Occupational stress in submariners: The impact of isolated and confined work on psychological well-being

Kate S. Brasher; Angela B. C. Dew; Shaun G. Kilminster; Robert S. Bridger

* Institute of Naval Medicine, Crescent Rd, Alverstoke, Hampshire, UK

Online publication date: 25 February 2010

To cite this Article Brasher, Kate S., Dew, Angela B. C., Kilminster, Shaun G. and Bridger, Robert S. (2010) 'Occupational stress in submariners: The impact of isolated and confined work on psychological well-being', Ergonomics, 53: 3, 305 – 313

To link to this Article DOI: 10.1080/00140130903067763

URL: http://dx.doi.org/10.1080/00140130903067763
Occupational stress in submariners: The impact of isolated and confined work on psychological well-being

Kate S. Brasher, Angela B.C. Dew, Shaun G. Kilminster and Robert S. Bridger*

Institute of Naval Medicine, Crescent Rd, Alverstoke, Hampshire PO12 2DL, UK

(Received 3 June 2008; final version received 26 May 2009)

This study aimed to identify work-related and personal factors associated with occupational stress in submariners. Work and well-being questionnaires were distributed to 219 male submariners (mean age 34 years), as part of a larger cohort study involving a stratified sample of 4951 Royal Navy (RN) personnel. The stress rate in submariners was 40%; significantly higher than the stress rate in the general RN, although once demographic factors were controlled for in a matched control sample, this difference was no longer significant. A summary model accounted for 49% of the variance in submariner stress, with key differences emerging between the occupational factors associated with stress in submariners and in the general RN. The longitudinal nature of this study permits stress in submariners to be monitored over 5 years, which will provide valuable insights into the chronicity of stress in this specialised occupational group.

Statement of Relevance: This paper contributes to the current literature on the negative impact of working in isolated conditions. It is demonstrated that occupational stress in submarines can be partially explained using current theories of stress in the workplace. However, the constraints of a restricted environment introduce additional factors which can also be associated with occupational stress.

Keywords: occupational stress; submariners; extreme environment; isolated environment

1. Introduction

According to Sandal et al. (2006), people who have to work in isolated and extreme environments are subject to additional psychosocial and physical stressors over and above those normally encountered in the workplace (such as an imbalance between work demands and worker control or a perceived imbalance between the effort made and the rewards obtained). The possible stressors of working in isolated environments over long periods of time will be discussed below.

Long-term exposure to isolated and extreme environments occurs in polar station expeditions (particularly when over-wintering) in real and simulated space missions, onboard submarines and in various other specialist occupations. It is important to understand the demands of working in these environments because of the difficulty of extracting personnel once the mission has started and the consequences of a breakdown in human reliability due to a failure to cope with work stressors.

Working in isolated conditions can result in negative effects on personnel well-being. Decrements in work performance, depressive mood, psychosomatic complaints, interpersonal conflict, lapses of attention and emotional lability have been reported (Sandal et al. 2006). Further evidence was provided by Parkes (1993), who reported significant occupational and psychosocial differences between control room operators based on platforms in the North Sea and operators working in onshore terminals. The offshore group experienced increased anxiety, more disturbed sleep patterns, perceived a higher workload and were more dissatisfied with the shift timings.

Sandal et al. (2006) discuss factors that might affect the psychological functioning of personnel working in extreme environments. Mood is often positive both during and after the mission (Suedfeld and Steel 2000) with a negative dip in the third quarter of the mission as personnel consider the time remaining (Bechtel and Berning 1991). The positive mood pattern during the early stages of the mission was described as a ‘salutogenic effect’ (Antonovsky 1979, Sandal 2000), occurring when personnel are effectively isolated from the normal anxieties of everyday life. However, Rotter and Boveja (1999) contradicted the presence of a salutogenic effect in isolated personnel, reporting that deployed military personnel who were provided with facilities to maintain regular contact with their families had a more positive outlook and found it easier to cope with separation.

