Sleep Quality and its Predictors in Brazilian Marines

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Abstract

Objectives The objective of this study was to evaluate the quality of sleep and its associated factors in marines (*Fuzileiros Navais - FN*) of the Brazilian Navy.

Material and Methods The participants included 1,248 military personnel who responded remotely to the following instruments: anamnesis, Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale, International Physical Activity Questionnaire, Eating Habits Scale, and the K10 Questionnaire. Anthropometric information was obtained from a database. Subgroup analysis (good x poor sleep) and regression analysis were performed to verify the factors associated with poor sleep quality.

Results A total of 74.12% of the military were characterized by poor sleep quality. There were differences between sleep quality and sociodemographic, behavioral, and professional factors. Age, being an Officer, and physical activity were protective factors, while living with young children, having more energy in the evening, daytime sleepiness, having problems at work, distress, and regular eating habits were predisposing to poor sleep.

Discussion Marines of the Brazilian Navy have a high prevalence of poor sleep quality associated with personal, family, and occupational factors as contributors to the problem, indicating the need to develop health actions that favor good sleep hygiene in these professionals.

Keywords
- inadequate sleep
- armed forces
- fatigue
- operational capacity
- military personnel
- national security

Introduction

Sleep is a cyclical behavior characterized by temporary and reversible changes in mobility and especially in consciousness, being essential for maintaining homeostasis.[1] Alteration in their quantity or quality can impair an individual's occupational performance and activities of daily living,[2] in addition to being associated with several health problems, including increased risk of cardiovascular disease, diabetes, and obesity.[3]

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Several professional categories are subject to inadequate sleep, including the military. Factors such as increased physiological and psychological demands,[4] military rank and marital status,[5] care for young children[2] and the work routine itself [6] can pose challenges to getting enough restful sleep. This can culminate in a high prevalence of poor sleep quality among these professionals.[7] This inadequacy can induce negative physiological and behavioral effects, increase reaction time, and worsen performance in visuospatial tasks[8] increasing the chances of errors and accidents. It can also impact physical performance, aggravate injuries, generate cognitive impairment, and interfere with leadership, and the ability to make decisions and carry out planning. Together, they all negatively influence the operational capacity of the military. However, modifiable factors such as physical exercise,[9] adequate nutrition[10] and increased mental resilience[11] are associated and contribute to better sleep quality.

In this context, evaluating the quality of sleep of the Marine Corps (*Corpo de Fuzileiros Navais - CFN*) - the armed wing of the Brazilian Navy, a group dedicated to amphibious and expeditionary operations - is necessary, since studies involving a profile on the quality of sleep of its military personnel have not been conducted in its 216 years of existence.

Given the lack of work examining this issue in the *CFN* in Brazil, an exploratory study is needed to determine the true extent of the problem to develop interventions (if necessary) to improve sleep based on evidence; these interventions would then be aimed at maintaining the readiness of this military personnel. Therefore, the objective of this work was to evaluate the sleep quality and associated factors in the Marine Corps of the Brazilian Navy.

Materials and Methods

Participants

This is a cross-sectional study developed with *CFN* soldiers, subordinate to the *Fleet Marine Force*, on active duty, and serving in the city of Rio de Janeiro, between June and July 2022.

The OpenEpi online version 3.01 program was used to calculate the sample size. An estimated population of 6,475 military personnel was considered, confidence level of 95%, expected prevalence of 58.8%,[7] predicted sampling error of 3, design effect of 1, and supplementation of 20% for cover losses and control for confounding factors, thus requiring a minimum sample of 1,079 individuals.

Participation was voluntary and each soldier answered the questionnaires only after reading and signing the informed consent form in electronic format. Incoherent responses in any questionnaire were disregarded and only questionnaires that were fully answered were counted. The study was approved by the Ethics Committee for Research with Human Beings (CAAE: 53174321.7.0000.5256/Protocol Number: 5.202.697; Marcílio Dias Naval Hospital/Rio de Janeiro).

Operational Procedures

The LimeSurvey® software program was used to administer the questionnaires, with operational procedures guided by the CHERRIES checklist.[12] Its objective was explained, and doubts were previously resolved in all participating Military Organizations before distributing the survey link. Cookies were used for access control, allowing participants to save partially answered questionnaires to be completed later. Manual verification of each response was performed to detect duplicates and inconsistencies. A pilot study was performed aiming at adjustments and standardization.

Instruments

Quality of Sleep

Sleep quality, a dependent variable, was assessed using the Brazilian version of the Pittsburgh Sleep Quality Index (PSQI).[13] This questionnaire contains 19 items that assess the subjective quality of sleep over the last month from 7 domains. Its score ranges from 0 to 21, with values up to 5 indicating good sleep quality and values above 5 indicating poor sleep quality.

Sociodemographic, Behavioral, and Professional Information

Sociodemographic information was collected (age; gender; education; marital status; self-reported skin color; if the individual lived with children up to five years old; behavioral information (use of tobacco and alcohol; time of day when one has more energy; health restriction in the last month consumption of stimulating drinks in the afternoon); and specific information about the military profession (rank; participation in military exercises lasting more than 72 hours in the last month; problems at work due to sleep whether they worked in operational or administrative work).

Sleepiness

Sleepiness was assessed using the Brazilian version of the Epworth Sleepiness Scale (ESE).[14] There are eight questions that verify the probability of the respondent to doze off in different daily situations, active or passive. Scores range from 0 to 3, with 0 - never dozing off; 1 - a low chance of dozing off; 2–a medium chance of dozing off; and 3–a high chance of dozing off. Values lower than or equal to 10 in the overall score indicate normal sleepiness, between 11 and 15 excessive daytime sleepiness (EDS), and values greater than or equal to 16 as very EDS.

