## Title

The effects of mood disturbances on sleep quality in oncology outpatients scheduled to begin radiation therapy



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# The Effects of Mood Disturbances on Sleep Quality in Oncology Outpatients Scheduled to Begin Radiation Therapy

by

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Christina N. Van Onselen

## ABSTRACT

Sleep disturbance, depression, and anxiety are frequently reported problems in oncology patients; however, no studies were found that evaluated how depression or anxiety or the co-occurrence of these two symptoms influenced sleep quality in oncology patients prior to the initiation of radiation therapy (RT). In a sample of oncology patients (breast, brian, lung, and prostate) prior to the initiation of RT, the purposes of this study were: (1) to describe the percentage of patients in one of four mood status groups (i.e., neither depression or anxiety, only depression, only anxiety, or both depression and anxiety) and (2) to evaluate for differences in sleep quality among these four mood status groups. This descriptive, correlational study is part of a larger longitudinal study. Upon obtaining written informed consent, patients completed baseline study questionnaires, including the Center for Epidemiologic Studies-Depression Scale (CES-D), the Speilberger State Trait Anxiety Inventory (STAI-T and STAI-S), and the Pittsburgh Sleep Quality Index (PSQI). Data analysis included descriptive statistics and frequency distributions for characteristics of the total sample and one-way analyses of variance (ANOVAs) or Chi Square analyses for demographic and clinical characteristics among the four mood status groups. Cut-points for the CES-D (≥16) and the STAI-S (≥33.36) were used to determine the mood status groups. A majority of the sample was male, white, married/partnered, well educated, had an average of 4.9 co-morbidities, and an average age of 60.1 years. A main effect of mood status group was found for the global

PSQI scores. The post hoc contrasts revealed that the neither depression or anxiety group had the lowest global PSQI scores among the four mood groups. While the only anxiety group scores were lower than the both depression and anxiety group, but higher than the neither depression or anxiety group. These findings demonstrate that those without mood disturbances report less sleep disturbance than those with mood disturbance, especially those with both depression and anxiety. The study findings suggest that oncology patients experience sleep disturbances prior to RT, especially those with mood disturbances.

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## Introduction

Sleep disturbance, depression, and anxiety are frequently reported problems in oncology patients (Clark, Cunningham, McMillan, Vena, & Parker, 2004; Lee, Cho, Miaskowski, & Dodd, 2004; Payne, Piper, Rabinowitz, & Zimmerman, 2006). While, three reviews summarized the paucity of research on sleep disturbances in oncology patients (Clark et al., 2004; Lee et al., 2004; Savard & Morin, 2001), recent estimates suggest that it occurs in 30% to 88% of patients (Clark et al., 2004; Lee et al., 2004; O'Donnell, 2004; Savard & Morin, 2001). Of note, higher rates of sleep disturbance were found in women with cancer compared to men (Lee et al., 2004; Savard & Morin, 2001). In addition, oncology patients worried about not getting enough sleep and reported decreases in quality of life (QOL) associated with sleep disturbance (Engstrom, Strohl, Rose, Lewandowski, & Stefanek, 1999; Monga, Kerrigan, Thornby, Monga, & Zimmermann, 2005; Theobald, 2004). Taken together, these findings suggest that sleep disturbance is a significant problem in oncology patients and that it has a negative impact on their mood, functional status, and QOL.

In several reviews (Evans et al., 1996; Petitto & Evans, 1998; Raison & Miller, 2003), the prevalence rates for depression in oncology patients ranged from 1% to 50%, which is well above the 5% prevalence rate in the general population. In addition, several studies (Kelly, Paleri, Downs, & Shah, 2007; Kilbride, Smith, & Grant, 2007; Stone, Richards, A'Hern, & Hardy, 2001) found that 2% to 24% of oncology patients reported depression prior to beginning radiation therapy (RT) and that increased depression was associated with a poorer QOL (Monga et al., 2005).

Another mood disturbance that is common among oncology patients is anxiety. In two recent reviews (Stark & House, 2000; van't Spijker, Trijsburg, & Duivenvoorden, 1997), anxiety was reported to occur in 1% to 49% of oncology patients; which is well above the 5% to 10% prevalence rate in the general population (Taylor, Lichstein, Durrence, Reidel, & Bush, 2005). In addition, in several studies (Kelly et al., 2007; Kilbride et al., 2007; Stone et al., 2001), 16% to 22% of oncology patients reported anxiety prior to initiating RT.

No studies were found that evaluated the relationship between depression and anxiety in oncology patients awaiting RT. In addition, while several studies have evaluated sleep disturbances, depression, and anxiety independently, only two studies examined the relationships between depression and/or anxiety and sleep disturbance in oncology patients. In one study of oncology patients who underwent RT (Mock et al., 1997), sleep disturbance was positively correlated with anxiety ($p<0.001$) and depression ($p<0.001$). In another study of RT patients with prostate cancer (Savard et al., 2005), 20.4% of the patients with sleep difficulties (i.e., increased sleep latency and sleep-wake disturbances) reported depression and anxiety, while 25.4% of those with insomnia (i.e., early morning awakenings, impairment in daytime function, distress related to poor sleep, and sleep difficulties) reported depression and anxiety.

Based on a limited number of studies, sleep disturbances, depression, and anxiety appear to be significant problems in oncology patients who underwent RT. However, no studies were found that evaluated how depression or anxiety or the co-occurrence of these two symptoms influenced sleep quality in oncology patients who were about to undergo primary or adjuvant RT. Therefore, the purposes of this study, in a sample of

oncology patients who underwent primary or adjuvant RT, were: (1) to describe the percentage of patients in one of four mood status groups (i.e., neither depression or anxiety, only depression, only anxiety, or both depression and anxiety) and (2) to evaluate for differences in sleep quality among these four mood status groups.

## Methods

### *Participants and Settings*

This descriptive, correlational study is part of a larger, longitudinal study that evaluated multiple symptoms in patients who underwent primary or adjuvant RT. The patients were recruited from two RT departments located in a Comprehensive Cancer Center and a community-based oncology program. The study was approved by the Committee on Human Research at the University of California, San Francisco and at the second study site.

Patients were eligible to participate if they: were an adult (≥18 years of age); were scheduled to receive primary or adjuvant RT for one of four cancer diagnoses (i.e. breast, prostate, lung, or brain); were able to read, write, and understand English; gave written informed consent; and had a Karnofsky Performance Status (KPS) score of ≥60. Patients were excluded if they had: metastatic disease; more than one cancer diagnosis; or a diagnosed sleep disorder.

### *Study Procedures*

At the time of the simulation visit (i.e., approximately one week prior to the start of RT), patients were approached by a research nurse to discuss participation in the study. After obtaining written informed consent, patients' height and weight were obtained and they were asked to complete the baseline study questionnaires.

*Instruments*

At baseline, patients completed a demographic questionnaire, the KPS scale (Karnofsky, 1977), the Center for Epidemiologic Studies-Depression Scale (CES-D) (Radloff, 1977), the Spielberger State Trait Anxiety Inventory (STAI-T and STAI-S) (Speilberger, Gorsuch, Lushene, Vaag, & Jacobs, 1983), and the Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). In addition, medical records were reviewed for disease and treatment information.

The demographic questionnaire obtained information on age, gender, marital status, education, ethnicity, employment status, and the presence of a number of co-morbid conditions.

The CES-D consists of 20 items selected to represent the major symptoms in the clinical syndrome of depression. Scores can range from 0 to 60, with scores $\geq$16 indicating the need for participants to seek a clinical evaluation for major depression. The CES-D has well-established concurrent and construct validity (Carpenter et al., 1998; Sheehan, Fifield, Reisine, & Tennen, 1995). In this study, the Cronbach's alpha for the CES-D was 0.89.

