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Original Article

Occupational health concerns: An analysis of physical activity of submariners

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ABSTRACT

Background: Submarine crew have low physical activity by virtue of their professional requirements. Lack of space and inadequacy of regeneration capabilities render physical activity almost impossible during deployments. However, sufficient data for physical activity levels and trends are required to measure the magnitude of inactivity.

Methods: Data was collected from 362 personnel belonging to six submarines and one submarine base using Global Physical Activity Questionnaire. Four study groups were defined: Base, Refit, Operational/Harbour and Operational/Sea.

Results: Overall, 30.11% of the crew had insufficient physical activity (4.04% in Base, 5.75% in Refit, 15% in Ops/Harbour and 91.67% in Ops/Sea groups). Of the total physical activity, 48.7% was contributed by activity at work, 18.71% by travel related activity and 32.62% by recreational physical activity. Base group recorded the highest recreational activity of 1468.28 Minutes-per-Week. Recreational activity contributed 43.22% to total physical activity for this group. Mean total physical activity was highest for ≥ 45 years and lowest for ≤ 24 years. ≥ 45 years old also recorded the highest recreational activity.

Conclusion: The greatest cause for concern comes from the crew in operational submarines and the younger crew. Physical activity profile of the crew when at sea cannot be changed and greater research is required to assess the long-term health effects of physical inactivity in this group. However, what can be modified are the work schedules for refit submarines and operational submarines when in harbour. Targeted interventions and strategies are required to establish sustainable behaviour patterns with regards to physical activity in these groups.

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Introduction

Physical inactivity has attracted a lot of concern due to increased incidences of non-communicable diseases. In 2009, physical inactivity was identified as the fourth leading risk factor and along with tobacco smoking a behavioural risk factor for non-communicable diseases and accounted for more than 3 million preventable deaths.¹ In 2012, Lancet highlighted the global health concerns due to physical inactivity. The studies revealed that 31.1% of adults worldwide are physically inactive and 80.3% of adolescents do fewer than 60 min of moderate to vigorous intensity physical activity per day.² The studies also revealed that a third of adults do not reach public health guidelines for recommended levels of physical activity. Data from India estimated that 12.7% of male population and 18.4% of female population (with an average of 15.6% of both sexes) are insufficiently active.³

Apart from concerns regarding physical inactivity related to sedentary lifestyles globally, attention has also been focussed on certain occupational groups who may have low physical activity by virtue of their profession. Submariners are one such group who are exposed to long periods of physical inactivity during deployments. Lack of space and inadequacy of regeneration capabilities render physical activity almost impossible. The situation is particularly worrisome for conventional diesel-electric submarines compared to the larger nuclear-powered submarines.⁴

However, for submariners, the physical inactivity has not been evaluated by many studies. Sufficient data is required to measure the magnitude of inactivity, and then implement effective programmes for better health and prevention of non-communicable diseases in this occupational category.

Material and methods

Study design

A cross-sectional surveillance study was conducted and data was collected from 362 personnel belonging to six randomly selected submarines and one submarine base including both officers and sailors. Individuals were asked to volunteer for the study and all participants were randomly selected on the basis of their availability on the days of recording of data. All crew in low medical category were excluded from the study. All non-submarine-cadre personnel posted to the submarine base were also excluded.

Four study groups were defined: Group 1 comprised individuals posted to the submarine base (referred hereafter as the 'Base group') and Group 2 comprised submarines in refit (called 'Refit group'). Groups 3 and 4 comprised individuals posted to operational submarines with data being collected for the period while in harbour and when at sea respectively (called 'Ops/Harbour group' and 'Ops/Sea group'). Because of the relative similarity in their working schedules compared to the Ops/Sea group, the three groups Base, Refit and Ops/Harbour were sometimes together referred to as Non-Sea groups for some comparisons and data analyses.

Data collection and analysis

The Global Physical Activity Questionnaire (GPAQ) version 2.0 was used for data collection which is a self-reported questionnaire comprising of 16 questions developed by the World Health Organization (WHO) for physical activity surveillance. GPAQ assesses the frequency (days) and time (min/h) spent in doing moderate- and vigorous-intensity physical activity during a typical week in three domains: work-related, transport-related, and recreational physical activity.⁵ GPAQ has been validated and widely employed to assess physical activity patterns. Previous studies have shown that GPAQ has good test-retest repeatability and relative validity⁶⁻⁸ and has been used by the WHO in 122 countries as part of the STEPS programme.^{3,5}

No changes were made to the original questionnaire and data collection was done with personal interviews. Study requirements were explained to all participating individuals and GPAQ data was collected in accordance with the method standardised by the WHO. Participants were asked to report any physical activity lasting more than 10 min carried out in a typical week in all three domains. All the questionnaires were manually cleaned to remove any invalid responses, over reporting of physical activity and implausible values prior to entering data into the final data sheet. Statistical analysis was carried out using Epi Info software developed by the WHO and Microsoft Excel. ANOVA and chi-square tests were used for analysis and $P < 0.05$ was taken as significant.

Definitions

Energy expenditure was estimated based on duration, intensity and frequency of physical activity performed in a typical week. The unit of measurement for energy expenditure was metabolic equivalent (MET) derived from activity variables of the GPAQ. MET is the ratio of specific physical activity metabolic rates to the resting metabolic rate. One MET is equal to the energy cost of sitting quietly (1 kcal/kg body weight/h) and oxygen uptake in ml/kg/min with one MET is equal to the oxygen cost of sitting quietly (about 3.5 ml/kg/min). MET values and formulas for computation were based on the intensity of specific physical activity. Moderate-intensity activities during work, transportation and leisure were assigned a value of 4 METs and Vigorous intensity activities assigned 8 METs. Total physical activity score was the sum of all METs-Minutes-per-Week derived from moderate-to-vigorous-intensity physical activity performed in work, transportation and recreation.⁵

Physical activity was classified into three levels: High, Moderate and Low in accordance with the GPAQ analysis framework.⁵ These three groupings were then categorised into 'Sufficiently Active' or 'Insufficiently Active' groups. The 'Sufficiently Active' group included participants who met the physical activity recommendations, therefore, classified as being in the High or Moderate physical activity levels.⁷

Results

Data was collected from 362 male individuals belonging to the four study groups, including 26 officers with mean age of 29.35

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