

A pilot study examining if satisfaction of basic needs can ameliorate negative effects of shift work

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Abstract: The objective of the present study was to investigate if satisfaction of the basic needs of autonomy, competence, and relatedness is related to shift work tolerance, specifically physical and mental fatigue, insomnia, and digestive troubles in a sample of shift workers. This is a cross-sectional pilot questionnaire study, including 252 shift workers employed in a municipality in Norway. Autonomy was negatively related to physical fatigue and digestive troubles, while competence was negatively related to mental fatigue. Relatedness showed significant correlations with insomnia and mental fatigue, but did not reach significance in the regression model controlling for the two other basic needs as well as work scheduling, night work exposure, and sleep medication. Sleep medication was significant in the final regression model for insomnia, but unrelated to fatigue and digestive troubles. The demographic variables, work hours per week, work schedule, and night work exposure were unrelated to all four measures of shift work tolerance. Autonomy and competence may be more important for fatigue and digestive troubles among shift workers than work arrangement variables, night work exposure, and sleep medication use.

Key words: Shift work tolerance, Autonomy, Competence, Relatedness, Fatigue, Insomnia, Digestive troubles

Introduction

Sleep is necessary for human life. Furthermore, having a regular and synchronized sleep/wake pattern is crucial for obtaining good sleep and preserving good health. Still today's society requires that someone is always awake and maintaining public services. A line of empirical research in motivational psychology postulates that basic satisfaction of three central psychological needs is related to health and well-being at work. The focus of this article is whether satisfaction of these basic needs can ameliorate

shift work's negative effects.

The extent and use of shift work is increasing all over the world¹. Shift work is often defined as work that takes place between 7 pm and 6 am² or any time during weekends³. Night work is a specific type of shift work where the majority of the work time falls between 10 pm and 6 am⁴. This type of work pattern conflicts with the need for a regular sleep pattern. Research has documented several serious health risks caused by shift work in general and night work in particular, including increased rates of cardiovascular disease^{5–7} and breast cancer⁸. Night work also seem to have a negative effect on safety and productivity⁹. Problems with fatigue, insomnia, digestive troubles, mental sensitivity, and aggression are especially prevalent in individuals with low tolerance for working shifts^{10–12}. The term “shift work tolerance” has been es-

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tablished in research to describe the ability to adapt to shift work without experiencing its adverse consequences¹⁰).

Several measures to counteract night work's negative effects have been identified¹³). The review by Pallesen and colleagues¹³) concludes that measures such as bright light and melatonin treatment, correctly timed naps during the work shift, use of stimulants, and proper work scheduling including forward rotation are recommended to ameliorate night work's negative effects. The benefit of shorter shifts and fewer work hours is also mentioned. However, Pallesen *et al.* question these measures' long-term effects. The authors highlight the relevance of the "healthy shift worker effect", referring to the tendency of healthy shift workers to stay in such work, while those that are insufficiently healthy leave shift work¹⁴). Thus, shift work exposure is probably a further variable that can affect the health of the shift worker.

Additionally, previous research has neglected some potential psychological factors. This especially pertains to motivation's effect on the ability to stay awake at night. In order to function well, humans need an optimal level of stimulation guided by intrinsic motivation¹⁵). A basic assumption of self-determination theory is that human beings are motivated by three inherent psychological needs: the needs for autonomy, competence, and relatedness, respectively¹⁶). The need for *Autonomy* describes people's universal urge to be causal agents and experience volition¹⁷). The need for *Competence* concerns people's inherent desire to be effective in dealing with their environments¹⁸), and the need for *Relatedness* or belonging reflects the universal propensity to interact with, be connected to, and care for other people¹⁹).

Work is clearly an arena that can both meet and thwart employees' needs in terms of autonomy, competence, and feelings of relatedness. Shift work can be of particular interest in this regard, as it is known to be physically and psychologically demanding in general and is potentially harmful for mental and physical health²⁰). Within the context of motivational psychology, needs are regarded as universal necessities that constitute nutriments required for proactivity, optimal development, and learning²¹). Moreover, these needs are understood as crucial for psychological health²²).

