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HEALTH PSYCHOLOGY | RESEARCH ARTICLE

Longitudinal and cross-sectional examination of the relationship between personality and fatigue among shift workers

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Abstract: The present study examines the relationship between the personality traits of the five-factor model and fatigue among shift workers. The participants were recruited from shift workers employed in a municipality in Norway. Questionnaires were administered at two times, once in January 2013 (T1) and again in June 2013 (T2). The results showed that neuroticism had a positive association with both physical and mental fatigue at T1, and was the only trait that could predict physical fatigue at T2. The study demonstrates the importance of distinguishing between physical and mental fatigue given the distinctive influence of personality traits on the two concepts.

Subjects: Health Psychology; Personality; Work & Organizational Psychology

Keywords: shift work; fatigue; personality; five-factor model; neuroticism

1. Introduction

Shift work is broadly defined as working hours that differ from traditional daytime working hours, e.g. 7 am to 6 pm Monday through Friday (Monk & Folkard, 1992). More specific, this includes full or part-time employees that work evenings, nights and rotating or fixed shifts on a regular basis. In the Norwegian population, 32.4% of the employees regularly work outside normal daytime (Statistics Norway, 2018), and a significant number of them are employed in the health sector. Shift work is an occupational stressor that has a negative impact on health, including mental fatigue and physical fatigue (Øyane, Pallesen, Moen, Åkerstedt, & Bjorvatn, 2013; Pati, Chandrawanshi, & Reinberg, 2001; Saksvik-Lehouillier et al., 2012), cancer (Hansen & Stevens, 2012; Haus & Smolensky, 2013),

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PUBLIC INTEREST STATEMENT

Fatigue, also known as a feeling of lack of energy, strength and motivation, is one of the most commonly reported conditions linked to irregular working hours. Fatigue can influence employee well-being, productivity and health, which in turn can have negative effects on the organization. Individuals can experience both mental and physical fatigue, and it is crucial to understand how individual differences can affect the onset of these conditions. The study showed that high scores on the personality trait neuroticism could predict physical fatigue 6 months after baseline measures. This knowledge can be used to design preventive measures and reduce the risk of fatigue among workers.

cardiovascular disease (Vyas et al., 2012), metabolic disease (Depner, Stothard, & Wright, 2014) and diabetes type 2 (Monk & Buysse, 2013). Shift work is also a potential risk factor for work-related accidents (Folkard & Lombardi, 2004; Folkard & Tucker, 2003). In addition, fatigue and insufficient sleep are related to a higher risk of injuries during working hours among employees that work nighttime compared to among employees working day (Violanti et al., 2012). Fatigue is one of the most important aspects of shift work intolerance (Saksvik-Lehouillier, Pallesen, Bjorvatn, Mageroy, & Folkard, 2015). The relationship between shift work and mental health factors, such as fatigue, is complex (Vogel, Braungardt, Meyer, & Schneider, 2012). In their systematic review, Vogel et al. (2012) conclude that several individual differences might be important in the relationship between shift work and mental health and that, moreover, longitudinal research is needed.

Fatigue is one of the most commonly reported problems linked to shift work (Åkerstedt, 2003; Åkerstedt, Fredlund, Gillberg, & Jansson, 2002; Costa, 2003; Eldevik, Flo, Moen, Pallesen, & Bjorvatn, 2013), and is a complex physical and/or mental condition or feeling of a lack of energy, strength and motivation (Huibers et al., 2003; Knutsson, 2004). Physical fatigue is related to muscle weakness and affects mobility, endurance and overall activity level (Davis & Walsh, 2010). Mental fatigue appears in the form of reduced concentration, memory loss, tiredness and lack of motivation to initiate and complete tasks. Although physical and mental fatigue can occur separately, they are highly comorbid conditions. A study by Mehta and Parasuraman (2013) suggest that mental fatigue can act as a precursor or catalyst for the development of physical fatigue, further linking the conditions together. Moreover, in the study by Roelen et al. (2013) physical fatigue, but not mental fatigue, could accurately predict sickness absence in nurses in a one-year follow-up study. This strongly emphasizes the need for research which examines the two concepts both separately and intertwined.

