# Analysis of Presentations to the Sickbay of a RAN Warship During An Overseas Deployment

*CMDR Ross Mills, RAN (MBChB, FRACGP, FAFOEM, FACAsM) and LSMED William Taylor, RAN (BSc Sport and Exercise).*

## Abstract

**Objectives**: To describe the pattern of sickbay utilisation and lost time aboard a RAN Major Fleet Unit during a prolonged overseas deployment.

**Methods:** A prospective cohort analysis was performed on the ships company of an Australian warship (n = 226) over a 100 day overseas deployment to multiple ports, to analyse sickbay utilisation (number of consultations) and lost time (number of days on reduced duties). Statistical analysis was performed using regression analysis, ANOVA and partitioning methods.

**Results:** Female gender and smoking were associated with increased sickbay utilisation and lost time. Males with MEC class 1 or non-smoking males with MEC 201 or worse were protective of sickbay utilisation. Being a non-smoking male over 22 years was protective of lost time. Gender, rank, MEC, age and smoker were all found to be discriminators. BMI was not related to either sickbay utilisation or lost time.

**Conclusions:** Being a male with no medical restrictions at the time of deployment was protective of sickbay utilisation, and being a non-smoking male older than 22 was associated with reduced morbidity. No association was found between BMI and either sickbay utilisation or morbidity.

**Key Words:** prospective cohort, sickbay utilisation, lost time, gender, smoking, age, BMI.

## Introduction

It is recognised that work attendance and absenteeism is governed by more than purely medical factors,[1] and thus medical planners need to consider more than just injury / illness incidence when constructing health support plans. The literature also suggests that females and smokers have an increased incidence of being medically certified for reduced duties[2,3] with higher lost productive time.[2,4,5]

Smoking is currently banned indoors in Royal Australian Navy (RAN) ships and establishments, and from 01 Jan 2012, excise-free tobacco is no longer available on RAN vessels.

There are also multiple studies which suggest that increasing age may be associated with increased absenteeism.[6,7,8,9,10,11]. There is some evidence which conflicts with this, with age either being protective,[12] or unrelated[13] to absenteeism. That increasing age is cited by both Consensus Review[9] and Government Policy[10] suggests that there is a widely held belief that increasing age is indeed associated with absenteeism.

In 2004 a retrospective analysis of the ship's medical journals of RAN major fleet units was conducted between the years of 1991 and 2003.[14] The authors found an evacuation (Casevac) rate of approximately 1.2 evacuations per ship year, compared with USN figures of 2 Casevac per ship year. Morbidity rates were calculated as being 0.54 per 1000 man days (95% confidence limits, CL, 0.11 – 0.98) during Persian Gulf deployments and 0.52 (0.23 – 0.82) during refits. Morbidity consisted of summing the days of admissions to sick list onboard, admissions to hospital and sick while on leave.

There was a poor correlation between the total sick per 6 months and the number of man sea days ($R^2$ 0.271).

These authors also estimated that (depending upon the size of the ship's complement) there would be 1 or 2 medical or surgical emergencies per ship year. These figures were not adjusted for the number of ship's company, although it is implied that this number was approximately 200. The presenting diagnoses and telephone calls to the Fleet Medical Officer are discussed, but not sickbay utilisation or lost time rates. The demographics of the ship's complement (including gender) were not analysed.

Royal Navy and South African Navy studies have found that female attendance rates at ship board medical facilities are at least twice the attendance rates of men.[15,16]

The purpose of this study is to analyse current sickbay utilisation rates and patterns and morbidity rates aboard a deployed RAN major fleet unit, and to compare these with historic rates.

## Background

HMAS Newcastle (FFG 06) is an Australian built US-designed Oliver Hazard Perry class escort frigate, operated by the RAN. Although usually manned by approximately 180 personnel, her crew was supplemented (to 226) for a four month deployment between April and August 2010. HMAS Newcastle has a Level One medical facility, having deployed with an embarked medical officer (the lead author).

