Excessive Daytime Sleepiness and Associated Factors in Military Search and Rescue Personnel

Rokshana Akter; Tricia L. Larose; Jannicke Sandvik; Vivianne Fonne; Anders Meland; Anthony S. Wagstaff

BACKGROUND: Abnormal excessive daytime sleepiness (EDS) has been reported worldwide, but too little is known about EDS and its determinants in Search and Rescue (SAR) populations. We aimed to determine the prevalence of abnormal EDS and contributing factors among Royal Norwegian Air Force (RNoAF) SAR helicopter personnel.

METHODS: In this cross-sectional study, a total of $N = 175$ RNoAF SAR personnel completed an electronic survey including socio-demographic and lifestyle questions. The Epworth Sleepiness Scale (ESS) was used as both a continuous and categorical outcome variable to measure EDS.

RESULTS: Abnormal EDS defined by ESS was found in 41% of the participants in this study. We observed no associations between socio-demographic and lifestyle factors and abnormal EDS in this study.

DISCUSSION: There is a high prevalence of abnormal EDS in the current RNoAF SAR population. Despite this elevated level of fatigue, we did not find that the socio-demographic and lifestyle factors assessed in this study were associated with abnormal EDS in RNoAF SAR helicopter personnel. Also unusually, the study cohort did not demonstrate higher scores in factors found to change ESS scores in similar study populations (e.g., caffeine use, tobacco use, exercise level). Further research is required to investigate other factors (organizational, operational) that may be associated with abnormal EDS in this and other SAR populations.

KEYWORDS: excessive daytime sleepiness, socio-demographic and lifestyle factors, Epworth Sleepiness Scale, search and rescue, aviation, military.

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Norway has a national, governmentally funded air ambulance service comprised of a fixed-wing air ambulance service, helicopter emergency medical service, and search and rescue (SAR) helicopters. Overall, the ambulance service contributes to major incident management with transportation of equipment, personnel, and patients, as well as providing overhead surveillance and search and rescue missions. The Royal Norwegian Air Force (RNoAF) SAR squadron is a major part of this service and, at the time of data collection, operated 12 Westland Sea King helicopters from 5 geographically separate military bases throughout Norway. The 330 squadron covers the main SAR part of this service, as well as ambulance missions. Currently, it is organized as a 15-min standby service on a 24/7 on-call duty schedule throughout the year. The crew of six often work 7-d shifts (with some variation), operating from the base. Frequently, they experience long duty days, irregular working hours, lack of sleep, and high workloads.

Sleepiness may be related to many things, such as boredom, lack of external stimuli, mood, or physical or mental exhaustion, but above all, lack of sleep. Sleepiness may be seen as the opposite of alertness, which is important for safety-critical activity. As such, sleepiness may be a flight safety risk in a safety-critical activity such as aviation. The operations

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conducted by the RNoAF 330 Squadron are often complex, are conducted at any time of day or night, and life-saving missions may challenge safety more than scheduled and planned flight operations. Sleepiness may, therefore, be seen as particularly important to avoid for flight safety in helicopter SAR and ambulance missions.

The Epworth Sleepiness Scale (ESS) is a simple, self-administered questionnaire that is shown to provide a measurement of the subject's general level of daytime sleepiness.[11] The ESS is the most widely used self-assessment questionnaire measuring daytime sleepiness.[8] Two Norwegian air ambulance studies used the ESS as a proxy to measure fatigue among pilots and crewmembers.[6,20] As sleepiness and fatigue are closely related, excessive daytime sleepiness (EDS) can also be seen as a proxy measure for fatigue.

In aviation, sleepiness is a major factor of concern due to its potential risk to flight safety.[12] There are many contributing factors to daytime sleepiness among individuals suffering from sleep-related problems such as advanced age, shift work, alcohol intake, etc.[2] Known risk factors for EDS include obesity, depression, extremes of age, insufficient sleep, and shift work.[15] Inadequate sleep, longer work schedules, and swing-shifts are the important risk factors for EDS.[4] Other factors include lower coffee consumption, smoking, insomnia, tiredness, chronic pain, and lower frequency of exercise.[10] Musculoskeletal symptoms, including in the lower back, knee, and ankle/feet, are associated with abnormal EDS.[14] Research on the association between abnormal EDS and socio-demographic and lifestyle factors is limited, particularly among aviation personnel. In this study, we sought to determine the prevalence of abnormal EDS among RNoAF SAR helicopter personnel and to identify possible associated socio-demographic indicators and lifestyle factors.

