Comparison of Sleep Problems and Posttraumatic Stress Disorder Associated Psychiatric States in Military Active-duty Army and Navy Personnel in Taiwan

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Abstract

Background: For decades, sleep problems have been proven to link to mental disorders and are independent risk factors for suicidality. But further details in the connections between them in the military are still understudied. In this study, we intended to fill this gap of linkage through by collecting self-reported responses from active-duty soldiers in Taiwan. **Methods:** In this study, we compared total sleep hours per day, sleep problems, prevalence of relevant psychological factors, and subclinical symptoms of posttraumatic stress disorder (PTSD) among Taiwanese soldiers using responses to Pittsburgh Sleep Quality Index (PSQI) item 5 from 808 Taiwanese soldiers. To examine their associations with each sleep problem, we used logistic regression models through redefining all sleep problems as dichotomous as outcome variables. **Results:** Compared with the navy, subjects in the army slept significantly fewer hours per day ($p < 0.001$), experienced significantly more difficulties with daily activities ($p < 0.001$), and displayed significantly less enthusiasm ($p = 0.001$). The female soldiers showed significantly more sleep problems than male soldiers, namely, waking up significantly more in the middle of night ($p < 0.01$), feeling significantly colder ($p < 0.05$) or significantly hotter ($p = 0.001$), having significantly more pain ($p < 0.05$), and having significantly more other reasons ($p < 0.01$). Samples from the male soldiers reported significantly more problems with enthusiasm in the past month ($p < 0.01$). After adjusting for interaction between other variables, the greater magnitude of "thwarted belongingness" is significantly more associated with sleep problems caused by pain or other reasons (all $p < 0.05$). "Perceived burdensomeness" was significantly more negatively related to sleep problems caused by waking up in the middle of the night and coughing or snoring loudly (all $p < 0.05$). All four subclinical symptoms of PTSD, namely, numbness, re-experience, avoidance, and arousal, affect soldiers' sleep differently. **Conclusion:** According to this study, Taiwanese Army and Navy soldiers suffer from different psychiatric conditions and sleep disorders depending on their gender. Aside from anxiety and depression, subclinical symptoms of PTSD were also associated with sleep problems, thwarted belongingness, and perceived burdensomeness in the military. The effects of treating sleep problems on suicide prevention in the military, especially among those with subclinical symptoms of PTSD, still require more focused research.

Key words: military suicide, perceived burdensomeness, posttraumatic stress disorder, thwarted belongingness
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Introduction

The concern about sleep problems in the military is on the rise lately because sleep disturbances are associated with depression and suicidality [1, 2]. Recent studies have found that the military lifestyle impacts sleep quality and cognitive performance negatively [3, 4]. According to the U.S. military Defense Medical Epidemiology Database (DMED), the rate of insomnia in the United States Military was increased from 6 to 272 (per 10,000) between 2005 and 2019 [4]. Yet, what and how the specific links exactly are

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between the individual sleep problems among the military remain unclear.

Naval vessel crews are considered a higher proportion of sleep distress and psychomotor vigilance performance [5]. Much of the discussion is attributed to its special duty mode [6]. The elongation of the duty/rest interval of crews a greater impact on sleep and work performance [7]. But according to the DMED, service members in the air force, navy, and marines are diagnosed with insomnia below average rates, while those in the army had higher than average rates ($p < 0.001$) [4]. In our opinion, insomnia is the result of various sleep problems, which may be different among military branches.

Regarding sex differences in sleep problems, a study from the All Army Study to Assess Risk and Resilience in Service with over 20,000 army soldiers has shown a higher prevalence of insomnia in females [8]. A retrospective review of U.S. military personnel was found that depression and anxiety are more common in females. And females are more likely to have posttraumatic stress disorder (PTSD), depression, and anxiety [9].