On 17 April 2010 HMAS Newcastle departed Sydney for a deployment including Guam, Japan (Yokosuka), Canada (Esquimalt) and USA (Hawaii). This deployment included diverting to the Aleutian Islands (Alaska) to Casevac one of its complement, attending the Canadian Naval Centenary Fleet Review (Esquimalt), and participating in exercise RIMPAC (Hawaii).

This paper describes the presentations to HMAS Newcastle's sickbay during the first 100 days of its deployment, analysing patterns of presentations and morbidity. Morbidity is assessed as sickbay utilisation (presentations) and lost time (days certified with a medical chit).

## Statistical Analysis

This paper attempts to identify relationships between the demographic variables age, gender, smoker, Body Mass Index (BMI) and rank, and sickbay utilisation and morbidity (with the measure of this being provided by a reduced duties medical chit).

Statistical analysis was performed using JMP statistical software package version 7.0.2 (SAS Institute).

In this paper the predictor variables are age, gender, BMI and Medical Employment Classification (MEC). At the time of this study the RAN was using a MEC numerical classification[17] to describe an individual's employability (and deployability) restrictions (Table 1).

**Table 1. MEC Classification System**

| MEC Class | MEC Subclass | Employment Restrictions |
|---|---|---|
| 1 | | NIL |
| 2 | | Fit for seagoing duties with restrictions |
| | 201 | Restricted range of duties, no specific support required |
| | 202 | With pharmaceutical or other medical support |
| | 203 | With Advanced Medical Assistant or Nursing Officer support |
| | 204 | With Clinical Manager, specialist Military Nursing Officer, or Advanced Practice Military Nursing Officer support. |
| | 205 | With Medical Officer support |
| 3 | | Temporarily unfit for seagoing duties |
| 4 | | Unfit for RAN |

BMI is a mathematical relationship between height and weight ( height$^2$/ weight), and is used by the RAN as a tool for defining the MEC class of an individual.

The response variables are:

1. Number of days provided with a medical chit (being the total of days excused duties and selected duties). This is a marker of lost time and morbidity.
2. Number of presentations to the sickbay. This is a marker of sickbay utilisation.

The following analytic techniques have been used:

1. Descriptive analysis, describing patterns within the data without determining their statistical significance.
2. ANOVA.
3. Regression analysis including bivariate analysis.
4. Partitioning analysis based on population diversity.

Analysis of Variance (ANOVA) analyses the relationship between a continuous response variable and a categorical predictor variable. It focuses on the differences between the means of the different groups, measuring the change in the mean of the response variable when there is a change between the levels of the predictor variable. This form of analysis assumes that all observations are independent, and that the noise component of the statistical model is normally distributed. The Regression Correlation Coefficient ($R^2$) was used as a measure of the proportion of the variability of the Response Variable explained by the Predictor Variables. $R^2$ is a measure of the degree of linear association between the Response and Predictor Variables being studied. The bigger the $R^2$ value (that is, the $R^2$ value being closer to 1.0), the more the variation in the Response Variable is explained on the basis of the Response Variable being tested.

Regression analysis (including Bivariate analysis) is a statistical method of modeling relationships between continuous variables calculating linear relationships (Linear Regression). This technique is used to identify the presence of statistically significant relationships between the Predictor Variables and the Response Variable(s).

This form of analysis assumes that:

- The relationship between the variables is linear
- The statistical noise is normally distributed
- The Response Variables are independent of each other
- There is constant variance of the Response Variable (the statistical noise has the same variance for all observations)

Partitioning analyses data on the basis of its population diversity, giving the probability that the second variable encountered comes from the same class as the first. Decision trees are based upon identifying splits which cause the maximum reduction in the population variability. The first splits are the best, with subsequent splits becoming less meaningful as the group size drops. Splitting was performed to four levels in this analysis.

