EFEIA FOUNDATION

EHS Global Census

Survey C: **Sleep Disorders**

Report Date: December 15, 2025
Analysis Period: August 2025 - December 2025
Total Participants: 113

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2025

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EHS GLOBAL CENSUS 2025
Survey C: **Sleep Disorders**

Executive Summary

Survey C assessed sleep quality and disorders among 113 participants in the EHS Global Census 2025, evaluating sleep architecture, 10 symptom dimensions, four binary disorder indicators, and functional impact on daily life.

Key Findings

1. **Nearly half require professional evaluation.** 47.8% score in the Moderate-to-Severe range (≥75/163), indicating clinically significant sleep dysfunction.
2. **The core problem is non-restorative sleep.** 63.7% report adequate sleep duration (6-8 hours), yet only 31% wake feeling refreshed. Sleep is occurring but failing to restore.
3. **Daytime consequences dominate.** Factor analysis reveals Daytime Functional Impairment (fatigue, concentration, mood, headaches) explains more variance than nighttime sleep initiation problems. The syndrome manifests primarily in daytime dysfunction.
4. **The problem is chronic.** 59.3% have experienced sleep problems for over 6 months, meeting criteria for chronic insomnia disorder.
5. **Sleep disorders cluster together.** 45% have bruxism, 31% vivid dreams/paralysis, 28% restless legs. Those with 2+ conditions score dramatically higher (mean 83-90 vs. 60-63), suggesting shared underlying mechanisms.
6. **Women bear disproportionate burden.** Females comprise 82.7% of the Moderate category and show significantly higher daytime impairment scores (p=0.030).

Finding	Result
Total Participants	113
Mean Sleep Score	70.0/163 (42.9% of maximum)
Moderate-to-Severe Cases	54 (47.8%)
Chronic Problems (>6 months)	67 (59.3%)
Most Common Co-morbid Condition	Teeth Grinding (Bruxism) - 45.1%
Dominant Factor	Daytime Functional Impairment (Factor 1)
Gender Pattern	Females comprise 82.7% of Moderate category

1. Purpose and Scope

Sleep is the biological system most vulnerable to electromagnetic disruption and the primary window through which EMF exposure translates into symptomatic illness.

Disturbed sleep is one of the most frequently reported complaints among individuals with EHS, often preceding or exacerbating other symptoms such as fatigue, anxiety, cognitive impairment, and chronic pain. Yet sleep dysfunction has historically been assessed only superficially in EHS research: typically as a single item ("Do you have sleep problems?") rather than as a complex, multidimensional phenomenon requiring dedicated evaluation.

Survey C was designed to address this gap.

1.2 What Survey C Measures

The survey evaluates sleep through multiple dimensions:

- Sleep Architecture (7 items)
- Symptom Severity Scales (10 items, 0-10 each)
- Binary Disorder Indicators (4 items)
- Chronicity and Impact (2 items)

These items were adapted from validated instruments including the Insomnia Severity Index (ISI), Epworth Sleepiness Scale (ESS), Pittsburgh Sleep Quality Index (PSQI), STOP-BANG (sleep apnea screening), and Restless Legs Syndrome Rating Scale (RLSRS).

1.3 Scoring Framework

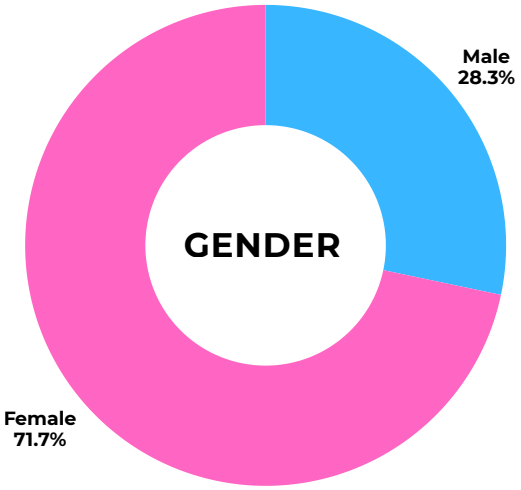
The maximum possible score is 163 points. Higher scores indicate greater sleep dysfunction.

