Personality factors related to shift work tolerance in two- and three-shift workers

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A B S T R A C T

This study aimed to investigate whether different personality variables were associated with shift work tolerance, and whether these potential associations were moderated by various types of shift work. The sample comprised 1505 nurses who worked either two or three rotating shifts. Personality traits were measured in terms of morningness, flexibility, languidity and hardiness. Morningness reflects the tendency to be alert relatively early in the morning and sleepy relatively early in the evening. Flexibility denotes the ability to both work and sleep at odd times of the day, while languidity concerns the tendency to become tired/sleepy when cutting down on sleep. Hardiness relates to resilience to stressful life events. The dependent variables in this study comprised of measures of insomnia, sleepiness, depression and anxiety. Hierarchical regression analyses, which controlled for demographic variables and work load, revealed that Morningness was significantly and negatively related to insomnia. The Morningness by Shift type interaction was overall significant for depressive symptoms. Morningness was near significantly associated with lower levels of depressive symptoms in three-shift workers, but unrelated to depressive symptoms in two-shift workers. Flexibility was associated with higher levels of depressive symptoms. Flexibility by Shift type interaction was significant for insomnia, indicating that flexibility was negatively associated with insomnia for three-shift workers and unrelated with insomnia for two-shift workers. Languidity was associated with higher levels of sleepiness, depressive and anxiety symptoms. Hardiness was associated with lower levels of all four dependent variables.

1. Introduction

Shift work usually refers to an arrangement of working hours that uses two or more teams to cover the time needed for production (Härmä, 1993), and can be defined as any regular employment which is taken outside the 7:00 am and 6:00 pm interval (Monk and Folkard, 1992). European statistics from 2002 demonstrated that alternating day (morning and afternoon) shifts were the most frequently used type of shift schedule, although 18.8% of the workforce was engaged in shift work which included night work (working hours situated between 22:00 and 06:00 h), with more men (24%) than women (12%) involved (Boisard et al., 2002).

Today, shift work is regarded as a significant occupational stressor which can have marked negative effects on both health and well-being (Bohle, 1997). Because of a different rhythm on days off (due to, e.g. social activities and because daylight entrains the endogenous circadian rhythm), a total adaptation to night work is often not achieved. As a result, sleep difficulties are the most frequently reported health problem among shift workers, especially regarding difficulties falling asleep, not getting enough sleep and daytime sleepiness (Åkerstedt, 2003). In the long run, shift work and specifically night work can cause several disorders which affect the gastrointestinal (colitis, gastroduodenitis and peptic ulcers), neuro-psychic (chronic fatigue, anxiety, depression) and most likely cardiovascular (hypertension, ischemic heart diseases) functions as well (Costa, 1996). Breast cancer in women (Megdal et al., 2005) has also been associated with shift work.

Shift work tolerance is a concept first introduced by Andlauer et al. (1979), based on their studies of the relationship of...
circadian rhythmicity and the subjective health of shift workers. Shift work tolerance is defined and assessed according to the existence and intensity of three types of medical complaints: digestive troubles, persistent fatigue/unnatural nervousness, and sleep alterations. Low tolerance to shift work was mostly observed in subjects who worked shifts for 10 years or more (Andlauer et al., 1979). Most previous studies have found that age is negatively associated with shift work tolerance (Härmä, 1993), while women seem to tolerate shift work more poorly than men (Gadbois, 1981; Nachreiner et al., 1995; Oginska et al., 1993).

Human circadian rhythms have long been known to demonstrate individual differences in terms of the rhythms’ phase, amplitude and stability, and it has also been discussed as to what degree personality is related to these individual differences (Milla et al., 2005). One of the main dimensions of “personality” which is related to the circadian phase is the morningness dimension (Härmä, 1993; Natale and Cicogna, 2002). People with high scores of measures of morningness are both more alert in the morning and have an earlier peak in body temperature compared to people with low scores (Natale and Alzani, 2001). Most previously conducted studies have shown that subjects with low scores on measures of morningness report better shift work tolerance than subjects with high scores on morningness (Steele et al., 2000; Takahashi et al., 2005b). In a recent review by our research group on individual differences in tolerance to shift work (Saksvik et al., in press) we report that morning types seem to have more adjustment difficulties related to shift work than evening types (Seo et al., 2000; Smith et al., 2005). Evening types (scoring low on Morningness) report better perception of adaptation to shift work (Takahashi et al., 2005a), better perception of their own shift work tolerance (Steele et al., 2000), in addition to better work performance (Burch et al., 2009) and higher job satisfaction with shift work (Korompeli et al., 2009).