Previous research has found that low family, peer and leader support is associated with how well...
personnel cope with working in isolated conditions. Lack of support from families and peers accounted for 23% of the variance in stress in British Forces personnel serving in the Falklands (Limbert 2004) and strong leader support exerted a positive effect on group morale in astronauts (Kanas et al. 2007). This finding supports models of occupational stress, such as Karasek (1979), which predict that social support (from peers, leaders and external support from family) acts as a buffer of stress. However, seeking peer support as a coping mechanism has also been found to relate to poor psychological adjustment during prolonged submarine missions (Sandal et al. 1999). Palinkas (2003) distinguished between peer support as a stress buffer and social dynamics as a stressor. Personnel too reliant on peer support might be more susceptible to tensions within the group, whilst those who adapt to the environment by refraining from relying on colleagues for support might adjust better.

In addition to support networks, certain personality traits appear to favour the ability to cope with isolated and extreme working environments. These include high levels of extraversion and low neuroticism (Steel et al. 1997) as well as low interpersonal aggressiveness and low competitiveness (Chidester et al. 1991). Further research reported that submariners at sea with high interpersonal sensitivity and those utilising problem-directed coping strategies coped better with the privacy and crowding onboard and exhibited fewer symptoms of stress (Sandal et al. 1999).

Levine and Ursin (1991) emphasise that the single most important determinant of coping is the meaning that personnel attach to their experiences. In terms of Siegrist’s (1996) model of psychosocial work stressors, this might include the intrinsic rewards of the mission itself, the status and prestige of participating and the recognition received, rather than merely the financial rewards.

The present paper concerns occupational stress in submariners in the Royal Navy (RN). Occupational stress (hereafter termed ‘stress’) refers to the physical or psychological reactions experienced when stressors in the workplace exceed an individual’s ability to cope. Submariners regularly spend long periods of time deployed at sea (an average deployment is 90 d), where they lose contact with the outside world both physically (e.g. exposure to daylight, freedom to roam) and in psychosocial terms (regular contact with family and friends, access to newspapers and television). They are an interesting occupational group in themselves and many aspects of their working conditions are similar to those experienced by others who work in extreme and isolated environments.

Because a submariner’s daily working life appears to be considerably different from life in the general RN, this suggests that the pattern of factors influencing stress occurrence in submariners warrants investigation in its own right. Whilst a bespoke model of stress has been developed for the general RN, no such model exists for submariners.

In January 2007, the Institute of Naval Medicine began the first phase of a 5-year longitudinal study of stress in the RN, including submariners. The aim of the present paper is to report the prevalence of stress and describe the personal, demographic and occupational factors associated with stress in submariners.

2. Method
2.1. Participants
A random stratified sample of Naval service personnel (n = 4951) were sent a work and well-being questionnaire (WWBQ) between January and May 2007 and 219 submariners were included in the survey. All submariners in this study were male (females do not serve on RN submarines). This was the first phase of a 5-year cohort study of stress in the Naval Service. The submariner response rate at 53% was relatively low, despite extra survey mail-outs targeting non-responders. This could be a result of the very nature of submariner work, as personnel are often based in inaccessible locations and are frequently non-contactable by post for considerable periods of time.

2.2. Measures
The WWBQ contained a section dealing with demographic factors, such as rank, marital status, gender, branch/specialisation and place of work. A second section dealt with exposure to workplace stressors, scored using 5-point Likert scales. Scale measures included: physical work environment; autonomy and control; organisational commitment; leader and peer support; role conflict and work–family conflict. The original WWBQ had good test–retest reliability (Kilminster and Bridger 2007).

The WWBQ was updated from a previous version (Slaven et al. 1999) to include additional stressor scales. These included effort–reward imbalance (ERI), overcommitment, mood — selected items from the Positive and Negative Affect Scale (Watson et al. 1988) and stressful life events (SLEs — using selected items from the Social Readjustment Scale; Holmes and Rahe 1967).

Factor analysis of the newly updated questionnaire revealed a factor structure consisting of physical work environment, physical living environment, autonomy and control, provision of resources, role conflict, organisational commitment, leader support, peer support, organisational support, work–family conflict and intention to leave (Kilminster and Bridger 2007).
The original ERI scale had 17 items, which were successfully reduced down to four items during piloting. Cronbach’s alpha for the new reduced test was maintained from 0.73 to 0.72 and the test–retest reliability improved from 0.82 to 0.84. The original over-commitment scale had six items and these were successfully reduced to three. Cronbach’s alpha for the reduced version of the over-commitment scale was improved from 0.56 to 0.83 and the test–retest reliability went up from 0.86 to 0.87. The SLE scale had good test–retest reliability of 0.93 for section A (major events scoring > 50) and 0.89 for section B (minor events scoring < 50).