Numerous studies showed that PTSD represents a risk factor for both suicidality and sleep problems [2]. Sleep problems, e.g., short sleep duration, have been proven evidence-based risk factors for suicidality [2]. According to the interpersonal-psychological theory (IPT) of suicide [10, 11], an individual will not die by suicide unless he/she has both the desire to die by suicide and the ability to do so. That theory was developed by Thomas Joiner and is outlined in why people die by suicide [10]. The theory consists of two components that both together lead to suicide attempts: first, the simultaneous presence of thwarted belongingness (TB), and second, perceived burdensomeness (PB) produces the desire for suicide [11]. Many trials exist in the integrating IPT and PTSD-suicide risks [12]. Together, the sex differences in sleep problems in the military are more complicated than we know and are still understudied.

In this study, we intended (a) to examine what and how differences exist between military branches and genders in each sleep problem and (b) to investigate the associations between individual sleep problems and the relevant psychological factors (anxiety, depression, TB, PB, and four subsymptoms of PTSD).

Methods

Study participants and study procedures

This study included 808 active-duty military personnel from northern Taiwan. After the approval of the institutional review board at the Tri-Service General Hospital, National Defense Medical Center in Taipei, Taiwan (IRB protocol number = I-107-05-029 date of approval= March 18, 2018), participants in this study signed informed consent forms. All participants were invited to join this study with their own will after a short introduction of this study. Participants then filled out anonymous study questionnaires about their current sleep problems and psychiatric states. The study started on June 1, 2018, and finished on January 31, 2019.

Study instruments

Beck's Anxiety Inventory (BAI-II) was used to assess subject's anxiety state, Beck's Depression Inventory (BDI-II) for subject's depression state, Interpersonal Needs Questionnaire (INQ) for subject's state of TB and PB, and Davidson Trauma Scale (DTS) for subject's current state of PTSD. Sleep quality was measured using Pittsburgh Sleep Quality Index (PSQI) with disturbance scores and self-rated dissatisfaction with sleep quality. For the individual sleep problems in depth, we used the 10 subitems found in PSQI item five, which includes ten different sleep difficulties that subjects can encounter. To determine the prevalence of sleep problems, we arbitrarily defined positive responses of sleep problems, while the answers are greater than two (more frequent than once or twice a week) in PSQI.

Beck's Anxiety Inventory-II

BAI was also developed by Beck et al., [13]. It is a self-reported tool with 21 four-point Likert scale (0–3 points) questions. The BAI can be used with individuals 17–80 years of age and has been found to be an useful screening instrument to detect the presence of a current anxiety disorder [14]. It asks subjects to answer questions according to their feelings in the previous one week (including the day of assessment).

Beck's Depression Inventory the second edition

The Beck Depression Inventory, the second edition (BDI-II), is a self-report 21-item instrument, evaluating the existence and severity of depressive symptoms listed in the *Diagnostic and Statistical Manual of Mental Disorders-IV* (*DSM-IV*) during the past two weeks. Each item is scored from 0 for "not at all" to 3 for "almost always" [15]. The Chinese version of the BDI-II has been demonstrated to have substantial internal consistency, reliability, and stability of military population in Taiwan [16].

Interpersonal Needs Questionnaire

The measurements of PB and TB are based on using the Chinese version of Interpersonal Needs Questionnaire(INQ)[17]. The INQ is a 15-item self-report assessment of "recent" TB (nine items, e.g., "These days I feel disconnected from people") and PB (six items, e.g., "These days I feel like a burden to the people in my life") from the interpersonal theory (IPT) of suicide. Respondents answer items using a seven-point scale ranging from 1 (not at all true for me) to 7 (very true for me). Higher scores on the INQ reflect greater TB or PB. The INQ has shown good psychometric properties among college samples [17]. Cronbach's alphas for the current sample were 0.83 for the TB subscale and 0.94 for the PB subscale. The Chinese version of INQ has been widely used in Taiwanese community [18], and military [17] populations.

