion**

Our goal was to conduct a longitudinal study investigating if the personality traits morningness, flexibility, languidity and hardiness can predict changes in SWT one year later in nurses working a rotating three-shift schedule. SWT was assessed in terms of sleepiness, fatigue, anxiety and depression. All the personality traits, except morningness, were related to at least one of the measures of SWT at T2 when controlling for SWT at T1. The strongest results were found for hardiness, which was related to three of the measures of SWT: fatigue, depression and anxiety.

**Demographic variables and SWT**

Age was positively related to sleepiness at T2 when controlling for sleepiness at T1. Accordingly, older shift workers may have lower SWT than younger ones. This is in line with the most recent reviews on the topic (Härmä, 1993; Nachreiner, 1998; Saksvik et al., 2011). Neither percentage of full-time position, nor number of nights worked last year was significantly related to any of the measures of SWT. Not having children at home, however, was positively related to sleepiness and fatigue at T2, but negatively related to symptoms of anxiety and depression at T2. In other words, nurses who had children living at home were less likely to be sleepy and fatigued, but they reported higher levels of anxiety and depression than nurses who did not have children at home.

**Hardiness and SWT**

In the present study, hardiness was the personality trait that was related to the highest number of the dependent variables. This supports one aspect of Hypothesis 1, that hardiness will be negatively related to increases in measures of SWT from T1 to T2. The relation between hardiness and SWT has been inadequately studied. However, the present findings run counter to one of the few studies performed in the last 20 years investigating the relation between hardiness and SWT longitudinally (Bohle, 1997). That study also examined rotating-shift-working nurses, and measured shift workers’ psychological symptoms and dissatisfaction with shift work 6 months and 15 months after starting shift work. In Bohle’s study, hardiness was found to be a poor predictor of adaptation to shift work. However, adaptation to shift work and hardiness were measured differently relative to our study. Hardiness was measured with the 36-item Revised Hardiness Scale and poor adaptation to shift work was measured with psychological symptoms and dissatisfaction with shift work.
Accordingly, hardiness may predict changes in scores of fatigue, anxiety and depression. However, the trait may not be able to predict the experience of stress and how satisfied workers are with shift work. Still, it can also be noted that the sample size in the study by Bohle (1997) was much lower than in the present study (102 vs. 642). As a result, the power of the Bohle (1997) study is considerably lower than the power of the present study. Hence, differences in statistical power may explain the discrepancy between the results. However, the effect sizes in the present study were low, indicating that although personality may predict changes in SWT over one year, their predictive power is probably not strong.

**Morningness and SWT**

Morningness was not related to any of the measures of SWT at T2 when controlling for the specific measure of SWT at T1. Hence, Hypothesis 2 was not supported. Although morningness was negatively correlated with sleepiness, fatigue and anxiety at T2 (see Table 1), no significant findings were detected when investigating the relation between morningness and sleepiness, fatigue and anxiety at T2 when controlling for these variables at T1. The present study has been the first for over a decade to investigate the relation between morningness and SWT with a longitudinal design. Most cross-sectional studies conclude that low scores on morningness is related to better SWT (Saksvik et al., 2011). Still, the opposite finding is also reported in some studies (Folkard & Hunt, 2000; Härma et al., 2008; Willis et al., 2008). Also, some studies have found no relation between morningness and SWT (Axelsson, Åkerstedt, Kecklund, Lindqvist, & Attefors, 2003; Axelsson, Lowden, & Kecklund, 2006; Petru, Wittmann, Nowak, Birkholz, & Angerer, 2005; Smith, Robie, et al., 1999). However, in the few studies of a predictive nature no association between morningness and SWT is most often reported (Härma, 1993). The mixed results for morningness and SWT can be due to the different shifts typically included in a three-shift rotating schedule. It is, for example, suggested that low scores on morningness are preferable when working night shifts, but that the opposite is an advantage when working morning shifts (Folkard & Hunt, 2000).

Hence, the fact that all participants in the present study worked rotating shifts may explain why we did not find any significant relations between morningness and SWT.