The stressors, buffers, outcomes and demographics details measured by the WWBQ are listed in Table 1.

The General Health Questionnaire-12 (GHQ-12; Goldberg and Williams 1988) was used to measure stress in this study. The GHQ-12 asks respondents to what extent they have recently experienced 12 indicators of stress, including loss of sleep due to worry and losing confidence. Results were scored using the case method (whereby four or more symptoms defines a stress ‘case’) and the Likert method (termed ‘GHQ-12 total score’). The total number of stress cases in the sample indicates the stress ‘rate’ or prevalence.

In order to investigate whether submariners had a higher stress rate than the general RN, male controls matched for age, rank and length of service were randomly selected from the remainder of the RN cohort. Three matched controls were selected in this way for each submariner in the sample.

Ethical approval was obtained from the Ministry of Defence Research Ethics Committee.

2.3. Statistical analysis

Two previous cross-sectional studies researching stress in the general RN provided data for retrospective analysis of stress prevalence in 1999 and 2004 (Slaven et al. 1999, Bridger and Kilminster 2004). These datasets were used in the current study to generate stress rates for submariners at these previous time points. A one-way ANOVA assessed whether stress rates changed significantly between the 1999, 2004 and 2007 surveys.

Submariner GHQ-12 total scores were compared to the scores of personnel on ship, shore and overseas using ANOVA and post-hoc tests identified which groups differed significantly.

In order to assess which factors were predictive of stress in submariners, a stepwise linear regression was conducted with means substituted for missing values. Self-reported general physical health was not included in the analysis as this was considered to be an outcome variable that will be reported on in a future paper.

Independent t-tests were conducted in order to analyse whether there were any statistical differences in perceived occupational stressors between submariners and controls. A Mann-Whitney U test compared GHQ-12 total score between submariners and controls.

3. Results

In total, 116 questionnaires from a total of 219 were returned (a 53% response rate). Of the 116 questionnaires returned, 105 were fully completed; therefore, this was the sample used in the remainder of the analyses. A total of 51% of the respondents were married and the average age was 34 years (range: 19–50 years, SD 7.9 years). Of the non-respondents, 46% were married and the average age was 30 years (range: 18–51 years, SD 7.7 years).

<table>
<thead>
<tr>
<th>Stressors</th>
<th>Buffers</th>
<th>Outcome</th>
<th>Demographics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial reward</td>
<td>Coping approach</td>
<td>GHQ-12</td>
<td>Job specialisation</td>
</tr>
<tr>
<td>Effort-reward imbalance</td>
<td>Stress-coping behaviour</td>
<td>Short-term absence</td>
<td>Draft preference</td>
</tr>
<tr>
<td>Over-commitment</td>
<td>Positive mood</td>
<td>Long-term absence</td>
<td>Physical workload</td>
</tr>
<tr>
<td>Role conflict</td>
<td>Negative mood</td>
<td>Exercise</td>
<td>Marital status</td>
</tr>
<tr>
<td>Work–family conflict</td>
<td>Organisational commitment</td>
<td></td>
<td>Alcohol intake</td>
</tr>
<tr>
<td>Physical work environment</td>
<td></td>
<td></td>
<td>BMI</td>
</tr>
<tr>
<td>Physical living environment</td>
<td></td>
<td></td>
<td>Sea-sickness</td>
</tr>
<tr>
<td>Autonomy/Control</td>
<td></td>
<td></td>
<td>Years left in RN</td>
</tr>
<tr>
<td>Resources</td>
<td></td>
<td></td>
<td>Age</td>
</tr>
<tr>
<td>Leader support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peer support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stressful life events</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GHQ-12 = General Health Questionnaire-12; RN = Royal Navy.
scores between the three different time frames revealed no statistically significant differences ($F = 1.53 \ (2,445), \ p = 0.22$). This suggests that the stress rate in submariners has remained relatively stable over time and therefore the remainder of the analyses in this paper focused on the 2007 dataset.

3.2. Stress in submariners vs. stress in ship-based, shore-based and overseas personnel

The stress rate found in submariners (40%) was considerably higher than the stress rate in general RN males (28%), see Table 2.

