# Methodology

## Study Design Summary:

This study used a secondary data analysis with a cross-sectional design to examine associations between dietary fiber intake and sleep outcomes among U.S. adults. Data were drawn from the 2017–2018 National Health and Nutrition Examination Survey (NHANES), administered by the Centers for Disease Control and Prevention.[8] Participants included adults aged ≥18 years with complete two-day dietary recall and sleep questionnaire data. Analyses were conducted in Stata version 17 using survey weights and design variables to produce nationally representative estimates.

This research involved publicly available, de-identified NHANES data and did not involve direct contact with human subjects. NHANES protocols were approved by the National Center for Health Statistics Research Ethics Review Board. As this project used publicly accessible, anonymized data, it was exempt from institutional review board approval.

## Study Population:

- **Inclusion Criteria:** Adults aged ≥18 years with complete Day 1 and Day 2 dietary recalls, valid BMI measurements, and complete sleep questionnaire responses.
- **Exclusion Criteria:** Pregnant participants and individuals missing key primary, descriptive, or outcome data.
- **Sample Size:** After applying inclusion and exclusion criteria, 4,251 participants remained for analysis.

- **Power Consideration:** Post hoc power analyses were conducted for key outcomes to evaluate whether the final sample size was adequate to detect statistically significant associations observed in the analyses.

**Study Procedures:**

*Sampling and Data Acquisition*

Publicly available 2017–2018 NHANES datasets were downloaded from the CDC website and imported into Stata version 17. The datasets included:

- Dietary Intake (Day 1 and Day 2): DR1TOT_J, DR2TOT_J
- Sleep Questionnaire: SLQ_J
- Demographics: DEMO_J
- Anthropometry (BMI): BMX_J

Each dataset was imported and cleaned by removing variables not relevant to the research question. Datasets were merged using the respondent identifier variable (SEQN) to create a single dataset containing exposure, outcome, and descriptive variables. Survey design elements including strata, primary sampling units, and the examination sample weight (WTMEC2YR) were applied using the svyset command to account for the complex sampling design and produce weighted estimates representative of the U.S. adult population.

*Descriptive Variables*

Descriptive variables included age, sex, race/ethnicity, and BMI. These variables were used to describe participant characteristics and to compare distributions across fiber intake categories.

*Inferential Variables*

The primary exposure variable was dietary fiber intake (grams per day), calculated as the average of Day 1 (DR1TFIBE) and Day 2 (DR2TFIBE) intake values. Fiber intake was categorized as follows:

- Below recommended range: <25 g/day
- Meets recommended range: 25–35 g/day
- Above recommended range: >35 g/day

The primary outcome variables were self-reported sleep measures derived from the NHANES Sleep Questionnaire. These included:

- Average sleep duration, categorized as:
  - Short sleep (<6 hours)
  - Adequate sleep (7–8 hours)
  - Long sleep (>9 hours)
- Trouble sleeping, coded as a binary variable (yes/no)
- Daytime sleepiness, recorded on a categorical scale ranging from 0 to 4

**Statistical Analysis:**

*Descriptive Analyses*

Descriptive statistics summarized the study population and fiber intake groups. For continuous variables (age, BMI), survey-weighted means and standard errors were calculated, and one-way ANOVA was used to compare means across fiber intake categories. For categorical variables (sex, race/ethnicity, and sleep duration category), frequencies and percentages were reported, and survey-weighted chi-square tests were used to compare distributions among groups.