Two other relevant classifications in regard to circadian factors, assessing the stability and amplitude of rhythms are flexibility and languidity, respectively. According to one study by Milla et al. (2005), subjects who scored low on languidity were significantly more alert across the day than those with high scores, suggesting that they are less influenced by sleep inertia, while subjects with high scores on languidity reported needing more sleep than those with low scores. Subjects with high scores on flexibility were more alert between 16:00 and 22:00 than subjects with low scores of flexibility. Furthermore, two studies concerning circadian rhythm stability and amplitude (flexibility/rigidity and vigourosity/languidity, respectively), support that high scores on flexibility (Ognianova et al., 1998) and low scores on languidity are positively related to high shift work tolerance (Ognianova et al., 1998; Smith et al., 1999).

Another and widely investigated characteristic when it comes to personality and resistance to occupational stress in general is hardiness which is described by Kobasa et al. (1982) as ‘a constellation of personality characteristics that function as a resistance resource in the encounter with stressful life events’. Hardiness is assumed to buffer the negative effects of stress by influencing the appraisal of stressful events and subsequent coping responses (Kobasa, 1979; Kobasa et al., 1982). To the best of our knowledge, the relationship between hardiness and shift work tolerance has not been previously investigated.

Knowledge concerning social and individual determinants of shift work tolerance can be important in terms of selection, health and the work scheduling of shift workers (Nachreiner, 1998). There have been few previous studies which have investigated whether different personality factors are associated with shift work tolerance, and we still have no knowledge of studies that have investigated whether specific personality traits are of more importance in two- vs. three-shift workers. In one study by Tamagawa et al. (2007) it was found that personality factors related to shift work tolerance were different when working consecutive night shifts compared to rotating shifts (Tamagawa et al., 2007). This implies interactions between the shift work schedule and personality related to shift work tolerance. In the present study, we therefore wanted to address the following research questions, controlling for age, number of working hours per week, and the presence of children living at home:

1) Which personality factors (morningness, flexibility, languidity and hardiness) are related to symptoms of insomnia, sleepiness, depression and anxiety in a sample of two- and three-shift rotating shift workers?

2) Are relations between insomnia, sleepiness, depression and anxiety, and personality factors (morningness, flexibility, languidity and hardiness) different for workers in different shift schedules (whether or not the shift schedule overlaps with the normal time of sleep, e.g. two- vs. three-shift workers)?

2. Methods

2.1. Sample and procedure

The data used in this study were obtained from “The survey of sleep, shift work and health” (SUSSH) in the period from December 2008 to March 2009 among nurses in Norway. The population consisted of registered members of the Norwegian Nurses Organisation (NNO), which includes most of the nurses currently working in Norway. A survey sample (N = 6000) comprised of five strata, each containing 1200 nurses maintaining at least a 50% work position, was randomly selected from the member register of the NNO. The criteria for the different strata were time elapsed since graduation, in this case 0–11 months (stratum 1), 1–3 years (stratum 2), 3.1–6 years (stratum 3), 6.1–9 years (stratum 4) and 9.1–12 years (stratum 5). Each nurse in the sample received a questionnaire by postal mail, and upon completion, the respondents could return it in a pre-paid envelope, with reminders sent out in December 2008 and in February 2009. An internet-based version of the questionnaire was available for those who preferred to complete it electronically. Only 2.4% answered the web-based version of the questionnaire. A total of 600 letters were returned due to wrong addresses, thus the survey sample consisted of 5400 nurses. A total of 2048 completed and returned the questionnaire, thereby yielding a response rate of 38.0%. Of these, 463 females worked two (day and evening) and 1042 females worked three (day, evening and nights) rotating shifts and were included in the present study. Table 1 presents the shift workers characteristics in the current study.