Davison Trauma Scale

The Davidson Trauma Scale (DTS) is a 17-item self-report questionnaire of general severity of PTSD and intensity of specific symptoms, developed for trauma survivors.

The measure includes a total score and scores for four subscales, namely, re-experiencing, avoidance, numbing, and arousal [19]. Each DTS item is measured on a scale of 0 – 4, for both severity and frequency. The higher the score, the worse the specific symptom of PTSD indicated. Scores can also be calculated for each of the four PTSD subsymptoms. The Chinese version of DTS was introduced in 2000 with good reliability and validity [20].

Pittsburgh Sleep Quality Index

The PSQI developed by Buysse and his coworkers in 1989 [21] is a common scale used for self-assessment of sleep quality into "poor" from "good" sleep through measuring seven areas of sleep quality [22], namely, sleep efficiency, sleep latency, average sleep disturbance per week, hours of actual sleep, subjective sleep quality, daytime dysfunction, and use of sleeping medication per week. Each component is scored 0 to 3 points with a maximal possible score of 21. Higher scores indicate poorer sleep quality. In general, a PSQI score lower than 5 means excellent sleep quality. In 2005, a Chinese version of the Pittsburgh Sleep Quality Index (CPSQI) was developed by Tsai and his coworkers [23], showing an overall good reliability.

Statistical analysis

We used the descriptive statistical analyses in this study. We compared demographic characteristics between samples from the army and navy or genders. We tested the differences of variables using t-test for continuous variables and Chi-squared test for dichotomous or categorical ones. For the four-point Liker's scales of sleep problems in subitem of PSQI item 5, we used Mann–Whitney U tests to compare differences between military branches and genders. To determine the prevalence of sleep problems, we then arbitrarily defined positive responses of sleep problems while the answers are greater than two (more frequent than once or twice a week) in PSQI. Finally, based on these dichotomous sleep problem variables, we did logistic regression analyses to determine their association with selected psychiatric states, namely, anxiety, depression, TB, PB, and subsymptoms of PTSD. Additionally, we used the generalized linear regression model to determine the associations between subjects' self-reported daily sleep hours and these psychiatric states.

All above variables were computed using Statistical Package for the Social Science version 25 for Windows (SPSS Inc., Chicago Illinois, USA). The differences were considered as significant if p-values were smaller than 0.05.

Results

In this study, 808 active-duty soldiers participated this study in northern Taiwan. About one quarter of them were from the navy (army:navy = 604:204) and one quarter of them were female (female:male: 194:614). Table 1 presents the comparisons of demographics and psychiatric states between the army and navy. Table 2 lists the demographic and psychiatric comparisons between genders.

Table 1. Differences in demographics and psychiatric states between samples from the army and navy