The STAI-T and STAI-S each consist of 20 items that are rated from 1 to 4. The scores for each scale are summed and can range from 20 to 80. A higher score indicates greater anxiety. The STAI-T measures an individual's predisposition to anxiety determined by his/her personality and estimates how a person feels generally. The STAI-S measures an individual's transitory emotional response to a stressful situation. It evaluates the emotional responses of worry, nervousness, tension, and feelings of apprehension related to how people feel "right now" in a stressful situation. The STAI-T

and STAI-S have well-established criterion and construct validity and internal consistency reliability coefficients (Bieling, Antony, & Swinson, 1998; Kennedy, Schwab, Morris, & Beldia, 2001; Stanley, Novy, Bourland, Beck, & Averill, 2001). In this study, the Cronbach's alphas for the STAI-T and the STAI-S were 0.92 and 0.95, respectively.

The PSQI consists of 19 items that are used to assess the quality of sleep in the past month. The global PSQI score is the sum of the seven component scores (i.e., subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, daytime dysfunction). Each component score ranges from 0 to 3 and the global PSQI score ranges from 0 to 21. Higher global and component scores indicate a higher level of sleep disturbance. A global PSQI score of >5 indicates a significant level of sleep disturbance (Buysse et al., 1989). The PSQI has established internal consistency, test-retest reliability, and construct validity (Beck, Schwartz, Towsley, Dudley, & Barsevick, 2004; Buysse et al., 1989; Carpenter & Andrykowski, 1998). In this study, the Cronbach's alpha for the PSQI global score was 0.72.

### *Data Analysis*

Data were analyzed using SPSS version 14. Descriptive statistics and frequency distributions were generated for the characteristics of the total sample. In order to create the four mood status groups, cutpoints were chosen for the CES-D and the STAI-S based on published reports of clinically meaningful differences. The cutpoints for the CES-D and STAI-S were ≥16 and ≥33.36, respectively (Radloff, 1977; Speilberger et al., 1983). Based on these cutpoints, patients were categorized as being in one of four mood groups:

neither depression or anxiety, only depression, only anxiety, or both depression and anxiety.

Differences in demographic and clinical characteristics among the four mood status groups were evaluated using one-way analyses of variance (ANOVAs) or Chi Square analyses. Based on these initial analyses, significant differences were found in the percentages of men and women in the four mood status groups. Based on reported gender differences in depression, anxiety, and sleep quality (Aass, Fossa, Dahl, & Moe, 1997; Ohayon, 2007; Ohayon & Roth, 2003; Taylor et al., 2005), gender was added along with mood status group in the subsequent analyses of symptom severity scores (i.e., CES-D, STAI, and PSQI global and subscale scores), as fixed factors in the analyses of variance (i.e., two-way ANOVA with two between subjects factors, namely mood status group and gender).

All calculations used actual values. Adjustments were not made for missing data. Therefore, the cohort for each analysis was dependent on the largest set of data across groups. If the overall ANOVA indicated differences among the four mood status groups, pairwise contrasts were done to determine where the differences were. The Bonferroni procedure was used to distribute a family $\alpha$ of 0.05 across the four pairwise contrasts. All p-values were adjusted so that values of $<0.05$ are considered statistically significant. However, given the relatively small sample size a more liberal alpha of 0.10 was considered statistically significant for the tests of the interaction (i.e. mood status group by gender) for the PSQI global and subscale scores, because it is well known that tests for interaction effects have less power than main effects (Aguinis, Beaty, Boik, & Pierce,

2005; H. Aguinis, Boik, & Pierce, 2001; Aiken & West, 1991; Morris, Sherma, & Mansfield, 1986).

## Results

### *Distribution of Mood Status Groups*

As shown in Table 1, 62.0% (n=111) of the sample was categorized with neither depression or anxiety, 3.3% (n=6) with only depression, 16.8% (n=30) with only anxiety, and 17.9% (n=32) with both depression and anxiety.

### *Demographic Characteristics*

As shown in Table 1, the majority of the sample was white (71.8%), male (52.5%), married/partnered (56.8%), well educated (16.0 years), with an average age of 60.1 years. No differences were found among the four mood status groups on any demographic characteristics except age and gender. In terms of age, the ANOVA revealed a significant main effect of gender ($F(1,171)=12.8$, $p<0.0001$), but no main effect of mood status group ($F(3,171)=0.7$, $p=0.56$) or gender by mood status group interaction ($F(3,171)=0.6$, $p=0.60$). Regardless of mood status group, women were significantly younger (54.3 ± 11.8 years) than men (66.2 ± 8.7 years; $p<0.0001$). In terms of gender differences among the four mood status groups, the Chi Square analysis revealed significant between group differences ($\chi^2=11.5$, $p=0.009$). Post hoc contrasts found that a significantly higher percentage of women were in the both depression and anxiety group (71.9%) compared to the neither depression or anxiety group (38.7%; $p<0.05$).

### *Clinical Characteristics*

As shown in Table 2, patients in this sample had an average KPS score of 90.6, an average of 4.9 comorbidities, an average weight of 82.2 kilograms, and an average Body

Mass Index (BMI) of 27.5. The majority of the sample was diagnosed with either breast (41.9%) or prostate (45.3%) cancer.

No differences were found among the four mood status groups on any clinical characteristics except for KPS score, weight, and diagnosis. In terms of KPS scores, the ANOVA demonstrated a significant main effect of mood status group ($F(3,167)=8.1$, $p<0.0001$), but no main effect of gender ($F(1,167)=0.3$, $p=0.58$) or gender by mood status group interaction ($F(3,167)=0.9$, $p=0.47$). Regardless of gender, the neither depression or anxiety group reported significantly higher KPS scores (93.7) than the only depression (80.0) and the both depression or anxiety (81.7; both $p<0.02$) groups. In addition, the only anxiety group reported significantly higher KPS scores (90.3) than the both depression and anxiety group (81.7; $p<0.02$).

In terms of weight, the ANOVA revealed a significant main effect of gender ($F(1,170)=10.9$, $p\leq0.001$), but no main effect of mood status group ($F(3,170)=2.2$, $p=0.09$) or gender by mood status group interaction ($F(3,170)=1.9$, $p=0.12$). Regardless of mood status group, men weighed significantly more (88.7 ± 14.3 kg) than women (74.8 ± 20.1). In terms of cancer diagnosis, the Chi Square analysis revealed significant between group differences ($\chi^2=35.5$, $p<0.0001$), which are largely attributable to the number of women with breast cancer compared to the number of men with prostate cancer.

*Depression and Anxiety Scores*

The mean CES-D score for the entire sample was 9.6 ± 8.7. Approximately 21.0% of the sample (n=38) reported a CES-D score ≥16. Of these 38 patients, 15.7% were in the only depression group and 84.3% were in the both depression and anxiety group. Figure 1

illustrates the CES-D scores for the total sample, as well as for the four mood status groups. In terms of CES-D scores, the ANOVA revealed a significant main effect of mood status group ($F(3,171)=130.7$, $p<0.0001$), but no main effect of gender ($F(1,171)=0.9$, $p=0.35$) or gender by mood status group interaction ($F(3,171)=1.2$, $p=0.30$). Post hoc contrasts demonstrated that the neither depression or anxiety group had the lowest CES-D scores among the four mood status groups (all $p<0.0001$). In addition, the CES-D scores for the only depression group (18.8) and the both depression and anxiety group (24.0) were not significantly different from each other. Finally, the CES-D scores for the only anxiety group (10.0) were significantly lower than those for the only depression (18.8) and the both depression and anxiety (24.0) groups, but significantly higher than the neither depression or anxiety group (4.0; all $p<0.0001$).