Category	Score Range	Interpretation
Healthy	**0-37**	Minimal disturbances
Mild	**38-74**	Minor interruptions
Moderate	**75-112**	Significant dysfunction
Severe	**113-163**	High risk of sleep disorder

A Note on Interpretation: Survey C findings describe a self-selected population concerned about electromagnetic exposure. The high prevalence of sleep dysfunction documented here reflects this specific cohort and should not be generalized to the broader population without appropriate caveats. However, for the clinical purpose of EHS assessment, this is precisely the relevant population. Survey C establishes normative ranges and identifies intervention thresholds for individuals presenting with EMF-related health concerns.

2. Demographic Profile

2.1 Gender Distribution



Gender	n	%	Mean Score
Female	81	71,7%	72,0
Male	32	28,3%	65,8

Statistical analysis: t=1.23, p=0.222. Female participants report sleep scores approximately 9% higher than male participants, though this difference does not reach statistical significance for total score.

2.2 Age Distribution

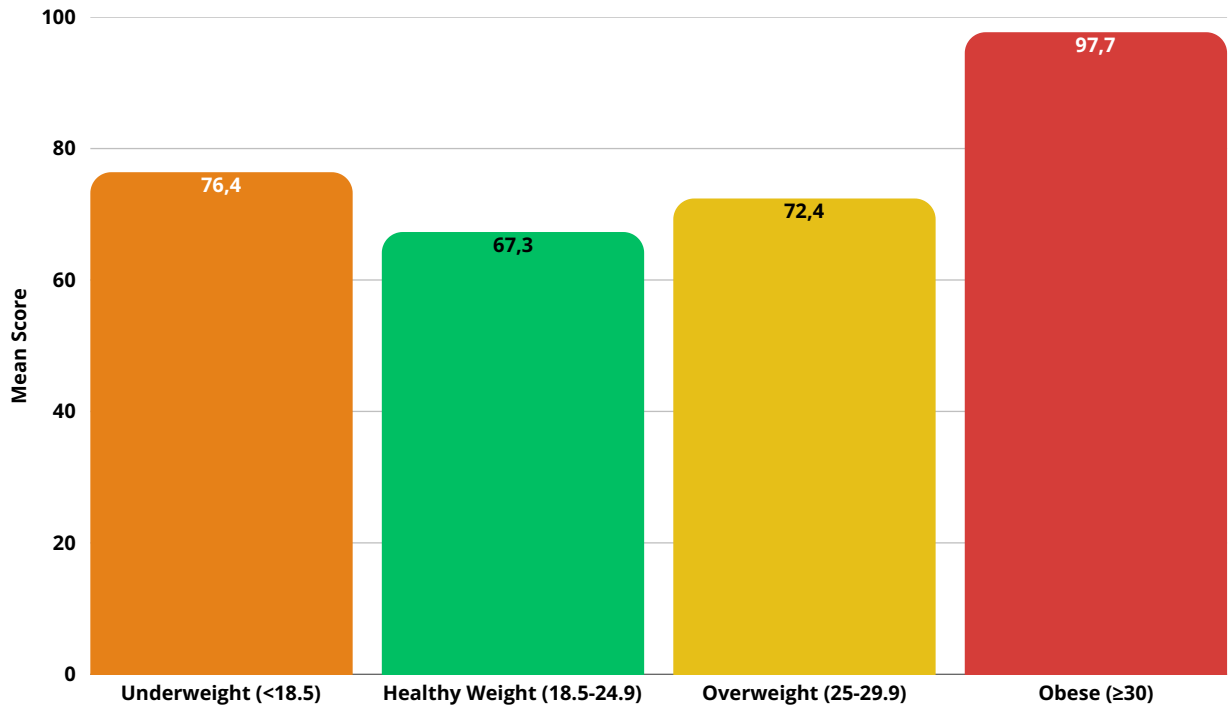
Mean: 44.4 years, **Median:** 45.0 years, **Std Dev:** 11.6 years, **Range:** 18-73 years

Key Insight:
No significant correlation between age and sleep score (r = -0.01, p = 0.91), suggesting sleep problems in this population are not age-related but may be driven by environmental or lifestyle factors. The 31-40 and 51-60 age groups show the highest mean scores (74.0 and 73.2), potentially reflecting peak occupational EMF exposure and hormonal transition periods respectively.