Physical Activity and Sedentary Behavior

Physical activity and sedentary behavior were verified using the International Physical Activity Questionnaire (IPAQ; short version), validated in Brazil.[15] The physical activity level was estimated by the time spent in moderate activities plus twice the time in vigorous physical activity. Participants who reported 150 minutes or more of physical activity in the week were classified as physically active, and those with less than 150 minutes were considered physically inactive. Sedentary behavior was assessed by sitting time investigated by the question "How much time in a day do you sit on a weekday/the weekend?" Sitting time on a weekday was multiplied by five, and on weekends by two; the value found

was later divided by seven to define the daily average (minutes) spent sitting.

Eating Habits

Eating habits were evaluated using the scale by Gabe & Jaime (2019).[16] The instrument evaluates eating practices through four dimensions: planning, domestic organization, food choice, and eating habits, represented by a set of 24 items that exemplify such practices. Categorization was performed by analysis of tertiles, in which scores greater than 41 indicate excellent eating habits; between 32 and 41 normal; and less than 32 as insufficient.[17]

Distress

The Kessler Psychological Distress Scale (K10),[18] validated in Brazil, was used to assess chronic stress through 10 questions about manifestations of distress in the last 30 days. The score ranges from 10 to 50, with values between 0 and 15 meaning absent or low mental disorder; between 16 and 21, moderate; between 22 and 29, severe; and between 30 and 50, very severe mental disorder.

Anthropometric Measurements

Secondary data belonging to the database of the Military Aspect Program of the Brazilian Navy, which only had the values of male soldiers, were used. This program evaluates the military aspect of *FN* using scientifically validated tests to measure individual body composition. Measurements were obtained as described in the Norms on Military Physical Training and Physical Assessment Tests in the Brazilian Navy.[19] All assessments were conducted in September and October 2022.

Measurements of height (m), total body mass (kg), waist circumference (cm)[20] and skinfolds[21] were considered. The Body Mass Index (BMI; Kg/m^2) was estimated, and classified according to the World Health Organization[22]; the waist-to-height ratio (WHR), adopting a cut-off point of ≥ 0.5 as increased[23]; the sum of skinfolds (ΣDC) and body fat percentage (%F) was calculated by the Siri equation[24].

Statistical Analysis

Data normality was verified by the Shapiro-Wilk test and graphically by histograms. Continuous variables were characterized by calculating the mean ($\bar{x}$)and standard deviation (SD), or median (Md) and interquartile range (IQR), depending on normality. Categorical variables were presented by absolute (n) and relative (%) frequency. The chi-squared test and independent *t*-test or Mann-Whitney test were used to compare groups with good (score ≤ 5) and poor (score >5) sleep quality, depending on data normality.

Poisson regression with robust variance was used to determine the factors associated with sleep quality. The associated factors were first investigated in a crude model (bivariate analysis), and subsequently in a model adjusted by covariates. The variables were included in the multiple models by the stepwise backward method when they presented $p \leq 0.20$ in the bivariate model. After analyzing the independent variables in the multiple regression model, the variables that were associated with the outcome with $p < 0.05$ were maintained in the final model and considered independently associated. Prevalence ratios (PR) and their respective 95%CI were calculated. All statistical analyses were performed using the Stata statistical version 14.0 software program.

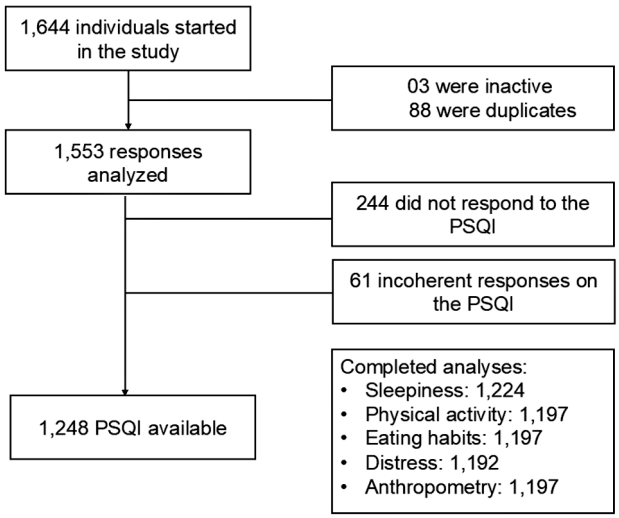

Fig. 1 Selection and analysis sample flowchart.

Results

The data analysis flowchart is shown in ►**Fig. 1**. Among the 1,553 research participants, 1,248 individuals correctly completed the PSQI.

Almost all the sample was made up of men, which is why the data were analyzed in aggregate considering both genders. The approximate age of the participants was 30 years old, more than half consumed alcohol, most did not smoke, were physically active, had a BMI classified as overweight and 925 of them (74.12%) had poor sleep quality.

Significant differences were observed in the comparison by subgroup between sleep quality and age, living with children younger than five years, physical activity level, daytime sleepiness, distress, eating habits, period of the day with greater energy, routine, problems at work, rank and type of work (►**Table 1**).

►**Table 2** presents the bivariate analysis related to poor sleep quality, while ►**Table 3** shows the associated covariates in the adjusted model. It was identified that age, being an officer and being physically active are protective factors (negative association) of poor sleep quality. On the other hand, living with children younger than 5 years old, having more energy at night, believing that they have problems at work due to sleep, being excessively sleepy, having a mental disorder, and having normal eating habits are predisposing factors (positive association) to poor sleep quality (►**Table 3**).