	Mean ± SD	
	Army (n = 604)	Navy (n = 204)
Male (sex), n (%)	454 (75.17)	160 (78.43)
Age (years)	26.59 ± 7.17	26.96 ± 6.87
Past history, n (%)		
Suspected ADHD*	49 (8.11)	8 (3.92)
Suspected bipolar	14 (2.32)	3 (1.47)
Suspected adjustment	14 (2.32)	0 (0)
Suspected PTSD	14 (2.32)	0 (0)
Suspected ASD	12 (1.99)	2 (0.98)
Suspected depression	10 (1.66)	3 (1.47)
Suspected insomnia	6 (0.99)	1 (0.49)
Anxiety	26.28 ± 7.45	24.42 ± 7.41**
Depression	7.39 ± 8.70	5.02 ± 8.58**
Perceived burdensomeness	9.19 ± 5.75	7.90 ± 4.31**
Thwarted belongingness	31.46 ± 8.88	33.15 ± 10.19*
PTSD symptoms		
PTSD numbness	3.54 ± 4.32	3.54 ± 4.72
PTSD re-experience	4.20 ± 4.70	4.47 ± 5.44
PTSD avoidance	3.21 ± 3.65	3.20 ± 3.93
PTSD arousal	2.06 ± 2.78	2.01 ± 2.96
Sleep disturbance (The higher the score, the worse)		
PSQI (sleep disturbance score)	13.07 ± 5.09	6.22 ± 5.85
PSQI9 (self-ratting sleep dissatisfaction)	1.03 ± 0.83	0.92 ± 0.87
PSQI4 (total sleep h/day)	5.79 ± 1.64	6.26 ± 1.76**
PSQI5a (fail to fall asleep for > 30 min)	5.31 ± 0.92	1.10 ± 1.07
PSQI5b (wake up in the middle)	1.28 ± 1.08	1.17 ± 0.97
PSQI5c (nocturia often occurs at night)	1.98 ± 1.75	1.01 ± 0.93
PSQI5d (cannot breathe comfortably)	1.58 ± 1.20	0.33 ± 0.70
PSQI5e (cough or snore loudly)	0.65 ± 0.95	0.57 ± 0.92
PSQI5f (feel too cold)	0.53 ± 0.79	0.55 ± 0.86
PSQI5g (feel too hot)	0.48 ± 0.76	0.42 ± 0.74
PSQI5h (have bad dreams)	0.63 ± 0.83	0.59 ± 0.78
PSQI5i (have pain)	0.31 ± 0.63	0.26 ± 0.60
PSQI5j (other reasons)	0.14 ± 0.50	0.11 ± 0.48
PSQI6 (sedatives taken in the past month)	0.09 ± 0.38	0.08 ± 0.41
PSQI7 (problems with daily activities in the past month)	0.49 ± 0.75	0.27 ± 0.60***
PSQI8 (problems with enthusiasm in the past month)	0.56 ± 0.72	0.38 ± 0.65**

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
SD, standard deviation; PTSD, posttraumatic stress disorder; PSQI, Pittsburgh Sleep Quality Index; ADHD, attention deficit hyperactivity disorder; ASD, acute stress disorder

After having redefined the dichotomous variables using an arbitrary cutoff point of two as mentioned above, we calculated the prevalence of each sleep problem (Table 3). The prevalence of each sleep problem is in the left column and the comparison

Table 2. Demographic and psychiatric differences among active-duty soldiers by genders

	Mean ± SD	
	Female (*n* = 194)	Male (*n* = 614)
Age (years)	24.62 ± 4.52	27.32 ± 7.62***
Past history, *n* (%)		
Suspected ADHD	12 (6.1)	36 (5.86)
Suspected bipolar	5 (2.58)	12 (1.95)
Suspected adjustment	8 (4.12)	6 (0.98)**
Suspected PTSD	8 (4.12)	6 (0.98)**
Suspected ASD	2 (1.03)	12 (1.95)
Suspected depression	8 (4.12)	5 (0.81)**
Suspected insomnia	3 (1.55)	4 (0.65)
Anxiety	26.83 ± 8.14	25.48 ± 7.23*
Depression	8.25 ± 9.81	6.33 ± 8.31**
Perceived burdensomeness	9.24 ± 5.45	8.73 ± 5.43
Thwarted belongingness	32.24 ± 9.75	31.79 ± 9.11
PTSD symptoms		
PTSD numbness	4.02 ± 4.57	3.39 ± 4.37
PTSD re-experience	4.62 ± 5.07	4.16 ± 4.85
PTSD avoidance	3.72 ± 3.88	3.04 ± 3.66*
PTSD arousal	2.21 ± 2.91	1.99 ± 2.80
Sleep disturbance (the higher the score, the worse)		
PSQI (sleep disturbance score)	7.41 ± 5.84	12.36 ± 5.12
PSQI9 (self-ratting sleep dissatisfaction)	1.23 ± 0.91	0.93 ± 0.80***
PSQI4 (total sleep h/day)	5.76 ± 1.55	5.97 ± 1.72
PSQI5a (fail to falling asleep for > 30 min)	1.17 ± 1.09	5.07 ± 0.96
PSQI5b (wake up in the middle)	1.41 ± 0.99	1.21 ± 1.07**
PSQI5c (nocturia often occurs at night)	1.01 ± 0.95	1.93 ± 2.09
PSQI5d (cannot breathe comfortably)	0.36 ± 0.69	1.50 ± 0.93*
PSQI5e (cough or snore loudly)	0.65 ± 0.99	0.62 ± 0.93
PSQI5f (feel too cold)	0.64 ± 0.85	0.50 ± 0.79*
PSQI5g (feel too hot)	0.64 ± 0.88	0.41 ± 0.71**
PSQI5h (have bad dreams)	0.73 ± 0.90	0.58 ± 0.79
PSQI5i (have pain)	0.38 ± 0.69	0.27 ± 0.60*
PSQI5j (other reasons)	0.26 ± 0.70	0.09 ± 0.39**
PSQI6 (sedatives taken in the past month)	0.13 ± 0.48	0.08 ± 0.35
PSQI7 (problems with daily activities in the past month)	0.51 ± 0.76	0.41 ± 0.70
PSQI8 (problems with enthusiasm in the past month)	0.62 ± 0.74	0.48 ± 0.69**