Competence is linked to any type of motivation, whereas autonomy is especially related to intrinsic motivation¹⁶). This could suggest that competence is in some manner different from the other two needs. One relevant question to ask in this respect is whether relatedness and autonomy are even more socially founded and perhaps even more

basic than competence. Future studies specifically addressing competence will help clarify this issue. A considerable amount of data indicates that basic needs and autonomy in particular are key predictors of workplace satisfaction across different work settings and occupations^{23, 24}). However, no studies have yet investigated the role basic needs' satisfaction plays in shift work tolerance.

Although no previous studies have investigated the three basic needs among shift workers, related concepts have been examined. The importance of social interaction can be seen as relevant and important to all the needs, especially relatedness. Research suggests that talking to others may mitigate the risk of fatigue and increase alertness during night shifts or sleep-deprivation scenarios^{25, 26}), and that social support may positively affect shift work tolerance²⁷).

Social exposure's effect on vulnerability to sleep deprivation has been confirmed by sleep deprivation experiments²⁸). Still, to the best of our knowledge, the relationship between the satisfaction of social needs and other motivational factors on one side and shift work tolerance on the other have not been examined sufficiently in sleep deprivation scenarios and not at all in naturalistic settings. It would be fruitful to investigate if autonomy, competence, and relatedness are as important to shift work tolerance as sleep medication, work scheduling, and shift work exposure, which are identified as important countermeasures to the negative effects of night work in the review by Pallesen *et al*¹³). If the needs for autonomy, competence, and relatedness are met, self-motivation and mental health will improve²⁹).

In the present study, we will investigate if satisfaction of the basic needs of autonomy, competence, and relatedness is related to shift work tolerance, specifically physical and mental fatigue, insomnia, and digestive troubles in a sample of shift workers. These four dependent variables are chosen because they are important aspects of shift work tolerance, as established by previous research^{10–12}). We will also examine how the importance of these factors compares to the importance of sleep medication, work scheduling, and prior night work experience. These variables are chosen because previous research has identified them as the most important countermeasures to ameliorate night work's problems¹³). Thus, we would like to challenge the established knowledge about measures to counteract night work's negative effects by examining the alternative, and unexplored, measures of satisfaction of basic needs. The aim of the study is therefore to examine shift workers in particular and not all workers. The study is to be considered a pilot study, with a rather small sample of almost 300

participants, but it answers a research question that has not been investigated by previous research. A pilot study like the present one is needed to guide future research in this area. If the importance of motivational variables can be supported by the present study, and further evidence can later be found, this could provide extensive help to improve work conditions for workers who have to stay awake at night, through focusing on promotion of their intrinsic motivation.

Subjects and Methods

Participants

A total of 353 out of 1,041 invited shift working municipal workers participated in this electronic questionnaire study. The response rate was 33.9%. All employees who worked night shifts or previously had experience with night shift in one municipality in Norway were invited to participate, totalling 1,106 altogether. Of these, 65 emails were returned due to incorrect email addresses. Of the 353 respondents who replied, all except 8 had some experience working nights, and 26 had worked nights for less than one year. These 34 participants and any participants who did not answer how many years they had worked nights were excluded from further analyses. The final sample comprised 252 participants. In the final sample 45 (17.9%) worked day and evening shifts, 122 (48.4%) worked night shifts only, and 85 (33.7%) were employed in rotating shift work with day, evening, and night shifts. There were 190 (75.4%) women and 59 (23.4%) men in the final sample. The mean age was 39.5 (SD=11.37) yr. Eighty-six (34.1%) had the full responsibility for children living at home, 32 (12.7%) had shared responsibility for children, and 127 (50.4%) did not have children. The respondents had experienced working night shifts for durations ranging from 1 to 32 yr with a mean of 7.0 yr (SD=6.12). The participants worked an average of 30.2 (SD=7.92) hours per week.

Procedure

Prior to initiating data collection, the study was approved by the Norwegian Data Protection Official for Research (NSD). Information about the project was also sent to the Regional Committee for Medical and Health Research Ethics in Central Norway, who responded that their approval was not required. All potential respondents received an email with a link to an online questionnaire during January, 2013. The email informed participants that their participation was voluntary and anonymous. Two email reminders were sent to individuals who had not par-

ticipated after the first invitation. The questionnaire was open for replies for 3 wk.

