

## Is Sleep Related to Mental Health in Middle-Aged Males and Females in the General Population?

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Madison E. Roman, Kayla F. Thornhill,  
Laura A. Rozell, Jamie P. Callahan, Julia O.  
Reynolds, Jessica L. Hartos\*

Department of Physician Assistant Studies,  
University of North Texas Health Science Center,  
USA

### Abstract

**Purpose:** Studies have related sleep disturbances and mental health disorders, but not sleep duration and current general mental health. Therefore, the purpose of this study was to assess whether sleep duration is related to current general mental health in middle-aged males and females in the general population.

**Methods:** This cross-sectional analysis used data from the 2016 Behavioral Health Risk Factor Surveillance System for males and females ages 35-54 in Alabama (N = 2000), Arkansas (N = 1118), Kentucky (N = 2890), Oregon (N = 1575), and West Virginia (N = 2087). Ordered logistic regression analysis, conducted separately by state and gender, assessed the relationship between sleep duration and mental health while controlling for health-related and demographic factors.

**Results:** For males, about one-third reported low to moderate mental health (31-37%) and less than one-fourth reported short sleep duration (11-21%). For females, about half reported low to moderate mental health (45-51%) and less than one-fourth reported short sleep duration (12-21%). Ordered logistic regression results indicated that mental health and sleep were moderately- to highly-related in both genders. Mental health was also consistently related to health conditions in both genders, and to tobacco use, moderate alcohol use, and physical activity in females.

**Conclusion:** The results indicated that mental health was consistently related to sleep duration and number of health conditions in middle aged adults of both genders. Clinicians should screen for mental health, sleep, and health conditions if middle-aged patients present with symptoms of any, and assess for management of these conditions, treat together, and refer to specialists as needed. For females, mental health was also related to smoking status, alcohol use, and physical activity. Practitioners should screen for all if symptoms of any present, educate about risks of substance use, encourage physical activity, and make referrals as necessary.

**Keywords:** Sleep, Mental health, Health conditions, Middle-aged, BRFSS

### Introduction

Mental health is more than the absence of mental illness [1-2] because it encompasses a state of emotional, psychological, and social well-being [3-6]. Optimal mental health refers to maintaining a psychologically healthy lifestyle, positively engaging with the community, positively contributing to society [4], maintaining satisfying relationships, coping with stress, and overcoming change [1]. Poor mental health refers to the inability to control one's thoughts, perceptions, emotions, and behaviors, and includes mental illnesses such as depression and anxiety [4,5]. Unfortunately, forty-six percent of adults in the U.S. will meet the criteria for diagnosis of a mental illness at some point in their lives [1]. Poor mental health is of concern due to an increased risk of suicidal behavior, poor overall health, and substance abuse [1,5-7].

Research shows that mental health status is related to various health, socioeconomic, and demographics factors. Mental health can be impacted by chronic conditions such as cardiovascular disease, diabetes [4,8,9], and activity limitations [4,10,11] as well as to health behaviors including physical activity [7,12], alcohol use [4,7,10,13], and tobacco use [4,7,10,12]. Research also indicates that mental health may vary by socioeconomic factors including employment status [12], income level [10], and education level [2,12]. Furthermore, mental health status shows differences by demographic factors including age and gender [7,12-14].

\*Corresponding Author: Jessica L. Hartos,  
Department of Physician Assistant Studies, University  
of North Texas Health Science Center, 3500 Camp  
Bowie Blvd, Fort Worth, Texas, 76107, USA, fax: (817)  
735-2529, Tel: (817) 735-2454,  
Email: jessica.hartos@unthsc.edu

In addition, sleep has been linked to mental health outcomes. Sleep is an active process that comprises one-third of the human lifespan [15] and is vital for the body to maintain several mental/cognitive processes, including cognitive functioning, forming memories, and maintaining psychological functioning [16]. Twenty-five percent of Americans report poor sleeps [17], which increases the likelihood of having poor mental health [13], including abnormal emotions, abnormal moods, and an increase in negative thoughts [18]. A variety of factors have been related to sleep, including socioeconomic status, education level, age, gender, ethnicity [15], employment, and health behaviors [8]. Although sleep and mental health are shown to be related, most research focuses on the relationship between sleep disturbances and specific mental disorders [4,7,15,16], such as depression [5,9,10,16,19] and anxiety [16,20]. To our knowledge there is no research that assesses the relationship between sleep duration and general mental health in various age and gender groups in the general population. Determining such relationships will allow for more comprehensive prevention and treatment plans [7,13,16]. Therefore, the purpose of this study was to assess whether sleep duration is related to current general mental health in middle-aged males and females in the general population.