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

SD, standard deviance; PTSD, posttraumatic stress disorder; PSQI, Pittsburgh Sleep Quality Index; ADHD, attention deficit hyperactivity disorder; ASD, acute stress disorder

in the prevalence between the army and navy in middle two columns and gender differences in left two columns.

Using logistic regression models with each sleep problem as dichotomous outcome variables, Table 4 lists the statistical analysis results (beta ± standard error) for all selected psychiatric states as independent variables in our logistic regression models.

Discussion

A recent study from the U.S. military Defense Medical Epidemiology Database has shown higher rates of sleep disorders in the army than other military branches [4]. Based on self-reported information, only a few differences existed between soldiers in the Taiwanese Army and Navy in terms of psychiatric states and sleep difficulties (Table 1). In the army, soldiers slept significantly fewer hours per day ($p = 0.001$), experienced significantly more difficulties with daily activities ($p = 0.001$), and displayed significantly less enthusiasm ($p = 0.001$). Furthermore, they reported higher anxiety ($p < 0.01$) and depression ($p = 0.001$) scores, as well as a significantly higher burdensomeness perception ($p < 0.01$). As shown in Table 1, naval personnel experienced a significantly greater sense of belongingness thwarted ($p < 0.05$).

In line with previous studies [4, 8], we found plenty of sex differences among Taiwanese soldiers in this study. The female soldiers were more likely to report having depression, PTSD, or adjustment disorders in the past (Table 1). They also had significantly higher mean scores for anxiety, depression, and PTSD avoidances, and suffered from more sleep problems than male soldiers, namely, waking up significantly more in the middle of night ($p < 0.01$), feeling significantly colder ($p < 0.05$) or significantly hotter ($p = 0.001$), having significantly more pain ($p < 0.05$), or having significantly more other reasons ($p < 0.01$). While sleep-related problems with daily activities were similar between two groups, samples from the male soldiers reported significantly more problems with enthusiasm in the past month ($p < 0.01$) only (Table 2).

As a result of redefining the positive cases of the PSQI 5th item with a threshold of two points (occurred frequently or always), "waking up in the middle of the night" was the most prevalent sleep problem. In general, over one-third of soldiers (35.15%) reported having this problem, especially the female soldiers (43.81%). The next most common sleep problem was "Failure to fall asleep within 30 minutes" (32% for females, 27% for males). Interestingly, more than 15% of female soldiers complained of significantly feeling hotter during sleep when only 7.5% of male soldiers reported the same ($p < 0.001$). In a recent study of 21,300 service members of the United States Army, the prevalence of insomnia was reported at 22.0% for males and 28.4% for females) [8]. Our findings support Polyné et.al's suggestion [8] that sleep problems are underdiagnosed in the military and deserve more attention, particularly among female soldiers.

