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Longitudinal relationship between mental health symptoms and sleep disturbances and duration in maltreated and comparison adolescents

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Abstract

Purpose—To examine the longitudinal relationships between mental health symptoms and sleep for male and female maltreated and comparison adolescents.

Methods—Participants were from a longitudinal study of child maltreatment (maltreated $n=247$; comparison $n=138$). The current analyses used data from Time 3 (T3; average age 13.7 years) and Time 4 (T4; average age 18.2 years). Path models tested cross-lagged effects between mental health symptoms (depression and PTSD) and sleep (disturbances and duration) and main effects of maltreatment on Time 4 variables, stratified by sex.

Results—Reciprocal relationships between depressive and PTSD symptoms and sleep disturbances were found only for females. Specifically, depressive and PTSD symptoms at T3 predicted sleep disturbances at T4 and sleep disturbances at T3 also predicted depressive and PTSD symptoms at T4. Regarding sleep duration, PTSD symptoms at T3 predicted shorter sleep duration at T4 among females but not for males. There was no effect of maltreatment status on mental health symptoms or sleep disturbance, but maltreated adolescents reported longer sleep duration at T4 than comparison adolescents.

Conclusions—The reciprocal nature of the relationship between mental health symptoms and sleep disturbances in females highlights the need to treat both mental health symptoms as well as

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sleep problems in female adolescents to improve mental and physical health. The absence of a negative effect of maltreatment on sleep may be due to the fact that the maltreated youth and comparison youth lived in the same low-income urban communities and were exposed to the same nocturnal environmental irritants.

Keywords

adolescents; sleep disturbances; sleep duration; depressive symptoms; PTSD symptoms; maltreatment; stratification by sex

Recent evidence details the serious effects of inadequate sleep on adolescents' physical and psychosocial health, involvement in risky behaviors, and school performance [1]. The relationship between mental health and sleep problems in adolescence is complex as there are likely reciprocal relations [2–4]. Additionally, mental health and sleep problems differ by sex, highlighting the need to examine these associations separately for males and females [5,6]. Furthermore, a history of childhood maltreatment has been linked to mental health problems and sleep problems [7–9]. Understanding how mental health affect sleep as well as how sleep affects mental health is important for developing prevention and interventions to enhance mental health and minimize sleep problems in at-risk youth. The present study used data from a study of maltreated adolescents and a comparison population to examine the longitudinal relationships between mental health symptoms (depression and PTSD) and sleep (disturbances and duration) separately for males and females and how mental health and sleep might be affected by experiences of childhood maltreatment in adolescence.

Existing studies showed a strong relationship between depressive and PTSD symptoms and sleep problems. In a sample of more than 10,000 adolescents in Norway, there was a significant relationship between insomnia and depression for both males and females [10]. Other evidence points to sleep problems at age 4 as a predictor of depressive symptoms in mid-adolescence [11]. In a longitudinal study of adolescents, sleep deprivation (6 hours or shorter) predicted a depression diagnosis one year later [12]. Research also suggests that sleep disruptions are present in adults with PTSD [13]. However, other studies show opposite effects, that mental health symptoms predict sleep problems [14]. In youth ages 8 to 15, there was both a cross-sectional relationship between sleep disturbances and PTSD symptoms and a longitudinal relationship of sleep disturbances to escalation of PTSD symptoms [15]. Overall, the causal associations between mental health and sleep are unclear.

Sex differences have further confounded the relations between depressive and PTSD symptoms and sleep problems [5, 6]. Two meta-analyses on sex differences concluded females were more likely to have insomnia [6] and meet the criteria of a PTSD diagnosis than men [16]. Sex differences in depression symptomology are supported for adolescents with females showing higher prevalence than males [5]. Few studies exist examining sex differences in depression and PTSD symptoms in maltreated youth, a population particularly vulnerable to mental health problems [17].

Childhood maltreatment has been found to affect sleep across development. In a study of maltreated school-aged children with behavior problems, sleep disturbances were greater than in a comparison population [18]. In a retrospective study, adults who identified any

child maltreatment reported more sleep disturbances than adults who did not report adverse childhood experiences [19]. Sex differences have been found for the relationship between child maltreatment and sleep problems. Self-report of childhood sexual abuse in both males and female adults was associated with insomnia within the last month, with females having higher odds of insomnia than men [20]. In summary, there are links between sleep, mental health symptoms, and maltreatment but the directionality and relationships between these three issues have not been established.