## Methods

### Design

This cross-sectional analysis used data from the 2016 Behavior Risk Factor Surveillance System (BRFSS) conducted by the Center for Disease Control and Prevention (CDC) [21]. BRFSS is used to gather prevalence data annually from over 400,000 U.S. adults across all 50 states and the District of Columbia through standardized telephone surveys related to overall health, health risk behaviors, and health prevention. The CDC compiles all BRFSS data and makes de-identified data available to researchers for secondary data analysis. This study was given exempt status by the Institutional Review Board at The University of North Texas Health Science Center.

### Sample

The samples for this study included males and females ages 35-54 in Alabama (N=2000), Arkansas (N=1118), Kentucky (N=2890), Oregon (N=1578), and West Virginia (N=2087). These states were chosen based on higher proportions of recent mentally unhealthy days and depression in male and female adults when compared to other states [22].

### Data

The outcome was current mental health. The original variable in BRFSS was measured in terms of "low" (0 days), "moderate" (1-13 days), and "high" (14 or more days) levels of "not good" mental health days "which includes stress, depression, and problems with emotions" in the past 30 days. Because we are interested in good mental health, we reversed this variable into categories of "low" (16 or less days), "moderate" (17-29 days), and "high" (30 days) levels of "good" mental health in the past 30 days. The factor of interest, sleep duration, was measured in BRFSS as the average number of hours of sleep in a 24-hour period that we categorized as "short" (less than 6 hours), "moderate" (6-8 hours), or "long" (greater than 8 hours).

Control variables included number of health conditions,

physical activity, tobacco use, alcohol use, age, sex, race, educational level, income level, and employment status. Number of health conditions was measured as the number of "yes" responses to having any of the following diagnoses: heart attack, coronary heart disease, stroke, skin cancer, cancer, COPD, arthritis, depression, kidney disease, diabetes, and asthma. This number was then categorized as "one", "two", or "three or more" health conditions. Physical activity was measured as yes/no to "performed physical activity or exercise in past 30 days other than their regular job." Tobacco use was categorized as "current smoker" versus "non-smoker." In BRFSS, alcohol use was measured as average number of drinks per day, which we categorized as "no use" (0), "light" (less than 1), "moderate" (1-3 females, 1-4 males), or "excessive" (4 or more females, 5 or more males) [23]. Age was categorized as "35-44" and "45-54." Most participants in the sample reported their race as white, so ethnicity/race was categorized as "white, non-Hispanic" versus "other." Education level was measured as "graduated college/technical school" or "did not graduate college/technical school." Income level was measured as "\$0 to less than \$50,000" or "\$50,000 or more." Employment status was measured as "employed" versus "not employed."

### Analysis

Frequency distributions conducted by state and gender were used to describe the sample and identify any issues with the variable distributions. We analyzed the data separately by state and gender to assess patterns in relations among variables across similar samples. Similar findings in three or more out of five states were considered consistent evidence for relations. Ordered logistic regression analysis conducted by state and gender was used to assess the relationship between mental health and sleep after controlling for health-related and demographic factors. An ordered logistic regression model is used to estimate a relationship between an ordinal dependent variable and a set of independent variables. The proportional odds produced for each IV relates "proportionally" or equally applies to comparisons of DV groups greater than  $k$  versus those who are in groups less than or equal to  $k$ , where  $k$  is any level of the response variable. Therefore, the interpretation of an associated OR is that for a one unit change in the predictor variable, the odds for a group that is greater than  $k$  versus less than or equal to  $k$  are the proportional odds times larger. Any observations with missing data for any variables in the models were excluded from the adjusted analysis. All analyses were conducted in STATA 15 (Copyright 1985-2017 StataCorp LLC).