Table 1 Sociodemographic, anthropometric, behavioral, and work characteristics of Marines

Variable	Good sleep quality (Score $\leq$ 5)	Poor sleep quality (Score >5)	*p-value*	Total
Age (years)[a]	33.00 (27.00–41.00)	30.00 (26.00–37.00)	<**0.001**[a]	31.00 (26.00–38.00)
Gender[c]				
Female	3 (0.93)	8 (0.86)	0.916[c]	11 (0.88)
Male	320 (99.07)	917 (99.14)		1.237 (99.12)
Education[c]				
Completed high school	173 (53.56)	492 (53.19)	0.908 [c]	665 (53.29)
Incomplete/complete higher education	150 (46.44)	433 (46.81)		583 (46.71)
Civil status[c]				
Single	94 (29.10)	319 (34.49)	0.077 [c]	413 (33.09)
With companion	229 (70.90)	606 (65.51)		835 (66.91)
Skin color[c]				
White	105 (32.51)	258 (27.89)	0.239 [c]	363 (29.09)
Black	43 (13.31)	145 (15.68)		188 (15.06)
Other	175 (54.18)	522 (56.43)		697 (55.85)
Smoke[c]				
No	296 (91.64)	834 (90.16)	0.434 [c]	1.130 (90.54)
Yes	27 (8.36)	91 (9.84)		118 (09.46)
Consume alcohol[c]				
No	144 (44.58)	362 (39.14)	0.076 [c]	506 (40.54)
Yes	179 (55.42)	563 (60.86)		742 (59.46)
Live with child(ren) $\leq$ 5 years of age[c]				
No	246 (76.16)	625 (67.57)	**0.004** [c]	871 (69.79)
Yes	77 (23.84)	300 (32.43)		377 (30.21)
Weight (kg)[b]	82.44 (11.95)	83.63 (13.06)	0.159 [b]	83.32 (12.79)
Height (m)[b]	1.76 (0.07)	1.76 (0.06)	0.759 [b]	1.76 (0.06)
BMI (kg/m^2)[b]	26.67 (3.45)	27.08 (3.76)	0.089 [b]	26.97 (3.69)
BMI[c]				
Underweight or eutrophic	101 (32.37)	259 (29.27)	0.335 [c]	360 (30.08)
Overweight	161 (51.60)	454 (51.29)		615 (51.37)
Obese	50 (16.03)	172 (19.44)		222 (18.55)
Waist circumference (cm)[b]	87.16 (8.76)	87.72 (9.16)	0.346 [b]	87.57 (9.06)
Waist circumference[c]				
Normal	199 (63.78)	534 (60.34)	0.277 [c]	733 (61.24)
Increased	113 (36.22)	351 (39.66)		464 (38.76)
Sum of folds (mm)[b]	53.38 (21.98)	53.60 (23.13)	0.881 [b]	53.54 (22.83)
Fat percentage[b]	16.32 (6.09)	16.21 (6.50)	0.798 [b]	16.24 (6.39)
Waist-to-height ratio[b]	0.50 (0.05)	0.50 (0.05)	0.281 [b]	0.50 (0.05)
Waist-to-height ratio[c]				
Normal	167 (53.53)	443 (50.06)	0.292 [c]	610 (50.96)
Increased	145 (46.47)	442 (49.94)		587 (49.04)

Table 1 (*Continued*)

Variable	Good sleep quality (Score $\leq$ 5)	Poor sleep quality (Score >5)	*p-value*	Total
NAFTS - (min)[a]	474.00 (230.00–790.00)	460.00 (220.00–770.00)	0.653[a]	460.00 (220.00–780.00)
NAFTS[c]				
Physically inactive	39 (12.70)	159 (17.87)	**0.036** [c]	198 (16.54)
Physically active	268 (87.30)	731 (82.13)		999 (83.46)
Time seated (min)[a]	206.00 (123.00–329.00)	197.00 (120.00–300.00)	0.282[a]	197.00 (120.00–309.00)
Sleepiness level[c]				
Normal	266 (84.18)	522 (57.49)	<**0.001** [c]	788 (64.38)
EDS	39 (12.34)	253 (27.86)		292 (23.86)
Very EDS	11 (3.48)	133 (14.65)		144 (11.76)
Distress[c]				
Absent or low mental disorder	258 (83.23)	380 (43.08)	<**0.001**[c]	638 (53.52)
Moderate mental disorder	33 (10.64)	264 (29.93)		297 (24.92)
Severe mental disorder	16 (5.16)	153 (17.35)		169 (14.18)
Very severe mental disorder	3 (0.97)	85 (9.64)		88 (7.38)
Eating habits[c]				
Excellent	129 (41.61)	247 (27.85)	<**0.001**	376 (31.41)
Normal	140 (45.16)	479 (54.00)		619 (51.71)
Insufficient	41 (13.23)	161 (18.15)		202 (16.88)
Stimulating drinks in the afternoon[c]				
No	117 (36.22)	302 (32.65)	0.242[c]	419 (33.57)
Yes	206 (63.78)	623 (67.35)		829 (66.43)
Period with more energy[c]				
Morning	256 (79.26)	610 (65.95)	<**0.001**[c]	866 (69.39)
Afternoon	49 (15.17)	205 (22.16)		254 (20.35)
Night	18 (5.57)	110 (11.89)		128 (10.26)
Normal routine[c]				
No	19 (5.88)	88 (9.51)	<**0.001**[c]	107 (8.57)
Yes	304 (94.12)	837 (90.49)		1.141 (91.43)
Problems at work[c]				
No	272 (84.21)	430 (46.49)	<**0.001**[c]	702 (56.25)
Yes	51 (15.79)	495 (53.51)		546 (43.75)
Rank[c]				
SD/Pr	108 (33.44)	443 (47.89)	<**0.001**[c]	551 (44.15)
SG/SO	178 (55.10)	432 (46.70)		610 (48.88)
Official	37 (11.46)	50 (5.41)		87 (6.97)
Type of work[c]				
Administrative	147 (45.51)	355 (38.38)	<**0.001**[c]	502 (40.22)
Operative	176 (54.49)	570 (61.62)		746 (59.78)

(*Continued*)

Table 1 (*Continued*)

Variable	Good sleep quality (Score $\leq$ 5)	Poor sleep quality (Score >5)	*p-value*	Total
Handling > 72h in the last month[c]				
No	203 (62.85)	556 (60.11)	0.242[c]	2759 (60.82)
Yes	120 (37.15)	369 (39.89)		489 (39.18)

Abbreviations: BMI, Body Mass Index; EDS, excessive daytime sleepiness; NAFTS, Total Weekly Physical Activity Level; SD/Pr, soldier/private; SG/SO, sergeant/non-commissioned officer.
[a]= quantitative variables with non-normal distribution [Median (Interquartile range), Mann-Whitney test].
[b]= quantitative variables with normal distribution [Mean ± (Standard deviation), Independent *t*-test].
[c]= categorical variables [n (%), Chi-Squared Test]; BMI: underweight or eutrophic $\leq$ 24.9 kg/m2; overweight = 25 kg/m2–29.9 kg/m2; obese $\geq$ 30 kg/m2; Waist circumference: men: $\geq$ 90 cm = increased; women: $\geq$ 80 cm = increased; Waist-to-height ratio: $\geq$ 0.5 = increased; bold = $p < 0.05$.