METHODS

Subjects

All SAR helicopter personnel ($N = 250$) in the RNoAF, including flight commanders, copilots, flight engineers, system operators, rescuers, medical doctors, and technicians (ground-based maintenance personnel), working across 5 bases received information about the study and were invited to participate. A total of 175 participants (80%) participated in the study. All participants provided informed written consent for participation in the study and the research protocol was reviewed and found exempt from requiring approval. The Norwegian Centre for Research Data approved the project.

Procedure

Participants completed an electronic questionnaire. The questionnaire component is part of a larger study that included daily logs over different periods. The current manuscript reports on cross-sectional survey data only. We provided privacy to the participants by making the data nonperson identifiable.

Materials

The complete electronic survey consisted of 70 questions and several standardized scales. The current analysis focuses on socio-demographics and lifestyle variables in association with the ESS. Data on socio-demographics included age (continuous), married/cohabiting (yes/no), the total number of children (continuous), personnel category (flight commander, copilot, flight engineer, system operator, rescuer, doctor, technician), commuting (continuous/number of times per month), and second job (yes/no).

Lifestyle factors included cups of caffeine per day when off duty (continuous), smoking status, daily intake of tobacco snuff (yes/no), self-assessed health score (very bad/bad/moderate/good/excellent), and average sessions of physical exercise per week (never/less than one session per week/1–2 sessions per week/2–3 sessions per week/more than 2–3 sessions per week). Population reference values for snuff users, health status, and physical activity were obtained from Statistics Norway for comparison.

The ESS is a self-administered standardized 8-item scale that measures the subject's general tendency to sleep or doze off during the day in eight different situations or activities.[11] Respondents are asked to rate daytime sleepiness on a 4-point scale from 0 "would never doze" to 3 "high chance of dozing". Scores for individual responses are summed to yield a total ESS score between 0 and 24. A score higher than 10 indicates abnormal excessive daytime sleepiness. In the current study, ESS was used as both a categorical (normal/abnormal) and continuous outcome variable.

Statistical Analysis

Descriptive data are presented as means, range, and standard deviations, and/or proportions. The prevalence of abnormal excessive daytime sleepiness was estimated. To compare normal/abnormal ESS scores according to explanatory variables, we used an independent-sample *t*-test for continuous variables and a Chi-squared test for categorical variables. To test the association between explanatory variables and ESS as a continuous outcome variable, we ran unadjusted linear regression models with 95% confidence intervals (CIs). *P*-values less than 0.05 were considered statistically significant. We also conducted a sensitivity analysis for the physical exercise variable where we compared participants who exercised 1–2 and 2–3 times per week to participants who exercised more than 2–3 times per week. Statistical analysis was performed using Stata software v.16.1 (StataCorp.2019 LP, College Station, TX, USA).

RESULTS

Participating in the current study were 175 RNoAF SAR helicopter personnel, among them flight commanders ($N = 29$), copilots ($N = 15$), flight engineers ($N = 13$), system operators ($N = 21$), rescuers ($N = 22$), doctors ($N = 29$), and technicians ($N = 46$) representing 5 different SAR bases across Norway (**Table I**). The commuting variable indicates that 61% of respondents

Table I. Demographic and Lifestyle Characteristics of RNoAF SAR Helicopter Personnel (*N* = 175).

LIST OF EXPOSURES	*N*	%	MEAN	RANGE	SD
Age	175	100	40.5	22–59	9.7
Married/cohabiting					
Yes	140	80	0.8		0.4
No	35	20			
Number of children (total)	175	100	1.5	0–9	1.5
Personnel category			4.5		2.2
Flight Commander	29	16.6			
Copilot	15	8.6			
Flight Engineer	13	7.4			
System operator	21	12			
Rescuer	22	12.6			
Doctor	29	16.6			
Technician	46	26.3			
Commuting number (per month)	174	99.4	2.92	0–25	4.8
Second job					
Yes	58	33.1	0.33		0.5
No	117	70			
*Cups of Caffeine per day when free	175	100	2.9	0–10	2.4
Tobacco snuff					
Yes	43	24.6	0.25		0.43
No	132	75.4			
Health (self-assessment)					
Moderate	13	7.4	4.4		0.62
Good	82	47			
Excellent	80	46			
Physical exercise (per week)					
Never/less than one session per week	18	10.3	3.95		1.07
1–2 sessions per week	38	22			
2–3 sessions per week	50	29			
More than 2–3 sessions per week	69	39.4			