## Results

### Descriptive statistics

Table 1 lists participant characteristics separately for middle-aged males and females in Alabama, Arkansas, Kentucky, Oregon, and West Virginia. Across states for males, about one-third reported low to moderate mental health (31-37%) and less than one-fourth reported short sleep duration (11-21%). About half of participants reported one or more health conditions (50-54%) and less than one-third reported no physical activity in the past month (15-30%). For substance use, about one-fourth reported being current smokers (19-27%) and less than one-fourth reported moderate alcohol use (17-22%). For demographic factors, the majority of participants were ages 45-54 (54-65%) and most were white (66-93%). For socioeconomic status, the

| Variables          | Alabama  |     | Arkansas |     | Kentucky |     | Oregon  |     | West Virginia |     |
|--------------------|----------|-----|----------|-----|----------|-----|---------|-----|---------------|-----|
|                    | N        | %   | N        | %   | N        | %   | N       | %   | N             | %   |
| Males              | N = 807  |     | N = 427  |     | N = 1179 |     | N = 732 |     | N = 935       |     |
| Mental Health      | 796      | 99  | 427      | 100 | 1179     | 100 | 732     | 100 | 935           | 100 |
| Low                | 109      | 14  | 64       | 15  | 156      | 13  | 81      | 11  | 147           | 16  |
| Moderate           | 157      | 20  | 81       | 19  | 210      | 18  | 191     | 26  | 156           | 17  |
| High               | 530      | 67  | 282      | 66  | 813      | 69  | 460     | 63  | 632           | 68  |
| Sleep              | 807      | 100 | 427      | 100 | 1179     | 100 | 732     | 100 | 935           | 100 |
| Short              | 136      | 17  | 60       | 14  | 218      | 18  | 81      | 11  | 193           | 21  |
| Moderate           | 623      | 77  | 331      | 78  | 921      | 78  | 608     | 83  | 699           | 75  |
| Long               | 48       | 6   | 36       | 8   | 40       | 3   | 43      | 6   | 43            | 5   |
| Health Conditions  | 778      | 96  | 406      | 95  | 1142     | 97  | 707     | 97  | 904           | 97  |
| 0                  | 363      | 47  | 201      | 50  | 574      | 50  | 396     | 56  | 417           | 46  |
| 1                  | 221      | 28  | 99       | 24  | 287      | 25  | 185     | 26  | 247           | 27  |
| 2                  | 93       | 12  | 53       | 13  | 136      | 12  | 74      | 10  | 129           | 14  |
| 3 or more          | 101      | 13  | 53       | 13  | 145      | 13  | 52      | 7   | 111           | 12  |
| Physical Activity  | 807      | 100 | 425      | 100 | 1177     | 100 | 729     | 100 | 934           | 100 |
| Yes                | 583      | 72  | 298      | 70  | 872      | 74  | 616     | 85  | 712           | 76  |
| No                 | 224      | 28  | 127      | 30  | 305      | 26  | 113     | 15  | 222           | 24  |
| Tobacco Use        | 775      | 96  | 412      | 96  | 1148     | 97  | 681     | 93  | 918           | 98  |
| Current smoker     | 206      | 27  | 104      | 25  | 307      | 27  | 129     | 19  | 246           | 27  |
| Not current smoker | 569      | 73  | 308      | 75  | 841      | 73  | 552     | 81  | 672           | 73  |