Fatigue among shift workers can be predicted by personality (Saksvik-Lehouillier et al., 2012). Ferguson (2013) argues that personality influences a broad range of health outcomes and is of concern not only at the individual level but also at the group and organizational levels. Personality can be viewed as a stable part of an individual that influences behaviour, thoughts, emotions and choices (McCrae & John, 1992), and may also have an impact on an individual's vulnerability to fatigue (Costa, Herbst, McCrae, & Siegler, 2000).

1.1. Neuroticism and fatigue

The five-factor model (FFM) has received substantial empirical support over the past 20 years and is centred on the domains of neuroticism, extraversion, openness to experience, conscientiousness and agreeableness (Costa & McCrae, 1992, 1995).

Previous literature shows a positive association between neuroticism and fatigue (Calderwood & Ackerman, 2011; DeVries & Van Heck, 2002; Vassend, Røysamb, Nielsen, & Czajkowski, 2018), and the related concept chronic fatigue (Deary & Chalder, 2010; Poeschla, Strachan, Dansie, Buchwald, & Afari, 2013; Valero, Sáez-Francàs, Calvo, Alegre, & Casas, 2013). In a longitudinal twin study by Vassend et al. (2018), the results demonstrated that individuals high in neuroticism were more susceptible to report symptoms of fatigue. In general, neuroticism is positively associated with high acceptance and self-reports of psychosomatic symptoms (Rosmalen, Neeleman, Gans, & de Jonge, 2007), and strongly related to both physical and mental symptoms of illness (Charles, Gatz, Kato, & Pedersen, 2008). Individuals with high scores on this trait tend to report that they feel exhausted, especially emotionally and mentally (May & Kline, 1988), and they experience fatigue more severely than individuals with lower scores (Kangas & Montgomery, 2011). Excessive perfectionism, anxiety, depression and low self-esteem have all been highlighted as potential vulnerability factors in regard to the development of physical and mental fatigue (Deary & Chalder, 2010; Magnusson, Nias, & White, 1996). Neuroticism is also related to greater reactivity on exposure to stressors and poorer coping (Suls & Martin, 2005), which in turn can lead to fatigue.

1.2. Conscientiousness, extraversion, openness to experience and agreeableness

Conscientiousness has in previous research showed negative relations to fatigue (Calderwood & Ackerman, 2011; DeVries & Van Heck, 2002). In a meta-analysis on burnout, the findings showed that conscientiousness was negatively related to emotional exhaustion (Alarcon, Eschleman, & Bowling, 2009). While neuroticism and extraversion are strongly associated with the report of various emotional symptoms, low conscientiousness is found to be the strongest predictor of the development of mental disorders (e.g. Kotov, Gamez, Schmidt, & Watson, 2010). Hence, conscientiousness might be important in predicting fatigue. Individuals with high scores on extraversion tend to experience less symptoms of fatigue than introverts do (Besharat, Behpajoo, Poursharifi, & Zarani, 2011; DeVries & Van Heck, 2000; May & Kline, 1988; Nater et al., 2010; Poeschla et al., 2013). In the study by Nater et al. (2010), lower scores in conscientiousness and agreeableness were found in individuals with symptoms of chronic fatigue syndrome, but no differences between this group and healthy individuals were found for openness. Overall, previous research indicates that agreeableness and openness play a less important role in the development of fatigue (DeVries & Van Heck, 2002).

1.3. The predictive value of personality on future symptoms of fatigue

A relevant debate in the research concerning the correlation between personality and fatigue is whether personality can predict fatigue and poor health related to shift work, or if the findings represent only cross-sectional associations (Härmä, 1993; Nachreiner, 1998; Saksvik, Bjorvatn, Hetland, Sandal, & Pallesen, 2011). Negative affect, which is the core of neuroticism, has been found to be related to symptom reporting (Kotov et al., 2010; Mulligan et al., 2014). More longitudinal research is needed to clarify the correlation between personality and fatigue and to understand the complex relationship between shift work and fatigue (Vogel et al., 2012). A wider use of cross-lagged analysis in the investigation of associations between individual differences and shift-work tolerance, where fatigue is a major component, is an important factor in this regard (Nachreiner, 1998).

