SHORT REPORT

Two year follow-up study of stressors and occupational stress in submariners

K. S. Brasher¹, K. F. Sparshott¹, A. B. C. Weir¹, A. J. Day¹ and R. S. Bridger¹

¹Human Factors Department, Institute of Naval Medicine, Crescent Road, Alverstoke, Hampshire, PO12 2DL, UK, ²European Patent Office, The Hague, The Netherlands, ³Trainee Forensic Psychologist, Gosport, Hampshire, UK.

Correspondence to: K. S. Brasher, Human Factors Department, Institute of Naval Medicine, Crescent Road, Alverstoke, Hampshire, PO12 2DL, UK. e-mail: kate.brasher549@mod.uk

Background
Submariners are an occupational group within the Royal Navy (RN) who work in isolated and extreme conditions. This preliminary study forms part of a longitudinal study of occupational stress in the RN.

Aims
To compare stress prevalence in submariners with matched controls and to identify predictors of occupational stress in submariners over a 2 year follow-up period.

Methods
Participants completed a Work and Well-Being Questionnaire to measure occupational stressors and the General Health Questionnaire-12 (GHQ-12) to measure stress at time point 1, and a follow-up GHQ-12 2 years later. Demographically matched controls from the surface fleet of the RN were identified for each submariner. Regression models were developed for submariners and their controls to predict future stress at time point 2 using psychosocial predictors from time point 1.

Results
Participants comprised 144 submariners and 144 general service controls. There were no differences between submariners and their surface fleet counterparts in the prevalence of occupational stress. Nevertheless, different predictors for the development of stress were found between the two groups. For submariners, over-commitment and rank were the main predictors; whereas for controls, the predictors were length of service, body mass index and physical work.

Conclusions
Submariners were not more likely to suffer from occupational stress than surface fleet controls in the RN. However, the psychosocial predictors of stress were significantly different for this RN specialist group, demonstrating the importance of developing individual models of stress for different occupational groups.

Key words
Extreme environment; occupational stress; submariners.

Introduction
The psychological stressors faced by submariners have been compared with those experienced by personnel from other extreme and isolated environments, such as exploratory polar missions [1]. Personnel in such environments have been found to experience depressive mood and increased anxiety [1,2]. However, there may be a ‘salutogenic’ effect [3], whereby being isolated from the stressors encountered in daily life has a positive effect on health and resilience [1]. A previous paper [4] found that stress levels in submariners were not higher than those in matched controls in the surface fleet of the Royal Navy (RN).

This study aimed to compare occupational stress prevalence in submariners with matched controls, and assess the predictors of stress in each group.

Methods
The current study was approved by the Ministry of Defence Research Ethics Committee. This was a case–control study utilizing a sample from a larger cohort study [5]. The participants were submariners, each matched to a general service control. ‘General service’ encompasses all naval personnel serving either ashore, or on ships in the surface fleet. All participants were
respondents to a questionnaire assessing work demands and stress at time point 1 (57% response rate to overall cohort study [5]) and to a follow-up stress questionnaire 2 years later at time point 2 (66% response rate). Controls were matched absolutely on gender and rank.

Stress was measured at time points 1 and 2 using the General Health Questionnaire-12 (GHQ-12) [6], which has been used throughout the cohort study [5]. The GHQ-12 is a 12 item questionnaire that provides a measure of current levels of stress, scored from 0–36, where higher scores indicate higher levels of stress. For the purpose of analysis, those classified as stress cases [7] at time point 1 were excluded, and a median split was used on the time point 2 GHQ-12 score to generate two groups; high stress and low stress.

The time point 1 questionnaire measured perceived occupational stressors using a Work and Well-Being Questionnaire which was assembled from existing measures of occupational stressors [5] and scored using five point Likert scales. Independent samples t-tests were used to compare time point 2 GHQ-12 scores between submariners and their matched controls. Logistic regression analyses were performed for submariners and matched controls to predict the development of high stress at time point 2.

**Results**

Participants comprised 144 submariners and 144 matched controls. There were no significant differences between submariners and matched controls in terms of age, length of service and GHQ-12 score at time point 2.

Of the 70 submariners and their matched controls that did not have stress at time point 1, 27 submariners and 35 controls had developed high stress at time point 2. Significant models emerged to predict the development of stress for both occupational groups but with very different predictors. The model accounted for between 15 and 21% of the variance in submariners and between 28 and 38% of the variance in matched controls. Submariners of higher rank and with higher levels of over-commitment at time point 1 were more likely to have high stress at time point 2. Indeed submariners with high over-commitment (indicated using a median split) at time point 1 were three times more likely to develop high stress at time point 2. The increased likelihood of developing stress in senior ranked submariners could be attributed to additional responsibility found at a senior level in submariners, or the lack of opportunity to engage with counterparts of equal status.