| Alcohol Use        | 781      | 97  | 409      | 96  | 1152     | 98  | 700     | 96  | 902           | 96  |
| None               | 365      | 47  | 197      | 48  | 584      | 51  | 199     | 28  | 448           | 50  |
| Light              | 94       | 12  | 50       | 12  | 127      | 11  | 87      | 12  | 164           | 18  |
| Moderate           | 156      | 20  | 70       | 17  | 212      | 18  | 155     | 22  | 150           | 17  |
| Excessive          | 166      | 21  | 92       | 23  | 229      | 20  | 259     | 37  | 140           | 16  |
| Females            | N = 1193 |     | N = 691  |     | N = 1711 |     | N = 843 |     | N = 1152      |     |
| Mental Health      | 1173     | 98  | 691      | 100 | 1711     | 100 | 843     | 100 | 1152          | 100 |
| Low                | 212      | 18  | 148      | 21  | 315      | 18  | 138     | 16  | 274           | 24  |
| Moderate           | 345      | 29  | 164      | 24  | 483      | 28  | 298     | 35  | 282           | 24  |
| High               | 616      | 53  | 379      | 55  | 913      | 53  | 407     | 48  | 596           | 52  |
| Sleep              | 1193     | 100 | 691      | 100 | 1711     | 100 | 843     | 100 | 1152          | 100 |
| Short              | 208      | 17  | 143      | 21  | 317      | 19  | 104     | 12  | 247           | 21  |
| Moderate           | 893      | 75  | 486      | 70  | 1303     | 76  | 689     | 82  | 841           | 73  |
| Long               | 92       | 8   | 62       | 9   | 91       | 5   | 50      | 6   | 64            | 6   |
| Health Conditions  | 1163     | 97  | 674      | 98  | 1666     | 97  | 809     | 96  | 1118          | 97  |
| 0                  | 434      | 37  | 265      | 39  | 643      | 39  | 335     | 41  | 376           | 34  |
| 1                  | 332      | 29  | 175      | 26  | 456      | 27  | 232     | 29  | 309           | 28  |
| 2                  | 178      | 15  | 122      | 18  | 262      | 16  | 142     | 18  | 207           | 19  |
| 3 or more          | 219      | 19  | 112      | 17  | 305      | 18  | 100     | 12  | 226           | 20  |
| Physical Activity  | 1190     | 100 | 690      | 100 | 1711     | 100 | 842     | 100 | 1152          | 100 |
| Yes                | 806      | 68  | 440      | 64  | 1237     | 72  | 720     | 86  | 809           | 70  |
| No                 | 384      | 32  | 250      | 36  | 474      | 28  | 122     | 14  | 343           | 30  |
| Tobacco Use        | 1161     | 97  | 669      | 97  | 1674     | 98  | 801     | 95  | 1128          | 98  |
| Current smoker     | 254      | 22  | 160      | 24  | 448      | 27  | 139     | 17  | 342           | 30  |
| Not current smoker | 907      | 78  | 509      | 76  | 1226     | 73  | 662     | 83  | 786           | 70  |
| Alcohol Use        | 1154     | 97  | 674      | 98  | 1656     | 97  | 812     | 96  | 1119          | 97  |
| None               | 672      | 58  | 426      | 63  | 1014     | 61  | 281     | 35  | 729           | 65  |
| Light              | 172      | 15  | 93       | 14  | 233      | 14  | 131     | 16  | 198           | 18  |
| Moderate           | 160      | 14  | 82       | 12  | 212      | 13  | 167     | 21  | 103           | 9   |
| Excessive          | 150      | 13  | 73       | 11  | 197      | 12  | 233     | 29  | 89            | 8   |