The current study used a longitudinal design with adolescents with child welfare-identified maltreatment ($n=247$) and a comparison group ($n=138$) living in the same community. Our research aim was to examine the relationship between mental health symptoms (depression and PTSD) and sleep (disturbances and duration) during adolescence. Since the relationship between mental health symptoms and sleep is likely complex and could be bidirectional [21] we used a cross-lagged model to test these relationships. We hypothesized that maltreatment would affect mental health symptoms and sleep in adolescence and mental health symptoms would be associated with poorer sleep across adolescence and vice versa. In addition, due to known sex differences in both sleep and mental health, we stratified the analysis.

Methods

Participants

At Time 1 (T1), the enrolled sample for this longitudinal study of the effect of maltreatment on adolescent development included 454 adolescents aged 9–13 years old (303 maltreated and 151 comparison). Participants were selected from a large city in California if they met the following criteria: 9–12 years old; identified as Latino, Black, or White (non-Latino); and resided in one of 10 zip codes in a designated county. The maltreated sample was recruited from active cases in the child welfare department (CWD) if they had a new referral to the CWD during the preceding month for any type of maltreatment. With the approval of the CWD, the county juvenile court, and the institutional review board of the affiliated university, potential participants were contacted by mail and 77% agreed to participate. The comparison group was recruited using school lists of children aged 9–12 years residing in the same zip codes. Comparison caregivers were also contacted by mail and approximately 50% agreed to participate. Comparison caregivers reported no previous or ongoing experience with CWDs. Upon enrollment in the study, the maltreatment and comparison groups were similar in age ($M = 10.93$ years, $SD = 1.16$), gender (53% male), and neighborhood characteristics. We used addresses of the homes in which the children were living and found only minor differences in the 9 categories relevant to characterizing the social, educational, economic, and demographic nature of neighborhoods and deemed important for child development [22]. We identified the maltreatment experiences of the children recruited from the CWD using case review at T1 (see [23] for details of the record abstraction). Categories included neglect ($n = 169$), emotional abuse ($n = 118$), physical abuse ($n = 113$), and sexual abuse ($n = 46$) and 76% of the youth experienced more than one type.

Data for the current study came from data collected at Time 3 (T3) and/or Time 4 (T4; approximately 4.5 years between T3 and T4) of this ongoing longitudinal study. At T3, the

average age of participants was 13.7 years ($SD=1.42$; $n=191$ maltreated and $n=128$ comparison; 2.7 years after T1) and at T4, the average age was 18.2 years ($SD=1.47$; $n=222$ maltreated; $n=128$ comparison, 7.2 years after T1). The final sample included 247 maltreated (64.2%) and 138 comparison (35.8%) participants with a fairly even distribution of males (48.3%) to females (51.7%). Participants were Black (40%) or Latino (36.9%), Bi-Racial (13.2%) or White (9.9%). Compared to T1, participants not seen at T3 were more likely to be Latino ($OR=3.37$, $p<.01$) and in the maltreatment group ($OR=5.36$, $p<.01$), and those not seen at T4 were more likely to be in the maltreatment group ($OR=2.45$, $p<.01$) and male ($OR=1.86$, $p<.01$).

Procedures

Assessments were conducted at an urban research university—After assent for adolescents < 18 years old, and consent for the adolescents ≥ 18 years old and caregivers were obtained, they completed questionnaires and tasks during a 4-hour protocol. Both the adolescent and caregiver were paid for their participation according to the National Institutes of Health standard compensation rate for healthy volunteers.

Measures

Depressive symptoms—The Children's Depression Inventory (CDI) is a 27-item, self-rated, symptom-oriented scale suitable for youth aged 7 to 17 (24, 25). In this study, the CDI was used as a continuous measure with higher scores indicating more depressive symptoms. In order to avoid measuring sleep problems more than once, one item included in the CDI that measured sleep problem was removed prior to calculating the sum score which ranged from 0 to 52. The internal consistency reliability of the CDI without the sleep item was .83 at Time 3 and .89 at Time 4.