## Descriptive Analysis

### Number of Consultations

The departure (Eastern Australian) time zone has been used for the dates in this analysis (to avoid adjusting for having crossed the International Date Line). The ship's company was dynamic during this deployment. For the purposes of the calculations in the analysis the ship's company has been deemed to be 226. (HMAS Newcastle left Sydney with 228 personnel, carrying 228 at its peak and 209 at day 100.) Twenty-two percent of the ship's company did not present to the sickbay for treatment. The data includes attendance at sick parade, vaccinations and medical examinations. The distribution of presentations is depicted in Figure 1.

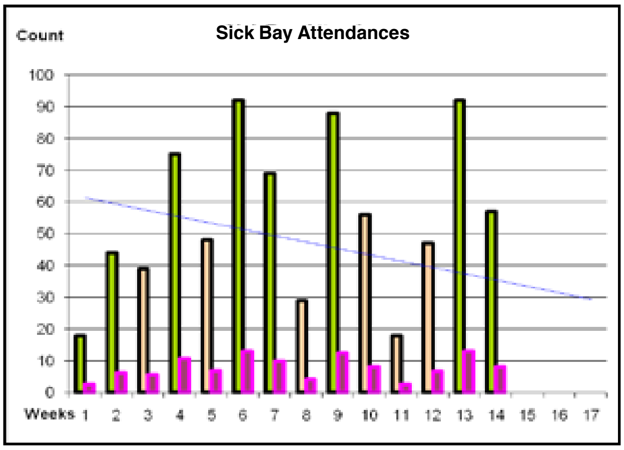


*Figure 1. Weekly Sickbay Attendances*

*Key:*

*Green = a week including 2 or fewer days alongside*
*Orange = a week including 3 or more days alongside*
*Pink = daily average*
*Blue = trend line*

There are three weeks with high presentations, being weeks 6 (a ship-wide viral illness), 9 (a ship- wide viral illness combined with sailing after a prolonged period alongside in Pearl Harbour) and 13 (where a flu vaccination programme was conducted).

A pattern was also identified between the number of sickbay presentations and whether HMAS Newcastle was alongside a port (in a foreign country), just about to depart from a port, or sailing (Figure 2).

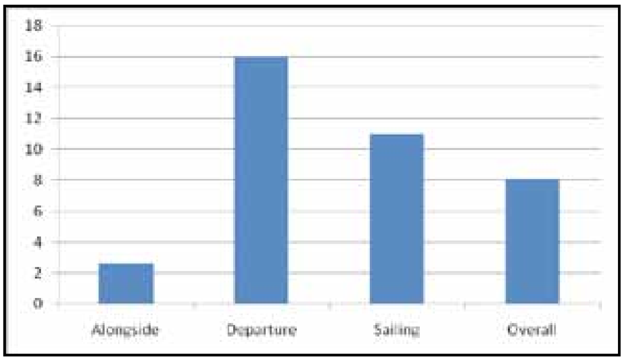


*Figure 2. Sickbay Presentations by Ship Status*

These presentations show the frequency of the most common diagnoses (based on the EpiTrack Descriptor) in Table 2.

**Table 2. Presentation by Frequency**

| EpiTrack Descriptor | Count | % |
|---|---|---|
| Upper Respiratory Tract Conditions (including URTI) | 101 | 11 |
| Other Musculo-Skeletal Diseases (excluding knees and backs) | 89 | 7.4 |
| Disorders of the Ear, Nose and Throat | 81 | 8.7 |
| Other Dermatological Conditions | 78 | 8.3 |
| Medical Examinations: Routine, Periodic etc | 48 | 5.1 |
| Diseases of the Digestive System (excluding viral, bacterial or parasitic conditions) | 47 | 5.0 |
| Vaccinations, Inoculations and Prophylactic Injections | 46 | 4.9 |
| Counselling, Specimen Collection and Special Screening | 33 | 3.5 |
| Disorders of the Knee | 32 | 3.4 |
| Miscellaneous Administration: Routine Medicals | 27 | 2.9 |
| Disorders of the Back | 26 | 2.8 |
| Injuries Not Due to TAs, Training, Sport of Hostile Action | 23 | 2.5 |
| Lower Respiratory Tract Conditions (including Asthma) | 22 | 2.4 |
| Other | 282 | 30 |
| Total | 935 | - |

A total of five cases required returning to Australia for medical reasons. None of the conditions for which these patients were casevaced were reflected in their pre-existing MEC.