1.4. Aim of the study

There is a lack of longitudinal studies investigating the role of personality for fatigue among shift workers. This type of research has been called for by several reviews (e.g. Härmä, 1993; Nachreiner, 1998; Saksvik et al., 2011). The present study seeks to answer this call by examining how the traits of the five-factor model are related to mental and physical fatigue at baseline and if the traits can predict fatigue from baseline to the follow-up 6 months later.

The present study examines the relationship between personality and fatigue among Norwegian shift workers in a cross-sectional and longitudinal design. Taking individual differences into account when investigating precursors to fatigue expands the existing knowledge, which in turn can contribute to improved health promotion and sickness prevention measures among shift workers and in the general population.

Based on the literature presented above, we suggest the following hypotheses:

- (1) Neuroticism will be positively related to mental and physical fatigue at both Time 1 and Time 2.
- (2) Conscientiousness will be negatively related to mental and physical fatigue at both Time 1 and Time 2.
- (3) Extraversion will be negatively related to mental and physical fatigue at Time 1 and Time 2.
- (4) Openness to experience and agreeableness will have either none or a weak negative relation to mental and physical fatigue at Time 1 and Time 2.

2. Methods

2.1. Ethics

The research project was approved by the Norwegian data protection agency Norwegian Centre for Research Data (NSD).

2.2. Sample

The participants were recruited from shift workers employed in a municipality in Norway at two separate data collections. All employees who worked shift work with night work were invited to participate ($n = 1106$) at T1. Of these, 65 emails were returned due to incorrect addresses. Thus, 1041 employees were invited. They were employed in the fields of public health care (79%) and social service (15%) (e.g. nurses and social workers), or other areas (5%). Respondents were not asked to specify their exact occupation for anonymity reasons. Of these, 327 responded to all or parts of the survey (response rate 31.4%). The sample at T1 consisted of 244 (75%) females and 83 (25%) males. The mean age was 38 ($SD = 11.37$). Of the valid answers, two respondents worked evenings only, 13 days only, and 122 nights only. A total of 82 respondents worked days, evenings and nights, and 51 alternated between days and evenings. Those who worked at night had done so for up to 32 years ($M = 6.3$, $SD = 6.03$).

All employees who were invited to the first data collection were also invited to join the second part of the study. A total of 199 individuals responded to all or parts of the survey (response rate: 19.1%). The sample at T2 consisted of 152 (76%) females and 47 (24%) males. The mean age was 38 ($SD = 11.48$). Those who worked nights had done so for up to 30 years ($M = 6.94$, $SD = 5.95$). A total of 85 participants in the two samples had to be excluded due to missing personal identification numbers, which was necessary to link the responses at T1 and T2 together. A total of 77 shift workers responded correctly to both of the surveys and were included in the longitudinal sample.

2.3. Procedure

An email list of all employees who were engaged in shift work with night work, or previously had worked nights was provided by the municipality. Data were collected through an online questionnaire distributed by email to all the names on this list. The online questionnaire was distributed to the same recipients twice, once in January 2013 and again in June/July 2013. It was open for three weeks each time, and two reminders were sent by email to those who did not respond in the previous round. The potential respondents were informed in the email that the questionnaire was voluntary and anonymous. They were also asked to provide the last five digits of their phone numbers as an anonymous code number so that it would be possible to connect the answers given in the two separate collection rounds. The study was approved by the Norwegian Social Science Data Services (NSD).

2.4. Measures

The online questionnaire contained measures for demographic and background information (e.g. sex, age, type of occupation, work schedule, hours worked per week and overtime) and personality and fatigue. Fatigue was measured using a self-report scale, the Norwegian version (Haukeland University Hospital, 2011) of the Fatigue Questionnaire (FQ) developed by Chalder et al. (1993). This instrument has proved to be internally consistent, reliable and valid (Chalder et al., 1993) and is widely used in shift-work research (e.g. Roelen et al., 2013). The scale comprises 11 individual questions concerning the need for rest, memory, concentration, muscle strength and so forth. The first seven questions measure physical fatigue and the last four questions measure mental fatigue, and the responses to the two different categories of questions construct separate total scores for physical and mental fatigue. These are answered on a 4-point scale ranging from “less than usual” to “much more than usual” or “better than usual” to “much worse than usual”. The response scale is designed to accommodate the notion that fatigue is more effectively seen as a dimension as opposed to a category (Chalder et al., 1993; Goldberg & Huxley, 1992).

