

PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Personality factors predict sleep related shift work tolerance in different shifts at two year follow-up: a prospective study
AUTHORS	Storemark, Sunniva; Fossum, Ingrid; Bjorvatn, Bjørn; Moen, Bente; Flo, Elisabeth; Pallesen, Staale

VERSION 1 - REVIEW

REVIEWER	John Axelsson, Associate Professor, Karolinska Institutet, Sweden I have no competing interest.
REVIEW RETURNED	21-Aug-2013

GENERAL COMMENTS	<p>The present study has investigated the relationship between some personality factors and later tolerance to shift work, where tolerance is defined as insomnia related problems. The unique parts of the present study are that 1) they have investigated the relationship between personality factors with the degree of insomnia problems for the respective type of shifts: day shifts, afternoon shifts and night shifts; and 2) that they have had a prospective approach, in the manner that the personality factors were measured 2 years before the insomnia related problems were reported.</p> <p>Shift-work tolerance is, as the authors point out, dependent on both characteristics amongst shift systems as well as on individual characteristics. The authors have accordingly shown that different individual characteristics are related to different problems, i.e. that hardiness and languidity is related to insomnia problems on all shifts, that the "flexibility to sleep" is related to problems to sleep during the day (i.e. night shift intolerance), and that morningness is related to better tolerance to dayshifts. These findings are also in line with the general literature. Although the manuscript is based on a sound design, with good analyses and written in good English, there are some issues that needs to be dealt with.</p> <p>Major comments</p> <ul style="list-style-type: none"> - The manuscript concerns how personality factors affect tolerance to shiftwork, which is also clearly stated in the title. While most readers would probably expect the manuscript to include several personality traits, the manuscript only includes a few personality factors. It should be clear why the authors have not included other personality factors, such as the big five, and, if suitable, include a short discussion of how other personality traits may have affected the results. - Even though the response rate at the follow-up was almost 75%, the authors should include an analyses whether personality factors
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	<p>were related to the drop-out. It would also be suitable with some information on the relationship between personality factors and general drop-out (the response rate was about 38% for the first questionnaire and it is likely that personality factors are related to participation in this step as well). Also add a short discussion of how a possible relationship between personality factors and drop-out may have affected the results.</p> <p>- It is really surprising that there is no multicolliniarity between hardiness and languidly (both from a theoretical and data perspective, when looking at the beta values). Please add some information on this and how it may have affected the estimated coefficients.</p> <p>- They authors rightly conclude that the data shown here may have practical implications. The manuscript would benefit if the authors included a more thorough discussion of what we can do with the knowledge obtained from this and earlier studies. What interventions should we carry out and for who?</p> <p>- A short discussion of how we should define shift work tolerance and particularly sleep related shiftwork intolerance. The authors define shift intolerance as insomnia symptoms, but several other definitions exist, such as health outcomes or satisfaction with the work hours. Interestingly, other work using actigraphy and sleep diaries suggest that the strongest sleep factor related to shift work intolerance was "insufficient sleep" (Axelsson et al 2004). Thus, it would be pertinent with a discussion whether insomnia related questions can really capture the sleep problems amongst shiftworkers properly.</p> <p>Minor comments.</p> <p>- Page 13, row 27: Explain why more research is needed on the relationship between morningness and shift work tolerance.</p> <p>- More clearly point out the strength of the present study, e.g. that the prospective approach reduces the influence of third variable problems (such as a stressful period), that would affect both the personally traits as well as insomnia at a certain time point.</p> <p>reference used above Axelsson J, Akerstedt T, Kecklund G, Lowden A. Tolerance to shift work-how does it relate to sleep and wakefulness? Int Arch Occup Environ Health. 2004 Feb;77(2):121-9</p>
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REVIEWER	Anders Knutsson Professor Department of Health Science Sweden
REVIEW RETURNED	27-Aug-2013