*Inferential Analyses*

Between-group differences in categorical outcomes were assessed using survey-weighted chi-square tests:

- Fiber intake category and trouble sleeping
- Fiber intake category and daytime sleepiness
- Fiber intake category and sleep duration category

Each test was conducted independently to ensure clarity of results. The relationship between fiber intake and trouble sleeping was further assessed using survey-weighted logistic regression to estimate odds ratios comparing fiber categories. One-way ANOVA was used to test whether mean BMI differed significantly across fiber intake groups. All tests were considered statistically significant at $p<0.05$. Post hoc power analyses were conducted for both BMI and trouble sleeping to assess the risk of type II error in the primary analyses. This analytic approach is consistent with methods commonly applied in NHANES-based research on diet and sleep.[2,6,9]

**Results:**

*Descriptive Results*

Across the weighted sample, the average BMI was 29.8 kg/m² (95% CI: 29.1–30.4), the average fiber intake was 16.5 grams per day, and the average sleep duration was 7.9 hours. Most participants (86%) consumed less than the recommended fiber intake, with only 4% exceeding recommendations.

Table 1 presents weighted participant characteristics stratified by fiber intake categories. Statistically significant differences were observed in BMI, sex, and race/ethnicity across fiber groups. The proportion of female participants decreased with higher fiber intake, ranging from 55.4% in the low-fiber group to 26.1% in the high-fiber group ($p < 0.001$). Similarly, the percentage of non-Hispanic White participants declined from 66.2% in the low-fiber group to 47.9% in the high-fiber group ($p < 0.001$).

Average BMI was also significantly lower in higher fiber intake groups, decreasing from 30.0 kg/m² among participants with low fiber intake to 27.3 kg/m² among those exceeding recommendations ($p = 0.0003$). Post hoc power analysis indicated >99% power to detect this difference; given an observed effect size ($f = 0.18$), three groups with sample sizes $n = 3590$, 467, and 195, and an alpha level of 0.05.

Other characteristics, including mean age, sleep duration, short sleep prevalence, and daytime sleepiness scores, did not differ significantly across fiber intake groups.

| Table 1. Weighted Characteristics of the Study Population by Fiber Intake Category | | | | | |
|---|---|---|---|---|---|
| **Characteristic** | **Overall (N=4,251)** | **Low Fiber (<25g)** | **Meets (25–35g)** | **Above (>35g)** | **P-Value** |
| Weighted % | n= 4251 (100%) | n= 3590 (85.8%) | n= 467 (10.3%) | n= 195 (3.9%) | — |
| Age, years | 47.8 ± 0.61 | 47.8 ± 0.58 | 47.4 ± 1.44 | 47.0 ± 2.33 | 0.92 (NS) |
| Female, % | 52.2% | 55.4% | 35.5% | 26.1% | <0.001 |
| Non-Hispanic White, % | 64.7% | 66.2% | 58.0% | 47.9% | <0.001 |
| BMI, kg/m² | 29.8 ± 0.30 | 30.0 ± 0.30 | 28.7 ± 0.51 | 27.3 ± 0.58 | 0.0003 |
| Sleep Duration, hours | 7.92 ± 0.04 | 7.91 ± 0.04 | 8.04 ± 0.08 | 7.84 ± 0.10 | 0.098 (NS) |
| Short Sleep (<6h), % | 9% | 9% | 7% | 2% | 0.098 (NS) |
| Trouble Sleeping, % | 31% | 33% | 22% | 18% | 0.016 |
| Daytime Sleepiness, mean (0–4) | 1.83 ± 0.03 | 1.89 ± 0.03 | 1.74 ± 0.04 | 1.58 ± 0.05 | 0.096 (NS) |

***Table 1****. Weighted Characteristics of the Study Population Overall and by Fiber Intake Category. P-values reflect weighted comparisons across fiber intake groups (chi-square tests for categorical variables and ANOVA for continuous variables). NS = Not Significant.*

*Inferential Results*

**Fiber Intake & Sleep Duration**

Survey-weighted chi-square analysis showed no significant association between fiber intake and sleep duration category (p=0.098), though a trend suggested shorter sleep in low-fiber groups.

### Fiber Intake & Daytime Sleepiness

A non-significant trend toward reduced daytime sleepiness was observed with higher fiber intake (p=0.096).