Personality was assessed using a Norwegian version of the Mini-IPIP (Engvik, 2011), a 20-item short form of the 50-item International Personality Item Pool-Five-Factor Model measure (Goldberg, 1999). It was developed and evaluated across five studies and has demonstrated satisfactory internal consistencies, retest correlations and criterion-related validity (Donnellan, Oswald, Baird, & Lucas, 2006). The scale is designed to provide adequate results when a thorough measurement is not feasible and only a brief assessment of the FFM is required. It has proven to be useful, easy to administer and effective tool to measure personality according to the FFM (Donnellan et al., 2006).

2.5. Statistical analysis

All analyses were performed using the Statistical Package for the Social Science (SPSS), version 25. Pearson correlation analysis was applied to examine the relationships between variables measured at both T1 and T2. Two separate hierarchical regression analyses were conducted in two steps with physical and mental fatigue at T1 and T2 as dependent variables. Step 1 included age and gender. Step 2 included age, gender and the five personality factors (neuroticism, conscientiousness, extraversion, agreeableness and openness). Preliminary analysis showed that family responsibility, shift-work schedule and shift-work experience were not significantly related to either mental or physical fatigue; hence, their variables were excluded from the preceding analysis to preserve statistical power. In addition, we performed follow-up analyses. Cross-lagged follow-up analysis was used to examine the relationships of the repeatedly measured constructs (Selig & Little, 2012; Tyagi & Singh, 2014). Drop-out analysis was performed to explore potential differences between those participating at T1 only and those participating at both T1 and T2. The data were examined for linearity, outliers, normality and independence of observations and residuals, multicollinearity and homoscedasticity before the regression analyses were performed. No major violations of the assumptions for regression analysis were detected, e.g. all VIF values ranging from 1.00 to 2.0, and Durbin-Watson values above 1.6.

3. Results

There were no significant differences between respondents who participated in both data collections compared to respondents who only participated at T1 regarding demographic, fatigue, or personality variables included between those identified with valid responses in both T1 and T2 and the non-respondents except for neuroticism score. Those who participated at both T1 and T2 scored significantly lower on neuroticism at Time 1 ($M = 2.65$, $SD = .88$) than drop-outs ($M = 2.89$, $SD = .79$), $t(231) = 2.06$, $p < .05$, $d = .28$.

Table 1 shows the descriptive statistics, correlations and reliability coefficients for gender, age, personality factors and physical/mental fatigue measured at T1 and T2. Significant although small to moderate correlations between the predictors and fatigue were observed. Females scored lower than males on mental fatigue at T1 and physical and mental fatigue at T2, but this difference was not significant. Physical and mental fatigue were not related to age. Women scored higher on neuroticism compared to men ($t(231) = 3.21$, $p < .01$, $d = .48$). There was a positive relationship between neuroticism and both physical fatigue and mental fatigue at T1 and physical fatigue at T2. Neuroticism T2 was related to mental fatigue at T2. Conscientiousness T1 was negatively associated with mental fatigue at T1 and physical fatigue at T2. Extraversion was negatively associated with mental fatigue when measured at the same time. There was a significant positive association between mental and physical fatigue at T1 and T2. Agreeableness and openness were not associated with physical or mental fatigue at any time.

The hierarchical regression analysis (see Table 2) showed that 16% of the variance in physical fatigue at T1 can be explained by the total model ($R^2 = .16$, $F(7, 220) = 6.06$, $p < .001$; Table 2). Personality, together with gender and age could explain 21% of the variance in mental fatigue at T1 ($R^2 = .21$, $F(7, 219) = 8.30$, $p < .001$). Neuroticism was the strongest predictor of physical and mental fatigue at T1 in the final step. Agreeableness had a positive relationship to physical fatigue at T1. Conscientiousness was a significant negative predictor of mental fatigue at T1. Demographic

Table 1. Descriptive statistics, reliability coefficients and correlations (n = 158–327)