ANOVA revealed that whether an RN employee was serving on ship, ashore on submarines or overseas did have a significant effect on their GHQ-12 total scores ($F = 7.57 \ (3,1526), \ p < 0.001$). Post-hoc analysis found significant differences between the GHQ-12 total scores of personnel serving on shore and on ships ($p = 0.02$), on shore and on submarines ($p < 0.001$) and on submarines and overseas ($p = 0.03$). However GHQ-12 total scores did not differ significantly between personnel based on ships and personnel based on submarines ($p > 0.05$).

3.3. Factors associated with stress in submariners and in matched controls

Bivariate correlations were conducted to identify which factors were potentially predictive of variance in GHQ-12 total score. Those factors that correlated significantly with GHQ-12 total score were entered into a stepwise linear regression and this produced a significant model to predict stress in submariners, see Table 3 (adjusted $R^2 = 0.49; F_{8,96} = 13.52, \ p < 0.001$). This model accounted for 49% of the variance in submariner stress.

A similar regression analysis was then conducted for matched control males from the general RN. To ensure that the submariner and control samples were accurately matched, t-tests were conducted, which confirmed there were no statistically significant differences between the age of submariners and controls (mean 34 years in both samples, $p = 0.34$) or the length of service (mean 14 years in both samples, $p = 0.09$). Rank did not differ between the samples as it was matched absolutely.

This stepwise linear regression accounted for 44% of the variance in matched controls’ stress levels, see Table 4 (adjusted $R^2 = 0.44; F_{6,92} = 13.25, \ p < 0.001$). Interestingly, the six significant predictors of stress in this model were very different from those appearing in the submariner model.

Tables 5 and 6 show the responses of the submariners and the matched controls sample to each WWBQ factor, categorised as ‘positive’, ‘neutral’ or ‘negative’, depending on the mean Likert scale score.

The factors that emerged as positive were very similar between the two groups, although matched controls reported higher organisational commitment to the RN as this was a positive factor for the controls but not for submariners. Lack of resources, positive mood and work–family conflict emerged as negative factors for both groups, but submariners also gave a negative evaluation of their physical work environment and their perceived exposure to role conflict.

Independent t-tests were conducted between submariners’ and matched controls’ responses to the WWBQ. The findings are displayed in Table 7. It should be noted that higher mean scores indicate lower satisfaction/commitment levels, with the exception of positive mood, where high scores indicate better mood.

Compared to their matched RN counterparts, submariners were significantly less committed to the

### Table 2. General Health Questionnaire-12 (GHQ-12) total scores and stress rates for males in shore-based establishments, aboard ships, on submarines and overseas.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Mean GHQ-total Score</th>
<th>No. of Stress Cases</th>
<th>% Stress Case (+ 95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall male sample</td>
<td>1530</td>
<td>12.3</td>
<td>425</td>
<td>28 (26–30)</td>
</tr>
<tr>
<td>Shore</td>
<td>1076</td>
<td>11.9</td>
<td>269</td>
<td>25 (22–28)</td>
</tr>
<tr>
<td>Ship</td>
<td>288</td>
<td>12.9</td>
<td>96</td>
<td>33 (28–39)</td>
</tr>
<tr>
<td>Submarines</td>
<td>105</td>
<td>14.1</td>
<td>42</td>
<td>40 (30–50)</td>
</tr>
<tr>
<td>Overseas</td>
<td>61</td>
<td>11.7</td>
<td>18</td>
<td>30 (18–41)</td>
</tr>
</tbody>
</table>
service, with the mean rating on this factor over 1 scale point higher than controls. Those on submarines were also significantly less satisfied with their physical work environment, the availability of resources and their financial rewards. However, submariners did have higher scores on the positive mood scale (emotional lability), indicating a more positive engagement with the work environment.

Chi square tests revealed that a significantly higher proportion of submariners were serving in their area of specialisation, i.e. performing the job they were trained to do, than general RN matched controls (92% and 76% respectively; \( \chi^2 = 11.44 \), degrees of freedom = 1, \( p < 0.001 \)).

A Mann-Whitney U test revealed that submariners did not have significantly higher GHQ-12 total scores than matched controls (mean GHQ-12 total scores 13.74 and 12.21 respectively, \( U = 3971 \), \( n_1 = 93 \), \( n_2 = 93 \), \( p = 0.34 \)). Lower GHQ-12 total scores indicate lower levels of stress; therefore, these results indicate that submariners did have higher stress levels than matched controls but that this difference was not significant.