The mean STAI-T and STAI-S scores for the entire sample were 34.3 ± 10.2 and 31.5 ± 11.2, respectively. Approximately 35% of the sample (n=62) reported a state anxiety score ≥33.36. Of these 62 patients, 48.4% were in the only anxiety group and 51.6% were in the both depression and anxiety group. Figure 2 illustrates the STAI-T and STAI-S scores for the total sample, as well as for the four mood status groups. In terms of the STAI-T scores, the ANOVA revealed a significant main effect of mood status group ($F(3,170)=56.1$, $p<0.0001$), but no main effect of gender ($F(1,170)=0.2$, $p=0.62$) or gender by mood status group interaction ($F(3,170)=1.3$, $p=0.26$). Post hoc contrasts revealed that the neither depression or anxiety group had the lowest STAI-T across the four mood status groups (all $p\leq0.001$). In addition, the STAI-T scores for the only anxiety mood status group (38.6) were significantly lower than for the both depression

and anxiety group (48.0), but significantly higher than for the neither anxiety or depression group (28.8; all $p<0.0001$).

In terms of the STAI-S, the ANOVA revealed a significant main effect of mood status group ($F(3,171)=146.8$, $p<0.0001$), but no main effect of gender ($F(1,171)=2.2$, $p=0.14$) or gender by mood status group interaction ($F(3,171)=1.7$, $p=0.17$). Post hoc contrasts demonstrated that the both depression and anxiety group had the highest STAI-S scores among the four mood status groups (all $p<0.0001$). In addition, the STAI-S scores for the only anxiety group (40.0) were significantly higher than either the neither depression or anxiety group (24.5) and the only depression group (30.0), but significantly lower than the both depression and anxiety group (48.3; all $p<0.0001$).

*Differences in Sleep Disturbances Among the Four Mood Status Groups*

*Global PSQI score.*

The mean global PSQI score for the entire sample was $6.7 \pm 3.8$. As shown in Figure 3, the ANOVA demonstrated a significant main effect of mood status group ($F(3,170)=15.7$, $p<0.0001$) and a gender by mood status group interaction ($F(3,170)=2.5$, $p=0.06$); no main effect of gender $F(1,170)=0.1$, $p=0.74$). Post hoc contrasts for the main effect of mood status group revealed that the neither depression or anxiety group had the lowest global PSQI scores among the four mood status groups (all, $p\leq 0.05$). However, the global PSQI scores for the only depression group (10.0) and the only anxiety group (7.1) were not significantly different from each other. Finally, the global PSQI scores for the only anxiety group (7.1) were significantly lower than the both depression and anxiety group (10.2), but higher than the neither depression or anxiety group (5.3; all $p\leq 0.05$).

*PSQI subjective sleep quality.*

The mean PSQI subjective sleep quality score for the entire sample was 1.0 ± 0.7. As shown in Table 3, the ANOVA demonstrated a significant main effect of mood status group ($F(3,170)=8.3$, $p<0.0001$), but no main effect of gender ($F(1,170)=1.5$, $p=0.23$) or gender by mood status group interaction ($F(3,170)=0.5$, $p=0.70$). Post hoc contrasts revealed that the both depression and anxiety mood status group reported significantly higher subjective sleep quality scores (1.5) than the neither depression or anxiety (0.8) and the only anxiety (1.0; both $p\leq0.02$) groups.

*PSQI sleep latency.*

The mean PSQI sleep latency score for the entire sample was 1.0 ± 1.0. As shown in Table 3, the ANOVA demonstrated a significant main effect of mood status group ($F(3,170)=5.3$, $p=0.002$), but no main effect of gender ($F(1,170)=0.3$, $p=0.58$) or gender by mood status group interaction ($F(3,170)=1.9$, $p=0.14$). Post hoc contrasts demonstrated that the only anxiety (1.3) and the both depression and anxiety (1.6; both $p\leq0.02$) groups had significantly higher sleep latency scores than the neither depression or anxiety group (0.8).

*PSQI sleep duration.*

The mean PSQI sleep duration score for the entire sample was 1.0 ± 0.9. As shown in Table 3, the ANOVA revealed a significant main effect of mood status group ($F(3,167)=6.8$, $p<0.0001$), but no main effect of gender ($F(1,167)=1.5$, $p=0.22$) or gender by mood status group interaction ($F(3,167)=1.6$, $p=0.20$). Post hoc contrasts demonstrated that the only depression (2.0) and the both depression and anxiety (1.4;

both $p \leq 0.02$) groups had significantly higher sleep duration scores than the neither depression or anxiety group (0.8).

*PSQI habitual sleep efficiency.*

The mean PSQI habitual sleep efficiency score for the entire sample was 0.7 ± 1.0. As shown in Table 3, the ANOVA revealed a significant main effect of mood status group ($F(3,166)=4.3$, $p=0.006$), but no main effect of gender ($F(1,166)=0.04$, $p=0.85$) or gender by mood status group interaction ($F(3,166)=0.9$, $p=0.46$). Post hoc contrasts revealed that the only depression (1.7) and the both depression and anxiety (1.1; both $p \leq 0.02$) groups had significantly higher sleep efficiency scores than the neither depression or anxiety group (0.5).

*PSQI sleep disturbances.*

The mean PSQI sleep disturbances score for the entire sample was 1.4 ± 0.6. As shown in Table 3, the ANOVA demonstrated a significant main effect of mood status group ($F(3,170)=3.8$, $p=0.012$), but no main effect of gender ($F(1,170)=2.2$, $p=0.14$) or gender by mood status group interaction ($F(3,170)=1.0$, $p=0.40$). Post hoc contrasts revealed that the both depression or anxiety mood status group had significantly higher sleep disturbance scores (1.7) than the neither depression and anxiety group (1.4; $p<0.02$).

*PSQI use of sleeping medication.*

The mean PSQI use of sleeping medication score for the entire sample was 0.7 ± 1.2. As shown in Figure 4A, the ANOVA demonstrated a significant main effect of mood status group ($F(3,168)=4.5$, $p=0.004$) and a gender by mood status group interaction ($F(3,168)=2.4$, $p=0.07$); no main effect of gender ($F(1,168)=0.1$, $p=0.75$). Post hoc

contrasts demonstrated that the both depression and anxiety group had significantly higher use of sleeping medication scores (1.6) than the neither depression or anxiety (0.5) and the only anxiety (0.7; both $p \leq 0.02$) groups.

*PSQI daytime dysfunction.*

The mean PSQI daytime dysfunction score for the entire sample was $0.8 \pm 0.7$. As shown in Figure 4B, the ANOVA demonstrated a significant main effect of mood status group ($F(3,170)=16.0$, $p<0.0001$) and a gender by mood status group interaction ($F(3,170)=2.6$, $p=0.06$); no main effect of gender ($F(1,170)=0.5$, $p=0.47$). Post hoc contrasts revealed that the neither depression or anxiety group had the lowest daytime dysfunction scores among all four mood status groups (all $p \leq 0.02$).

## Discussion

To our knowledge, this study is the first to evaluate for differences in sleep quality among oncology patients who were categorized into one of four mood status groups (i.e., neither depression or anxiety, only depression, only anxiety, or both depression and anxiety) using clinically relevant cut-off scores for the CES-D and the STAI-S. Consistent with previous reports (Massie, 2004; Pirl, 2004), 21.2% of these patients reported clinically significant levels of depressive symptoms. Interestingly, 34.7% reported clinically significant levels of anxiety which is higher than previous reports (Kilbride et al., 2007; Stone et al., 2001). For example, in two studies of outpatients awaiting initiation of RT, the occurrence of anxiety ranged from 16% (Stone et al., 2001) to 22% (Kilbride et al., 2007). Reasons for these inconsistent findings may be related to differences in the instrument used to measure anxiety, the cut-off scores used, or the timing of the measures. For example, in the study by Kilbride and colleagues (2007),

75% of the patients with brain tumors reported anxiety at the initiation of RT and 35% reported anxiety that was associated with the experience of RT. Therefore, differences in anxiety occurrence rates may be related to the patient's point in their treatment trajectory or their cancer diagnosis.