	M	SD	Correlations																		
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			
1. Gender ^a	1.24	.43	-																		
2. Birthyear	1975	11.37	-.09	-																	
3. T1. Neuroticism	2.81	.83	-.21**	.13	(α = .67)																
4. T1. Conscientiousness	4.06	.69	-.22**	-.07	-.13**	(α = .64)															
5. T1. Extraversion	3.56	.84	-.15*	.08	-.17**	.11	(α = .80)														
6. T1. Agreeableness	4.44	.57	-.23**	.02	.30**	.24**	.30**	(α = .74)													
7. T1. Openness	3.52	.74	.15*	.08	-.03	-.16*	.18**	.14*	(α = .65)												
8. T1. Physical fatigue	9.17	3.88	-.08	.07	.36**	-.08	-.07	.11	-.09	(α = .87)											
9. T1. Mental fatigue	4.80	1.92	.09	.05	.36**	-.27**	-.17**	-.04	-.03	.60**	(α = .79)										
10. T2. Neuroticism	2.74	.91	-.31**	.16	.71**	-.11	-.10	.03	.07	-.11	-.06	(α = .76)									
11. T2. Conscientiousness	3.98	.76	-.19	-.08	.10	.71**	.03	.12	-.26*	-.07	-.24*	-.05	(α = .67)								
12. T2. Extraversion	3.48	.87	-.18	.09	-.05	.14	.90**	.17	.13	.03	-.07	-.18*	.25**	(α = .78)							
13. T2. Agreeableness	4.36	.62	-.31**	.00	.02	.24*	.27*	.78**	.05	-.09	-.08	-.06	.26**	.28**	(α = .74)						
14. T2. Openness	3.58	.73	.20	.05	-.07	-.15	.10	.10	.81**	-.09	-.01	-.09	-.22**	.12	-.01	(α = .65)					
15. T2. Physical fatigue	8.92	3.46	.09	.17	.24*	-.24*	-.07	-.11	-.08	.44**	.55**	.14	-.25**	-.11	-.15	-.10	(α = .90)				
16. T2. Mental fatigue	4.73	1.80	.13	.17	-.01	-.09	-.06	.11	.06	.39**	.68**	.18*	-.19*	-.21**	-.03	-.04	.55**	(α = .67)			

T1 are variables measured at Time 1. T2 are variables measured 6 months later at Time 2.

^a Female = 1, Male = 2 **p < .01 (2-tailed) *p < .05 (2-tailed).

Table 2. Hierarchical regression analysis for variables at Time 1 predicting physical and mental fatigue at Time 1 and Time 2 (n = 77–227)

	Physical fatigue T1				Mental fatigue T1				Physical fatigue T2				Mental fatigue T2			
	B	SE B	β	R ²	B	SE B	β	R ²	B	SE B	β	R ²	B	SE B	β	R ²
Step 1				.01				.01				.07				.05
	-.72	.60	-.08		.42	.29	.10		1.39	.83	.19		.77	.41	.21	
	.00	.01	.05		.00	.00	.04		.06	.04	.20		.01	.02	.07	
Step 2				.16***				.21***				.19*				.09
	.21	.62	.02		.46	.30	.13		2.07	.93	.28*		1.05	.48	.29*	
	.00	.02	.04		.00	.01	.07		.05	.04	.16		.01	.02	.07	
	1.62	.31	.35**		.78	.15	.34***		1.04	.46	.27*		.13	.24	.07	
	-.47	.39	-.08		-.60	.19	-.22**		-.84	.56	-.18		-.15	.29	-.07	
	-.07	.31	-.02		-.20	.15	-.09		.23	.45	.06		.20	.23	.11	
	.98	.47	.14*		.23	.23	.07		.10	.65	.02		.46	.33	.17	
	-.64	.34	-.12		-.19	.17	-.07		-.92	.55	-.20		-.11	.28	-.05	

T1 are variables measured at Time 1. T2 are variables measured 6 months later at Time 2.

*p < .05. **p < .01. ***p < .001

variables and personality factors measured at T1 could explain 19% of the variance in physical fatigue at T2 ($R^2 = .19$, $F(7, 71) = 2.40$, $p < .05$), but no significant results were found in regard to mental fatigue. Gender was a significant predictor of both physical and mental fatigue at T2, indicating that being male predicted higher levels of fatigue at T2 than what was the case for females. None of the personality traits did predict mental fatigue at T2. Neuroticism was the only trait that could predict physical fatigue at T2.