Age Group	n	Mean Score	Mean Score
≤30	12	10,6%	65,7
31-40	29	25,7%	74,0
41-50	48	42,5%	69,0
51-60	12	10,6%	73,2
60+	12	10,6%	65,7

2.3 Body Mass Index Distribution

BMI Category	n	%	Mean Score
Underweight (<18.5)	12	12,4%	76,4
Healthy Weight (18.5-24.9)	29	69,0%	67,3
Overweight (25-29.9)	48	15,9%	72,4
Obese (≥30)	12	2,7%	97,7



Key Insight: Obese participants show markedly elevated sleep disruption scores, consistent with known associations between obesity and sleep disorders such as obstructive sleep apnea. The elevated scores in underweight participants (76.4) may reflect the bidirectional relationship between sleep dysfunction and metabolic dysregulation.

3. Total Score Distribution

3.1 Overall Statistics

Statistic	Value
Mean	70,0
Median	72,0
Standard Deviation	22,9
Minimum	26,0
Maximum	124,0
Range	98 points

3.2 Severity Categories (0-163 Scale)

Category	Score Range	n	%	Cumulative %
Healthy	0-37	12	10,6%	10,6%
Mild	38-74	47	52,2%	52,2%
Moderate	75-112	52	98,2%	98,2%
Severe	113-163	2	100,0%	100,0%

3.3 Clinical Interpretation

- **Healthy (0-37 points, N=12, 10.6%)**

Healthy sleep habits with minimal disturbances. No significant sleep problems present. Maintain current habits and continue electromagnetic hygiene practices.

- **Mild (38-74 points, N=47, 41.6%)**

Mild sleep disturbances where lifestyle adjustments may help. Minor interruptions that can benefit from better sleep hygiene, reduced evening screen exposure, and attention to bedroom electromagnetic environment.

- **Moderate (75-112 points, N=52, 46.0%)**

Moderate sleep problems requiring improved sleep hygiene and symptom monitoring. Consistent difficulty falling or staying asleep, daytime fatigue, or concentration problems. Professional evaluation recommended to assess EMF-related disturbances and underlying sleep disorders.

- **Severe (113-163 points, N=2, 1.8%)**

Severe sleep disturbances with high risk of an underlying sleep disorder. Professional medical evaluation is strongly recommended. May require polysomnography, comprehensive EMF assessment, and multidisciplinary intervention.

3.4 Population Burden Summary

Risk Level	n	%	Intervention Level
Low Risk (Healthy + Mild)	59	52,2%	Lifestyle guidance, electromagnetic hygiene
High Risk (Moderate + Severe)	54	47,80%	Professional evaluation recommended

3.5 Gender Distribution by Severity

Category	Female	% Female	Male	% Male
Healthy	9	75,0%	3	25,0%
Mild	28	59,60%	19	40,4%
Moderate	43	82,70%	9	17,3%
Severe	1	50,00%	1	50,0%

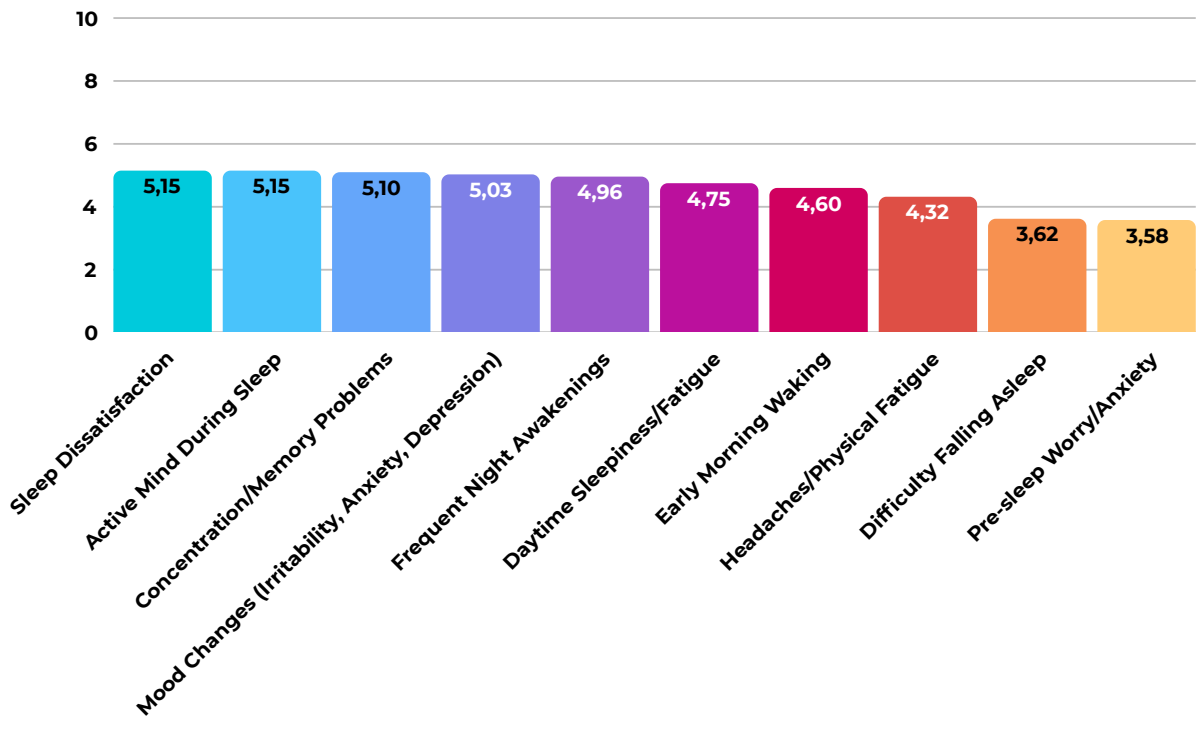
Key Insight: Females are disproportionately represented in the Moderate category (82.7% vs. 17.3% male), suggesting women may be more vulnerable to moderate-level sleep dysfunction in this population.