Table 2 Factors associated with poor sleep quality in Marines – crude model – (bivariate analysis)

Variable ($n = 1{,}248$)	PR	95%CI	*p-value*
Age	0.99	0.98–0.99	< **0.001**
Education			
Completed high school	1.00	–	–
Completed/incomplete higher education	1.00	0.94–1.07	0.908
Civil status			
Single	1.00	–	–
With companion	0.94	0.88–1.00	**0.068**
Smoke			
No	1.00	–	–
Yes	1.04	0.94–1.16	0.409
Consume alcohol			
No	1.00	–	–
Yes	1.06	0.99–1.14	**0.092**
Live with children under 5 years of age			
No	1.00	–	–
Yes	1.11	1.04–1.18	**0.002**
Rank			
SD/Pr	1.00		–
SG/SO	0.88	0.82–0.94	< **0.001**
Officers	0.71	0.59–0.86	< **0.001**
Type of work			
Administrative	1.00		–
Operative	1.08	1.01–1.16	**0.028**
Period with more energy			
Morning	1.00	–	–
Afternoon	1.15	1.06–1.24	< **0.001**
Night	1.22	1.12–1.32	< **0.001**

Table 2 (*Continued*)

Variable ($n = 1,248$)	PR	95%CI	*p-value*
Problems at work			
No	1.00	–	–
Yes	1.48	1.39–1.58	< **0.001**
Normal routine			
No	1.00	–	–
Yes	0.89	0.81–0.98	**0.018**
Handling >72h			
No	1.00	–	–
Yes	1.03	0.96–1.10	0.381
Level of sleepiness ($n = 1,224$)			
Normal	1.00	–	–
EDS	1.31	1.22–1.40	< **0.001**
Very EDS	1.39	1.30–1.49	< **0.001**
NAFTS ($n = 1,197$)	1.00	1.00–1.00	0.700
NAFTS ($n = 1,197$)			
Physically inactive	1.00	–	–
Physically active	0.91	0.84–0.99	**0.020**
Time seated ($n = 942$)	1.00	1.00–1.00	0.300
Distress ($n = 1,192$)			
Absent or low mental disorder	1.00	–	–
Moderate mental disorder	1.49	1.38–1.61	< **0.001**
Severe mental disorder	1.52	1.40–1.65	< **0.001**
Very severe mental disorder	1.62	1.50–1.75	< **0.001**
Eating habits ($n = 1,197$)			
Excellent	1.00	–	–
Normal	1.15	1.06–1.25	< **0.001**
Insufficient	1.20	1.10–1.32	< **0.001**
Stimulating drinks in the afternoon			
No	1.00	–	–
Yes	1.04	0.97–1.12	0.251
BMI ($n = 1,197$)	1.09	0.99–1.03	0.385
BMI category ($n = 1,197$)			
Underweight or Eutrophic	1.00	–	–
Overweight	1.03	0.95–1.11	0.528
Obese	1.08	0.98–1.19	**0.130**
Waist circumference ($n = 1,197$)	1.00	1.00–1.01	0.335
Fat percentage ($n = 1,197$)	1.00	0.99–1.00	0.792
Waist-to-height ratio ($n = 1,197$)	1.42	0.76–2.68	0.273

Abbreviations: BMI, Body Mass Index; EDS, excessive daytime sleepiness; NAFTS, Total Weekly Physical Activity Level; SD/Pr, soldier/private; SG/SO, sergeant/non-commissioned officer; bold, $p < 0.2$.

Table 3 Factors associated with poor sleep quality in Marines – adjusted model – (multivariate analysis)

Variable ($n = 1{,}248$)	PR	95%CI	*p-value*
Age (years)	0.99	(0.98–0.99)	**0.016**
Live with children $\leq$ 5 years of age			
No	1.00	–	–
Yes	1.10	1.03–1.17	**0.002**
Rank			
SD/Pr	1.00	–	–
SG/SO	1.09	0.98–1.20	0.101
Officers	0.81	0.67–0.98	**0.032**
Period with more energy			
Morning	1.00	–	–
Afternoon	1.06	0.99–1.14	0.114
Night	1.12	1.04–1.21	**0.003**
Problems at work			
No	1.00	–	–
Yes	1.26	1.19–1.35	< **0.001**
Sleepiness level ($n = 1{,}224$)			
Normal	1.00	–	–
EDS	1.14	1.06–1.21	< **0.001**
Very EDS	1.11	1.04–1.19	**0.002**
NAFTS ($n = 1{,}197$)			
Physically inactive	1.00	–	–
Physically active	0.92	0.85–0.99	**0.036**
Distress ($n = 1{,}192$)			
Absent or low mental disorder	1.00	–	–
Moderate mental disorder	1.36	1.27–1.47	< **0.001**
Severe mental disorder	1.26	1.16–1.37	< **0.001**
Very severe mental disorder	1.34	1.23–1.45	< **0.001**
Eating habits ($n = 1{,}197$)			
Excellent	1.00	–	–
Normal	1.09	1.01–1.18	**0.035**
Insufficient	1.00	0.91–1.10	0.986

Abbreviations: CI, confidence interval; EDS, excessive daytime sleepiness; NAFTS, Total Weekly Physical Activity Level; PR, prevalence ratio; SD/Pr, soldier/private; SG/SO, sergeant/non-commissioned officer.
Results only refer to individuals with complete data on all instruments used. bold = $p < 0.05$.