Higher rates of sleep problems in the Army than other military branches has been reported [4]. But in this study (Table 3), the only difference in the prevalence of sleep problems between the army and navy comes from "the difficulties with daily activities due to sleep problems," the army had a significantly higher prevalence rate (11.65%) than the Navy (5.45%, $p < 0.05$, Table 3). Even when interaction effects between variables were excluded from logistic regression models, the army and navy only differed

Table 3. Comparisons of military branches and sex differences in dichotomous sleep problem outcomes ($n = 808$)

Sleep problems (positive as score > 1)	Military branches		Sex difference	
	Army ($n = 604$), n (%)	Navy ($n = 204$), n (%)	Female ($n = 194$), n (%)	Male ($n = 614$), n (%)
PSQI5a (fail to fall asleep for >30 min)	164 (30.54)	65 (32.18)	62 (31.96)	167 (27.20)
PSQI5b (wake up in the middle)	213 (39.37)	71 (35.15)	85 (43.81)	199 (32.41)**
PSQI5c (nocturia often occurs at night)	118 (21.77)	54 (26.73)	49 (25.26)	123 (20.03)
PSQI5d (cannot breathe comfortably)	32 (5.96)	15 (7.50)	12 (6.19)	35 (5.70)
PSQI5e (cough or snore loudly)	108 (19.93)	32 (15.84)	33 (17.01)	107 (17.43)
PSQI5f (feel too cold)	70 (12.99)	28 (13.86)	30 (15.46)	68 (11.07)
PSQI5g (feel too hot)	58 (10.78)	18 (9.00)	30 (15.46)	46 (7.49)***
PSQI5h (have bad dreams)	77 (14.29)	25 (12.50)	30 (15.46)	72 (11.73)
PSQI5i (have pain)	38 (7.04)	11 (5.47)	16 (8.25)	33 (5.37)
PSQI5j (other reasons)	14 (3.68)	5 (2.89)	10 (5.15)	9 (1.47)**
PSQI6 (sedatives taken in the past month)	12 (2.23)	5 (2.48)	6 (3.09)	11 (1.79)
PSQI7 (problems with daily activities in the past month)	63 (11.65)	11 (5.45)*	22 (11.34)	52 (8.47)
PSQI8 (problems with enthusiasm in the past month)	53 (9.87)	11 (5.45)	17 (8.76)	47 (7.65)

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
PSQI, Pittsburgh Sleep Quality Index

Table 4. Results (beta $\pm$ standard deviance) of logistic regressions with dichotomous sleep problems in Pittsburgh Sleep Quality Index 5 items individually