PTSD symptoms—Youth Symptom Survey Checklist (YSSC) was used to obtain the adolescents' PTSD symptoms [26]. The YSSC is a 17-item self-report measure of the PTSD symptoms such as hyperarousal, avoidance/numbness, and re-experiencing. Two items of the YSSC that measured sleep were excluded when calculating PTSD sum scores. The total score was used for this analysis (15 items) and ranged from 15 to 60. The internal consistency reliability of the PTSD measure without the sleep items was .88 at Time 3 and .90 at Time 4.

Sleep—Adolescents completed a modified Pittsburgh Sleep Inventory questionnaire (PSQI) only at T3 and T4. This measure was developed for adults but is used with adolescents [27]. For this study, we used the number of hours slept (sleep duration) as a continuous measure. Sleep duration was determined from the PSQI question: In the last month, "How many hours of actual sleep did you get at night?" We also calculated the sleep disturbance score, which includes 9 items and the score can range from 0 to 27. Examples of items for sleep disturbance measure include: "Wake up in the middle of the night or early morning" and "Had bad dreams". The sleep disturbance questions included whether these problems occurred over the last month and the answer options were: 0= "not during the past month"; 1= "less than once a week"; 2 = "once or twice a week"; and 3 = "three or more times a

week". The internal consistency reliability for sleep disturbance measure was .71 at Time 3 and .79 at Time 4.

Data Analysis

Independent samples t-tests were used to examine mean differences at T3 and T4 between males and females and between maltreated and comparison adolescents for study variables. Cross-lagged path models were used to test longitudinal relationships among the study variables using Mplus 7.2 with the Robust Maximum Likelihood (MLR) estimator. Full-information maximum likelihood estimation was used to address missingness. Four separate models examined cross-lagged effects between mental health symptoms and sleep and included the main effect of maltreatment on mental health and sleep variables at T4. The first model included depressive symptom and sleep disturbances at T3 and T4, the second included PTSD symptoms and sleep disturbances, the third included depressive symptoms and sleep duration, and the fourth included PTSD symptoms and sleep duration. All models included autoregressive effects, e.g., the main effect of T3 depressive symptoms on T4 depressive symptoms. Each of the four models were stratified by sex, with males and females tested separately. Age at Time 1 was included as a covariate.

Results

Descriptive statistics (Table 1)

Females reported significantly higher levels of depressive symptoms, PTSD symptoms, and sleep disturbances compared with males at T4. There was a significant difference in sleep duration between the maltreated and comparison groups at T4, indicating maltreated adolescents reported longer sleep duration than comparison adolescents.

Cross-Lagged Models Testing the Longitudinal Relationships Between Sleep Characteristics and Mental Health Problems

Table 2 summarizes model fit indices of the models tested and overall indicated good fit of the data.

Model 1. Depressive Symptoms and Sleep Disturbances (Figure 1)

Females—The results indicated a bidirectional relationship between sleep disturbances and depressive symptoms. Sleep disturbances at T3 positively predicted depressive symptoms at T4 ($\beta=.157, p<.05$) and depressive symptoms at T3 also positively predicted sleep disturbances at T4 ($\beta=.248, p<.01$). Depressive symptoms at T3 significantly predicted depressive symptoms at T4 ($\beta=.371, p<.01$). Child maltreatment experience predicted neither sleep disturbances ($\beta=-.002, p=.97$) nor depressive symptoms ($\beta=-.001, p<.98$) at T4.

Males—No bidirectional relationships between sleep disturbances and depressive symptoms were found among males. While depressive symptoms at T3 significantly and positively predicted sleep disturbances at T4 ($\beta=.257, p<.01$), sleep disturbances at T3 did not predict depressive symptoms at T4. Significant autoregressive effects were found for

both depressive symptoms and sleep disturbances from T3 to T4. As in the female model, maltreatment did not predict either outcome at T4.

Model 2. Sleep Disturbance and PTSD Symptoms (Figure 2)

Females—There were significant bidirectional relationships between sleep disturbances and PTSD symptoms among females. Sleep disturbances at T3 positively predicted PTSD symptoms at T4 ($\beta=.157, p<.05$) and PTSD symptoms at T3 predicted sleep disturbances at T4 ($\beta=.217, p<.05$). The only significant autoregressive effect was for PTSD symptoms ($\beta=.288, p<.01$). Maltreatment did not have an effect on either sleep disturbances or depressive symptoms at T4.