RNoAF: Royal Norwegian Air Force; SAR: Search and Rescue.
*Cups of coffee, tea, cola, or energy drink containing caffeine.

lived on the base when on duty due to long-distance commuting at the time of data collection. The mean age of study participants was 40.5 yr (SD = 9.7), varying between 22 and 59 yr. In all, 80% were married or cohabiting and the majority had children living at home (79%). Around 10% had special care responsibilities in the family and 33% had a second job. The mean caffeine intake off duty was 2.9 cups per day and one-quarter of the study population were tobacco snuff users. Only one of the participants reported being a daily smoker. The majority of respondents reported good or very good health, with only 7% reporting moderate health, and no participants reporting bad or very bad health. Among all the participants, 40% did physical exercise more than 2–3 times a week.

Table II shows that the overall prevalence of abnormal excessive daytime sleepiness to be 41% among RNoAF SAR personnel. Among the participants with abnormal excessive daytime sleepiness (mean ESS = 9.6), 19% had mild, 18% had moderate, and 4.5% had severe excessive daytime sleepiness.

Simple linear regression models showed no relationship between excessive daytime sleepiness and the socio-demographic and lifestyle variables among RNoAF SAR helicopter personnel (**Table III**). All *P*-values from *t*-tests and Chi-squared tests with ESS as a categorical variable (normal/abnormal) were statistically nonsignificant (data not shown). We only found a statistically significant association between the variable "special care responsibility in the family" and ESS. However, this result was discarded due to the low sample size (*N* = 18), which was further reduced when comparing across groups.

Table II. Prevalence of Excessive Daytime Sleepiness Among SAR Helicopter Personnel (*N* = 175) Measured with ESS.

	SCORE	*N*	%	MEAN SCORE
Normal	0–10	103	58.9	
Abnormal	11–24	72	41	
Mild	11–12	33	19	9.6
Moderate	13–15	31	18	
Severe	16–24	8	4.5	

ESS: Epworth Sleepiness Scale.

DISCUSSION

To our knowledge, this is the first study investigating an association between socio-demographic and lifestyle factors and abnormal EDS among military SAR personnel. A 41% prevalence of abnormal excessive daytime sleepiness was found among RNoAF SAR helicopter personnel in Norway. We did not find any significant association between the high prevalence of EDS and any of the socio-demographic factors we measured among our SAR helicopter personnel group. We found a mean ESS of 9.6 in our study among the SAR population.

Other prevalence studies of abnormal EDS were reported in a prospective population-based cohort study and an epidemiological study in Switzerland (5.1%)[1] and Iceland (13.1%),[18] respectively, showing much lower results than our findings. A higher prevalence of EDS has also been reported; 51.5% among

Table III. Linear Association Between Socio-Demographic and Lifestyle Variables and Excessive Daytime Sleepiness (EDS) Among RNoAF SAR Helicopter Personnel (*N* = 175).

EXPLANATORY VARIABLE	REGRESSION COEFFICIENTS	95% CI	*P*-VALUE
Age	0.02	−0.04, 0.07	0.6
Married/cohabiting	−0.48	−1.86, 0.90	0.5
Number of children (total)	−0.21	−0.58, 0.15	0.3
Personnnel category	−0.10	−0.36, 0.14	0.4
Commuting number (per month)	−0.02	−0.13, 0.09	0.8
Second job	0.45	−0.72, 1.62	0.5
Cups of caffeine per day when free	0.07	−0.19, 0.34	0.6
Tobacco snuff	0.37	−1.7, 0.91	0.6
Health (self-assessment)	0.35	−1.24, 0.54	0.4
Physical activity (per week)	0.22	−0.77, 0.32	0.4

RNoAF: Royal Norwegian Air Force; SAR: Search and Rescue.

online ESS users' patients suffering from sleep-related problems[2] and 68.4% among military personnel who underwent a sleep medicine evaluation.[9] However, these groups were already undergoing investigations or treatments for sleep-related problems. Our group needs to function at a very high level as search and rescue personnel.

Flaa et al.[6] found a mean ESS of 7.1 among crewmembers who experienced a low level of sleepiness among Norwegian air ambulance personnel, whereas we found a relatively higher mean ESS of 9.6 in our study among the RNoAF SAR population. Our findings, therefore, constitute a relatively high prevalence of EDS compared to the general population and relatively high compared to the air ambulance study mentioned above, which is the closest comparable group we could find in the research literature.