Sleep problem	PSQI5a	PSQI5b	PSQI5c	PSQI5d	PSQI5e	PSQI5f	PSQI5g
Demographics							
Sex (female = 1)	0.20 ± 0.21	0.46 ± 0.21*	0.24 ± 0.23	−0.33 ± 0.45	−0.13 ± 0.25	0.12 ± 0.30	0.72 ± 0.30*
Military (army = 1)	−0.20 ± 0.22	−0.05 ± 0.21	−0.43 ± 0.23	−0.16 ± 0.45	0.32 ± 0.27	−0.39 ± 0.31	0.20 ± 0.36
Age	0.01 ± 0.01	−0.02 ± 0.02	0.01 ± 0.01	−0.02 ± 0.04	0.01 ± 0.01	−0.06 ± 0.03*	−0.02 ± 0.03
Psychiatric states							
Anxiety	0.04 ± 0.02*	0.05 ± 0.02**	0.03 ± 0.02	0.04 ± 0.02	0.06 ± 0.02**	0.06 ± 0.02**	0.04 ± 0.02*
Depression	0.03 ± 0.01*	0.03 ± 0.01	0.04 ± 0.01**	0.06 ± 0.02**	0.02 ± 0.02	0.04 ± 0.02*	0.05 ± 0.02**
Perceived burdensomeness	−0.04 ± 0.02	−0.04 ± 0.02*	−0.02 ± 0.02	−0.03 ± 0.03	−0.05 ± 0.02*	−0.04 ± 0.03	−0.04 ± 0.03
Thwarted belongingness	0.01 ± 0.01	−0.01 ± 0.01	−0.01 ± 0.01	0.01 ± 0.03	−0.01 ± 0.01	0.01 ± 0.02	0.01 ± 0.02
PTSD symptoms							
PTSD numbness	−0.09 ± 0.05	−0.05 ± 0.05	0.03 ± 0.05	0.07 ± 0.08	0.08 ± 0.05	−0.04 ± 0.06	0.05 ± 0.06
PTSD re-experience	−0.01 ± 0.03	−0.02 ± 0.03	−0.06 ± 0.04	0.08 ± 0.06	0.01 ± 0.04	0.06 ± 0.04	−0.02 ± 0.05
PTSD avoidance	0.22 ± 0.06***	0.19 ± 0.06**	0.07 ± 0.06	−0.05 ± 0.11	−0.06 ± 0.07	0.09 ± 0.08	0.10 ± 0.08
PTSD arousal	0.05 ± 0.06	0.06 ± 0.06	0.06 ± 0.07	0.16 ± 0.11	0.03 ± 0.07	0.11 ± 0.08	−0.02 ± 0.09

Sleep problem	PSQI5h	PSQI5i	PSQI5j	PSQI6	PSQI7	PSQI8	Sleep hour/day†
Demographics							
Sex (female = 1)	0.11 ± 0.30	0.30 ± 0.39	1.10 ± 0.62	0.17 ± 0.63	0.31 ± 0.32	−0.24 ± 0.39	−0.08 ± 0.15
Military (army = 1)	−0.04 ± 0.33	0.01 ± 0.44	0.21 ± 0.70	−0.38 ± 0.67	0.72 ± 0.41	0.47 ± 0.44	−0.30 ± 0.15*
Age	−0.01 ± 0.02	−0.02 ± 0.03	0.08 ± 0.05	0.01 ± 0.04	−0.01 ± 0.03	0.01 ± 0.02	−0.01 ± 0.01
Psychiatric states							
Anxiety	0.09 ± 0.02***	0.09 ± 0.02***	0.14 ± 0.04***	0.01 ± 0.04	0.04 ± 0.02	0.02 ± 0.02	−0.05 ± 0.01***
Depression	0.03 ± 0.02*	0.01 ± 0.02	−0.05 ± 0.04	0.05 ± 0.03	0.03 ± 0.02	0.08 ± 0.02***	−0.02 ± 0.01
Perceived burdensomeness	−0.03 ± 0.03	0.02 ± 0.03	0.07 ± 0.05	0.02 ± 0.05	0.03 ± 0.03	0.03 ± 0.03	0.02 ± 0.01
Thwarted belongingness	0.02 ± 0.02	0.05 ± 0.02*	0.14 ± 0.05**	0.06 ± 0.04	−0.03 ± 0.02	−0.02 ± 0.02	0.01 ± 0.01
PTSD symptoms							
PTSD numbness	0.04 ± 0.06	0.08 ± 0.08	0.27 ± 0.16	0.17 ± 0.11	0.01 ± 0.07	0.10 ± 0.07	0.08 ± 0.03*
PTSD re-experience	0.07 ± 0.04	0.01 ± 0.06	−0.26 ± 0.13*	0.01 ± 0.09	0.01 ± 0.05	−0.03 ± 0.05	0.06 ± 0.02**
PTSD avoidance	−0.03 ± 0.08	0.03 ± 0.11	0.08 ± 0.24	0.08 ± 0.17	−0.07 ± 0.09	−0.16 ± 0.10	−0.22 ± 0.04***
PTSD arousal	0.01 ± 0.08	−0.07 ± 0.11	0.01 ± 0.19	−0.21 ± 0.18	0.24 ± 0.09**	0.31 ± 0.1**	0.001 ± 0.05

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$;
†Analyzed using a generalized linear regression model.
SD, standard deviance; PTSD, posttraumatic stress disorder; PSQI, Pittsburgh Sleep Quality Index

significantly relative to the total number of sleep hours per day self-reported (Table 4).