There were an additional four patients with diagnoses requiring management away from HMAS Newcastle, but who were able to rejoin the ship at the completion of their treatment.

The variables, the total number of days certified “Excused Duties” (33 days) and “Modified Duties” (24 days) were added to produce the predictor variable “Number of Days with Chit”. These variables were not analysed separately due to their small sample size. The total number of days “With Chit” comprised only 0.25% of the available man-days in this study (100 days with a ship’s company of 226). Using O’Connor and Parrish’s[14] definition of morbidity, this is equivalent to a morbidity rate of 1.4 days per 1000.

The ship’s company was 85.8% male. By comparison, the population which did not present to the sickbay (22%) was 88.3 % male.

The age range was between 17 and 54, with a mean of 28.0 and median of 26. Age was not distributed normally, as depicted in Figure 3 (Normal Distribution and Smooth Curve). The dark colour represents male gender. The population which did not attend the sickbay (“Non-attender Group”) had a mean age of 28.5 and median of 26.

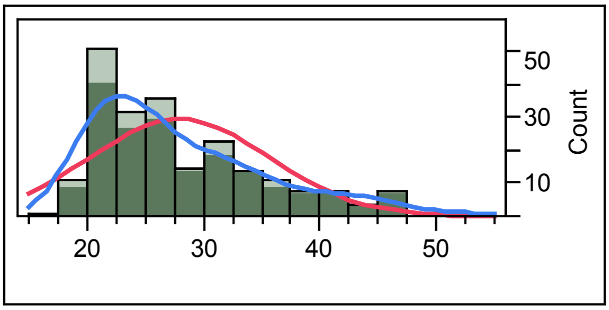


*Figure 3. Distribution of Age*

BMI ranged from 18.0 to 37.0, with a mean of 26.1 and median of 26.0. As depicted in Figure 4, BMI is close to being normally distributed (Normal Distribution and Smooth Curve). The Non-attender group was also close to being normally distributed, with a mean of 26.4 and median of 26.1.

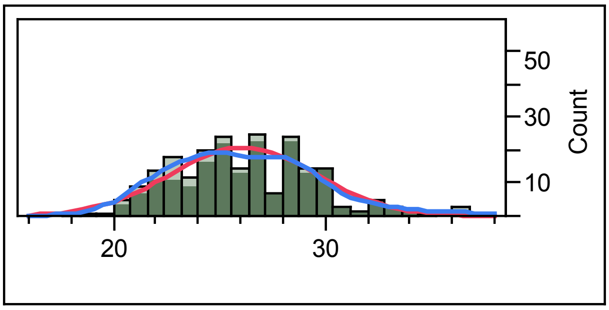


*Figure 4. Distribution of BMI*

The rank of Able Seaman (AB) comprised 43% of the ship’s company and Seaman (SMN) 8.4%. By comparison, in the group of non-attenders these lower ranks were slightly under-represented (AB 42% and SMN 6.7%).

Twenty two percent (22.2%) of the ship's company were MEC 201 or lower (Table 3).

**Table 3. Distribution of MEC**

| MEC | 1 | 201 | 202 | 203 | 204 | 205 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|
| Count | 178 | 6 | 23 | 15 | 4 | 0 | 0 | 0 |

## Regression Analysis

Oneway analysis of the number of consultations by gender found females to have more consultations than males, with the means being significantly different (Tukey-Kramer HSD). This is depicted in Table 4, with the Confidence Limits (CL) being 95%. Females account for 19.8% of the consultations or 1.39 the rate of males.