Several other studies showed that age was positively associated with abnormal EDS.[2,5,19] Surprisingly, we did not find any association between age and ESS in the current data. A study conducted on the general population in Iceland also showed that there was a significant difference between ages, with the youngest age groups being more prone to doze off.[18] As our population had a low proportion of subjects under 30, our lack of association could be due to less age difference in our study population. The study on Norwegian air ambulance personnel, pilots whose work pattern is similar to the participants in the current study, did not find any statistical difference in married/cohabiting, age, or children at home variables.[20]

Although we did not find any association between caffeine use and the prevalence of EDS, a prospective cohort study in Switzerland stated that moderate coffee consumption could be an independent protective factor (e.g., countermeasure) for EDS.[1] Similar findings reported from a U.S. Army aviation personnel study showed that the use of caffeine in various forms is common, often including energy drinks for reducing degradation in physical and cognitive function associated with frequent night operations.[3] The caffeine use in our RNoAF SAR personnel group is high, but not higher than the consumption of the general population in Norway, ranking second only to Finland in coffee consumption per capita according to Statistics Norway.[17] Coffee is readily available on all bases. This, together with the fact that the variation of coffee consumption is not so large in our group, may explain our null findings.

In the current study, 25% of the population reported using snuff daily, which is similar to that reported in the general Norwegian population (male) in 2020 (19–25%).[17] A cross-sectional study among U.S. adults reported that smokeless tobacco usage was associated with insufficient rest/sleep.[13] Contrary to these findings, we found no association between tobacco snuff and the prevalence of EDS in the current study. The reason for this difference between Norwegian and U.S. populations is unclear.

In an airline pilot study, lower perceived health and less physical activity were shown to be predictors for fatigue.[19] However, we found no association between EDS and health status or physical activity in our study. While EDS can be used as proxy for fatigue, the outcome measurements for EDS and fatigue are not the same and this could explain the differences between the airline pilot study and our study. Moreover, military personnel, and particularly aircrew, are generally physically active and are subject to stricter, higher medical standards and health checks which may reduce the variation of these lifestyle variables in our population. With regards to the factor "lack of exercise" in our population (13%), our results were similar to those of the general Norwegian population (10.3%).[17]

In contrast to studies of British cabin crew and pilots[7] and Dutch employees,[16] we did not observe differences in EDS status regarding socio-demographic factors such as the number of children, second job, and long-distance commuting. In the Norwegian context, work-life interference may be less than in other countries due to strong social support systems, including high kindergarten availability, free healthcare and education, and regulations regarding leave for maternity/paternity (One-year parental leave per child) and sickness in children (10 d per sick child per year).

Since work and personal or family life is more flexible in Norway than in many other countries, we might assume that work and personal life harmony is maintained so that other factors not analyzed in the current study might be associated with the high prevalence of EDS. Although our finding coincides with a few similar studies conducted in the military and air ambulance operators, including SAR to some extent, the factors associated with the high prevalence of EDS in this group remain unclear.

The response rate for the survey was quite high (80%); this is a strength of the study. The use of a validated scale for EDS with strong psychometric properties can be considered a strength.[11] The ESS questionnaire is shown to be reliable, to be internally consistent, and conceptually unique in measuring the whole range (very high to very low) of sleep tendencies.[11] Although this study is somewhat limited by its small sample size, the high response rate reduces nonresponder bias. This is a unique group with unique stressors and, therefore, provides meaningful evidence for health, safety, and risk analysis in an operational setting.

The use of self-reported data on health status and the subjective answers may have low reliability with potential response bias. The fact is that the ESS may be unintentionally measuring aspects other than sleepiness, such as boredom or inattentiveness. The generalizability of the findings in this study may be limited. However, these results may be of interest for similar occupational groups working in on-call helicopter SAR or ambulance operations. Given the small numbers of participants who report current smoking ($N = 1$) and care duties for family ($N = 18$), further association studies research can be done with abnormal excessive daytime sleepiness in similar populations.

The findings of the current study report that a large proportion (41%) of this RNoAF SAR study cohort has excessive daytime sleepiness. Since several socio-demographic and lifestyle factors were not associated with a high prevalence of excessive daytime sleepiness in this population, other organizational factors (e.g., location of the base) or operational factors may be of interest in future analyses.

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