Discussion

This study aimed to evaluate the quality of sleep and its associated factors in Brazilian *FN* (Marines). As the main results, we found a high prevalence (74.12%) of military personnel with poor sleep quality and the existence of significant differences between sleep quality and sociodemographic, behavioral, and professional factors (►**Table 1**). Protective factors for sleep quality were age, being an officer, and being physically active. Living with children younger than five years old, having more energy at night, thinking they had problems at work due to sleep, EDS, mental disorders, and having normal eating habits were predisposing factors to poor sleep quality (►**Table 3**). No associations were observed between poor sleep quality and anthropometric measurements.

Quality of Sleep Analysis

Sleep quality is a subjective and multifactorial concept that considers quantitative and qualitative aspects,[25] with the PSQI being the recurrent instrument for assessing this variable in different populations. Several studies have reported

different prevalences of poor sleep quality in military personnel, such as Wang et al. (2020)[26] reporting 40.9% poor sleep quality in the Chinese military; Roustaei et al. (2017)[27] found 48% in the Iranian military; and Plumb et al. (2014)[28] 89.1% in US military participants in conflicts. Publications on sleep parameters in Brazilian military personnel, in addition to being scarce, involve a reduced sample size and are not uniform in terms of the method used, making comparisons difficult. However, our results were similar to those of Iahnke et al. (2022),[29] Oliveira (2020)[30] and Pinto et al. (2018),[31] who found 66.2%, 81.59% and 63.6% prevalence of poor sleep quality using the PSQI in army personnel, firefighters and military police, respectively. The fact that our study took place shortly after the COVID-19 pandemic may have contributed to the high prevalence of poor sleep, showing a final reflection of social changes such as confinement and social isolation, less exposure to sunlight, reduced activity physical activity, and increased stress.[32] Lack of knowledge about the importance and need for care for sleep hygiene by the Brazilian military may have also contributed to the result found.

Subgroup Analysis

There were significant differences in the subgroup analysis. Sociodemographic,[33] behavioral[8] and professional[6] aspects were related to sleep quality. Among the tested variables, only having a normal routine and the type of work (administrative and operative) did not remain significant in the regression model. However, in researching US Air Force soldiers, Tvaryanas et al. (2018)[34] reported that insufficient sleep was related to limitations at work and lack of physical tests, an aspect which can interfere with the routine in the barracks. Roustaei et al. (2017)[27] reported that 62.9% of Iranian police officers in the operational sector had poor sleep quality compared with 20.0% in the administrative sector. The demands related to constant preparation, the risk of death inherent to operational activities, even in training, and the physical overload can mean stressful and difficult factors for good sleep quality in military personnel in the operational sector.

Protective Factors

Older marines had better sleep quality than younger ones. Our study shows that the prevalence of poor sleep quality decreased by 1% for each year of increasing military age (PR 0.99 [95%CI: 0.98–0.99]). The study by Choi et al. (2022)[7] found that advancing age is a risk factor for poor sleep quality (OR 1.11 [95%CI: 1.05–1.17]), increasing the chance of this occurrence by 11%. The studies by Chou et al. (2016)[35] and Plumb et al. (2014)[28] found no association between age and sleep quality in the regression analysis. These results show a lack of consensus regarding the association of age with sleep quality, requiring further research. In the military context, it is relevant to consider that the type of service of an individual changes with advancing age, which may include a decrease in shift work, which makes it difficult to sleep.[36] Despite the statistical significance in our regression analysis, the small difference in the medians in the subgroup analysis (►**Table 1**) points to a possible clinical irrelevance of the outcome when considering sleep ontogeny.

Being an officer was a protective factor (PR 0.81 [95%CI: 0.67–0.98]) for sleep quality. A study by Caldwell et al.[5] (2019) pointed out that sleep disorders may be related to the ranks of officers, especially older ones. Other studies in the literature did not contemplate the association of sleep quality in officers.[7,35] Compared with soldiers, officers do not perform the same services in shifts, in addition to having a higher education level and salary, which can improve sleep in these individuals.[37] Furthermore, our study includes officers in a single category, not differentiating according to their rank due to statistical representativeness; As a result, even though they are officers, there are a large number of military personnel with low ranks in the officer corps who do not have a command function; this can alter health aspects such as less stress, less responsibility at work and even family issues, such as not having children.

Regular practice of physical exercise is beneficial for sleep quality, a fact which was also observed in our study (PR 0.92 [95%CI: 0.85–0.99]) and is, therefore, a non-pharmacological strategy for treating sleep-related problems. There is evidence that moderate to vigorous physical exercise can decrease sleep fragmentation and improve sleep latency,[9] contributing to the treatment and prevention of sleep-wake cycle disorders.

Risk Factors

Factors unrelated to military life can influence combatants' sleep. Parents of children younger than six years of age may suffer from sleep fragmentation. Mysliwiec et al. (2021)[2] reported that the birth or adoption of a child is one of the factors that most negatively affect the sleep of American military personnel. According to our research, military personnel living with children up to five years old increased the prevalence of poor sleep quality by 10% (PR 1.10 [95%CI: 1.03–1.17]). The challenges inherent to night rest for parents of young children can be exacerbated by the existing difficulties for military personnel to sleep. Furthermore, considering the high prevalence of poor sleep quality in our sample, an increase in their stress level may occur, which also influences the child and may start a vicious circle of poor sleep quality at home.[38]

The prevalence of individuals with poor sleep quality was significant among those who had more energy at night (PR 1.12 [95%CI: 1.04–1.21]). The need to sleep is mediated by external (light-dark cycle) and internal (physiological processes) factors.[39] Circadian preference was verified using a direct question about the period in which the soldier thought they had more energy. Individuals with nocturnal preferences feel better at night and sleep later.[40] Although we did not investigate other social issues such as watching television, using cell phones, following sports games, and playing online games, these are increasingly prevalent today and are factors of satisfaction. Case studies conducted with American Marines noted that excessive use of video games (30 hours or more per week, beyond a 40-hour or more workday) may be associated with sleep deprivation, resulting in poor job

performance and mood disorders.[41] Work in the Brazilian Navy starts at 07:30 AM in the Marine Force Squad, and many military personnel have to wake up even earlier due to commuting to the barracks. This may be related to poor sleep quality in these military personnel and cause bias when they must do daytime tasks.[42] In addition, a study by Tonon et al. (2019)[43] in Brazilian military states that afternoon individuals were those who had more depressive symptoms (PR 2.58 [95%CI: 1.54–4.33]), which may contribute to poor sleep quality. However, the preference for the nocturnal period would not be a risk factor, but the chronodisruption it causes would.[43]