GENERAL COMMENTS	This study is an epidemiological study (population size N=700) with a follow-up time of two years. The main focus is studying the effect of four personality factors on shift work tolerance. The factors are morningness, flexibility, languidity and hardiness. Shift work tolerance was measured with a sleep questionnaire. The results
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	<p>showed that languidity and hardiness were associated with all types of shift. Morningness was associated only with day shifts, and flexibility with evening and night shifts.</p> <p>The results of the study are new and interesting. Established indices for measuring personality factors are used. The analyses are appropriate, and the results are reported in a clear way.</p> <p>My major concern is the study design. The study is described as a prospective cohort study. This is true with respect to the study of associations between personality factors and outcome. The personality factors were measured at base-line, and outcome at follow-up two years later. However, all other variables were measured at follow-up. The associations reported on associations between gender, age, marital status, children, alcohol, caffeine, smoking, percentage position and outcome, are based on cross-sectional data. This is probably not a problem regarding the variables gender and age, but could create problems in behavior variables that change over time. The selection of the population is also based on data at follow-up, and not information at base-line. Only those who worked according to a three shift system at follow-up were included. If the intention was to follow a cohort of three-shift nurses, the study design is not appropriate. They have followed only nurses who worked three-shift both at base-line and follow-up. In addition, nurses, who have changed from day work to shift work, have been included, and those nurses who worked three-shift at base-line and left the cohort are not studied at all.</p> <p>If the design problems described above have biased the results is difficult to determine. If the authors have data on all variables both at base-line and follow-up, I suggest that new analyses are done using exposure determinants from base-line and outcome from follow-up. The cohort should be defined on properties at base-line. If this is not possible, the authors should discuss the design problems in the discussion.</p> <p>Other suggestions:</p> <ul style="list-style-type: none"> - In the introduction shift work is defined as work that occurs between 7pm and 6 am. Does this mean that working morning and afternoon is not regarded as shift work? - The tables should be self-explaining. Coding should be included for categorical variables.
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VERSION 1 – AUTHOR RESPONSE

Reviewer 1.

The present study has investigated the relationship between some personality factors and later tolerance to shift work, where tolerance is defined as insomnia related problems. The unique parts of the present study are that 1) they have investigated the relationship between personality factors with the degree of insomnia problems for the respective type of shifts: day shifts, afternoon shifts and night

shifts; and 2) that they have had a prospective approach, in the manner that the personality factors were measured 2 years before the insomnia related problems were reported.

Shift-work tolerance is, as the authors point out, dependent on both characteristics amongst shift systems as well as on individual characteristics. The authors have accordingly shown that different individual characteristics are related to different problems, i.e. that hardiness and languidity is related to insomnia problems on all shifts, that the "flexibility to sleep" is related to problems to sleep during the day (i.e. night shift intolerance), and that morningness is related to better tolerance to dayshifts. These findings are also in line with the general literature. Although the manuscript is based on a sound design, with good analyses and written in good English, there are some issues that needs to be dealt with.

1. The manuscript concerns how personality factors affect tolerance to shiftwork, which is also clearly stated in the title. While most readers would probably expect the manuscript to include several personality traits, the manuscript only includes a few personality factors. It should be clear why the authors have not included other personality factors, such as the big five, and, if suitable, include a short discussion of how other personality traits may have affected the results.