3.1. Cross-lagged analysis

Cross-lagged follow-up analysis was used to estimate the directional influence of neuroticism and physical fatigue over time. This is done by comparing the relationship between neuroticism at Time 1 and physical fatigue at Time 2 with the relationship between physical fatigue at Time 1 and neuroticism at Time 2. Gender, a significant predictor of fatigue in the initial analysis, was included as a control. Physical fatigue at T1 did not predict neuroticism at T2 ($\beta = -.11$, $p = .35$), and controlling for gender did not change the result. Neuroticism at T1 was a significant predictor of physical fatigue in the initial analysis, and follow-up analysis controlling for gender and physical fatigue measured at T1 showed that neuroticism still was a significant predictor ($\beta = .22$, $p < .05$). However, baseline physical fatigue (T1) was a stronger predictor of physical fatigue at T2 ($\beta = .39$, $p < .001$) than neuroticism.

4. Discussion

To move beyond the cross-sectional association between personality traits and symptom-reporting, this longitudinal study aimed to investigate the predictive power of personality traits on mental and physical fatigue among shift workers. Cross-sectional relationships were compared to longitudinal relationships. We found that neuroticism had a positive relationship to both physical and mental fatigue at T1 and that neuroticism was the single trait that could predict physical fatigue at T2, hence supporting hypothesis 1. Conscientiousness had a negative relationship with mental fatigue at T1, which is in support of hypothesis 2. Hypothesis 3 is not supported, as extraversion was not significantly related to fatigue. In regards to hypothesis 4, the results showed that openness had no significant relation to fatigue, whereas agreeableness had a weak positive relation to physical fatigue at Time 1. This hypothesis is therefore only partly supported. Our findings show that personality traits are cross-sectionally related to reports of fatigue, but less effective in predicting fatigue over time.

A stable positive relationship between neuroticism and fatigue has been argued for in earlier research (e.g. DeVries & Van Heck, 2002; Vassend et al., 2018), and is supported by the findings in the present study. Previous studies have questioned the predictive value of personality traits, among them neuroticism, on shift-work tolerance (Saksvik-Lehouillier et al., 2012). However, our results support that neuroticism can be a valuable predictor of the fatigue component of shift-work tolerance. It has been suggested that different components of this trait, e.g. insecurity, negative perfectionism, anxiety and depression, might pose as vulnerability factors in regard to developing and experiencing fatigue (Deary & Chalder, 2010; Magnusson et al., 1996; White & Schweitzer, 2000). High scores on neuroticism have been associated with increased attention to, incidence and reporting of symptoms of fatigue (Calderwood & Ackerman, 2011; DeVries & Van Heck, 2000; Vassend et al., 2018). Neuroticism is also associated with higher acceptance and self-report of psychosomatic symptoms in general (Ormel et al., 2013). In addition, there is some evidence suggesting that individuals high in neuroticism may experience increased sensitivity to unpleasant stimuli like pain, minor aches and internal physical sensations (Geisser, Roth, Theisen, Robinson, & Riley III, 2000). Neuroticism may, in other terms, pose an increased risk for developing and experiencing fatigue, but it is also possible that it simply increases the likelihood of reporting fatigue. However, neuroticism is consistently related to greater reactivity on exposure to stressors and poorer coping strategies (Suls & Martin, 2005), and high scores might represent a higher risk of burnout and fatigue among nurses (Shimizutani et al., 2008; Yu, Jiang, & Shen, 2016). The stability coefficient of neuroticism was high, whereas symptoms of

physical fatigue represent a more transient state with a lower stability coefficient. Cross-lagged analysis supported that neuroticism might be a precursor of fatigue, while physical fatigue at T1 but did not predict neuroticism at T2. However, a follow-up analysis of neuroticism as a predictor of physical fatigue, controlling for level of physical fatigue at T1, showed that baseline physical fatigue was a stronger predictor of physical fatigue at T2 than neuroticism, suggesting that also the fatigue construct inherit some dispositional characteristics.

The negative relationship between conscientiousness and fatigue observed in the present study is in accordance with earlier findings of conscientiousness being negatively related to fatigue (Calderwood & Ackerman, 2011; DeVries & Van Heck, 2002). Although conscientiousness did not reach statistical significance as a predictor of physical fatigue at T2, the magnitude of the effect size suggests that high scores may protect against physical fatigue and that a lack of significant results is best attributed to limited statistical power in the longitudinal part of this study.