**Table 4. Oneway Analysis of the Number of Consultations by Gender**

| Variable | Count | Mean | SD | Std Error | Lower CL | Upper CL |
|---|---|---|---|---|---|---|
| F | 32 | 5.06 | 4.28 | 0.757 | 3.52 | 6.61 |
| M | 194 | 3.29 | 3.65 | 0.262 | 2.77 | 3.81 |

Bivariate analysis of the number of consultations found no relationship by age ($R^2$ 0.001), BMI ($R^2$ 0.003), or MEC ($R^2$ all 0.000). Comparisons for all pairs of rank (using Tukey-Kramer HSD) found no association. Oneway analysis of the number of consultations by smoker / non-smoker found no significant difference between the groups.

Stepwise regression calculated $R^2 = 0.090$ for gender, rank, smoker, age, MEC and BMI against the response variable number of consultations. This is interpreted as the predictor variables listed, accounting for 9% of the variation in the response variable number of consultations.

Oneway analysis of the number of days of chit by gender also found females to have more consultations than males, with the means being significantly different (Tukey-Kramer HSD). This is depicted in Table 5. Females account for 34 days on chit (30.0%), or 2.11 times the rate of males.

**Table 5. Oneway Analysis of Number of Days of Chit by Gender**

| Variable | Count | Mean | SD | Std Error | Lower CL | Upper CL |
|---|---|---|---|---|---|---|
| F | 32 | 1.06 | 1.95 | 0.345 | 0.3359 | 1.77 |
| M | 194 | 0.41 | 1.12 | 0.08 | 0.25 | 0.57 |

Bivariate analysis of the number of days of chit found no relationship by age ($R^2$ 0.003), BMI ($R^2$ 0.003), or MEC ($R^2$ all 0.000). Comparisons for all pairs of rank (using Tukey-Kramer HSD) found no association, with all CLs including one.

Stepwise regression calculated $R^2 = 0.125$ for gender, rank, smoker, age, MEC and BMI against the response variable number of consultations. This is interpreted as the predictor variables listed, accounting for 12.5% of the variation in the response variable number of consultations.

## Partitioning

The variables identified as being the best discriminators in rank order for number of consultations were:

1. Gender
2. Rank (AB / SMN)
3. MEC (< 201)
4. Smoker

This form of analysis identified the two groups with the least number of consultations to be males of MEC 1 (n = 154, mean 3.01) and non-smoking Males with MEC 201 or higher (n = 25, mean 3.00). The group with the highest number of consultations was female with the rank of SMN / AB (n =19, mean 6.68).

The variables identified as being the best discriminators in rank order for number of days on chit were:

1. Gender
2. Age (22 years)
3. Smoker
4. MEC (< 201)

This form of analysis identified the group with the smallest number of days on chit to be non-smoking males over the age of 22 (n = 96, mean 0.198). The groups with the largest number of days on chit were females (n = 32, mean 1.06) and male smokers with MEC 201 or lower (n = 5, mean 1.4).

## Discussion

This deployment had a very high rate of Casevacs, being 18 per ship year compared with the 1 – 2 per ship year predicted by O'Connor and Parrish. The morbidity rate was also found to be significantly higher, being 1.4 days per 1000 compared with 0.54 man sea days per 1000 found by O'Connor and Parrish. The difference in sample size and study design between this paper and,[14] combined with the lack of demographic data of the study population in,[14] make meaningful comparison between these two study groups difficult. Potential explanations for the difference in medevac and morbidity rates between these two studies include:

- There being a more conservative medical practice aboard HMAS Newcastle (in the face of geographic isolation, the lack of ancillary diagnostic aids and a risk averse culture),
- There having been a change in the cultural approach to illness since 2004, and
- Personnel posting to sea with pre-existing conditions not reflected in their MEC (which resulted in half of the Casevacs).

There was one medical emergency (which required the patient to be Casevaced to Alaska for definitive treatment) during this deployment, consistent with the predictions of O'Connor and Parrish.