**Table 1:** Participant characteristics by state

majority of participants did not graduate college or technical school (58-71%) and reported an income of \$50,000 or more (53-64%), and most were employed (74-83%).

Across states for females, about half reported low to moderate mental health (45-51%) and less than one fourth reported short sleep duration (12-21%). About two-thirds of participants

reported one or more health conditions (59-66%) and less than one-third reported no physical activity in the past month (14-36%). For substance use, about one-fourth reported being a current smoker (17-30%) and less than one-fourth reported moderate alcohol use (9-21%). For demographic factors, the majority of participants were ages 45-54 (56-62%) and most

were white (63-94%). For socioeconomic status, the majority of participants did not graduate college or technical school (54-68%), about half reported an income of \$50,000 or more (43-59%), and about two-thirds were employed (60-70%).

**Adjusted statistics**

Table 2 shows the results of ordered logistic regression

analysis separately for middle-aged males and females in Alabama, Arkansas, Kentucky, Oregon, and West Virginia. For males, the results indicated that after controlling for all other variables in the model, mental health was significantly related to sleep duration in three of five states. Participants who reported short sleep duration were about 2 to 3 times less likely to report each successive level of mental health compared to those who

| Predicting Good Mental Health (low vs. moderate vs. high) | Alabama     |        |      | Arkansas    |        |      | Kentucky    |        |      | Oregon      |        |      | West Virginia |        |      |
|---|-------------|--------|------|-------------|--------|------|-------------|--------|------|-------------|--------|------|---------------|--------|------|
|   | AOR         | 95% CI |      | AOR         | 95% CI |      | AOR         | 95% CI |      | AOR         | 95% CI |      | AOR           | 95% CI |      |
|   |             | Low    | High |             | Low    | High |             | Low    | High |             | Low    | High |               | Low    | High |
| <b>Males</b>  |             |        |      |             |        |      |             |        |      |             |        |      |               |        |      |
| Sleep   |             |        |      |             |        |      |             |        |      |             |        |      |               |        |      |
| Short   | 0.68        | 0.42   | 1.10 | 0.63        | 0.30   | 1.31 | <b>0.48</b> | 0.33   | 0.70 | <b>0.36</b> | 0.20   | 0.65 | <b>0.34</b>   | 0.22   | 0.52 |
| Moderate  | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref           | -      | -    |
| Long  | 1.06        | 0.46   | 2.43 | 0.83        | 0.33   | 2.12 | 0.54        | 0.24   | 1.20 | 0.88        | 0.38   | 2.04 | 0.90          | 0.41   | 2.00 |
| Health Conditions   |             |        |      |             |        |      |             |        |      |             |        |      |               |        |      |
| 0   | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref           | -      | -    |
| 1   | <b>0.57</b> | 0.37   | 0.88 | <b>0.31</b> | 0.16   | 0.59 | <b>0.43</b> | 0.30   | 0.61 | <b>0.51</b> | 0.33   | 0.79 | <b>0.60</b>   | 0.39   | 0.92 |
| 2   | <b>0.31</b> | 0.18   | 0.54 | <b>0.28</b> | 0.13   | 0.62 | <b>0.30</b> | 0.19   | 0.48 | <b>0.44</b> | 0.24   | 0.81 | <b>0.27</b>   | 0.16   | 0.44 |
| 3 or more   | <b>0.27</b> | 0.15   | 0.47 | <b>0.08</b> | 0.04   | 0.19 | <b>0.15</b> | 0.09   | 0.25 | <b>0.16</b> | 0.08   | 0.33 | <b>0.13</b>   | 0.07   | 0.24 |
| Physical Activity   |             |        |      |             |        |      |             |        |      |             |        |      |               |        |      |
| No  | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref           | -      | -    |
| Yes   | 1.27        | 0.82   | 1.94 | 1.44        | 0.82   | 2.55 | 0.94        | 0.66   | 1.35 | 1.39        | 0.82   | 2.36 | 1.22          | 0.80   | 1.87 |
| Tobacco Use   |             |        |      |             |        |      |             |        |      |             |        |      |               |        |      |