Of note, approximately 18% of the patients in this study had clinically significant levels of both depression and anxiety. In addition, women (23%) were more likely to be in this mood status group compared to men (9%). While no studies were found that investigated the co-occurrence of depression and anxiety in outpatients prior to the initiation of RT, in two studies of heterogeneous samples of oncology patients undergoing a variety of cancer treatments the co-occurrence of depression and anxiety ranged from 5% (Aass et al., 1997) to 9.5% (Frick, Tyroller, & Panzer, 2007). The high co-occurrence of depression and anxiety in this study may relate to differences in cancer diagnoses, differences in the instruments used to measure the symptoms, as well as the differences in cut-off scores used to categorize the mood status groups. Given the paucity of research on the co-occurrence of depression and anxiety, these findings warrant replication particularly as it relates to cancer diagnosis and gender.

Based on the mean global PSQI score of 6.7 for the total sample, the majority of the patients in this study experienced a significant amount of sleep disturbance (Buysse et al., 1989). In fact, 56% of this sample reported a global PSQI score above 5, which is above the 39% rate reported in a study of a heterogeneous sample of patients who underwent RT for bone metastasis (Lee et al., 2004), but similar to the rate of 61% found in a sample of women who underwent RT for breast cancer (Fortner, Stepanski, Wang, Kasprowicz, & Durrence, 2002). In addition, the mean PSQI subscale scores, as well as the mean

global PSQI score for the total sample, are similar to those reported in previous studies of heterogeneous samples of oncology patients (Beck et al., 2004; Carpenter & Andrykowski, 1998; Fortner et al., 2002).

As illustrated in Figure 5, compared to the other three mood status groups, patients in the neither depression or anxiety mood group reported the lowest scores on the majority of the PSQI subscales, as well as the global score. Of note, while this group's subscale and total PSQI scores are higher, they follow a similar pattern to those previously reported for healthy controls (Buysse et al., 1989). In contrast, the both depression and anxiety mood status group reported the highest global PSQI scores, as well as the highest subscale scores for subjective sleep quality and sleep latency which suggest more of a problem with initiation of sleep. Finally, it is interesting to note that patients in the only depression mood status group demonstrated a different pattern to their PSQI scores than the other three mood status groups. These patients reported higher scores on the duration, efficiency, and sleep disturbance subscales of the PSQI which suggests more of a problem with sleep maintenance. While these differences in sleep maintenance based on mood status groups are consistent with previous reports (Hubain, Le Bon, Vandenhende, Van Wijnendaele, & Linkowski, 2006; Taylor et al., 2005), no studies were found that evaluated for changes in sleep latency in people with both depression and anxiety. Therefore, these findings need to be interpreted with caution due to the relatively small sample sizes and warrant confirmation in future studies.

As shown in Figure 4B, for the "daytime dysfunction" subscale, while both the only depression and the both depression and anxiety mood groups reported higher levels of daytime dysfunction than the other two mood groups, males in the only depression mood

group (n=3) reported higher scores compared to the other three groups. While this finding warrants replication, the excessive daytime sleepiness in these men may be partially due to their diagnosis of prostate cancer. This finding is consistent with a previous study (Monga et al., 2005) that found that the majority of patients with prostate cancer reported excessive daytime sleepiness prior to the initiation of RT.

As shown in Figure 4A, for the "use of sleep medications" subscale, females in the both depression and anxiety mood group (n=23) reported the highest scores compared to the other three groups. In contrast, females in the only depression mood group (n=3) reported very low scores, while the males in the same mood group (n=3) reported much higher scores. This finding is consistent with a previous report using the PSQI (Buysse et al., 1989) that noted that in a sample of depressed patients, males reported significantly higher use of sleep medications than females. While these findings suggest gender differences in the use of sleeping medications based on the type of mood disturbance, they need to be interpreted with caution and require replication in larger sample because of the small number of patients in the only depression group (n=6).

Interestingly, despite reporting the highest use of sleep medications compared to the other three mood groups, the both depression and anxiety mood group demonstrated elevated mean PSQI global, subjective sleep quality, and sleep latency scores. This finding suggests that while the both depression and anxiety group, as a whole, were taking more medication to help them sleep, these medications were not effective. Additional research is warranted on the use of sleep medication and their effectiveness in oncology patients with mood disturbances.

Several limitations of this study need to be mentioned. The cause-and-effect relationships between various types of mood disturbances and types of sleep disturbance could not be determined because of the study's cross-sectional design. In addition, because only self report measures were used to evaluate for anxiety, depression, and sleep disturbance definitive diagnoses of specific psychiatric conditions and sleep disorders are not possible. While the overall sample size was relatively large, various mood status groups were small, which means that these findings warrant replication with larger samples. Finally, data are not evaluable on specific sleep, anxiety, and depression medications used by these patients.

Despite these limitations, findings from this study suggest that sleep disturbance is a significant problem in oncology patients prior the initiation of RT and that patients' level and type of mood disturbance influences various aspects of sleep quality. Longitudinal studies are warranted to evaluate for patterns of change in sleep disturbance in relationship to patients' level of depression and anxiety.

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Table 1. Demographic Characteristics of the Total Sample and Differences in Demographic Characteristics Among the Four Mood Status Groups

| Characteristic | | Total sample (n=179) Mean (SD) | (1) Neither depression or anxiety 62.0% (n=111) Mean (SD) | (2) Only depression 3.3% (n=6) Mean (SD) | (3) Only anxiety 16.8% (n=30) Mean (SD) | (4) Both depression and anxiety 17.9% (n=32) Mean (SD) | Statistics |
|---|---|---|---|---|---|---|---|
| Age (years) | Male | 66.2 (8.7) | 67.0 (8.8) | 59.0 (14.3) | 64.7 (7.5) | 65.4 (7.8) | Main effect of gender $F(1,171)=12.8$; $p< 0.0001$ |
| | Female | 54.3 (11.8) | 55.3 (12.5) | 58.5 (10.8) | 51.9 (13.1) | 53.6 (9.8) | |
| Education (in years) | | 16.0 (2.9) | 16.0 (2.9) | 14.8 (4.2) | 15.6 (2.9) | 16.7 (2.6) | N.S. |
| | | % (n) | % (n) | % (n) | % (n) | % (n) | |
| Gender | Male | 52.5 (94) | 61.3 (68) | 50.0 (3) | 46.7 (14) | 28.1 (9) | $\chi^2 = 11.5$ $p= 0.009$ a. |
| | Female | 47.5 (85) | 38.7 (43) | 50.0 (3) | 53.3 (16) | 71.9 (23) | |
| Ethnicity | Non-white | 28.2 (50) | 22.7 (25) | 66.7 (4) | 37.9 (11) | 31.3 (10) | N.S. |
| | White | 71.8 (127) | 77.3 (85) | 33.3 (2) | 62.1 (18) | 68.8 (22) | |
| Marital Status | Married | 56.8 (100) | 60.9 (67) | 50.0 (3) | 48.3 (14) | 51.6 (16) | N.S |
| | Non-married | 43.2 (76) | 39.1 (43) | 50.0 (3) | 51.7 (15) | 48.4 (15) | |
| Lives alone | Yes | 30.7 (55) | 29.7 (33) | 33.3 (2) | 26.7 (8) | 37.5 (12) | N.S. |
| | No | 69.3 (124) | 70.3 (78) | 66.7 (4) | 73.3 (22) | 62.5 (20) | |
| Employed | Yes | 44.8 (78) | 47.7 (52) | 50.0 (3) | 46.7 (14) | 31.0 (9) | N.S. |
| | No | 55.2 (96) | 52.3 (57) | 50.0 (3) | 53.3 (16) | 69.0 (20) | |
| Children at home | Yes | 17.7 (28) | 15.2 (15) | 40.0 (2) | 19.2 (5) | 21.4 (6) | N.S. |
| | No | 82.3 (130) | 84.8 (84) | 60.0 (3) | 80.8 (21) | 78.6 (22) | |