Judging that you had problems at work due to sleep increased the prevalence of poor sleep quality in the sample (PR 1.26 [95%CI: 1.19–1.35]). This is a result that reveals the subjective perception of the influence of sleep on the military. Negative self-perception of sleep quality is associated with difficulty concentrating (OR 1.73 [95%CI: 1.13–2.65]), regardless of the number of hours of continuous sleep. Issues such as emotional exhaustion,[44] pain, hypervigilance, awakenings, nightmares, and even the fear of sleeping to avoid bad dreams[28] may be related to subjective complaints about sleep. Comparing the prevalence found of poor sleep quality (74.12%) and its relationship with the prevalence of individuals who believe they have problems at work due to sleep (26% - ►**Table 3**), a lack of knowledge about sleep characteristics and its importance for well-being and operability are perceived, as many military personnel may have an impact on this poor quality of sleep and do not attribute it to it.

Excessive sleepiness occurs from increased pressure to sleep due to circadian (decreased core temperature) or homeostatic (sleep deprivation) issues.[39] EDS is the propensity to sleep under circumstances that would be inappropriate for the affected individual. It relates to lower cognition, which influences decision-making, reaction time, and information processing.[45] Both EDS (PR 1.14 [95%CI: 1.06–1.21]) and severe EDS (PR 1.11 [95%CI: 1.04–1.19]) were positively associated with low sleep quality. The demands related to constant preparation can mean stressful factors that hinder good quality sleep.[4] In addition, poor sleep quality may be a risk factor for sleepiness[46] and fatigue,[47] which may contribute to a model that cycles back.

Studying the relationship between mental health and sleep in military personnel is relevant as they face several stressors[11] such as exposure to combat, shift work, and changes in the type of work.[48] A study performed with the US military reported that troops who had higher levels of mental problems were also those who had lower sleep quality.[49] Our work found that poor sleep quality was at least 26% more prevalent (►**Table 3**) in individuals with any level of mental disorder in the K10 assessment. In addition, Choi et al. (2022)[7] found a greater chance of poor sleep quality in military personnel at four stress levels (low to very high), while a study by Kim et al. (2016)[50] in Korean military personnel showed an association between distress (K10) and moderate ($\beta = 2.789$, $p < 0.0001$) and severe ($\beta = 5.245$, $p < 0.0001$) difficulty sleeping.

Regarding eating habits, the literature shows a promising association between healthy eating habits and improvement in sleep quality and components,[10] although the molecular mechanisms of this relationship need to be elucidated. Our study unexpectedly found regular eating habits to be a predisposing factor to poor sleep quality. Disorders caused by changes in the body's circadian cycle influence food consumption from changes in appetite and satiety, favoring weight gain.[51] Eating habits can be altered due to a greater window of opportunity to eat when there is sleep loss.[52] This situation allows neuroendocrine and metabolic alterations, such as a reduction in leptin levels and an increase in ghrelin levels.[51] This scenario may apply to our sample, since 51.29% of the subjects who had poor sleep quality were also overweight (►**Table 1**). However, a systematic review of the relationship between diet and sleep quality concluded that the overall quality of the studies performed so far is poor to regular, not allowing us to clearly define cause and effect relationships.[3] Thus, one of the reasons for our result may be due to the collection instrument itself. The Eating Habits Scale used has a discrete numerical result. Categorization was performed based on possible tertiles. Since this classification was not validated together with the questionnaire, the statistical evaluation of this variable categorically may have interfered with the relationship with sleep quality. As we performed a cross-sectional study, the instrument only allows a subjective analysis of the availability of food for consumption, in addition to not including questions about changes in appetite and regular portion sizes, which are important aspects since increased appetite can lead to increased caloric intake without affecting eating behaviors. Furthermore, questionnaires often fail to predict nutritional status, presumably because individuals, especially obese individuals, tend to underestimate their food intake.[53]

There was no association between anthropometric variables (waist circumference, fat percentage, and waist-to-height ratio) in the bivariate analysis, and in particular BMI in the multivariate analysis. The association between sleep quality and anthropometric measures was non-significant. Although most of the sample was classified as overweight, most military personnel had normal values for waist circumference and waist-to-height ratio (►**Table 1**). Additionally, a significant portion of the sample (83.46%) was physically active, and the body fat percentage ($16.24 \pm 6.39\%$) (►**Table 1**) was considered slightly better than the average according to the body composition standards of the Brazilian Navy.[19] It is likely that Brazilian FN is more homogeneous in terms of anthropometric characteristics, corroborating the physical fitness required for the success of military operations.[54] Therefore, Brazilian FN have sleep profiles that do not seem to be distinguished according to body composition. In addition, as they are soldiers who make up the Navy's special troops, they must present a certain physical activity level, anthropometric standards, and a body composition profile specifically oriented toward the mission, unlike other military units of the corps, or even soldiers from other forces.[55]

Our results also support the study by Rush et al. (2016)[56] showing that obesity is lower for Marines, and de Barlas et al.

(2013)[57] who showed a lower obesity prevalence and higher physical activity rates in these military personnel compared with other operational services of other Forces, indicating that there are probably differences related to the activities performed. Another factor that may have influenced this non-significant result is that we used secondary data from a pre-existing databank in the electronic system of the Brazilian *CFN* herein. However, when extracting and analyzing the information, we considered the normative documents that detail the methodological aspects of obtaining body measurements and the possible implausible measures, ensuring greater reliability of the data available.

Limitations and Strengths

Our work had some limitations. Anthropometric variables were obtained using secondary data from *CFN* systems in Brazil. The size of the female sample did not allow a stratified analysis by gender. Due to the nature of a cross-sectional study, it was not possible to establish a causal relationship between sleep quality and the investigated factors. The number of responses from officials was small, which may interfere with the interpretation of the data. In addition, objective measurements were not used in the study.