| Not current smoker  | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref           | -      | -    |
| Current smoker  | 0.67        | 0.44   | 1.00 | 1.32        | 0.68   | 2.55 | 0.80        | 0.57   | 1.12 | 0.83        | 0.51   | 1.35 | 1.31          | 0.86   | 2.01 |
| Alcohol Use   |             |        |      |             |        |      |             |        |      |             |        |      |               |        |      |
| None  | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref           | -      | -    |
| Light   | 1.81        | 1.00   | 3.26 | 1.26        | 0.57   | 2.74 | 1.35        | 0.80   | 2.28 | 0.96        | 0.51   | 1.82 | 0.90          | 0.56   | 1.43 |
| Moderate  | 1.09        | .69    | 1.72 | 0.71        | 0.34   | 1.47 | 0.70        | 0.47   | 1.06 | 0.76        | 0.45   | 1.28 | <b>0.60</b>   | 0.37   | 0.99 |
| Excessive   | 1.02        | 0.63   | 1.67 | 0.62        | 0.31   | 1.22 | 0.70        | 0.47   | 1.05 | 0.66        | 0.41   | 1.07 | <b>0.40</b>   | 0.24   | 0.66 |
| <b>Females</b>  |             |        |      |             |        |      |             |        |      |             |        |      |               |        |      |
| Sleep   |             |        |      |             |        |      |             |        |      |             |        |      |               |        |      |
| Short   | <b>0.41</b> | 0.28   | 0.60 | 0.71        | 0.45   | 1.10 | <b>0.62</b> | 0.46   | 0.83 | <b>0.53</b> | 0.32   | 0.87 | <b>0.65</b>   | 0.47   | 0.92 |
| Moderate  | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref           | -      | -    |
| Long  | 0.89        | 0.55   | 1.45 | 0.82        | 0.44   | 1.52 | 1.21        | 0.73   | 2.03 | 1.35        | 0.69   | 2.64 | 0.94          | 0.51   | 1.75 |
| Health Conditions   |             |        |      |             |        |      |             |        |      |             |        |      |               |        |      |
| 0   | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref           | -      | -    |
| 1   | <b>0.64</b> | 0.45   | 0.90 | <b>0.46</b> | 0.30   | 0.72 | <b>0.53</b> | 0.40   | 0.71 | <b>0.56</b> | 0.38   | 0.81 | <b>0.52</b>   | 0.36   | 0.74 |
| 2   | <b>0.35</b> | 0.23   | 0.53 | <b>0.27</b> | 0.16   | 0.46 | <b>0.27</b> | 0.19   | 0.37 | <b>0.30</b> | 0.19   | 0.45 | <b>0.25</b>   | 0.16   | 0.37 |
| 3 or more   | <b>0.15</b> | 0.10   | 0.23 | <b>0.17</b> | 0.10   | 0.29 | <b>0.18</b> | 0.13   | 0.25 | <b>0.18</b> | 0.10   | 0.30 | <b>0.14</b>   | 0.09   | 0.21 |
| Physical Activity   |             |        |      |             |        |      |             |        |      |             |        |      |               |        |      |
| No  | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref           | -      | -    |
| Yes   | 1.22        | 0.90   | 1.65 | <b>1.64</b> | 1.13   | 2.37 | <b>1.30</b> | 1.004  | 1.69 | 1.37        | 0.85   | 2.22 | <b>1.39</b>   | 1.02   | 1.88 |
| Tobacco Use   |             |        |      |             |        |      |             |        |      |             |        |      |               |        |      |
| Not current smoker  | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref           | -      | -    |
| Current smoker  | <b>0.61</b> | 0.43   | 0.86 | 0.79        | 0.52   | 1.19 | <b>0.70</b> | 0.54   | 0.91 | 0.82        | 0.56   | 1.27 | <b>0.73</b>   | 0.54   | 0.99 |
| Alcohol Use   |             |        |      |             |        |      |             |        |      |             |        |      |               |        |      |
| None  | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref         | -      | -    | ref           | -      | -    |
| Light   | <b>0.62</b> | 0.43   | 0.90 | 1.06        | 0.63   | 1.80 | 0.81        | 0.59   | 1.12 | 0.69        | 0.44   | 1.09 | <b>0.68</b>   | 0.48   | 0.97 |
| Moderate  | <b>0.62</b> | 0.42   | 0.93 | <b>0.54</b> | 0.32   | 0.91 | <b>0.70</b> | 0.50   | 0.98 | 0.94        | 0.60   | 1.46 | <b>0.47</b>   | 0.30   | 0.74 |
| Excessive   | <b>0.58</b> | 0.37   | 0.90 | 1.30        | 0.67   | 2.53 | 0.78        | 0.54   | 1.14 | 0.85        | 0.56   | 1.30 | <b>0.31</b>   | 0.18   | 0.55 |