N.S.-not significant

a. Group 4 versus Group 1 = females>males ($p<0.05$)

Table 2. Clinical Characteristics of the Total Sample and the Differences in Clinical Characteristics Among the Four Mood Status Groups

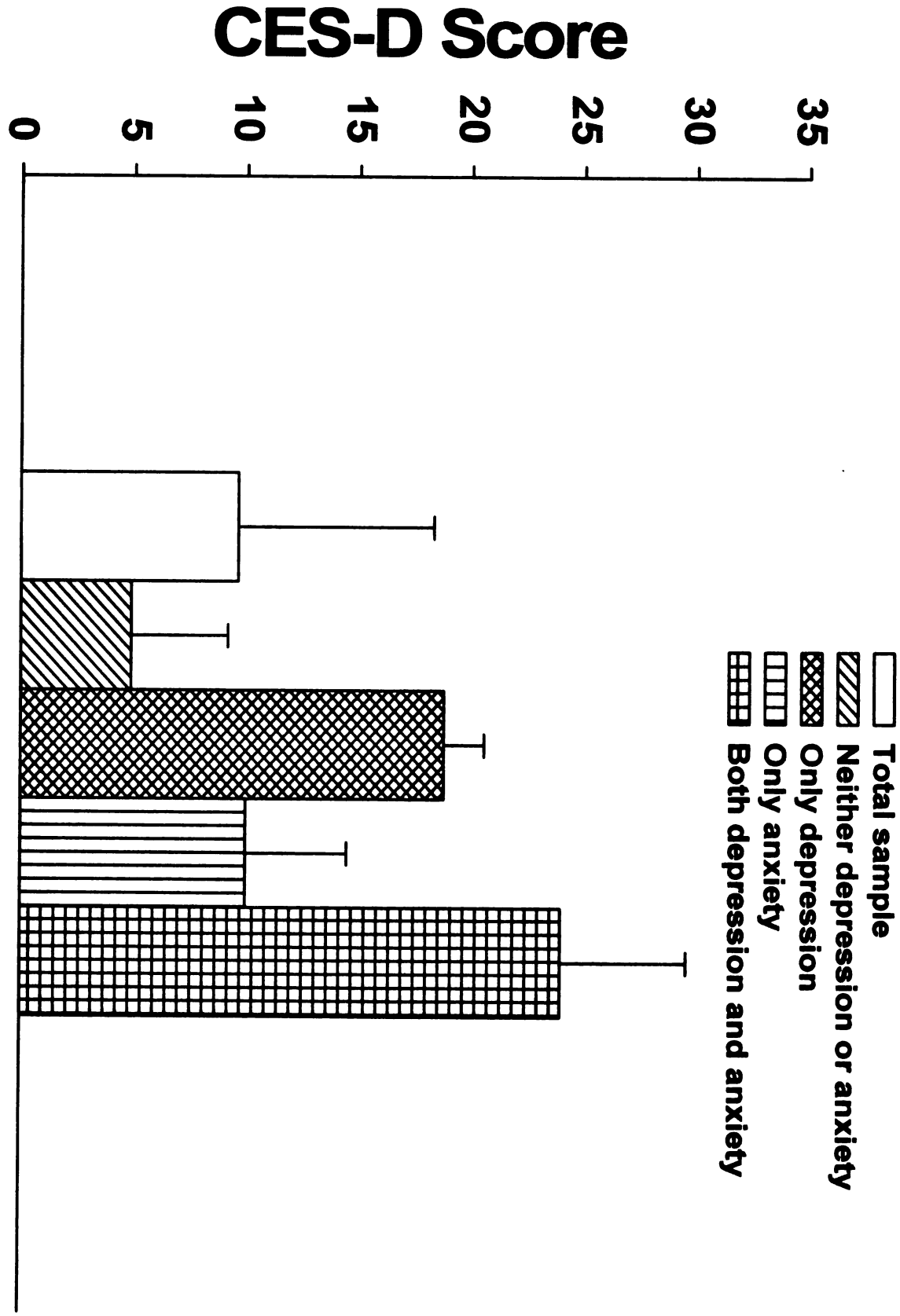
| Characteristic | | Total sample (n=179) Mean (SD) | (1) Neither depression or anxiety 62.0% (n=111) Mean (SD) | (2) Only depression 3.3% (n=6) Mean (SD) | (3) Only anxiety 16.8% (n=30) Mean (SD) | (4) Both depression and anxiety 17.9% (n=32) Mean (SD) | Statistics |
|---|---|---|---|---|---|---|---|
| Karnosfky Performance Status Score | | 90.6 (11.7) | 93.7 (8.9) | 80.0 (21.0) | 90.3 (13.0) | 81.7 (12.1) | Main effect of mood status $F(3,167)= 8.1$; $p<0.0001$ 1 >2 and 4* 3 > 4* |
| Number of comorbidities | | 4.9 (2.5) | 4.7 (2.4) | 5.8 (2.0) | 5.0 (2.4) | 5.2 (2.8) | N.S. |
| Weight (kilograms) | Male | 88.7 (14.3) | 88.5 (13.6) | 95.4 (14.1) | 80.7 (8.8) | 100.6 (18.5) | Main effect of gender $F(1,170)= 10.9$; $p\leq0.001$ |
| | Female | 74.8 (20.1) | 76.0 (18.7) | 88.1 (39.3) | 72.7 (21.0) | 72.4 (19.9) | |
| Body Mass Index | | 27.5 (5.9) | 27.6 (5.0) | 30.6 (8.9) | 26.6 (5.9) | 27.5 (7.8) | N.S. |
| | | % (n) | % (n) | % (n) | % (n) | % (n) | |
| Diagnosis | Breast | 41.9 (75) | 35.1 (39) | 50.0 (3) | 46.7 (14) | 59.4 (19) | $\chi^2=35.5$ $p<0.0001$ |
| | Prostate | 45.3 (81) | 58.6 (65) | 16.7 (1) | 33.3 (10) | 15.6 (5) | |
| | Brain | 6.7 (12) | 5.4 (6) | 0.0 (0) | 6.7 (2) | 12.5 (4) | |
| | Lung | 6.1 (11) | 0.9 (1) | 33.3 (2) | 13.3 (4) | 12.5 (4) | |