Males—There was no relationship between sleep disturbances and PTSD symptoms among males. Child maltreatment did not have effect on sleep disturbances or depressive symptoms at T4.

Model 3. Sleep Duration and Depressive Symptoms (Figure not shown)

Females—No significant longitudinal relationship was found between sleep duration and depressive symptoms. Child maltreatment had a significant effect on sleep duration at T4, indicating maltreated females ($\beta=.119, p<.05$) were more likely to have longer sleep duration compared with comparison females. Autoregressive effects from T3 to T4 were significant for both sleep duration ($\beta=.068, p<.01$) and depressive symptoms ($\beta=.438, p<.01$).

Males—There were no significant associations between sleep duration and depressive symptoms. However, maltreatment predicted sleep duration at T4 ($\beta=.221, p<.01$) indicated maltreated males reported longer sleep duration than comparison males. Autoregressive-lagged effects from T3 to T4 assessment were significant for both sleep duration ($\beta=.167, p<.05$) and depressive symptoms ($\beta=.412, p<.01$).

Model 4. Sleep duration and PTSD Symptoms (Figure 3)

Females—Sleep duration at T3 did not predict PTSD symptoms at T4 for females. However, PTSD symptoms at T3 significantly predicted shorter sleep duration at T4 among females ($\beta = -.158, p<.05$). Child maltreatment had a significant effect on sleep duration, indicating maltreated females ($\beta = .119, p<.05$) were more likely to have longer sleep duration than comparison females at T4. Significant autoregressive effects from T3 to T4 were found for both sleep duration and PTSD symptoms.

Males—Sleep duration at T3 did not predict PTSD symptoms at T4 nor did PTSD symptoms at T3 predict sleep duration at T4 among males. Child maltreatment had significant effects on sleep duration, indicating maltreated males ($\beta = .221, p<.01$) were more likely to have longer sleep duration than comparison males. Significant autoregressive effects from T3 to T4 were found for both sleep duration and PTSD symptoms.

Discussion

This study examined the longitudinal relationships between mental health symptoms and sleep separately for males and females. For females, this study found reciprocal relationships between mental health symptoms and sleep disturbances as well as a significant association between PTSD symptoms and shorter sleep duration. In males, only T3 depressive symptoms were associated with sleep disturbances at T4. Thus, by examining the relationships between mental health symptoms and sleep problems separately for males and females, sex-specific associations were identified. Maltreatment was not associated with mental health symptoms or sleep disturbances, but it positively affected sleep duration in both males and females at T4.

Reciprocal relationships between mental health symptoms sleep disturbances were found in the female sample. That is, higher level of depressive and PTSD symptoms at T3 predicted sleep disturbances at T4 as well as sleep disturbances at T3 predicted more depressive and PTSD symptoms at T4. Research has shown that the prevalence of depressive symptoms, PTSD diagnoses, and sleep disturbances are high in females [5, 16, 28]. Similar to this study, a population-based study found that the longitudinal association between depressive symptoms and the development and persistence of sleep problems [29]. A review of PTSD and sleep problems found that PTSD may result in self-reported sleep problems but limited evidence suggesting sleep problems could interfere with recovery from elevated PTSD symptoms [30]. The present study fills the gap noted by the authors of the review [30], in which they suggest the need for more studies that assess females and males separately. Adolescent females have been found to have a stigmatized view of mental health diagnoses and treatment [31], thus sleep may be a more acceptable target and could be addressed by professionals without having to enter into the traditional therapy context.

In terms of sleep duration, T3 PTSD symptoms predicted T4 sleep duration but not vice versa and only in females. Specifically, those females with more PTSD symptoms at T3 had shorter sleep duration subsequently at T4. The mean nighttime duration at T4 for females in our sample was 7.95 hours, which is close to the recommended sleep duration for adolescents (greater or equal to 8 hours) [32]. Females with more PTSD symptoms at T3 who had shorter sleep duration at T4 are at risk for poorer well-being. Shorter nighttime sleep duration is associated with psychosocial problems (e.g. depressive symptoms and low self-esteem), physical health problems (e.g. impaired insulin resistance and obesity) and risk behaviors (e.g. cigarette smoking and marijuana use) [1].