As strengths, we used validated questionnaires and scales that minimize biases and enable reliable results, and their remote application, which allowed the analysis of a large sample. Furthermore, as far as we know, this was the first study on sleep quality in Brazilian *FN*, thereby to date constituting the largest epidemiological study on sleep in military personnel ever performed in Brazil.

Conclusion

It is concluded that the Brazilian Navy Marines had a high prevalence of poor sleep quality associated with personal, family, and occupational factors as contributors to the problem, indicating the need to develop health actions that favor good sleep hygiene in these professionals.

Conflict of Interest
We have no conflict of interest to disclose.

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References

1 Tufik S, Andersen ML. O sono: da neurobiologia à prática médica. Rio de Janeiro: Dilivros; 2022:p.25–51
2 Mysliwiec V, Pruiksma KE, Brock MS, et al; STRONG STAR Consortium. The Military Service Sleep Assessment: an instrument to assess factors precipitating sleep disturbances in U.S. military personnel. J Clin Sleep Med 2021;17(07):1401–1409
3 Godos J, Grosso G, Castellano S, Galvano F, Caraci F, Ferri R. Association between diet and sleep quality: A systematic review. Sleep Med Rev 2021;57:101430
4 Grandou C, Wallace L, Fullagar HHK, Duffield R, Burley S. The effects of sleep loss on military physical performance. Sports Med 2019;49(08):1159–1172
5 Caldwell JA, Knapik JJ, Shing TL, Kardouni JR, Lieberman HR. The association of insomnia and sleep apnea with deployment and combat exposure in the entire population of US army soldiers from 1997 to 2011: a retrospective cohort investigation. Sleep 2019;42(08):zsz112
6 Bernhardt KA, Kelley AM, Feltman KA, Curry IP. Rest and activity patterns of Army aviators in routine and operational training environments. Aerosp Med Hum Perform 2019;90(01):48–52
7 Choi Y, Son B, Shin WC, et al. Association of Dietary Behaviors with Poor Sleep Quality and Increased Risk of Obstructive Sleep Apnea in Korean Military Service Members. Nat Sci Sleep 2022;14(14): 1737–1751
8 McEwen BS, Karatsoreos IN. Sleep Deprivation and Circadian Disruption Stress, Allostasis, and Allostatic Load. Sleep Med Clin 2022;17(02):253–262
9 Wang F, Boros S. The effect of physical activity on sleep quality: a systematic review. Eur J Physiother 2021;23(01):11–18
10 Faris ME, Vitiello MV, Abdelrahim DN, et al. Eating habits are associated with subjective sleep quality outcomes among university students: findings of a cross-sectional study. Sleep Breath 2022;26(03):1365–1376
11 Farhadian N, Moradi A, Nami M, et al. The nexus between sleep disturbances and mental health outcomes in military staff: a systematic review. Sleep Sci 2022;15(03):356–362
12 Eysenbach G. Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). J Med Internet Res 2004;6(03):e34
13 Buysse DJ, Reynolds CF III, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res 1989;28(02):193–213
14 Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. Sleep 1991;14(06):540–545
15 Matsudo S, Araújo T, Marsudo V, Andrade D, Andrade E, Braggion G. Questinário internacional de atividade f1sica (IPAQ): estudo de validade e reprodutibilidade no Brasil. Rev. bras. ativ. fís. Saúde. 2001;6(02):05–18
16 Gabe KT, Jaime PC. Development and testing of a scale to evaluate diet according to the recommendations of the Dietary Guidelines for the Brazilian Population. Public Health Nutr 2019;22(05): 785–796
17 Dos Santos Quaresma MV, Marques CG, Magalhães ACO, Dos Santos RVT. Emotional eating, binge eating, physical inactivity, and vespertine chronotype are negative predictors of dietary practices during COVID-19 social isolation: A cross-sectional study. Nutrition 2021;90:111223
18 Kessler RC, Andrews G, Colpe LJ, et al. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. Psychol Med 2002;32(06):959–976
19 Brasil. Normas sobre Treinamento Físico Militar e Testes de Avaliação Física na Marinha do Brasil (CGCFN-108). Marinha do Brasil, RJ:: Comando-Geral do Corpo de Fuzileiros Navais.; 2021
20 Alberti KGMM, Zimmet P, Shaw J. Metabolic syndrome—a new world-wide definition. A consensus statement from the international diabetes federation. Diabet Med 2006;23(05):469–480
21 Jackson AS, Pollock ML. Generalized equations for predicting body density of men. Br J Nutr 1978;40(03):497–504
22 World Health Organization (WHO) Obesity: preventing and managing the global epidemic. Geneva: WHO; 2000

23 Milagres LC, Martinho KO, Milagres DC, Franco FS, Ribeiro AQ, Novaes JFD. Relação cintura/estatura e índice de conicidade estão associados a fatores de risco cardiometabólico em idosos. Cien Saude Colet 2019;24(04):1451–1461

24 Siri WE. Body composition from fluid spaces and density: analysis of methods. Lawrence Berkeley National Laboratory. 1956 Mar.