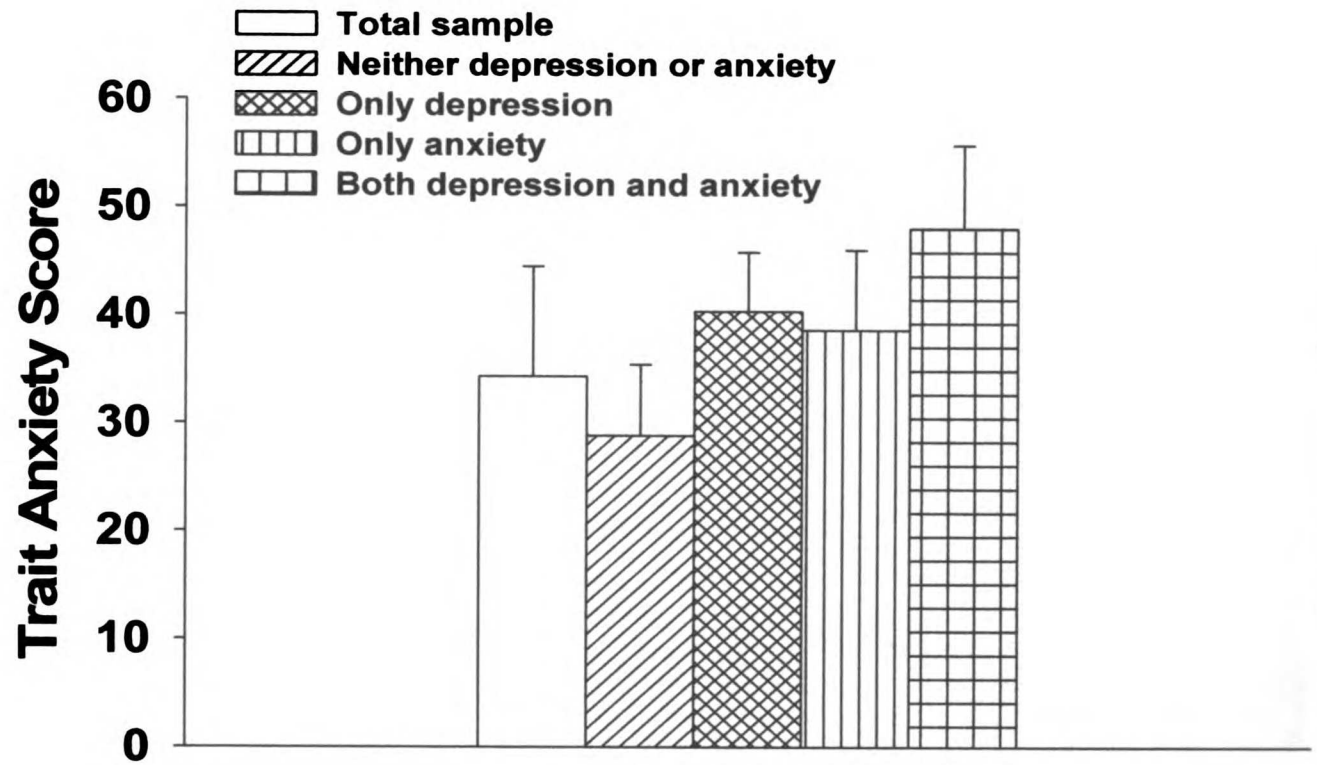
N.S.- not significant
* $p<0.02$

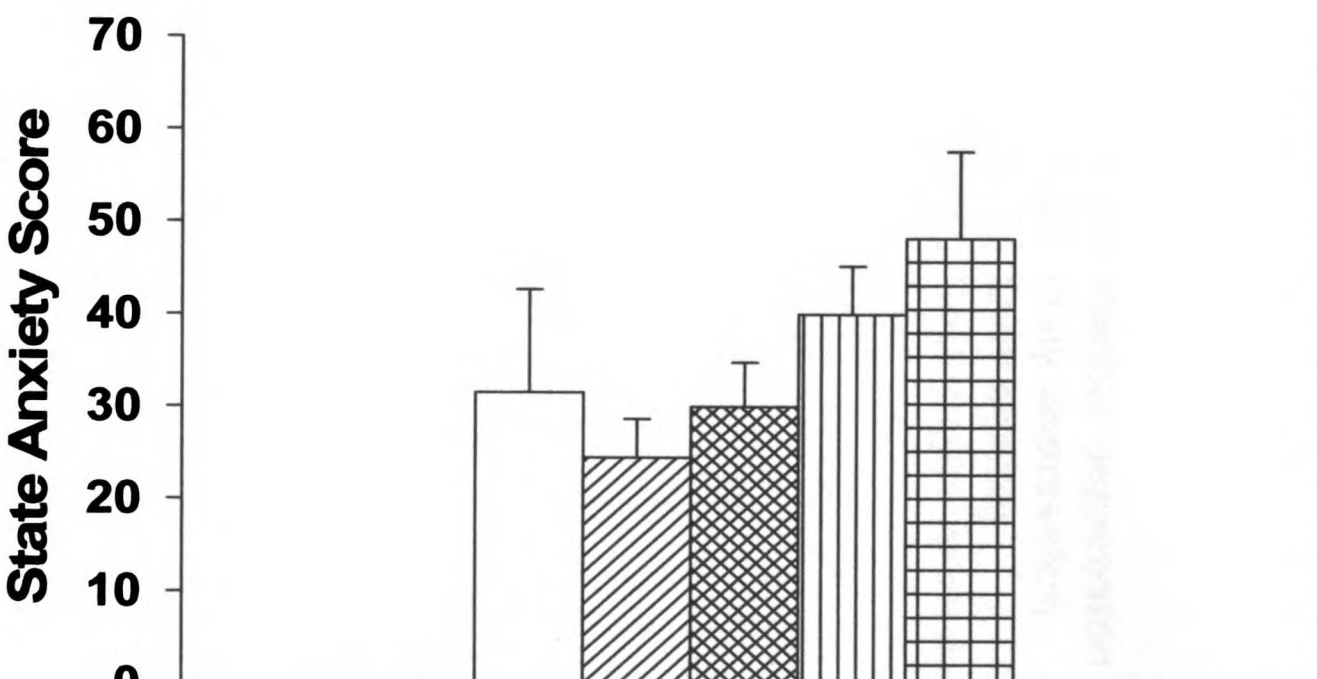
Table 3. Pittsburgh Sleep Quality Index Scores of the Total Sample and Differences in the Pittsburgh Sleep Quality Index Scores Among the Four Mood Status Groups and Gender