Neither age nor BMI were found to be associated with an increase in sickbay utilisation or morbidity. That two of the three fractures Casevaced subsequently required surgery suggests that overly conservative medical practice was insufficient on its own to explain the high Casevac and morbidity rates.

The small population size (n = 226) and the small number of days with chit (0.25%) markedly weakened the validity of this study. The only predictor variable with a statistically significant association with the response variables was gender. Female gender is associated with both increased sickbay utilisation and with a modified or excused duties medical chit.

The failure of this study to demonstrate statistically significant associations with the predictor v ariables of age, rank, BMI and smoking may also be a consequence of the other predictor variables not being normally distributed and thus not meeting the underlying assumptions of the regression model.

Partitioning did however demonstrate possible associations between the predictor variables of age (17 to 21 year old males), smoking, MEC, and rank. BMI was the only predictor variable not to show any degree of association with the response variables.

Although partitioning is unable to identify statistically significant associations, it is a useful tool for identifying clusters, and thus for hypothesis generation. This form of analysis found that being a male with MEC 1, or a male with MEC worse than 1 but a non-smoker, are protective of sickbay consultations, and a female of lower rank (AB or SMN) was associated with increased sickbay utilisation. Being a non-smoking male older than 22 was protective for lost time, and being a female was associated with increased lost time.

The findings of partitioning analysis for gender are consistent with the findings of regression analysis.

The findings of increased utilisation of the sickbay by females (and increased time on a medical chit) are potentially explainable at a variety of levels, including cultural, different disease/illness patterns. Females populate all of the different occupational classes onboard HMAS Newcastle, and thus this finding probably does not reflect a gender difference in work duties or the availability of selected duties. This finding is consistent with other literature which has also found increased absences due to sickness in females.

## Conclusions

This study has found high rates of both morbidity and Casevacs during the first 100 days of HMAS Newcastle's deployment. Compared with males, females had increased rates of sickbay utilisation and morbidity. Being a MEC 1 male was protective of sickbay utilisation and being a non-smoking male older than 22 was associated with reduced morbidity.

The small size of the study population and the unique nature of this deployment (being a non-warlike cruise around the pacific rim) limit the general application of the findings of this study. Tests of statistical difference were not used when comparing sub-populations within this study, as the differentiation between "similar" and "statistically the same / different" were moot given the small population sizes. The failure of regression techniques to demonstrate statistically significant relationships is a reminder, not only of the limitations arising from small sample sizes, but also from potential failures of the study population(s) to meet the underlying regression assumptions.

The use of partitioning as a statistical tool attempts to overcome the major weakness of this study (small population size) by identifying potential relationships buried within the data. This form of analysis is however only hypothesis generating. Further study (achieved through either larger study populations or applying metanalysis techniques) is needed to clarify these potential relationships within the RAN operational context.

This study also highlights some of the difficulties associated with the medical data currently available for analysis. Epitrack is a system of classification based around causality rather than pathology. It thus has limited application for analysing medical trends or illness/injury patterns.

The primary focus of this paper was sick bay utilisation to allow workload planning for future RAN deployments. To facilitate this, consolidated sick bay data (including vaccinations and medical) was used. The specifics of certain diseases/illness were not included in this paper to ensure that no personnel could be identified. This has resulted in dirty data, which combined with the limitations of the Epitrack classification system, further limits the ability to undertake meaningful analysis.

Future studies will need to consider how information is categorised, sample size and which statistical techniques are used in the analysis.

## Study Implications

These study findings demonstrate that an embarked Medical Officer will be faced by a wide variety of health conditions encompassing multiple disciplines and sub-specialties. The pattern of presentations also has implications for health resource planning for mixed gender seagoing deployments, for ensuring that the MEC of personnel truly reflects their medical status, for the construction of medical watch bills when alongside (in foreign ports), and for the structuring of ship's sick parade timings when departing foreign ports.