In the same way, after adjusting for interaction between other variables, only two significant sex differences existed in "waking up in the middle of the night" and "feeling hot while sleeping" (Table 4). As shown in Table 4, soldiers whose ages are younger tended to complain about "feeling too cold while sleeping". As expected, anxiety and/or depression dominate the risk of almost all the sleep problems except for the "taking sedatives" and the "having trouble with daily activities due to sleep disturbances."

On the other hand, the greater magnitude of psychological TB is associated with sleep problems caused by pain or other reasons among Taiwanese soldiers (Table 4). In contrast, that of perceived burdensomeness negatively relates to sleep problems caused by "waking up in the middle of the night" and "coughing or snoring loudly while sleeping." Even though our cross-section study limited the conclusion to causality, their associations support some researchers' claim that promotion of healthy sleep can improve resilience among service members [24] as well as military suicide prevention [2].

In line with many studies [2, 25], our findings show that all four subclinical symptoms of PTSD affect soldiers' sleep differently in depth. The numbness symptoms and re-experience symptoms tend to be associated with longer sleep hours, while the avoidance symptoms tend to be associated with shorter sleep hours, higher risks of "not falling asleep within 30 minutes" and "waking up in the middle of the night" (Table 4). Arousal, the another PTSD subsymptom, is associated with an increased risk of "having trouble with daily activities" and "having less enthusiasm in the past month." A recent systemic review of studies in the field of sleep disturbances and suicidality in patients with PTSD confirms that short sleep duration is a significant predictor of suicide risk as well as the strongest predictor of PTSD symptoms [2].

Study limitations

In this study, Taiwanese active-duty personnel serving in the army and navy were compared in the first time. Our findings provided a first-step understanding about their commonalities and variations in sleep problems, PTSD symptoms, and psychodynamic mechanisms of suicidality. Nevertheless, as a cross-sectional survey study, this study had three inevitable limitations:

- The association present in this study was not enough to provide direct evidence for the causality. The relationships between sleep problems, PTSD, thwarted belongingness and PB may have mutual impact differently in other situations or populations. Especially, the linkage between last two variables and suicidality still need further investigations in the military population in Taiwan.
- Suicidality, including suicidal ideation, self-harm behavior or committed suicide can also differ in characteristics and/or psychological dynamics. In this study, we did not directly measure due to the special atmosphere in the military

environment. Therefore, further studies with suicide assessments in a protective or specific environment, e.g., in a clinic or an individual consulting room, would clarify their differences.

- Our findings alone are not adequate to answer the question whether early detection and treatment of sleep problems can prevent suicide, particularly among those who with other psychiatric comorbidities presenting similar symptoms of PTSD. Neither self-reported past history nor anonymous responses to questionnaires can be thought of as accurate as the clinical diagnosis. Thus, further chronological studies with diagnosed patients in practice are needed to fill this knowledge gap.

Study summary

Using self-reported responses from about 800 active-duty soldiers in Taiwan, our study showed little differences in psychiatric states and sleep difficulties between the army and navy but plenty of gender differences. Aside from anxiety and depression, PTSD symptoms and some other psychological factors associated with suicide, namely, TB and PB, have also been proven to be associated with different sleep problems. According to our findings, early detection and treatment of sleep problems can be another possibility to prevent suicide in the military, especially in those with subclinical symptoms of PTSD.

Conflicts of Interest

Yueh-Ming Tai, an executive editorial board member at *Taiwanese Journal of Psychiatry* (Taipei), had no rôle in the peer review process of or decision to publish this article. The other authors declared no conflicts of interest in writing this paper.

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