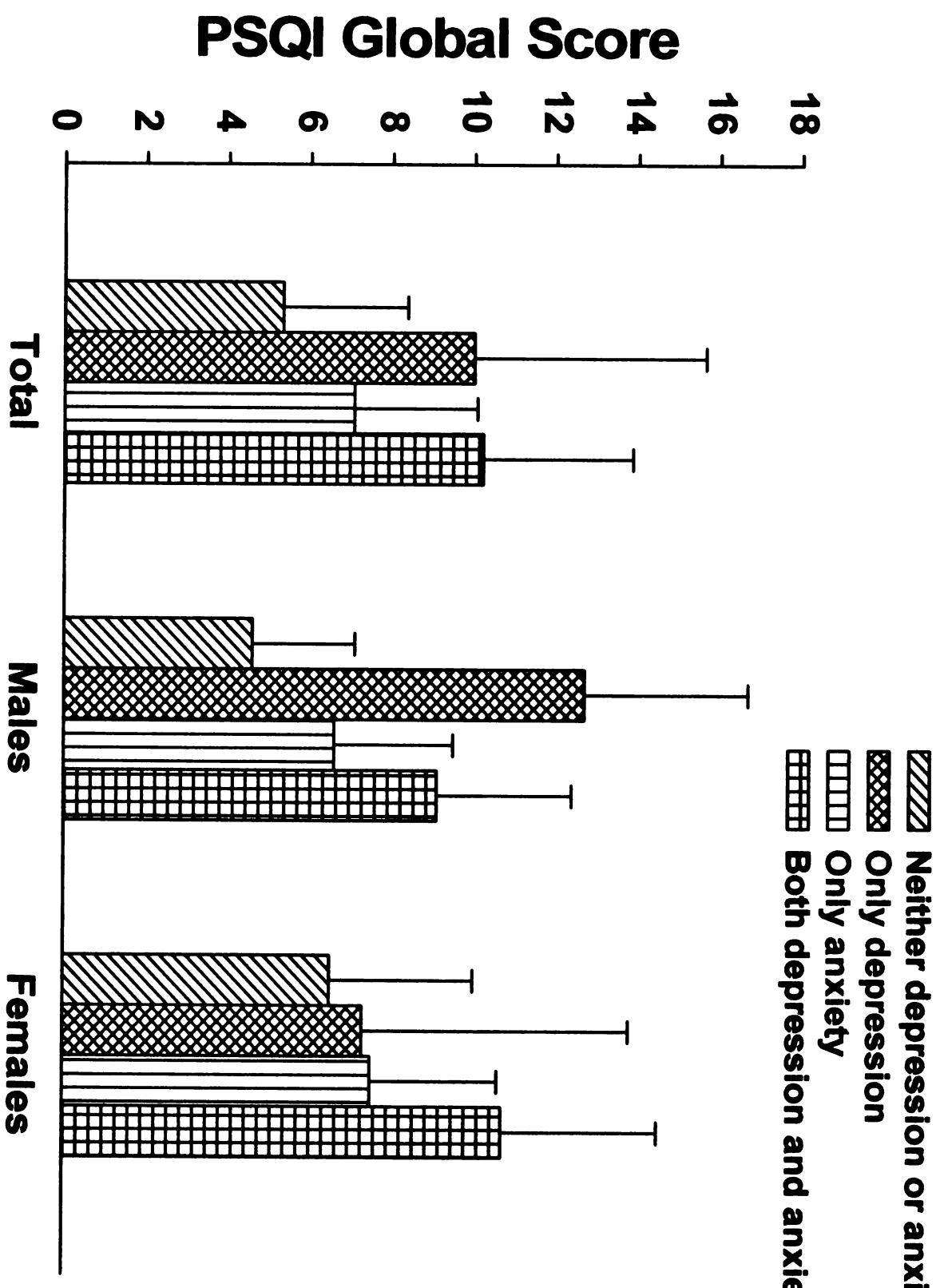
| Subscales | Total Sample (n=179) Mean (SD) | (1) Neither depression or anxiety 62.0% (n=111) Mean (SD) | (2) Only depression 3.3% (n=6) Mean (SD) | (3) Only anxiety 16.8% (n=30) Mean (SD) | (4) Both depression and anxiety 17.9% (n=32) Mean (SD) | Statistics |
|---|---|---|---|---|---|---|
| Subjective Sleep Quality | 1.0 (0.7) | 0.8 (0.7) | 1.3 (0.8) | 1.0 (0.6) | 1.5 (0.8) | Main effect of mood status F(3,170)=8.3; p<0.0001 4>1 and 3* |
| Sleep Latency | 1.0 (1.0) | 0.8 (0.9) | 1.2 (1.0) | 1.3 (0.9) | 1.6 (0.9) | Main effect of mood status F(3,170)=5.3; p=0.002 3 and 4>1* |
| Sleep Duration | 1.0 (0.9) | 0.8 (0.8) | 2.0 (1.3) | 1.0 (0.9) | 1.4 (0.8) | Main effect of mood status F(3,167)=6.8; p<0.0001 2 and 4>1* |
| Habitual Sleep Efficiency | 0.7 (1.0) | 0.5 (0.8) | 1.7 (1.2) | 0.9 (1.1) | 1.1 (1.1) | Main effect of mood status F(3,166)=4.3; p=0.006 2 and 4>1* |
| Sleep Disturbances | 1.4 (0.6) | 1.4 (0.5) | 1.8 (0.8) | 1.4 (0.6) | 1.7 (0.5) | Main effect of mood status F(3,170)=3.8; p=0.012 4>1* |