Note. AOR= adjusted odds ratio; 95% CI=95% confidence intervals; ref=referent group; boldface indicates significance (AORs with 95% CI that do not include 1.00 are significant). Each analysis was also adjusted for age, race, education level, income level and employment status.

Table 2: Adjusted results across states

reported moderate sleep duration. In addition, compared to those who had no health conditions, participants in all five states who had one health condition were about 1.5 to 3 times less likely, those with two health conditions were about 2 to 4.5 times less likely, and those with three or more health conditions were about 3.5 to 12.5 times less likely, to report each successive level of mental health. In contrast, compared to their referent groups, the following participants in all five states were more likely to report each successive level of mental health: those who reported ages 45-54 and those who were employed.

For females, the results indicated that after controlling for all other variables in the model, mental health was significantly related to sleep duration in four of five states. Participants who reported short sleep duration were about 1.5 to 2.5 times less likely to report each successive level of mental health compared to those who reported moderate sleep duration. In addition, compared to those who had no health conditions, participants in all five states who reported one health condition were about 1.5 to 2 times less likely, those who reported two health conditions were about 3 to 4 times less likely, and those who reported three or more health conditions were about 5.5 to 7 times less likely to report each successive level of mental health. In addition, compared to their referent groups, participants in three out of the five states who reported being a current smoker were about 1.5 times less likely, and participants in four out of the five states who reported moderate alcohol use were about 1.5 to 2 times less likely, to report each successive level of mental health. In contrast, compared to their referent groups, the following participants in three to five states were more likely to report each successive level of mental health: those who reported physical activity, ages 45-54, an income of \$50,000 or more, and being employed.

## Discussion

The purpose of this study was to assess whether sleep duration is related to current general mental health in middle-aged males and females in the general population. The results of adjusted analysis indicated that sleep duration was consistently related to good mental health in both males and females. Across states, middle-aged males who reported short sleep duration were about 2.5 times less likely, and middle-aged females who reported short sleep duration were about 2 times less likely, to report each successive level of mental health when compared to those who reported moderate sleep. Prior research also showed a significant relationship between sleep and mental health [7,15,16]. However, these studies measured sleep disturbances and specific mental disorders. The results from our study add to the literature in showing that sleep duration may be related to current general mental health in middle-aged males and females in the general population.

In addition, the results of this study also indicated that mental health may be moderately- to highly-related to one or two health conditions, and highly related to three or more health conditions, in middle-aged males and females. Previous research also found a relationship between mental health and cardiovascular disease and diabetes [4,8,9]. Our study extends these findings to show relations with having multiple health conditions. In addition, for middle-aged females, mental health was consistently related to current smoking status, moderate alcohol use, and physical activity. Previous research also found relationships between mental health and health behaviors including physical activity

[7,12], alcohol use [4,7,10,13], and smoking status [4,7,10,12]. However, these studies did not consistently perform the analysis separately by gender. Our study shows relations for mental health, physical activity, alcohol use, and tobacco use for middle-aged females, but not for middle-aged males.

## Limitations

The BRFSS data allowed for the use of large sample sizes across multiple similar samples for assessing the association between sleep duration and current general mental health in specific target populations. Unfortunately, we lacked information on sources of stress and social support which may have an effect on current mental health and sleep duration. We also lacked information on how well participants were managing any current health conditions and any medication use, both of which may also affect current mental health and sleep duration. Future studies should include information for stress, social support, health condition management, and medication use. In addition, there was a lack of data on races other than the "White, non-Hispanic" population, which may limit generalizability of the results to the diverse population of the United States. Future research should be conducted within various races/ethnicities to determine if patterns are similar.

## Recommendations

The results of this population-based study may generalize to middle-aged males and females in the primary care setting. For middle-aged males, clinicians may expect about one-third to report low to moderate mental health, less than one-fourth to report short sleep duration, and a moderate to high relationship between mental health and sleep. Similarly, for middle-aged females, clinicians may expect about half to report low to moderate mental health, less than one-fourth to report short sleep duration, and a moderate relationship between mental health and sleep. Thus, clinicians should screen for mental health and sleep duration in all middle-aged patients. Clinicians should treat any issues related to mental health and sleep concurrently, provide education on the importance of sleep and mental health, and refer to a sleep specialist and/or psychiatrist as needed.

In addition, clinicians may expect about half of middle-aged males and two-thirds of middle-aged females to report one or more health conditions, and moderate to high relations between mental health and multiple health conditions. As such, all middle-aged males and females should be screened for multiple health conditions. Clinicians should assess for management of these conditions, provide strategies for managing multiple health conditions, treat concurrently, and refer to specialists as needed.

Furthermore, for middle aged females, clinicians may expect about one-third to report no physical activity, less than one-fourth to currently smoke, and the majority to drink alcohol. Given the variable low to high relations between mental health and physical activity, tobacco use, and alcohol use in middle aged females, patients in this target population presenting with any of these issues should be screened for all. Clinicians should educate middle-aged females on the importance of physical activity and help them to consider different activities that could fit within their lifestyle. Clinicians should also provide education on the risks of tobacco and alcohol use and provide resources for smoking cessation and referrals to substance abuse programs as needed.



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