Agreeableness had a small positive relationship to physical fatigue at T1, contradicting hypothesis 4, in which we assumed that agreeableness would have either none or negative relation to fatigue. Employees in health care, especially nurses, have been shown to experience compassion fatigue and burnout due to factors associated with the work they perform (Hooper, Craig, Janvrin, Wetsel, & Reimels, 2010; Maytum, Heiman, & Garwick, 2004). Compassion and care for the needs of others rather than oneself are the core of agreeableness and could explain why the finding is in contrast to what we expected. Although extraversion had a significant negative correlation with mental fatigue, this relationship was not significant in the multivariate regression model. As expected, openness was not significantly related to physical or mental fatigue at either times. Overall, our findings demonstrate that neuroticism and conscientiousness can be considered the most important personality traits related to fatigue.

4.1. Strengths and limitations

The present study measured personality and fatigue at two times using a longitudinal design that is called for in this field of research. This is an important strength. However, the sample size and response rate, especially for Time 2, were low, which may compromise the statistical power of this study (Cohen, 1992). Further, the low response rate might limit the possibility to generalize the findings. Also, the two observation points in the present study were only six months apart. Conducting data collection more than twice and controlling for shift-work experience by questioning participants before they entered shift work would have been beneficial (Reinberg & Ashkenazi, 2008). Moreover, the natural light conditions in Norway are heavily influenced by seasonal changes and could represent a source of error in this study. However, paired sample t-test indicated no significant differences in fatigue at T1 compared to T2.

The instruments used in this study to measure personality and fatigue are considered valid and reliable, even in the short versions (Chalder et al., 1993; Goldberg, 1999) and should, therefore, be able to provide sufficient data to answer the research questions. The Mini-IPIP is designed to provide adequate results when the thorough measurement is not feasible and only a brief assessment of the FFM is required (Goldberg, 1999). On the one hand, measuring fatigue using only 11 questions may give a less nuanced picture of fatigue than a more comprehensive measuring tool. On the other hand, the instrument can effectively distinguish between physical and mental fatigue. Both personality and fatigue were measured with questionnaires; hence, common method bias may contribute to inflated relationships between constructs.

4.2. Implications and suggestions for future research

Although personality traits refer to stable dispositions, their manifestations in emotional states and behaviours are not immutable (McCrae, 2010). Investigation of the relationships between personality traits and fatigue can contribute to the development of more individualized tools and interventions to promote shift-work tolerance (Saksvik-Lehouillier et al., 2012). Knowledge about the relationship between personality and fatigue, both in terms of concurrent reporting of

symptoms and in terms of predictive power, can be utilized in career counselling. The distinction between mental and physical fatigue is of great importance. Mental and physical fatigue pose different challenges in a shift-work context in regard to performing various combinations of mental and physical tasks. Failing to take the distinction between these two concepts into account in research may subsequently hamper the organization's efforts to improve working conditions.

Knowledge of the relationship between personality and fatigue among shift workers can be valuable in identifying risk factors and early symptoms, as well as in the development of preventive measures. Taken into consideration that mental fatigue, and possibly also compassion fatigue and burnout, can act as a precursor to physical fatigue, the knowledge can be used to take organizational actions to counteract these effects. Taking personality into account might contribute to more integrative forms of prevention and treatment of fatigue and improving general health among shift workers, a group that is at greater risk for a wide number of illnesses and injuries compared to people working daytime only. Finding specific personality patterns related to fatigue can be regarded as important in the task of identifying vulnerable individuals in a work environment. Due to the limited amount of longitudinal research on the area, a large-scale investigation of the role of personality traits as predictors of specific types of fatigue in longitudinal studies is strongly encouraged.

4.3. Conclusion

The present study examined the relationship between the personality traits of the five-factor model and physical and mental fatigue among shift workers. Neuroticism had a positive relation to both physical and mental fatigue at T1, and could predict physical fatigue at T2. Conscientiousness had a negative relation to mental fatigue at T1. Our findings show that personality traits are associated with fatigue at the same time of measure, but less effective in predicting fatigue over time. Further, the study demonstrates the importance of distinguishing between physical and mental fatigue since distinct personality traits not necessarily have the same relationship to both.

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