4. Discussion
This study has provided an important insight into stress in submariners working for long periods of time in isolated and confined environments.

It should be noted that this study is, at present, cross-sectional and therefore it cannot be stated that stress is caused by exposure to the factors measured here. In many cases, there may be reverse-causality (e.g. where high levels of stress cause personnel to lose their commitment to the organisation). The findings are therefore interpreted with caution, allowing for the cross-sectional nature of the study.

4.1. Stress in submariners over time
The findings showed that stress rates in submariners were stable across time, as has also been found in the general RN (Bridger et al. 2007). This is in direct contrast to a report issued by the Health and Safety Executive, which states that stress is an increasing problem in the UK (Mackay et al. 2004). Whilst the stress rate in submariners at 40% is considerably higher than that of the general British population (18%; Dollard et al. 2003), it does not appear to be increasing.

4.2. Stress in submariners compared to stress in the general RN
Overall, the stress rate in submariners was 40% compared to only 28% in the general male RN, but
once age, rank and length of service were controlled for there was no difference in stress rate. This suggests that submariners are no more susceptible to stress than personnel in general RN occupations once demographic factors are taken into account.

Submariners did have higher GHQ-12 scores than personnel serving in shore-based establishments and overseas. However, there were no significant differences in GHQ-12 scores between submariners and ship-based personnel. This is an unexpected finding as submariners cope with more adverse work and living conditions than those on ships and have a more restricted and isolated lifestyle. Possible explanations are discussed below.

4.2.1. Self-selection bias
The majority of submariners have actively volunteered to work in this profession, so it is possible that a self-selection bias is in operation whereby submariners are innately more resilient than those who join the general RN and are then drafted to work on ships. This increased resilience would help buffer submariners from the negative psychological impact of working in extreme conditions.

4.2.2. Submariner prestige
Working onboard a submarine is a highly specialised occupation with a certain degree of prestige attached to it. Given Levine and Ursin’s (1991) theory that the meaning that personnel attach to their work determines how well they cope, it could be that the added status and recognition (Siegrist 1996) associated with submariner work also helps this occupational group in countering the negative effects of working in isolated conditions.

4.2.3. Isolation from family demands
The complete insulation from everyday family concerns might further account for why submariners are protected to some extent from sources of stress that the general RN are more exposed to (Sandal 2000). The lack of an association between work–family conflict and stress and between SLEs and stress in submariners provides support for Antonovsky’s (1979) ‘salutogenic effect’ of isolated environments. Despite the majority of submariners reporting some dissatisfaction with the conflict between their work and their family, this was not associated with stress, whereas work–family conflict was associated with stress for matched controls from the general RN, who have more contact with their families than submariners. This contradicts the work of Rotter and Boveja (1999), who found that regular contact with families when working away from home helps buffer against the effects of stress.

4.3. Description of personal, demographic and occupational factors associated with stress in submariners
Whilst submariners were not found to be any more stressed than RN personnel onboard ships, the submariner sample was found to have a unique model