Instruments

The questionnaire included demographic questions concerning age, gender, and if they were responsible for children at home (full responsibility, shared responsibility, or no). The respondents answered how many hours they worked per week by inserting the number of hours into a box. The respondents were also asked to describe their work schedule arrangement from a choice of four different answers; day work; day and evening work; night work only; or rotating shift work with day, evening, and night work. The day workers were excluded, and the variable was then treated like a categorical variable with three different options. Exposure to night work was measured by a single question asking the respondents to provide the number of years they had worked night shifts, and to write zero if they had worked night shifts less than one year. Sleep medication use was measured by questions that asked respondents if they had used any of the following the previous 12 months: sleep medication with prescription, light treatment, melatonin, or sleep medication without prescription. The answers were then collapsed into one variable measuring sleep medication use, where a score of zero indicated no use of sleep medication, a score of one indicated use of one of the aids to sleep, and a score of two indicated use of two aids to sleep. No respondents reported use of more than two of the listed sleep aids.

The three basic needs of competency, autonomy, and relatedness were measured with a short form of the Basic need satisfaction at work questionnaire³⁰. This version, written in the Norwegian language, has previously been validated and applied in a Norwegian study³¹. The translation is based on a standardized translation-back-translation process. This instrument included nine statements: for example, "I really like the people I work with", and "When I work I do not feel very competent". The respondents were asked to indicate how well these statements were true for them on a 7-point scale ranging from "do not fit at all" to "fit very well". There were three questions for each of the three basic needs.

The four shift work tolerance variables were measured with the Bergen Insomnia Scale, the Fatigue Questionnaire, and two questions concerning digestive troubles. The *Bergen Insomnia Scale (BIS)*³² consists of six items measuring insomnia in line with the descriptions of insomnia in the DSM-IV. The items ask respondents, "how many times per week during the last month have you

experienced” any of six different insomnia symptoms, for example, “it has taken more than 30 min to fall asleep after the light was switched off”. The respondents answer how many days per week over the past month each symptom has occurred, from zero (zero days per week) to seven (daily). The validity of the BIS has been previously demonstrated³²⁾.

To assess physical and mental fatigue, we applied the *Fatigue Questionnaire (FQ)*³³⁾, which measures fatigue with 11 questions answered on a four-point scale. The respondents indicated how often during the past month they had experienced different signs of fatigue, using a four-point response scale ranging from “less than usual” to “much more than usual” or “better than usual” to “much worse than usual”. Seven items measure physical fatigue and four items measure mental fatigue. The Fatigue Questionnaire has been validated in Norway³⁴⁾.

Lastly, to measure digestive troubles, four of the eight digestive trouble questions in the Standard Shift Work Index (SSI)³⁵⁾ were adopted and collapsed into two questions for the present study. These questions were: “How often is your appetite disturbed?” and “How often do you suffer from stomach ache, nauseous, or digestive troubles?” The respondents provided their responses on a four-point scale ranging from “almost never” to “almost always”.

Statistical analyses

All analyses were performed with IBM SPSSP Statistics. Correlation analyses between all study variables were conducted. The main analyses consisted of four multiple regression analyses with two steps. There was one analysis for each of the shift work tolerance variables: insomnia, mental fatigue, physical fatigue, and digestive troubles, where these variables represented the dependent variables for each analysis. The demographic variables, as well as work hours per week, work schedule, night work exposure, and sleep medication use, were entered in Step 1 of the regression analyses. Autonomy, competence, and relatedness were entered in Step 2.

Results

Means and standard deviations for all continuous variables as well as frequencies for all categorical variables can be seen in Table 1. This table also shows correlations between all study variables. Autonomy and competence had significant, negative correlations with all the shift work tolerance variables: insomnia, physical fatigue, mental fatigue, and digestive troubles. Relatedness was

Table 1. Means or frequencies, standard deviations and correlations of all study variables (n=206–249)