2.2. Instruments

2.2.1. Demographics

Questions about the respondents’ background covered their age, gender, whether they had children living at home and the number of hours worked per week.

2.2.2. Working schedule

The questionnaire established the type of working schedule the nurses were assigned to. The three-shift schedule was organised into rotas (including day, evening and night shifts), whereas the two-shift system comprised day and evening work only.

2.2.3. The Bergen Insomnia Scale

The Bergen Insomnia Scale (BIS) is a self-reporting measure of insomnia comprised of six items, each scored on an 8-point scale that reflects the number of days per week a specific symptom is
2.2.5. Epworth Sleepiness Scale (ESS)

On each item, subjects are asked to rate on a scale ranging from 0 to 4, measuring the subjective probability of falling asleep over the next 20 minutes, during various situations. The ESS has been shown to provide a reliable and valid measurement of the subject's general level of daytime sleepiness. The ESS questionnaire consists of eight items which has been shown to provide reliable and valid measurement of the subject's general level of daytime sleepiness. The ESS questionnaire with eight items which has been shown to provide good reliability and validity in a working sample (Milia et al., 2005). The short hardiness scale is a 15-item scale for measuring personality hardiness, which has been found to be a stress/health moderator in a wide range of studies. The 15-item scale includes positively- and negatively-keyed items that cover the three conceptually important hardiness facets, consisting of commitment, control and challenge (Bartone, 1995), with each facet covered by five items. The short hardiness scale has been further improved through elaborate techniques for cultural test adaption (Hambleton, 2005) and translated into Norwegian (Hystad et al., 2010), and in the present study, the revised Norwegian version was used.

### Table 1

Characteristics of the shift workers in the present study among female nurses.

<table>
<thead>
<tr>
<th></th>
<th>Two-shift rotating workers (n = 463)</th>
<th>Three-shift rotating workers (n = 1042)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean years of age (SD)</td>
<td>33.9 (9.6)</td>
<td>32.2 (7.7)</td>
</tr>
<tr>
<td>Mean hours of work/week (SD)</td>
<td>33.6 (6.5)</td>
<td>34.2 (5.7)</td>
</tr>
<tr>
<td>Percentage children at home</td>
<td>50.6</td>
<td>47.1</td>
</tr>
<tr>
<td>Mean score (SD) of independent measures in the study:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morningness (Diurnal Scale)</td>
<td>17.6 (3.1)</td>
<td>17.8 (3.3)</td>
</tr>
<tr>
<td>Flexibility</td>
<td>10.7 (3.5)</td>
<td>12.0 (3.7)</td>
</tr>
<tr>
<td>Languidity</td>
<td>20.7 (3.8)</td>
<td>21.0 (3.6)</td>
</tr>
<tr>
<td>Hardiness</td>
<td>31.1 (4.7)</td>
<td>31.5 (4.3)</td>
</tr>
<tr>
<td>Mean score (SD) of dependent measures in the study:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bergen Insomnia Scale</td>
<td>14.0 (8.0)</td>
<td>13.6 (8.0)</td>
</tr>
<tr>
<td>Epworth Sleepiness Scale</td>
<td>8.5 (3.6)</td>
<td>8.9 (3.8)</td>
</tr>
<tr>
<td>Hospital Anxiety and Depression Scale – depression</td>
<td>2.9 (3.1)</td>
<td>2.8 (2.9)</td>
</tr>
<tr>
<td>Hospital Anxiety and Depression Scale – anxiety</td>
<td>5.0 (3.7)</td>
<td>4.7 (3.6)</td>
</tr>
</tbody>
</table>