**Table 1.** Odds ratios for developing high stress at time point 2 for submariners

<table>
<thead>
<tr>
<th>Time point 2 stress</th>
<th>Time point 1 (over-commitment)</th>
<th>High</th>
<th>Low</th>
<th>Total</th>
<th>Odds ratio (95% CIs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Over-commitment</td>
<td>17</td>
<td>16</td>
<td>33</td>
<td>2.87 (1.06–7.77)</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>10</td>
<td>27</td>
<td>37</td>
<td>(1.06–7.77)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>27</td>
<td>43</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Time point 1 (rank)</td>
<td>Officer</td>
<td>18</td>
<td>21</td>
<td>39</td>
<td>2.09 (0.77–5.68)</td>
</tr>
<tr>
<td></td>
<td>Rating</td>
<td>9</td>
<td>22</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>27</td>
<td>43</td>
<td>70</td>
<td></td>
</tr>
</tbody>
</table>

in 2 years of time as those with low over-commitment, see Table 1. In this study, ‘over-commitment’ refers to an inability to disengage from work once your shift has finished, and was measured by items regarding thinking about work problems before bed and having trouble sleeping if work tasks were left unfinished.

Matched controls who had served longer in the RN, had a higher body mass index (BMI) and performed more physical work at time point 1 were more likely to have high stress at time point 2, see Table 2.

**Discussion**

In line with the cross-sectional study at time point 1 [4], submariners did not exhibit greater stress prevalence at time point 2 than their counterparts in the surface fleet. However, different models emerged to predict the development of stress in these two groups.

The main limitations of this study are that the occupational stressors were not re-assessed at time point 2, and that there was a relatively low response rate at time point 1 from submariners. In the final stage of the longitudinal study, all respondents will be re-sent the time point 1 questionnaire enabling the psychosocial stressor scales to be re-assessed, and response bias will be assessed by comparing objective outcomes between responders and non-responders.

The similar prevalence of stress in submariners and matched controls is a positive finding as it suggests that submariners are coping with their demands as well as the surface fleet, despite working in isolated conditions. This provides tentative support for the salutogenic effect of working in an isolated environment, whereby personnel are completely cut off from the stressors of daily life, which has a beneficial impact on their well-being [1].

Over-commitment and rank were significant predictors of high stress at time point 2 in submariners but not in matched controls. The increased likelihood of developing stress in senior ranked submariners could be attributed to additional responsibility found at a senior level in submariners, or the lack of opportunity to engage with counterparts of equal status.

**Table 2.** Odds ratios for developing high stress at time point 2 for matched controls

<table>
<thead>
<tr>
<th>Time point 2 stress</th>
<th>Time point 1 (physical work)</th>
<th>High</th>
<th>Low</th>
<th>Total</th>
<th>Odds ratio (95% CIs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>12</td>
<td>4</td>
<td>16</td>
<td>4.04 (1.15–14.2)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>23</td>
<td>31</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>35</td>
<td>35</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Time point 1 (years served)</td>
<td>Low</td>
<td>15</td>
<td>7</td>
<td>22</td>
<td>3.00 (1.03–8.70)</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>20</td>
<td>28</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>35</td>
<td>35</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Time point 1 (BMI)</td>
<td>Low</td>
<td>12</td>
<td>21</td>
<td>33</td>
<td>3.21 (1.18–8.71)</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>22</td>
<td>12</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>34</td>
<td>33</td>
<td>67</td>
<td></td>
</tr>
</tbody>
</table>
It should be noted that over-commitment is likely to be higher than average in submariners due to the requirement of being on call at all hours, which could make it difficult to wholly disengage from work. However, it appears that some submariners have more problems disengaging than others and that these individuals are more prone to developing stress in the future. Over-commitment was also significantly associated with concurrent stress in submariners at time point 1 [4].

This study has confirmed the finding that submariners do not have significantly higher stress levels than matched controls in the surface fleet, despite the isolation of patrols and the specialist nature of their work [4]. The study has also demonstrated that the variables affecting future stress in the submariner group are different from the matched controls. This supports the proposal that different occupational groups need bespoke models of stress, as the variation in occupational stressors is too great to develop one universal model for all groups [8].

**Funding**

Ministry of Defence.

**Conflicts of interest**

None declared.

**References**


**Key points**

- The predictors of future occupational stress in submariners were found to be different from those in surface fleet matched controls.
- Over-commitment to work role and rank predicted future occupational stress in submariners.
- This paper implies that coping with work in isolated and extreme conditions requires specific coping mechanisms.