<table>
<thead>
<tr>
<th>Factor</th>
<th>p</th>
<th>Submariner Group</th>
<th>Matched Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisational commitment</td>
<td>&lt;0.001</td>
<td>Mean 2.80 SD 0.91</td>
<td>Mean 1.70 SD 0.34</td>
</tr>
<tr>
<td>Physical work environment</td>
<td>&lt;0.001</td>
<td>Mean 3.28 SD 0.78</td>
<td>Mean 2.76 SD 0.50</td>
</tr>
<tr>
<td>Lack of personnel/Resources</td>
<td>0.003</td>
<td>Mean 3.89 SD 0.72</td>
<td>Mean 3.61 SD 0.49</td>
</tr>
<tr>
<td>Financial reward</td>
<td>0.007</td>
<td>Mean 2.63 SD 1.28</td>
<td>Mean 2.22 SD 0.67</td>
</tr>
<tr>
<td>Positive mood</td>
<td>0.007</td>
<td>Mean 2.42 SD 1.27</td>
<td>Mean 2.17 SD 0.43</td>
</tr>
<tr>
<td>Work/Family conflict</td>
<td>0.091</td>
<td>Mean 3.81 SD 0.88</td>
<td>Mean 3.63 SD 0.51</td>
</tr>
<tr>
<td>Stress coping behaviour</td>
<td>0.281</td>
<td>Mean 3.36 SD 0.82</td>
<td>Mean 3.46 SD 0.43</td>
</tr>
<tr>
<td>Effort reward</td>
<td>0.251</td>
<td>Mean 2.52 SD 0.74</td>
<td>Mean 2.42 SD 0.45</td>
</tr>
<tr>
<td>Negative mood</td>
<td>0.081</td>
<td>Mean 1.61 SD 0.67</td>
<td>Mean 1.47 SD 0.40</td>
</tr>
<tr>
<td>Leader support</td>
<td>0.316</td>
<td>Mean 2.41 SD 1.06</td>
<td>Mean 2.28 SD 0.55</td>
</tr>
<tr>
<td>Coping approach</td>
<td>0.455</td>
<td>Mean 3.09 SD 1.10</td>
<td>Mean 2.99 SD 0.60</td>
</tr>
<tr>
<td>Peer support</td>
<td>0.131</td>
<td>Mean 2.68 SD 0.98</td>
<td>Mean 2.51 SD 0.51</td>
</tr>
<tr>
<td>Over-commitment to role</td>
<td>0.188</td>
<td>Mean 2.56 SD 0.70</td>
<td>Mean 2.46 SD 0.35</td>
</tr>
<tr>
<td>Role conflict</td>
<td>0.467</td>
<td>Mean 3.28 SD 0.99</td>
<td>Mean 3.19 SD 0.54</td>
</tr>
<tr>
<td>Living environment</td>
<td>0.425</td>
<td>Mean 3.06 SD 0.90</td>
<td>Mean 2.92 SD 1.11</td>
</tr>
<tr>
<td>Autonomy and control</td>
<td>0.961</td>
<td>Mean 2.95 SD 0.96</td>
<td>Mean 2.95 SD 0.59</td>
</tr>
</tbody>
</table>

Note: Items shown in bold indicate significant differences. The values for living environment are lower as only those currently living in Service accommodation were asked to respond.
in terms of the factors associated with stress. This highlights the necessity for specific models of stress for different occupational groups (Rydstedt et al. 2007).

The regression analysis accounted for 49% of the variance in submariner stress. The model indicated that those with high stress levels would tend to be emotionally labile individuals who are over-committed to their work roles, but lack commitment to the RN as a whole. They might also perceive a lack of support from leaders and peers and feel dissatisfied with the physical work environment.

4.3.1. Organisational commitment
A lack of organisational commitment accounted for over one-fifth of the variance in submariner stress and submariners reported significantly lower levels of commitment to the organisation than matched controls. Organisational commitment is essentially a sense of unity with the organisation. RN personnel with high organisational commitment see themselves as an integral part of the RN. The reason submariners do not feel as committed to the RN as most Naval personnel could be that they identify first and foremost as submariners before they identify as RN personnel. It is also possible that the increased rate of stress in submariners is responsible for the low rate of organisational commitment, i.e. a submariner who is suffering from stress might lose his commitment to the RN. Focus groups might help to clarify the causes of low organisational commitment.

4.3.2. Over-commitment
Over-commitment was associated with stress in submariners but not matched controls. Over-commitment is defined as a pattern of excessive striving at work combined with a constant need for approval. Symptoms of over-commitment include an inability to ‘switch off’ at the end of a day at work and thinking about the next day’s tasks during the night. Given that submariners work and live in the same confined environment for an average of 90 d, and when on deployment cannot go home at the end of a working day, this lifestyle might account for the high levels of over-commitment to work role found in this sample.

4.3.3. Emotional lability
The measure of mood was a significant predictor of stress in submariners, as those with high emotional lability were more susceptible to stress, whether the mood was positive or negative. Emotional lability is likely to be an innate trait, which personnel bring with them when they join the RN, and this has been associated with neuroticism (Scheier et al. 1994). Therefore, the measure of mood adopted in the WWBQ might be indicative of personality type, particularly neuroticism, which has previously been linked to poorer adaptation to isolated working conditions (Palinkas et al. 2000). Intriguingly, matched RN controls were significantly less emotionally reactive than the submariner sample in terms of positive mood. The fact that 92% of submariners were working in the job they were trained to do might account for the higher levels of positive emotional engagement reported by this sample.