2.2.4. Hospital Anxiety and Depression Scale (HADS)

HADS is a self-assessment scale that was developed and found to be a reliable instrument for detecting states of depression and anxiety in the setting of a hospital medical outpatient clinic (Zigmond and Snith, 1983), which is now a widely used measure that has been extensively translated and utilised in a broad variety of clinical populations. The HADS consists of 14 items (each scored on a 5-point scale). The HADS has been shown to have a high validity and reliability (Johns, 1992). The short hardiness scale is a 15-item scale for measuring personality hardiness, which has been found to be a stress/health moderator in a wide range of studies. The 15-item scale includes positively- and negatively-keyed items that cover the three conceptually important hardiness facets, consisting of commitment, control and challenge (Bartone, 1995), with each facet covered by five items. The short hardiness scale has been further improved through elaborate techniques for cultural test adaption (Hambleton, 2005) and translated into Norwegian (Hystad et al., 2010), and in the present study, the revised Norwegian version was used.

### 2.2.6. The Diurnal Scale

The Diurnal Scale comprises seven items and was constructed to measure ‘diurnal type’ (morning or evening disposition), and each item is rated on a 4-point scale. The Diurnal Scale has been shown to possess a high internal reliability and high consistency among measurements, and to differentiate well between morning and evening types regarding sleep/wake habits. Higher scores indicate higher levels of morningness (Torsvall and Åkerstedt, 1980).

### 2.2.7. The short hardiness scale

The short hardiness scale is a 15-item scale for measuring personality hardiness, which has been found to be a stress/health moderator in a wide range of studies. The 15-item scale includes positively- and negatively-keyed items that cover the three conceptually important hardiness facets, consisting of commitment, control and challenge (Bartone, 1995), with each facet covered by five items. The short hardiness scale has been further improved through elaborate techniques for cultural test adaption (Hambleton, 2005) and translated into Norwegian (Hystad et al., 2010), and in the present study, the revised Norwegian version was used.

### 2.2.8. The revised Circadian Type Inventory

The revised Circadian Type Inventory (rCTI) is an 11-item self-reporting questionnaire designed to measure circadian rhythm flexibility and the amplitude of circadian rhythm/languidity. Flexibility is measured by six items which reflect the ability to sleep and work at odd times. Languidity is measured by five items and is related to difficulties overcoming drowsiness and feelings of lethargy following a reduction in sleep. All items are concerned with daily sleep/work habits and preferences (Milia et al., 2005). The answers are rated on a 5-point scale ranging from 1 ‘almost never’ to 5 ‘almost always’ in which high scores indicate a tendency towards possessing the trait to a high degree. The revised Circadian Type Inventory has been demonstrated to possess high reliability and validity in a working sample (Milia et al., 2005).

### 3. Results

The model for insomnia (Table 2) as a whole explained 12.6% of the variance, $F(12, 1373) = 16.40, p < .001$. While the demographic factors entered in Step 1 explained 1.6% of the variance. The five predictors of morningness, languidity, flexibility, hardiness and shift type (two vs. three) explained an additional 10.5% of the variance in Step 2. Interactions between two- and three-shift work and morningness, languidity, flexibility and hardiness in Step 3 explained an additional 0.5% of the variance in insomnia. Age and hours of work per week were significantly and positively associated with insomnia score, whereas morningness and hardiness were significantly and negatively associated with insomnia in the final
model (Step 3). In addition, there was a statistically significant interaction between flexibility and shift type (two vs. three). The post hoc probing showed that the regression slope was significant for the 3-shift workers (β = -0.15, p < 0.001), but non-significant for the 2-shift workers (β = 0.01, p = 0.91). Thus, flexibility was negatively associated with insomnia symptoms for the 3-shift workers and unrelated to insomnia for the 2-shift workers.

For daytime sleepiness (Table 2), the model as a whole explained 11.5% of the variance, F(12, 1373) = 14.86, p < 0.001, and the demographic factors explained 1.7% of the variance. The predictors morningness, languidity, flexibility, hardiness and shift type (two vs. three), explained an additional 9.5% of the variance in Step 2, and the variables in Step 3 added 0.3% to the variance for daytime sleepiness. In the final model, the number of hours worked per week and languidity were significantly and positively associated with daytime sleepiness, whereas hardiness was significantly and negatively associated with this dependent variable.