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Gender	75.4% female	-	-													
2. Age	39.5	11.37	-0.06	-												
3. Children at home (1=yes, 2=no)	46.8% yes	0.11	0.02	-												
4. Work hours per week	30.2	7.92	0.31**	-0.08	0.04	-										
5. Work schedule (1=day and evening, 2=rotating, 3=night only)	17.9% day and evening/ 33.7% rotating/ 48.4% night only	-0.10	-0.08	-0.13*	-0.14*	-										
6. Night work exposure (yr)	7.03	6.12	0.17**	-0.55**	-0.02	0.18**	0.11	-								
7. Sleep medication (1=no, 2=one type, 3=two types)	13.4% yes	-0.05	-0.08	0.01	-0.03	0.09	0.09	-								
8. Autonomy	4.94	1.13	0.04	-0.04	0.06	0.03	-0.04	0.13	-0.09	-						
9. Competence	5.65	1.03	-0.03	-0.23**	0.05	0.05	-0.08	0.28**	-0.07	0.35**	-					
10. Relatedness	5.83	1.01	-0.06	-0.05	-0.01	-0.05	0.03	0.06	-0.08	0.47**	0.32**	-				
11. Insomnia	19.18	9.32	-0.03	0.04	-0.03	0.08	0.14*	-0.01	0.31**	-0.19**	-0.17*	-0.18**	-			
12. Physical fatigue	9.27	4.05	-0.06	0.00	-0.06	0.04	0.13	-0.05	0.09	-0.20**	-0.18**	-0.08	0.53**	-		
13. Mental fatigue	4.73	1.93	0.11	0.02	-0.04	0.03	0.04	-0.06	0.06	-0.19**	-0.27**	-0.13	0.38**	0.61**	-	
14. Digestive troubles	4.07	1.55	-0.06	0.07	0.01	0.04	0.06	0.00	0.09	-0.26**	-0.19**	-0.09	0.45**	0.50**	0.36**	-

*p<0.05, **p<0.01

significantly and negatively correlated with insomnia. Use of sleep medication had a significant, positive correlation with insomnia, but not with the other shift work tolerance variables. Work schedule was also significantly related to insomnia, but not to fatigue or digestive troubles. None of the other work scheduling variables (work hours per week or work schedule), night work exposure, or the background variables of gender, age and children at home had any significant correlation with the shift work tolerance variables.

Prior to conducting the analyses, the assumptions for multiple regression analysis were examined. All the assumptions (multicollinearity, outliers, normality, linearity, homoscedasticity, and independence of residuals) were met. None of the demographic variables (age, gender and children at home) had significant correlations with the shift work tolerance variables. Because of this, and to reduce the number of predictors in the regression analysis due to the low sample size ($n=212-252$), these demographic variables were excluded from further regression analysis. The inter-correlation between the three basic need variables ranged from 0.32–0.47, confirming that they are suitable for separate investigation and do not measure the same concept. Four separate multiple regression analyses were conducted, one for each of the shift work tolerance variables.

For insomnia, Step 1, including background variables, work arrangement, night work exposure and sleep medication use, explained 11% of the variance. Adding the basic need variables in Step 2 led to a significant, 4% increase in the explained variance ($F=(7,198)=5.46, p=0.00$). In the first step, work schedule and sleep medication use were significantly related to insomnia. In the final model, only sleep medication had a significant relation to insomnia, which was positive. None of the basic need variables were significantly related to insomnia in the final model, controlling for all the other variables. However, the significant increase in explained variance when adding these three variables indicate that together they may have some relation to insomnia.

Regarding physical fatigue, in Step 1 the background variables, work arrangement, night work exposure, and sleep medication did not contribute to the explained variance in physical fatigue. For Step 2, including the basic need variables led to a 4% increase in explained variance ($F=(7,198)=2.34, p=0.02$). Autonomy had a significant, negative relation to physical fatigue in the final model.

With respect to mental fatigue, Step 1 revealed no significances, but Step 2 led to a significant increase in explained variance to 7% ($F=(7,198)=2.71, p=0.01$). Competence was in this model the only variable that reached significance.

Competence was negatively related to mental fatigue.

Lastly, Step 1 was not significant with regard to digestive troubles, but adding the basic need variables in Step 2 made the explained variance significantly increase to 8% ($F=(7,198)=2.88, p=0.01$). Here, autonomy was the only significant variable, demonstrating a negative relation to digestive troubles (Table 2).

Discussion

The present pilot study indicates that satisfaction of the basic needs of autonomy, competence, and relatedness is important for the health, sleep, and fatigue levels of shift workers. In particular, in some cases autonomy and competence appear to be more important for shift work tolerance than the variables of work arrangement, night work exposure, and sleep medication use. This highlights the importance of investigating motivation variables in later research that aims to ameliorate the negative effects of night and shift work. Along these lines, one study revealed that basic psychological need satisfaction in work settings is in fact positively related to enjoyment of work³⁶). A recent study also revealed that exposure to transformational leadership, an inspirational and motivational form of leadership, demonstrated substantial relationships with fulfillment of the basic psychological needs of relatedness, autonomy, and competence at work³⁷).