Males did not show a reciprocal relationship between mental health symptoms and sleep problems, but depressive symptoms at T3 predicted sleep disturbances at T4 in males. This finding is not consistent with a meta-analysis which found that sleep disturbances act as a precursor to developing a major depressive disorder but little evidence for depressive symptoms being longitudinally related to the development of a sleep disturbances [33]. The difference could be explained by the fact that our study was looking at changes in severity of symptoms rather than development of a problem. In a study of a general U.S. school population, the prevalence of male students (ages 10–15) with depressive symptoms was 10% and as the youth aged, the prevalence of depressive symptoms suggested an increase

[34]. Thus, depressive symptoms are not infrequent in male adolescents as previously assumed.

Contrary to existing research, the experience of child welfare-documented maltreatment did not negatively affect sleep or mental health symptoms compared to adolescents who lived in the same community [7]. Adolescents who live in low-income, urban environments are often exposed to traumatic events, and this exposure could have affected the mental health symptoms of both comparison and maltreated groups similarly [35]. Sleep patterns in adolescence differ by geography [36], and it could be that the environmental context could have affected the maltreated and comparison youth equally. Road traffic noise, which is prevalent in the zip codes where the youth in this study lived, affects both sleep structure and subjectively people's assessment of their own sleep quality [37]. Other studies have found that maltreatment has negative effects on sleep and depressive and PTSD symptoms so this should not be discounted as an important possible predictor [7].

Surprisingly, at T4 when the sample was approximately 18 years old, maltreatment was associated with longer sleep duration in both males and females. An explanation could be that some of the maltreated youth may have been less busy with school or work at the T4 assessment than the comparison adolescents were and had more time to sleep. At T4, 31% of maltreated and 20% of comparison adolescents were not in school while 86% of maltreated and 72% of comparison adolescents did not have a job. Technology availability might be limited for the maltreated sample, as much of the decrease in sleep duration in adolescence is associated with a 24-hour lifestyle of technology use [38]. The longer sleep duration at T4 in the maltreated group could be helpful for the well-being of this group although we are cautious of this finding because this is the first study we know of that examined differences in sleep duration in maltreated and comparison adolescents and replication of this finding is needed.

Limitations

There are limitations to the study in spite of the many strengths; strengths include a longitudinal design, males and females tested separately, and a maltreated and comparison population matched by geography and demographics. One limitation is that the findings have restricted generalizability because the study population was primarily minority and urban. The comparison population's caregivers did not report child-welfare-reported maltreatment or involvement with the child welfare system but the youth could have experienced maltreatment that was not reported. The adolescents' self-report of mental health symptoms may have been affected by social expectations. Direct measurement of sleep disturbances and duration is preferable but it was not available for this sample of adolescents. Fewer males completed T3 and T4 interviews and fewer Latinos completed T3 while fewer maltreated youth completed the T4, which could lead to some bias. Lastly, we did not test for mechanisms linking maltreatment to mental health or sleep problems. Other researchers have found that psychological distress mediates the relationship between the self-described severity of maltreatment on sleep disturbances [39]. This finding should be investigated further.

Conclusions

The reciprocal nature of the relationship between mental health symptoms and sleep disturbances in females highlights the need to treat both mental health symptoms as well as sleep problems in female adolescents to improve mental and physical health. In male adolescents, we found a relationship between depression and sleep disturbances, thus practitioners should recognize the importance of treating depression in boys during mid-adolescence to prevent possible future sleep disturbances. Male and female adolescents may have different relationships between mental health symptoms and sleep and these differences might be important for intervention development. More exploration of the relationship between sleep and mental health symptoms in males and females is needed, especially longitudinal studies that follow at-risk adolescents into adulthood.

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Abbreviations

PTSD	Post Traumatic Stress Disorder
YAP	Young Adolescent Project
T	Time

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Implications and Contributions

By testing females and males separately, this study was able to identify the reciprocal associations between mental health symptoms (depression and PTSD) and sleep disturbances in females. It is important to treat both mental health symptoms as well as sleep problems in female adolescents to improve mental and physical health.

Figure 1.