In case of depressive symptoms (Table 3), the total variance explained by the model as a whole was 25.5%, F(12, 1373) = 37.57, p < .001 with the demographic factors explaining 1.3% of the variance. Morningness, languidity, flexibility, hardiness and shift type (two vs. three) in Step 2 explained an additional 23.7%, and in Step 3 an additional 0.5% of the variance was explained by the interaction terms. Age, languidity and flexibility were significantly associated with higher levels of depressive symptoms, whereas children living at home and hardiness were significantly associated with lower levels of depressive symptoms. In addition, the interaction of Shift × Morningness was significant. The post hoc probing showed that the regression slope was near significant for the 3-shift workers (β = -0.06, p = 0.051), but non-significant for the 2-shift workers (β = 0.01, p = 0.83). Thus, morningness was close to being associated with lower levels of depression symptoms for the 3-shift workers and unrelated to insomnia for the 2-shift workers.

In terms of anxiety symptoms (Table 3), the model as a whole explained 19.9% of the variance, F(12, 1373) = 28.41, p < .001.

The demographic factors explained 0.6%, and the predictors in Step 2 explained an additional 19.1% of the variance. Interactions between shift type (two vs. three) and morningness, languidity, flexibility and hardiness in Step 3 added 0.2% to the explained variance for insomnia, none of which were statistically significant. Significant variables in the final model were languidity, which was positively associated with anxiety symptoms, and hardiness, which was negatively associated with anxiety symptoms.

4. Discussion

The major findings of the present study were that some personality traits, especially hardiness seemed to be a protective factor in terms of shift work tolerance, whereas languidity seemed to be a vulnerability factor concerning shift work tolerance. Morningness was nearly significantly and negatively related to depression in three-shift workers, but unrelated to depression in two-shift workers. Flexibility was negatively associated with insomnia symptoms for the 3-shift workers and unrelated to insomnia for the 2-shift workers.

When it comes to age, this was significantly and positively associated with insomnia and depressive symptoms in the final models of the regression analyses, thus supporting previous findings that age is a negative factor in regard to the ability to cope with shift work (Forêt et al., 1981). Sleep of older individuals has been found to be shorter, more easily disrupted, more fragmented and lighter (Miles and Dement, 1980). Differences between old and young workers also exist in variables related to the circadian system. Advancing age is characterised by a lower circadian amplitude, and earlier phased circadian rhythms (Weitzman et al., 1982). It appears...
that older individuals may be less able to achieve as much sleep as younger individuals as opposed to needing less sleep (Monk and Folkard, 1992). Previous research has suggested that lower shift work tolerance in older individuals is related to an advancement of the circadian rhythm which seems to occur with advancing age (Monk and Folkard, 1992). Nevertheless, as morningness was controlled for in our study and not found to be a powerful predictor, it seems most likely that the association between age and shift work tolerance can primarily be explained in terms of a general better sleep quality in younger than older individuals, or by other age-related sleep variables.

The number of hours of work per week was positively associated with insomnia and sleepiness in the present study. Hence, a low quantitative work load in terms of the number of working hours related sleep variables.

Sleep quality in younger than older individuals, or by other age-tolerance can primarily be explained in terms of a general better it seems most likely that the association between age and shift work controlled for in our study and not found to be a powerful predictor, (Monk and Folkard, 1992). Nevertheless, as morningness was the circadian rhythm which seems to occur with advancing age (Bjorvatn and Pallesen, 2009), as well as by short intervals between shifts (Kecklund and Åkerstedt, 1995).

We found that not having children living at home was significantly associated with lower levels of depression, thereby indicating that not having children living at home can be a protective factor for depression among rotating shift workers. Having children living at home makes coping with shift work more difficult, especially for women (Beermann and Nachreiner, 1995). One explanation for this is that children add to domestic obligations and influence work load and leisure time activities, in addition to exerting an influence on when sleep is possible.