Autonomy, competence, and to a somewhat lesser degree, relatedness were each independently related to all of the shift work tolerance variables in the correlation analysis in the study reported in this paper. However, controlling for work schedule, night work exposure, and sleep medication, as well as for the other basic needs, autonomy was related only to physical fatigue and digestive troubles, while competence was related only to mental fatigue. All relationships were negative, indicating that autonomy and competence were related to experiencing fewer fatigue and digestive troubles. These findings are in line with Ryan and Deci's reports concerning the relationship between the satisfaction of these needs and better mental health²⁹).

In particular, the connection between competence and mental fatigue are consistent with Ryan and Deci²⁹) and Deci and Vansteenkiste's²²) findings. It is also interesting to note that autonomy and competence were related to different shift work tolerance variables. As mentioned in the introduction, competence is linked to any type of motivation, whereas autonomy is related to intrinsic motivation in particular²³). Thus, general motivation may be more important for mental fatigue, while intrinsic motivation

Table 2. Work hours per week, work schedule, night work exposure, sleep medication use and the three basic needs predicting insomnia, physical fatigue, mental fatigue and digestive troubles (n=211–252)

Variables	Insomnia			Physical fatigue			Mental fatigue			Digestive troubles		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Step 1												
Work hours per week	0.15	0.08	0.12	0.04	0.04	0.07	0.01	0.02	0.06	0.01	0.01	0.05
Work schedule (1–3)	1.75	0.84	0.14*	0.75	0.38	0.14*	0.14	0.18	0.06	0.13	0.15	0.07
Night work exposure (yr)	-0.11	0.10	-0.07	-0.06	0.05	-0.09	-0.03	0.02	-0.08	-0.01	0.02	-0.03
Sleep medication use	6.16	1.34	0.31**	0.80	0.61	0.09	0.27	0.29	0.06	0.30	0.24	0.09
Step 2												
Work hours per week	0.14	0.08	0.12	0.04	0.04	0.07	0.01	0.02	0.05	0.01	0.01	0.05
Work schedule (1–3)	1.61	0.84	0.13	0.63	0.38	0.12	0.06	0.18	0.02	0.07	0.14	0.04
Night work exposure (yr)	-0.04	0.11	-0.03	-0.02	0.05	-0.03	0.00	0.02	0.00	0.01	0.02	0.04
Sleep medication use	5.68	1.33	0.28**	0.60	0.60	0.07	0.14	0.29	0.03	0.20	0.23	0.06
Autonomy	-0.74	0.63	-0.09	-0.58	0.29	-0.16*	-0.18	0.14	-0.11	-0.34	0.11	-0.25**
Competence	-0.74	0.67	-0.08	-0.46	0.31	-0.12	-0.44	0.14	-0.23**	-0.21	0.12	-0.14
Relatedness	-0.81	0.70	-0.09	0.15	0.32	0.04	0.00	0.15	0.00	0.11	0.12	0.07

Insomnia: R^2 Step 1=0.11**; ΔR^2 Step 2=0.04**; Physical fatigue: R^2 Step 1=0.02; ΔR^2 Step 2=0.04* Mental fatigue: R^2 Step 1=0.01; ΔR^2 Step 2=0.07**; Digestive troubles: R^2 Step 1=0.02; ΔR^2 Step 2=0.08* ; * p <0.05, ** p <0.01

is essential specifically for physical fatigue and digestive troubles. Another explanation as to why general motivation was related to some aspects of better health among shift workers may be financial reasons. Some individuals choose to work extended work hours and shift work for financial benefits^{38–40}. Financial benefits may increase motivation and thereby lead to better health as well. However, recent research seem to indicate that pay levels are not related to intrinsic motivation and basic need satisfaction⁴¹. Consequently, this may not be a likely reason for the relation between autonomy and fatigue and digestive troubles.