4.3.4. Physical work environment
The physical work environment was associated with stress in submariners and submariners were less satisfied with their physical working conditions than matched controls. This is line with a priori expectation, as the workspace onboard a submarine is restricted and can be very cramped. Interestingly, the physical living environment was not associated with stress and submariners were no more dissatisfied with their living quarters than general RN personnel. This implies that submariners can cope better with the confines of a restricted living space than they can with a cramped workspace.

4.3.5. Peer and leader support
In total, 80% of submariners were satisfied with the peer support they received at work, but the minority who did report a lack of positive interaction with their colleagues were more likely to suffer from stress, supporting the role of peer support in alleviating stress in isolated environments (Limbert 2004). Encouragingly, 84% of the submariner sample were happy with the leader support they received in their job and working with supportive and approachable leaders was associated with a reduced likelihood of stress. These findings suggest that turning to colleagues and superiors for support when under stress is an adequate coping mechanism when working in an isolated environment. This is despite the more complicated group cohesion patterns that can arise during long periods of confinement and isolation (Sandal et al. 1998). However, it could also be possible that personnel suffering from stress perceive lower levels of peer and leader support as a consequence of their state of increased anxiety.

4.3.6. Age
Age was found to be inversely related to stress, indicating that older personnel had lower stress rates.
RN personnel of a higher rank have previously been found to suffer less stress (Bridger and Kilminster 2004) and those of a higher rank tend to be older. Therefore, rank may indirectly account for the association between age and stress. It is posited that the lower levels of stress in higher ranked personnel might be due to the increased status, autonomy, task variation and living accommodation associated with superior rank in the RN. This relationship could also be indicative of a general age effect whereby maturity increases acceptance of or the ability to cope with a stressful working life.

4.4. General discussion

A significant proportion of the explained variance is attributable to occupational factors described by Karasek (1979) and Siegrist (1996), thus demonstrating that, to some extent, these models are applicable to submariner stress. However, factors such as over-commitment, organisational commitment and physical work environment are not acknowledged by existing models, thus highlighting the importance of developing a bespoke model of stress for personnel working in isolated and confined conditions.

Whilst these findings are cross-sectional, the ongoing study is longitudinal and will continue until 2012. This will allow further analysis of the extent to which the present exposures predict stress in submariners in 6, 12 and 24 months time and whether stress in 2007 is related to outcomes in the future, such as medical downgrading and premature voluntary release, i.e. voluntarily leaving the RN. The longitudinal survey will also attempt to combat any concerns raised by the cross-sectional nature of the present study.

The value of the present findings is twofold. First, the survey enables factors that were associated with stress in submariners to be distinguished from those that were not so related. Second, the survey has identified the strength of the associations between stress and occupational factors. These findings could help to develop stress management programmes for submariners. Such programmes should ideally be targeted at an organisational level rather than placing the emphasis of change on the individuals. For example, over-commitment to role (defined by a lack of disengagement from work role and a constant need for approval) was strongly associated with stress in submariners. The organisation could aim to encourage disengagement from the work role by taking practical steps to ensure that personnel take their full leave allowance, do not work overly long hours when on deployment and are given regular respite in the form of training courses, including adventurous training. The ‘constant need for approval’ aspect of over-committed behaviour could be addressed by introducing staff management courses for line managers on how to administer relevant praise and positive feedback and by ensuring that the organisation has a fair and impartial promotion system in place, which is understood and valued by its employees. Further research would need to be conducted to establish possible means of managing the other occupational factors that were found to relate to stress in submariners and to confirm the viability and potential implementation of these recommended interventions.

5. Conclusions

It is concluded that:

1. The main personal and demographic factors associated with stress in submariners were low organisational commitment, over-commitment to role, emotional lability and age. The main occupational factors associated with higher stress levels were physical working conditions aboard submarines, lack of peer support and lack of leader support.

2. Stress in submariners can be partially explained using current theories of occupational stress, such as the demand control support and ERI theories. However, for submariners, and possibly for other groups working in isolated and extreme environments, the constraints of a restricted environment introduce additional factors that can be associated with stress.

3. These findings can be used to guide organisational stress management programmes for submariners and the longitudinal RN survey will provide further information on stress in this specialised group. It is further hoped that the present paper might inform future research conducted into coping with isolated work conditions.

References