As far as morningness is concerned, significant results in the final models was a negative association to insomnia, and the interaction of Shift × Morningness explaining depressive symptoms. The latter result showed that morningness was unrelated with depressive symptoms for two-shift workers, but nearly significantly associated with lower levels of depressive symptoms for three-shift workers, though we have no clear explanation for this. We do know, however, that night shifts normally imply a circadian phase delay (Burgess and Eastman, 2004, 2006). This is expected to be smaller for morning than for evening types (Dumont et al., 2001). Moreover, it has been suggested that circadian disruption may be related to the development of depression (Pandi-Perumal et al., 2009). As a consequence, we might speculate that a three-shift schedule causes stronger circadian disruption in subjects who are not morning types. Workers with problems related to night work may choose a two-shift type to avoid nights, and the two populations will therefore become different. Future studies should investigate this topic further since previous studies have generally reported inconsistencies in the findings that concern the association between morningness and measures of shift work tolerance (Härma, 1993). Nachreiner (1998) concluded that although morningness and measures of shift work tolerance have been found to be related to each other in some studies, this relationship has not been found when tested in predictive contexts. Thus, future studies should investigate the predictive value of morningness in two- and three-shift workers for depression in follow-up studies.

Surprisingly, flexibility was significantly associated with higher levels of depressive symptoms in the present study. This finding is opposite to what was found in the study conducted by Milia et al. (2005), which indicates that flexibility should be associated with shift work tolerance. As we cannot provide any explanation for our finding from either theory or previous research, this finding must be interpreted with caution, and should be substantiated by more studies. The interaction Flexibility × Shift Type was significantly related to the scores on the Bergen Insomnia Scale. The post-hoc probing showed that for three-shift workers, flexibility was negatively associated with insomnia, while flexibility was unrelated to insomnia in two-shift workers. Therefore, flexibility seems to be a protective factor for three-shift workers specifically. As three-shift workers work nights, as opposed to two-shift workers, it seems reasonable that flexibility, which reflects the ability to sleep and work at odd times, is particularly important for the former group of workers.

Languidity was strongly and positively related to sleepiness, depression and anxiety symptoms in the present study, and its relationship with these variables was not moderated by the type of shift schedule. This finding is supported by earlier studies (Milia et al., 2005) which indicates that low scores on languidity are associated with good shift work tolerance.

Of the four personality factors, hardiness seemed to be the factor most related to shift work tolerance. In the present study, hardiness was significantly and negatively associated with all the dependent variables in the final regression models. According to theoretical conceptions of hardiness, it buffers the negative effects of stressors by influencing the appraisal of stressful events and subsequent coping responses (Kobasa, 1979; Kobasa et al., 1982), and the effects of hardiness on shift work tolerance were not moderated by shift schedule. Since hardiness has only been investigated as a predictor of shift work tolerance in previous studies to a small extent, this makes our finding very interesting, but replication in future studies with other occupational groups is also called for.

As far as the strengths of the present study are concerned, it should be noted that the sample consisted of a relatively large and homogenous group of workers, thus limiting the possible influence from differences in work content on the dependent variables. Another strength of this study is that all the concepts measured were based on standardised and validated instruments. An obvious limitation of the present study is its cross-sectional design which precludes us from drawing any firm conclusion about cause and effect. It is therefore questionable as to whether the independent variables actually predict variance in the dependent variables or the other way around (Knutsson, 2004). However, most of the predictors in the present study consisted of measures of personality traits, which are generally shown to have good temporal stability (Roberts and DeVecchio, 2000). Given that the population studied is relatively young, this may to some extent support the assertion that personality influences shift work tolerance, although this cannot be concluded with any certainty.

In conclusion, the present study supports that some personality factors are related to the negative effects of shift work, especially concerning the personality factors of hardiness and languidity. The effects of flexibility and morningness seem to depend on shift schedule, while a high score on flexibility and morningness seemed to be an especially protective factor for three-shift workers. Our findings point to several personality traits which seem to have implications for shift work tolerance, especially for three-shift workers. The implications of these findings in terms of ergonomics are that selection of shift workers may emphasize scores on measures of such traits. However, more research is needed before any clear cut recommendations are warranted.

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References