Response: It is correct that we in the present study focused on relatively few personality traits. The reason for this is twofold. First, from a practical perspective – we included all the personality traits that so far have been assessed in the first 3 waves of the SUSSH-study. Secondly, the choice of personality variables to be included in the SUSSH study in the first place was not at random, as we emphasized personality traits that we expected to be of specific relevance to shift work tolerance. When it comes to flexibility and languidity, the instrument for assessing these two traits was specifically developed within the shift work research sphere (Personality and Individual Differences 2005;39:1293-1305). Morningness-eveningness is a central personality trait related to the circadian phase. In a review of individual differences in tolerance to shift work published by our research group (Sleep Medicine Reviews 2011;15:221-235) 60 studies published between 1998 and 2009 were included, and a total of 16 studies focused on this trait. The results for this trait were in addition equivocal, which in our view is an important argument for including it in the present study. The fourth and last trait we included was hardiness as we also wanted to include a trait related to general resilience / good coping skills. We do of course agree that other personality traits could have been included and have accordingly added the following sentence to the discussion. "Thirdly, the present study included only four distinct personality traits. Other personality traits could however be highly relevant for shift work tolerance, thus future studies should include a wider range of traits when investigating the relationship between shift work tolerance and personality".

2. Even though the response rate at the follow-up was almost 75%, the authors should include an analyses whether personality factors were related to the drop-out. It would also be suitable with some information on the relationship between personality factors and general drop-out (the response rate was about 38% for the first questionnaire and it is likely that personality factors are related to participation in this step as well). Also add a short discussion of how a possible relationship between personality factors and drop-out may have affected the results.

Response: Unfortunately, we have no data in terms of personality of those who did not participate in wave 1. However, we compared those who participated in wave 1 and 3 with those who participated in wave 1, but not in wave 3, on the four personality traits. There were no differences between the two groups on any personality traits. Based on this we have added the following sentence to the discussion: "Even though there was no difference between those who participated and those who did not participate in wave 3 on any of the four personality traits (results not shown), personality traits may still have had an influence on participation in the study in the first place. Thus, we cannot rule out that selection factors may have influenced the relationships between shift work tolerance and personality in the present study.

3. It is really surprising that there is no multicollinearity between hardiness and languidity (both from a theoretical and data perspective, when looking at the beta values). Please add some information on this and how it may have affected the estimated coefficients.

Response: Multicollinearity was estimated based on the variance inflation factor (VIF). Values between 5 and 10 indicate a multicollinearity problem. In the present study the VIF value was below 2 for all predictors in all analyses. The bivariate correlation coefficient between hardiness and languidity was $-.24$, so they shared a very small amount of variance.

4. They authors rightly conclude that the data shown here may have practical implications. The manuscript would benefit if the authors included a more thorough discussion of what we can do with the knowledge obtained from this and earlier studies. What interventions should we carry out and for who?

Response: We agree with the reviewer's suggestion, and the following paragraph has been added to the paper: "On the basis of knowledge obtained in the present and previous studies, employers may run personality tests in terms of personality variables such as morningness, flexibility, languidity and hardiness in order to get some indication of how well the employee will deal with different types of shift work. Further, based on the scorings, shift work may be easier adjusted to the different individuals, which in turn may cause less complications related to sleep, and less negative health consequences. It should however be noted that the relationship between personality and shift work tolerance is not very strong and some previous research have found equivocal results."

5. A short discussion of how we should define shift work tolerance and particularly sleep related shift work intolerance. The authors define shift intolerance as insomnia symptoms, but several other definitions exist, such as health outcomes or satisfaction with the work hours. Interestingly, other work using autography and sleep diaries suggest that the strongest sleep factor related to shift work intolerance was "insufficient sleep" (Axelsson et al 2004). Thus, it would be pertinent with a discussion whether insomnia related questions can really capture the sleep problems amongst shift workers properly.

Response: The classic definition of shift work tolerance by Andlauer et al. (1979) is provided in the introduction. Sleep problems are the most commonly reported problems as a consequence of shift work. Sleep related shift work tolerance was in the present study assessed by the BSWSQ. It should be noted that the BSWSQ not only assesses insomnia, but also covers sleepiness/tiredness both during work time and time off on workdays. Still, we have included the following sentences in the discussion: "Also, the BSWSQ was specifically constructed in order to assess sleep related shift work tolerance/intolerance and the items reflect insomnia and sleepiness/tiredness related to specific shifts. Still, it may be other sleep related variables, such as insufficient sleep (Axelsson et al. 2004) that might better reflect sleep related shift work tolerance. It could thus be beneficial for future research to assess sleep related shift work tolerance/intolerance in relation to other sleep related variables"

6. Page 13, row 27: Explain why more research is needed on the relationship between morningness and shift work tolerance.