In the full regression model, the basic needs were not related to insomnia. This is probably due to the control for sleep medication, as the variance in insomnia in the regression model was largely explained by sleep medication use. The significant correlations between all three basic need variables and insomnia indicates that the needs also may be important for insomnia, but that use of sleep medication has a stronger relationship to insomnia. In this regard, it is important to discuss causality, as the results in the present study cannot define any causal relationships. For insomnia, sleep medication use is perhaps a more likely cause of insomnia than a factor that leads to further insomnia. For basic needs, the causal relationship is not as clear, as experience of less satisfaction with needs can lead to greater experience of insomnia symptoms, but also vice versa.

Relatedness was only significant in the correlation analysis and only to insomnia, but not when controlling for other variables in the regression analysis. This indicates

that relatedness may not be as important for shift work tolerance as the other basic needs. This is in line with Deci and Ryan's¹⁶ assumption that relatedness may not be as important as competence and autonomy for some activities. However, Deci and Ryan also emphasize that relatedness and autonomy are more basic than competence¹⁶, which runs counter to our findings. In addition, previous studies have reported that social support may be important in shift work tolerance²⁷. Also, social interaction may alleviate experiences of fatigue²⁵. Thus, an explanation of the seeming discrepancies in results may be due to the fact that relatedness is different from social support. More research on relatedness and shift work tolerance with a larger sample of shift workers is needed to make stronger conclusions.

Our results support the idea that autonomy and competence are related to some aspects of shift work tolerance. However, it would also be interesting to know how the basic needs relate to physical health consequences of shift work, for example metabolic syndrome or cancer. To the best of our knowledge, no research has yet been performed to investigate this question, and this is an important avenue for future research.

Strengths and limitations

This study is a cross-sectional one, and thus cannot state anything about causal relations. The n and response rate were relatively low. Nevertheless, the response rate is close to the acceptable response rate stated in previous organizational psychology research⁴². Also, the n is

acceptable for performing the analyses. The respondents were employed in service-oriented and social positions in a municipality, and the generalizability to other groups of shift workers can be discussed.

The way in which we assessed the work schedule variable in our study can be critiqued. Preferably we would have included further measures of the work schedule to assess this dimension more thoroughly, including factors such as speed and direction of rotation. Additionally, our method of assessing sleep medication may not be illustrative of sleep medication's importance for shift work tolerance. Some argue that use of sleep medication is in fact a part of shift work tolerance¹¹⁾, and it should therefore be among the dependent variables in our analyses. However, one of present study's goals was to examine the importance of some countermeasures for mitigating night work's effects as mentioned in Pallesen *et al.*¹³⁾, among them sleep medication, relative to the importance of basic needs' satisfaction. Sleep medication was measured the same way as in previous shift work studies⁴³⁾. Furthermore, the instruments we used to assess insomnia and fatigue are well validated and frequently used in previous research, although using only two questions to measure digestive troubles, as we did in the present study, is not ideal. Our version of the instrument assessing basic needs was a truncated one, and using the scale in its entirety is encouraged for later research. In all, the use of many validated instruments is one of the study's strengths. However, the validity of such a mixed set of questionnaires could be critiqued. Still, the use of different instruments to measure shift work tolerance has recently been supported by research¹²⁾. In particular, this study applies the same instruments as the current one to measure fatigue, insomnia, and sleep medication.

Despite these limitations, the present study includes an acceptable number of participants, has similar gender distributions as seen in other shift work research on social dominating occupations, and uses many validated instruments. Thus, the findings can be used as an important basis for future research.

Conclusion and suggestions for future research

A feeling of competence and autonomy may ameliorate specific problems often seen among shift workers, especially fatigue and digestive troubles. Although more research is needed to make definite conclusions, the fact that these relations were found in this pilot study support the importance of basic needs to shift workers. Organizations employing shift workers should work towards improving their employees' competence and autonomy to lessen the

negative effects of shift work.

Within specific domains, especially those central to people's lives such as work settings, satisfaction of the needs is also suggested to be related to general well-being¹⁶⁾. A focus on and further development of autonomy, competence, and preferably also relatedness among employees is something that can be accomplished by more information and support from management, but also by furnishing courses and education related to the job. More research on the relationship between basic needs and shift work tolerance is needed. In particular, longitudinal studies across several types of shift workers in natural settings would likely be fruitful to better measure and control for "the healthy shift worker effect" and to establish causal relations.

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