**Flexibility and SWT**

Flexibility was negatively related to symptoms of anxiety at T2 when controlling for anxiety at T1, but had no relationship to the other measures of SWT. Accordingly, higher levels of flexibility seem to predict reduction in anxiety over time. This partly supports Hypothesis 3. To the best of our knowledge, there has only been one longitudinal study examining flexibility and SWT published in the last 20 years (Kaliterna, Vidacek, Prizmic, & Radosevic-Vidasek, 1995). In this study of male shift workers engaged in a rotating shift schedule, flexibility was measured before the participants entered shift work and was positively correlated with subjective good health, fewer respiratory complaints and psychosomatic-digestive complaints, measured after both one and three years of shift work experience (Kaliterna et al.,
This is in line with our findings of the relation between flexibility and anxiety. Accordingly, flexibility appears to be able to predict some aspects of SWT.

**Languidity and SWT**

Languidity was positively related to sleepiness and fatigue at T2 when controlling for the scores on these two variables at T1. This indicates that individuals with higher scores on languidity at T1 were more likely to experience an increase in sleepiness and fatigue from T1 to T2, which partly support Hypothesis 4. However, languidity was not related to changes in symptoms of anxiety and depression. High scores on languidity are characterized by low circadian rhythm amplitude, and associated with lower alertness and higher sleep need (Di Milia et al., 2005). It therefore seems reasonable that languidity is more strongly related to sleepiness and fatigue than to symptoms of anxiety and depression.

In the past 20 years only one study has investigated languidity and shift work tolerance using a longitudinal design (Kaliterna et al., 1995). In that study high scores on languidity measured before the participants entered shift work was positively correlated to subjective health complaints, as well as respiratory and psychosomatic digestive complaints, measured after the participants had worked shift work for three years (Kaliterna et al., 1995). However, the authors note that these correlations were of small magnitude. Furthermore, they remark that the correlations between languidity and health obtained one year after the participants entered shift work were not significant. Still, these results are in line with our findings.

**Strengths and limitations**

The main strength of the present study is that it is based on a longitudinal design. To our knowledge, no other longitudinal studies investigating the relation between personality and SWT have been published between 1998 and now (2011). Between 1993 and 1998 only two studies of a predictive nature on this topic were identified (Nachreiner, 1998). The study by Kaliterna et al. (1995) had two follow-ups, after one and three years, respectively. The fact that our study applies only one year of follow-up is a limitation. However, the ability to predict outcomes based on the current study is an asset compared to the large bulk of cross-sectional studies in this area. Still, our study would probably also have been improved if we had measured the predictors at two times as well. Along these lines, it is recommended that studies seeking to predict individual differences in tolerance to shift work should study individuals both before starting and during shift work (Reinberg & Ashkenazi, 2008). Unfortunately, in the present study we did not examine the participants before they entered shift work. It is thus possible that personality traits may have caused intolerance to shift work before T1. This may lead to an underestimation of the predictive power of the personality traits in the present study.

Another positive aspect of the current study is the use of well-established and validated instruments. However, in questionnaire research, there will always be possible common method problems and response bias that may contribute to inflated relationships between constructs (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).
Specifically for the control variable “number of nights worked last year” it can be noted that it may have been difficult for the respondents to recall this accurately.

It can also be noted that the measures of fatigue, anxiety and depression showed correlations of between .51 and .69 with each other. This questions if these three constructs can be investigated separately. However, our use of the data is in line with the originally intended use of the HADS when it comes to anxiety and depression (Zigmond & Snaith, 1983). Moreover, the theoretical content of the three constructs is different, and it is of practical importance to examine possible differences in relations between personality and the three constructs. We found that hardiness was negatively related to changes from T1 to T2 in all three constructs, but we also found that flexibility was negatively related to anxiety only. This underlines the importance of investigating the three constructs separately. However, possible solutions for combining these measures, and others, when investigating SWT should be considered in future studies.