Results of longitudinal cross-lagged model testing the relationship between sleep disturbances and depressive symptoms. For simplicity of presentation, only significant paths were shown. Age was entered as a covariate. * $p < .05$, ** $p < .01$

Figure 2.

Results of longitudinal cross-lagged model testing the relationship between sleep disturbances and PTSD symptoms. For simplicity of presentation, only significant paths were shown. Age was entered as a covariate. * $p < .05$, ** $p < .01$

Figure 3.

Results of longitudinal cross-lagged model testing the relationship between sleep duration and PTSD symptoms. For simplicity of presentation, only significant paths were shown. Age was entered as a covariate. * $p < .05$, ** $p < .01$

Table 1
Results of Independent T-Tests Comparing Study Variables between Males and Females and between Maltreated and Comparison Groups

	Females			Males		
	<i>M</i>	<i>SD</i>		<i>M</i>	<i>SD</i>	<i>Sig.</i>
Depressive Symptoms at T3 ^a	8.29	6.38		7.17	5.53	<i>p</i> =.10
Depressive Symptoms at T4 ^a	10.00	7.89		7.36	6.36	<i>p</i> <.01
PTSD Symptoms at T3 ^b	25.85	8.52		25.81	8.27	<i>p</i> =.97
PTSD Symptoms at T4 ^b	27.49	9.82		25.37	7.87	<i>p</i> <.05
Sleep Disturbances at T3 ^c	5.72	4.84		6.53	4.83	<i>p</i> =.14
Sleep Disturbances at T4 ^c	8.05	6.03		6.55	5.33	<i>p</i> <.05
Sleep Duration at T3 ^d	9.34	10.29		8.71	1.81	<i>p</i> =.44
Sleep Duration at T4 ^d	7.95	2.84		7.53	1.85	<i>p</i> =.09

	Maltreated			Comparison		
	<i>M</i>	<i>SD</i>		<i>M</i>	<i>SD</i>	<i>Sig.</i>
Depressive Symptoms at T3 ^a	8.11	6.20		7.16	5.62	<i>p</i> =.09
Depressive Symptoms at T4 ^a	8.83	7.33		8.37	7.17	<i>p</i> =.57
PTSD Symptoms at T3 ^b	26.51	8.94		24.83	7.41	<i>p</i> =.96
PTSD Symptoms at T4 ^b	26.27	5.56		26.66	9.02	<i>p</i> =.69
Sleep Disturbances at T3 ^c	6.42	4.95		5.70	4.67	<i>p</i> =.14
Sleep Disturbances at T4 ^c	7.21	5.83		7.41	5.56	<i>p</i> =.75
Sleep Duration at T3 ^d	8.85	6.78		9.27	8.12	<i>p</i> =.44
Sleep Duration at T4 ^d	8.03	2.73		7.22	1.53	<i>p</i> <.05

Note.

^a = Depressive symptoms score ranges from 0–52;

^b = PTSD symptoms score ranges from 15–60;

^c = Sleep disturbance score ranges from 0–27;

hours.
Sleep duration is in hours.
= p

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Model Fit Indices of Cross-Lagged Models Testing the relationship between Sleep Characteristics and Mental Health Symptoms (stratified by sex)

Table 2

Model	χ^2 (df)	p	CFI	RMSEA	C.I. of RMSEA	PCLOSE	SRMR
1. Sleep Disturbances and Depressive Symptoms							
Female (n=186)	3.04 (4)	.55	1.0	.00	.00–.09	.74	.03
Male (n=199)	2.89 (4)	.57	1.0	.00	.00–.09	.77	.03
2. Sleep Disturbances and PTSD Symptoms							
Female (n=186)	8.88 (4)	.06	.93	.08	.00–.15	.19	.05
Male (n=199)	4.74 (4)	.32	.97	.03	.00–.11	.55	.03
3. Sleep Duration and Depressive Symptoms							
Female (n=186)	1.29 (4)	.86	1.0	.00	.00–.06	.94	.02
Male (n=199)	4.09 (4)	.39	.99	.01	.00–.11	.62	.04
4. Sleep Duration and PTSD Symptoms							
Female (n=186)	5.89 (4)	.21	.93	.05	.00–.13	.41	.04
Male (n=199)	4.74 (4)	.31	.97	.03	.00–.12	.55	.03