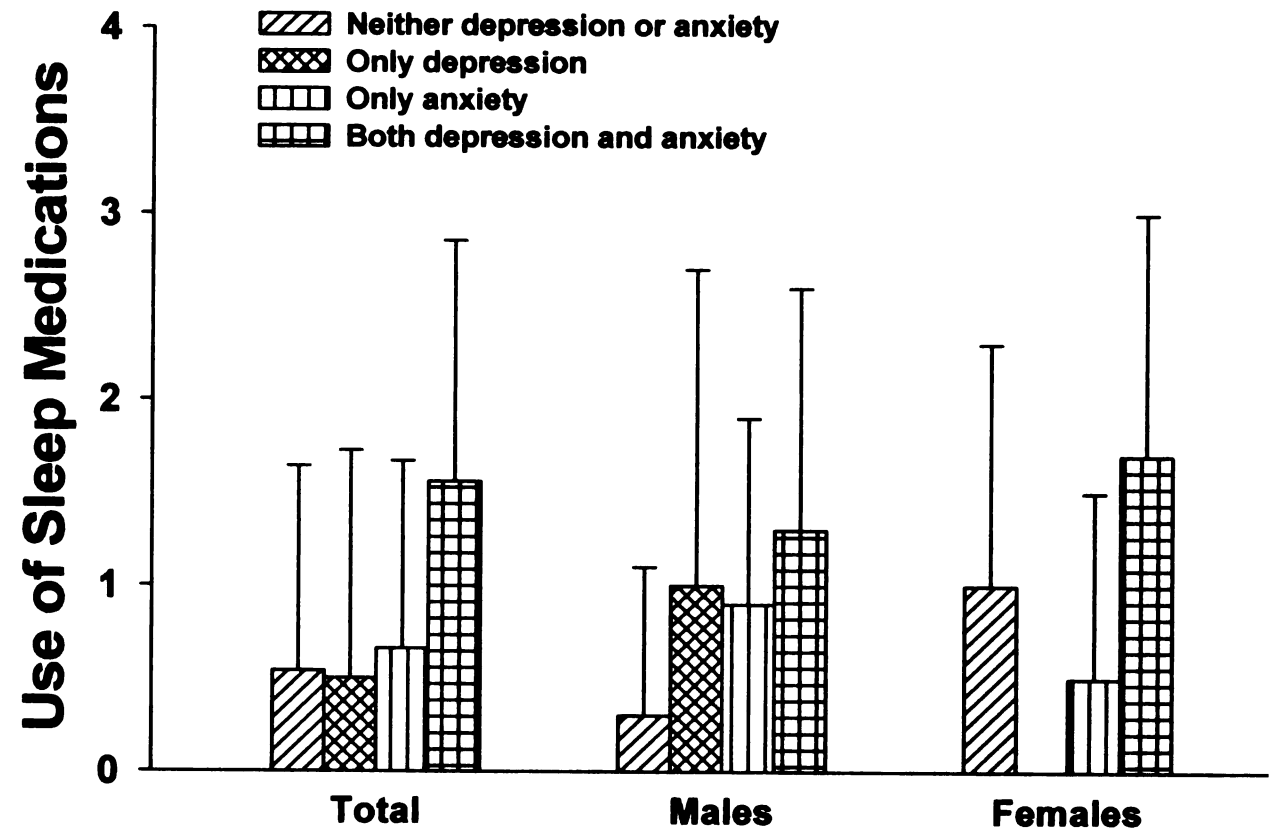
* $p \leq 0.02$

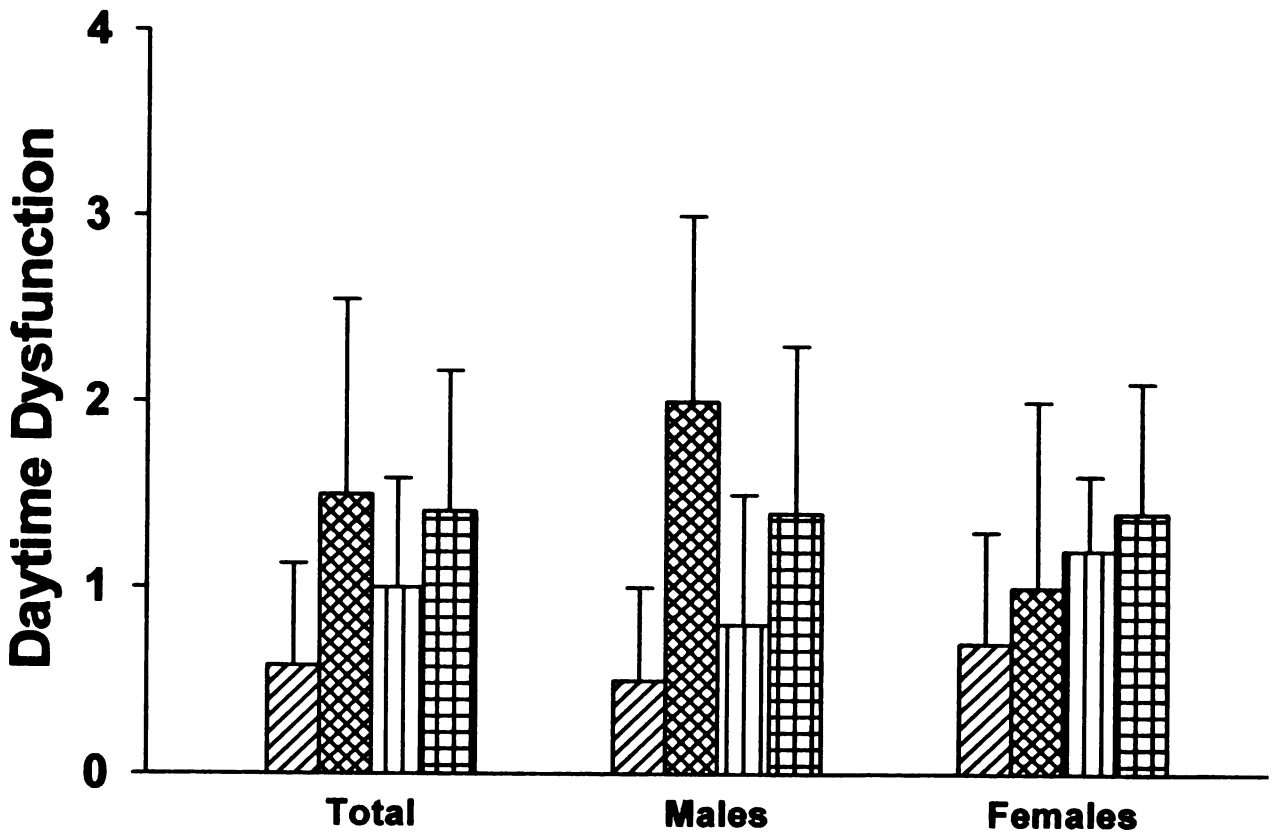

CES-D Score
0
5
10
15
20
25
30
35
Total sample
Neither depression or anxiety
Only depression
Only anxiety
Both depression and anxiety

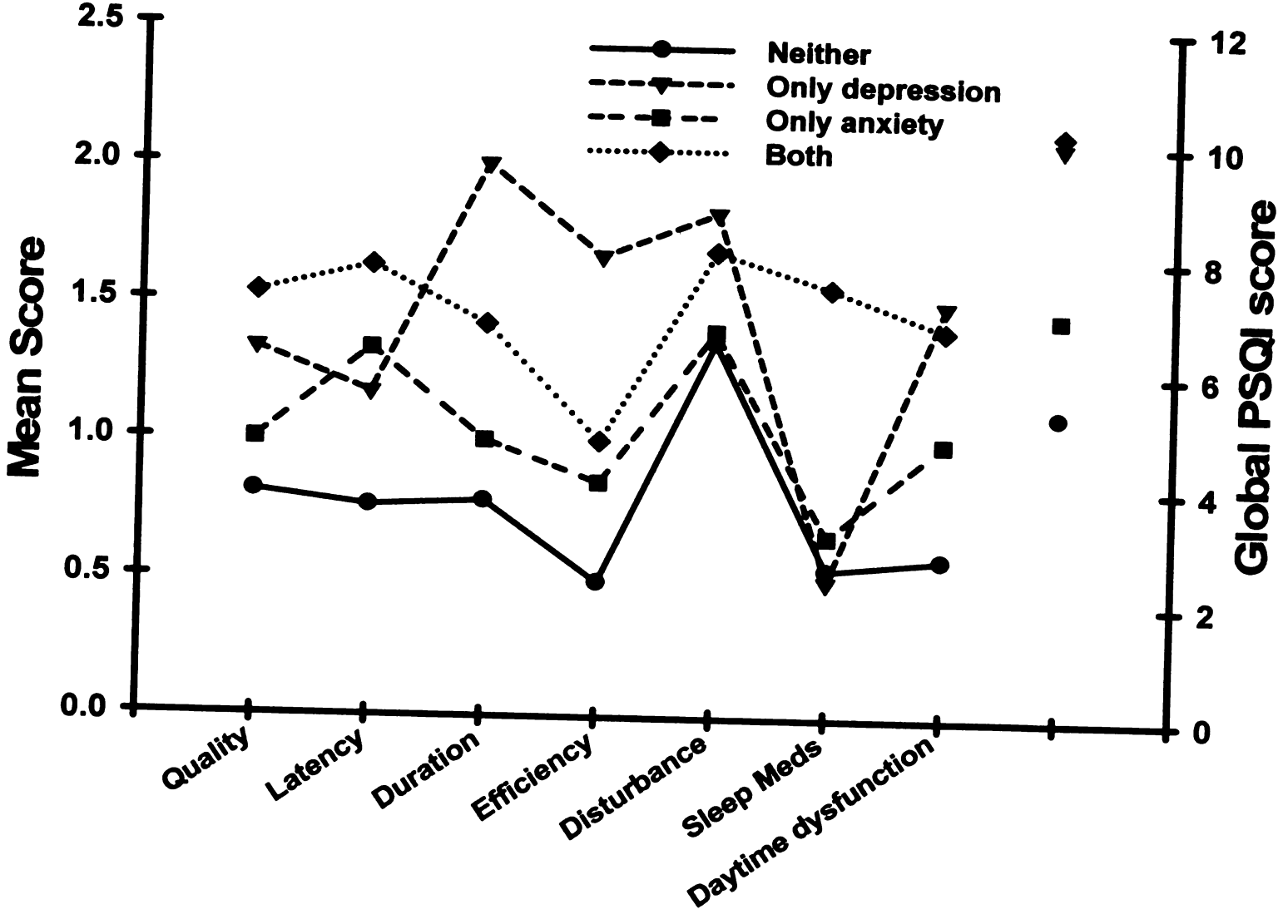

Total sample
Neither depression or anxiety
Only depression
Only anxiety
Both depression and anxiety
Trait Anxiety Score
60
50
40
30
20
10
0


State Anxiety Score
70
60
50
40
30
20
10
0


PSQI Global Score
0
2
4
6
8
10
12
14
16
18
Total
Males
Females
Neither depression or anxiety
Only depression
Only anxiety
Both depression and anxiety


Neither depression or anxiety
Only depression
Only anxiety
Both depression and anxiety
Use of Sleep Medications
4
3
2
1
0
Total
Males
Females


Daytime Dysfunction
4
3
2
1
0
Total
Males
Females


Neither
Only depression
Only anxiety
Both
Mean Score
Global PSQI score
2.5
2.0
1.5
1.0
0.5
0.0
12
10
8
6
4
2
0
Quality
Latency
Duration
Efficiency
Disturbance
Sleep Meds
Daytime dysfunction