In the present study we controlled for both age, percentage of full-time position, number of nights worked last year and children living at home. We did not, however, control for years of shift work experience, or years of working as a nurse, which may be related to SWT. Still, we did control for age. This could account for at least some of the potential effects of shift work experience. Nevertheless, we performed some additional analyses to test whether adding experience as a control variable in the regression would affect our results, which we found it did not.

As the sample of nurses in the present study was collected randomly through five strata, it is likely that the sample distribution represented the nursing population. However, the response rate at T1 was only 38.1%, which is low. Nevertheless, due to the longitudinal design, the result may with some caution be generalized to other health care professions with similar sample characteristics and shift schedule. Also, generalization to other occupational groups with this shift schedule might be possible. However, the populations in the present study were only females and generalization to male-dominated groups is not possible. Nevertheless, it can be noted that several of our findings of relations between personality traits and measures of SWT, are consistent with a previous longitudinal study performed among male shift workers also working a three-shift rotating schedule (Kaliterna et al., 1995).

The focus of the present study was rotating shift work, composed of day, evening and night work. Personality factors may be related to SWT in different ways in other types of shift working arrangements not included in the present study. Moreover, the nature of the rotating shift schedule of the nurses in the present study varied somewhat, although they all worked day, evening and night work. We did control for the number of nights the nurses had worked during the last year. Still, it probably would have been beneficial if we also had controlled for other variables related to the nature of the shift schedule as, for example, speed and direction of rotation. However, we were precluded from this as we did not have information concerning other aspects of their shift work schedule.

**Practical implications**

The present study may offer some practical implications. Knowledge about relations between personality and SWT may be applied in personnel selection and vocational
counselling, but this should be done with caution when considering the present study. It should be noted that only six of the 16 tests of relations between the four personality traits and the four measures of SWT reached significance. Moreover, the personality traits investigated in the present study explained very small portions of the variance in changes of the indicators of SWT. The low effect sizes question the practical significance of our findings (Kotrlik & Williams, 2003). The personality variables explained only 1–3% of the variance of the measures of SWT. According to Cohen’s (1988) classification of effect sizes, all these would be considered small. Still, applying guidelines to judge effect sizes, as those made by Cohen, can be criticized as other elements of the research should be considered (Breaugh, 2003). In fact, small to moderate effect sizes are often seen in studies of personality (Zhao & Seibert, 2006). Furthermore, Breaugh (2003) advocates that small effect sizes can suggest an important relationship, a notion that has been recognized in personality and organizational research since the so-called “rebirth” of personality research in the 1990s. It should also be noted that the personality variables in the present study were used to investigate changes in shift work tolerance variables over a relatively short time span, thus it could not be expected that the personality variables could explain very high proportions of the variance in this change.

Still, we agree with the conclusion made by Hårmä (1993) that: “It seems unjustified to make any definitive selection of the future ‘good’ or ‘bad’ shift workers before experience in shift work” (p. 107). This type of research may still contribute to identifying individuals who need extra help in adaptation to shift work.

Furthermore, in line with the person-environment fit theory, this kind of knowledge will make it possible to develop more individualized tools and interventions to promote shift work tolerance in the future. Previous studies have highlighted that individual differences as, for example, morningness and age, may affect interventions initiated to promote adaptation to shift work (Burgess et al., 2002). In keeping with this, the results of the present study may contribute to knowledge about tailoring shift work schedules and working times to the specific individual. For example, individuals with higher scores on flexibility and hardiness may cope better with unpredictable rotating patterns of the shift schedule than individuals with high scores on languidity. When it comes to implications for individuals with high scores on morningness, however, more research on different shift schedules is needed before more practical implications regarding this trait can be outlined.

**Conclusion**

In this study it was found that personality factors were related to changes in some aspects of shift work tolerance over a period of one year. The findings indicate that hardiness, in particular, may predict changes in SWT over the time span of one year. However, morningness did not predict SWT over one year in our sample. This finding needs validation, especially in studies including measures of personality and SWT both prior to entering and during shift work, before more certain conclusions are made. More studies, with longer follow-up periods on hardiness and SWT are encouraged to further explore the role of this personality trait.
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