25 Tufik S, Andersen ML. O sono: da neurobiologia à prática médica. Rio de Janeiro: Dilivros;2022. p. 245–273

26 Wang Z, Chen B, Li W, Xie F, Loke AY, Shu Q. Sleep quality and its impacts on quality of life among military personnel in remote frontier areas and extreme cold environments. Health Qual Life Outcomes 2020;18(01):227

27 Roustaei N, Jamali H, Jamali MR, Nourshargh P, Jamali J. The association between quality of sleep and health-related quality of life in military and non-military women in Tehran, Iran. Oman Med J 2017;32(02):134–130

28 Plumb TR, Peachey JT, Zelman DC. Sleep disturbance is common among servicemembers and veterans of Operations Enduring Freedom and Iraqi Freedom. Psychol Serv 2014;11(02):209–219

29 Iahnke V, Moraes C. Associação de atividade física com qualidade do sono de jovens militares: um estudo transversal. Revista de Educação Física. J Phys Educ (Maringá) 2022;91(01):26–35

30 Oliveira DIPD. Prevalência de sintomas musculoesqueléticos e associações com sensibilização central e qualidade do sono em militares do corpo de bombeiros do Distrito Federal. Brasília.: Dissertation [Masteŕs in Rehabilitation Sciences] – University of Brasilia; 2020

31 Pinto JDN, Perin C, Dick NRM, Lazzarotto AR. Avaliação do sono em um grupo de policiais militares de elite. Acta Paul Enferm 2018;31 (02):153–161

32 Cellini N, Canale N, Mioni G, Costa S. Changes in sleep pattern, sense of time and digital media use during COVID-19 lockdown in Italy. J Sleep Res 2020;29(04):e13074

33 Barker M, Gilles A, Ghani S, et al. 207 Sociodemographic, Behavioral, and Health-Related Factors Associated with Sleep Among Native Hawaiians and Other Pacific Islanders. Sleep (Basel) 2021; 44(Suppl 2):A83

34 Tvaryanas AP, Greenwell B, Vicen GJ, Maupin GM. The commander's wellness program: assessing the association between health measures and physical fitness assessment scores, fitness assessment exemptions, and duration of limited duty. Mil Med 2018;183(9-10):e612–e618

35 Chou HW, Tzeng WC, Chou YC, et al. Stress, sleep and depressive symptoms in active duty military personnel. Am J Med Sci 2016; 352(02):146–153

36 Wright KP Jr, Bogan RK, Wyatt JK. Shift work and the assessment and management of shift work disorder (SWD). Sleep Med Rev 2013;17(01):41–54

37 Varghese NE, Lugo A, Ghislandi S, Colombo P, Pacifici R, Gallus S. Sleep dissatisfaction and insufficient sleep duration in the Italian population. Sci Rep 2020;10(01):17943

38 Varma P, Conduit R, Junge M, Jackson ML. Examining sleep and mood in parents of children with sleep disturbances. Nat Sci Sleep 2020;12:865–874

39 Tufik S, Andersen ML. O sono: da neurobiologia à prática médica. Rio de Janeiro: Dilivros; 2022:p.11–24

40 Reid KJ, Zee PC. Principles and practice of sleep medicine: Circadian disorders of the sleep-wake cycle. Amsterdam: Elsevier; 2005:p. 691–701

41 Eickhoff E, Yung K, Davis DL, Bishop F, Klam WP, Doan AP. Excessive video game use, sleep deprivation, and poor work performance among US Marines treated in a military mental health clinic: a case series. Mil Med 2015;180(07): e839–e843

42 McGinnis GR, Thompson ST, Aguilar CD, Dial MB, Tandy RD, Radzak KN. Chronotype and Social Jetlag Influence Performance and Injury during Reserve Officers' Training Corps Physical Training. Int J Environ Res Public Health 2022;19(20):13644

43 Tonon AC, Carissimi A, Schimitt RL, de Lima LS, Pereira FDS, Hidalgo MP. How do stress, sleep quality, and chronotype associate with clinically significant depressive symptoms? A study of young male military recruits in compulsory service. Br J Psychiatry 2020;42(01):54–62

44 Demir Zencirci A, Arslan S. Morning-evening type and burnout level as factors influencing sleep quality of shift nurses: a questionnaire study. Croat Med J 2011;52(04):527–537

45 Fullagar HH, Skorski S, Duffield R, Hammes D, Coutts AJ, Meyer T. Sleep and athletic performance: the effects of sleep loss on exercise performance, and physiological and cognitive responses to exercise. Sports Med 2015;45(02):161–186

46 Hoge CW, McGurk D, Thomas JL, Cox AL, Engel CC, Castro CA. Mild traumatic brain injury in U.S. Soldiers returning from Iraq. N Engl J Med 2008;358(05):453–463

47 Toblin RL, Riviere LA, Thomas JL, Adler AB, Kok BC, Hoge CW. Grief and physical health outcomes in U.S. soldiers returning from combat. J Affect Disord 2012;136(03):469–475

48 Taylor DJ, Pruiksma KE, Hale WJ, et al; STRONG STAR Consortium. Prevalence, correlates, and predictors of insomnia in the US Army prior to deployment. Sleep 2016;39(10):1795–1806

49 Meadows SO, Engel CC, Collins RL, et al. 2015 Department of Defense Health Related Behaviors Survey (HRBS). Rand Health Q 2018;8(02):5

50 Kim TK, Lee HC, Lee SG, Han KT, Park EC. The combined effect of sleep duration and quality on mental health among Republic of Korea armed forces. Mil Med 2016;181(11):e1581–e1589

51 Padez C, Mourao I, Moreira P, Rosado V. Long sleep duration and childhood overweight/obesity and body fat. Am J Hum Biol 2009; 21(03):371–376

52 Spiegel K, Tasali E, Penev P, Van Cauter E. Brief communication: Sleep curtailment in healthy young men is associated with decreased leptin levels, elevated ghrelin levels, and increased hunger and appetite. Ann Intern Med 2004;141(11):846–850

53 Nishiura C, Noguchi J, Hashimoto H. Dietary patterns only partially explain the effect of short sleep duration on the incidence of obesity. Sleep 2010;33(06):753–757

54 Sefton JM, Burkhardt TA. Introduction to the tactical athlete special issue. J Athl Train 2016;51(11):845

55 Havenetidis K, Bissas A. A structured review of literature on body composition profiles in Navy personnel: current practices and considerations for the future. J R Nav Med Serv 2019; 105:40–46

56 Rush T, LeardMann CA, Crum-Cianflone NF. Obesity and associated adverse health outcomes among US military members and veterans: Findings from the millennium cohort study. Obesity (Silver Spring) 2016;24(07):1582–1589

57 Barlas FM, Higgins WB, Pflieger JC, Diecker K. 2011 Health related behaviors survey of active duty military personnel. Department of Defense. 2013