Response: We have now added a sentence explaining why more research is needed: "Still, more research on the relationship between morningness and sleep related shift work tolerance is needed, as there generally have been inconsistent findings related to this relationship".

7. More clearly point out the strength of the present study, e.g. that the prospective approach reduces the influence of third variable problems (such as a stressful period), that would affect both the

personally traits as well as insomnia at a certain time point.

Response: We thank you for pointing this out. In line with the reviewer's suggestion we have now added a sentence to the text, which reads: "The use of this type of study design reduces the influence of confounding variable problems (such as a stressful period) that could affect both the personality traits as well as insomnia at a certain point in time".

Reviewer 2.

This study is an epidemiological study (population size N=700) with a follow-up time of two years. The main focus is studying the effect of four personality factors on shift work tolerance. The factors are morningness, flexibility, languidity and hardiness. Shift work tolerance was measured with a sleep questionnaire. The results showed that languidity and hardiness were associated with all types of shift. Morningness was associated only with day shifts, and flexibility with evening and night shifts. The results of the study are new and interesting. Established indices for measuring personality factors are used. The analyses are appropriate, and the results are reported in a clear way.

8. My major concern is the study design. The study is described as a prospective cohort study. This is true with respect to the study of associations between personality factors and outcome. The personality factors were measured at base-line, and outcome at follow-up two years later. However, all other variables were measured at follow-up. The associations reported on associations between gender, age, marital status, children, alcohol, caffeine, smoking, percentage position and outcome, are based on cross-sectional data. This is probably not a problem regarding the variables gender and age, but could create problems in behavior variables that change over time. The selection of the population is also based on data at follow-up, and not information at base-line. Only those who worked according to a three shift system at follow-up were included. If the intention was to follow a cohort of three-shift nurses, the study design is not appropriate. They have followed only nurses who worked three-shift both at base-line and follow-up. In addition, nurses, who have changed from day work to shift work, have been included, and those nurses who worked three-shift at base-line and left the cohort are not studied at all.

If the design problems described above have biased the results is difficult to determine. If the authors have data on all variables both at base-line and follow-up, I suggest that new analyses are done using exposure determinants from base-line and outcome from follow-up. The cohort should be defined on properties at base-line. If this is not possible, the authors should discuss the design problems in the discussion.

Response: We agree, and have now redone the analyses. All exposure determinants are now from base-line (wave 1) whereas all outcomes are assessed at wave3. It should be noted that the number of missing data for some variables were somewhat higher at wave 1 than at wave 3, which results in a somewhat lower number of participants in the new analyses. The main findings are however unchanged.

9. In the introduction shift work is defined as work that occurs between 7pm and 6 am. Does this mean that working morning and afternoon is not regarded as shift work?

Response: Shift work has been defined in various ways across studies. The definition we have used in the present study is one of the most commonly used. Accordingly, working mornings only is normally not defined as shift work unless the shift starts very early. As we recently have pointed out in a previous study (*Occupational and Environmental Medicine* 2013;70:238-245) some, for example evening types, may obtain less sleep than normal when working morning shifts, especially if the shift starts early or the workers have long commuting time. So even though working morning seldom is regarded as shift work, some may have problems with it. Evening shift normally lasts to 9 or 10 pm, thus this kind of work is normally regarded as shift work. As the BSWSQ assessed problems related

to day, evening and night shift separately, we implicitly regarded all the three shifts as shift work in the present study.

10. The tables should be self-explaining. Coding should be included for categorical variables.

Response: We thank the reviewer for pointing this out. Coding for all categorical variables has now been included.