4. Symptom Severity Analysis

4.1 Symptom Rankings (0-10 Scale)

Survey C assesses 10 sleep-related symptoms on a 0-10 severity scale. Rankings from most to least severe:

Rank	Symptom	Mean	SD	Median	Severe (≥7)
1	Sleep Dissatisfaction	5,15	2,48	5,0	39 (34.5%)
2	Active Mind During Sleep	5,15	3,12	5,0	44 (38.9%)
3	Concentration/Memory Problems	5,10	3,12	5,0	41 (36.3%)
4	Mood Changes (Irritability, Anxiety, Depression)	5,03	3,24	5,0	46 (40.7%)
5	Frequent Night Awakenings	4,96	3,13	5,0	42 (37.2%)
6	Daytime Sleepiness/Fatigue	4,75	3,18	4,0	40 (35.4%)
7	Early Morning Waking	4,60	3,28	5,0	38 (33.6%)
8	Headaches/Physical Fatigue	4,32	3,31	3,0	35 (31.0%)
9	Difficulty Falling Asleep	3,62	2,99	3,0	25 (22.1%)
10	Pre-sleep Worry/Anxiety	3,58	3,41	3,0	28 (24.8%)



4.2 Key Observations

- **Daytime vs. Nighttime Predominance:** The highest-severity symptoms are primarily daytime functional consequences rather than nighttime sleep initiation problems:
  - Top 4 symptoms relate to daytime function (dissatisfaction, cognitive issues, mood, fatigue)
  - Traditional insomnia markers (difficulty falling asleep, pre-sleep worry) rank lowest
- **High Severity Prevalence:** Between 22-41% of participants rate each symptom as severe (≥7/10), indicating widespread dysfunction across multiple domains.
- **Mood Changes Most Prevalent at Severe Level:** 40.7% of participants report severe mood changes, making this the most common severe symptom, highlighting the psychological burden of sleep disruption.

4.3 Symptom Clustering Pattern

Symptoms cluster into two distinct patterns based on correlation analysis:

Cluster A: Daytime Functional Impairment

- Daytime Sleepiness ↔ Headaches/Fatigue (r = 0.80)
- Daytime Sleepiness ↔ Concentration/Memory (r = 0.73)
- Concentration/Memory ↔ Mood Changes (r = 0.71)
- Concentration/Memory ↔ Headaches/Fatigue (r = 0.68)

Cluster B: Sleep Initiation/Maintenance Anxiety

- Sleep Worry ↔ Difficulty Falling Asleep (r = 0.52)
- Active Mind ↔ Sleep Worry (r = 0.46)
- Active Mind ↔ Difficulty Falling Asleep (r = 0.45)

5. Factor Analysis Results

5.1 Two-Factor Solution

Factor analysis of the 10 symptom scores revealed two underlying dimensions explaining 53.8% of total variance:

Statistical Validity:

- **Bartlett's Test of Sphericity:** $\chi^2 = 571.4$ ($p < 0.001$) ✓
- **KMO Measure of Sampling Adequacy:** 0.849 (Meritorious) ✓

5.2 Factor Structure

Factor 1: "Daytime Functional Impairment" (28.6% variance)

Symptom	Loading
Headaches/Physical Fatigue	0,85
Daytime Sleepiness/Fatigue	0,83
Concentration/Memory Problems	0,78
Mood Changes	0,62

This factor captures the daytime consequences of poor sleep: physical symptoms, cognitive dysfunction, and emotional dysregulation that impair daily functioning.