### Fiber Intake & Trouble Sleeping

A statistically significant association was observed between fiber intake groups and trouble sleeping (p = 0.016). (Figure 1) Compared to participants with low fiber intake, those meeting recommended intake had 42% lower odds of reporting trouble sleeping (OR = 0.58, p = 0.005), while those exceeding recommendations had 54% lower odds (OR = 0.46, p = 0.010). A post hoc power analysis indicated that the study had greater than 99% power to detect this association.

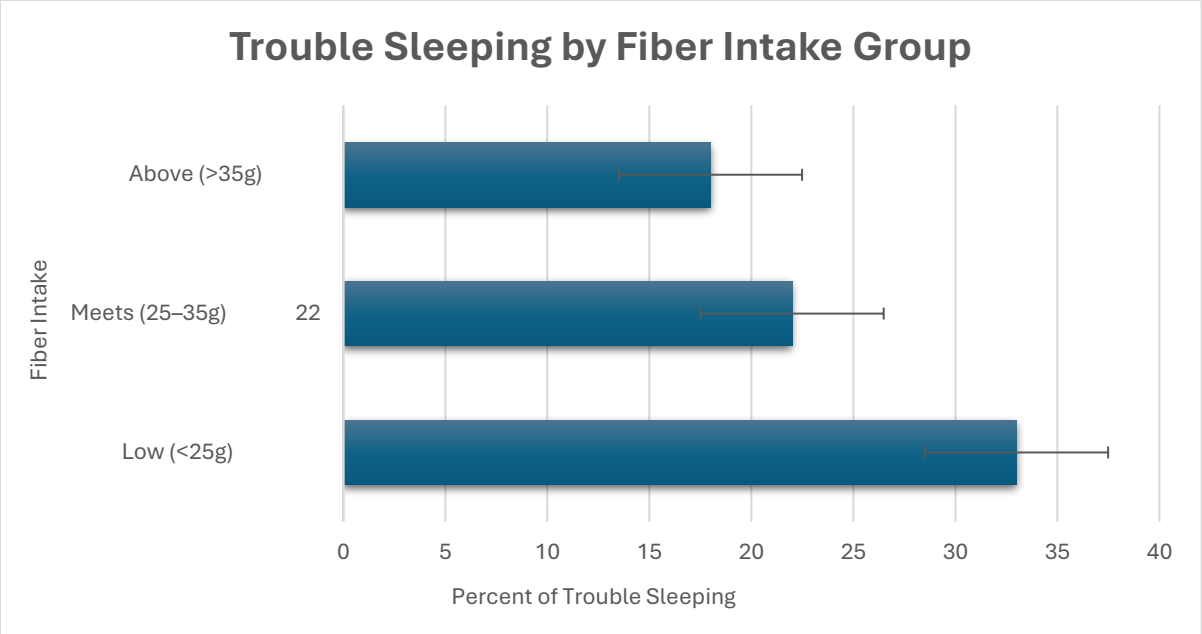


***Figure 1. Trouble Sleeping by Fiber Intake Group.*** *Bars show the percentage of adults reporting trouble sleeping within each fiber group (low, meets, or above). Higher fiber intake was associated with significantly lower prevalence of trouble sleeping (p=0.016).*

*Results Summary*

Overall, the analyses identified significant differences in BMI, sex, race/ethnicity, and trouble sleeping across fiber intake categories among U.S. adults. Individuals consuming higher amounts of dietary fiber had significantly lower average BMI compared to those consuming less fiber, as well as a lower prevalence of self-reported sleeping trouble. Specifically, adults meeting or exceeding recommended fiber intake had between 42% and 54% reduced odds of reporting trouble sleeping relative to those consuming less than 25 grams per day. The distribution of sex and race/ethnicity also varied significantly by fiber intake group, with a higher proportion of female and non-Hispanic White participants in the lowest fiber category. Although trends suggested that higher fiber intake might be linked to longer sleep duration and lower daytime sleepiness, these associations did not reach statistical significance.

**References:**


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