Operational commanders should therefore expect a level of personnel attrition (including both temporary and permanent) during sea- going deployments of longer duration, and approximately one medical or surgical emergency every 6 month deployment.

No evidence was found for any relationship between BMI and the health indicators sickbay utilisation or lost time.

Further research needs to be conducted to determine the general application of these findings. The small sample numbers prevented any meaningful analysis of a potential relationship between job stress and morbidity. This potential association may however be able to be analysed in a bigger sample, where there is sufficient statistical power to compare morbidity rates between either departments or employment categories.

*Disclaimer: The opinions expressed in this paper are those of the primary author alone and do not reflect those of the RAN.*

## Acknowledgements

The support of the Clinical Manager of HMAS Newcastle (POMED M Rowbottom) is gratefully acknowledged.

*Authors' affiliation: Royal Australian Navy*
*Corresponding author: CMDR Ross Mills, CP4-6-009*
*PO Box 7913 BC, Canberra, Australian Capital Territory 2610*
*Email: ross.mills2@defence.gov.au*

## References

1. Australasian Faculty of Occupational and Environmental Medicine: Workplace Attendance and Absenteeism. A consensus statement.
2. Mills R, Predicting Failure to Return to Work; Internal Medicine Journal. 2012; 42: 924-27
3. Atlas SJ, Chang Y, Kammann E, Keller RB Long-term disability and return to work among patients who have a herniated lumbar disc: the effect of disability compensation.; J Bone & Joint Surgery. 2000; 82: 4
4. Stewart W F, Ricci J A, Chee E, and Moranstein D. Lost Productive Work Time Costs From Health Conditions in the United States: Results From the American Productivity Audit. 2003. JOEM 45 12: 1234-46
5. Boyce R W, Perko M A, Jones G R, Hiatt A H, and Boone E L. Physical fitness, absenteeism and workers' compensation in smoking and non-smoking police officers. Occ Med 2006; 56: 353-356
6. Terry L Blackwell, Stephen J Leierer, Stephanie Haupt, Angeliki Kampitsis. Predictors of vocational rehabilitation return-to-work outcomes in workers' compensation Rehabilitation Counseling Bulletin. Washington: 2003; 46: 108-14
7. Johansson JA. Work-related and non-work-related musculoskeletal symptoms. Applied Ergonomics 1994 25(4) 248-51
8. Kovacs F M, Abraira V, Zamora J, and Fernandez C The Spanish Back Pain Research Network, "The Transition from Acute to Subacute and Chronic Low Back Pain", SPINE, 2005; 30: 1786-1792.

9. Work related traumatic fatalities in Australia 1989 to 1992. Author: Work-related Traumatic Fatalities Study Team. 12 February 1999
10. Assessing Fitness to Drive. Austroads. 2003
11. Ijzelenberg W, and Burdorf A, 'Risk Factors for Musculoskeletal Symptoms and Ensuring Health Care Use and Sick Leave', SPINE 2005; 30: 1550-1556
12. Voss M, Floderus B, & Diderichsen F, 'How Do Job Characteristics, Family Situation, Domestic Work, and Lifestyle Factors Relate to Sickness Absence? A Study Based on Sweden Post', JOEM, 2004; 46: 1134-1143.
13. Wasiak R, Verma S, Pransky G, and Webster B. Risk factors for recurrent episodes of care and work disability: Case of low back pain JOEM. 2004; 46: 68
14. O'Connor, M and Parrish M. 'Morbidity and mortality on RAN ships.' ADF Health. 5 Sep 2004. pp 51 – 58.
15. Dorrell, M.G. 'Sick bay attendances by Royal Navy Women at sea.' J. R. Nav Med Serv. 1994 80 (2) pp 83-5.
16. Van Wijk, C. 'Never, Never Sick At Sea: Gender Differences in Health Care Utilisation on Board South African Naval Vessels.' Journal of Gender Studies. 14 (3) November 2005. pp 251-260.
17. Defence Instructions (General) PERS 16 – 15. Australian Defence Force Medical Employment Classification System.