Factor 2: "Sleep Initiation/Maintenance Anxiety" (25.2% variance)

Symptom	Loading
Pre-sleep Worry/Anxiety	0,75
Active Mind During Sleep	0,62
Difficulty Falling Asleep	0,57
Frequent Night Awakenings	0,55

This factor captures the cognitive-arousal dimension: racing thoughts, worry about sleep, and the resulting difficulty initiating and maintaining sleep.

5.3 Factor-Total Score Correlations

Factor	Correlation with Total Score	p-value
Factor 1 (Daytime Impairment)	r = 0.71	< 0.001
Factor 2 (Sleep Anxiety)	r = 0.75	< 0.001

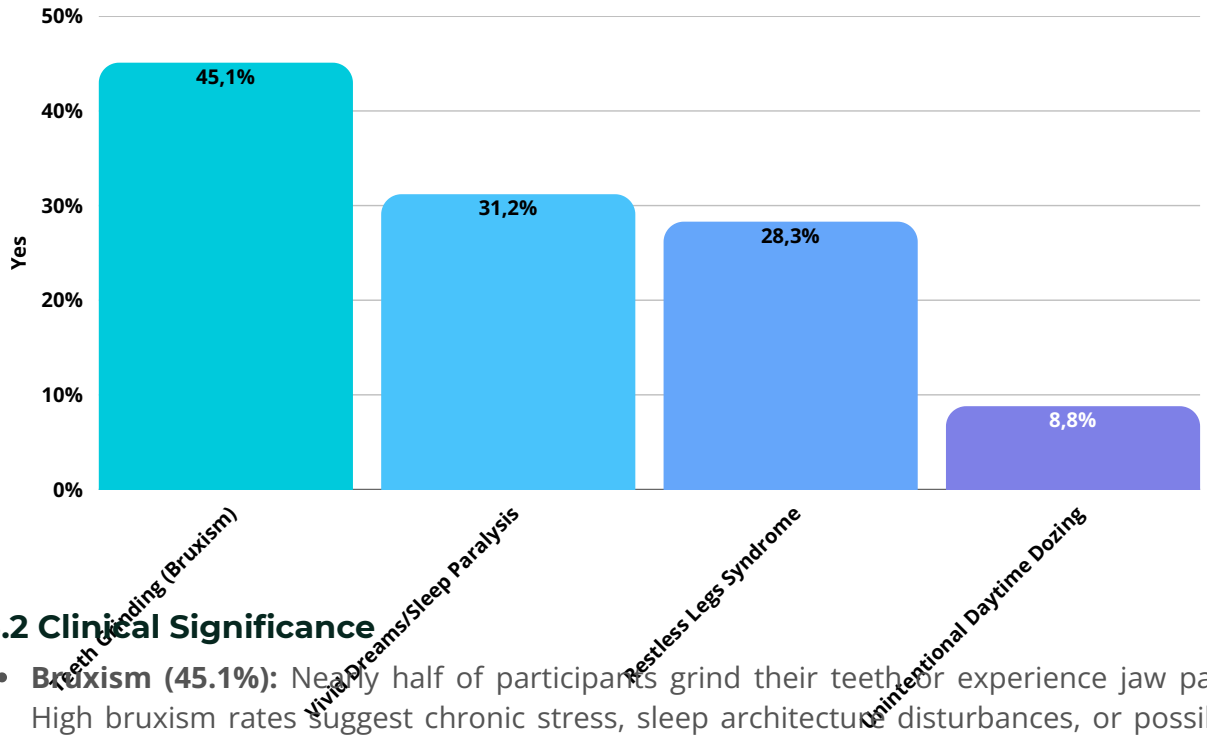
Both factors strongly predict total sleep dysfunction, suggesting comprehensive interventions should address both nighttime sleep quality and daytime recovery.

6. Binary Sleep Disorder Indicators

6.1 Prevalence of Sleep-Related Conditions

Survey C screens for four additional sleep-related conditions using binary (Yes/No) questions:

Condition	Yes	%
Teeth Grinding (Bruxism)	51	45,1%
Vivid Dreams/Sleep Paralysis	35	31,2%
Restless Legs Syndrome	32	28,3%
Unintentional Daytime Dozing	10	8,8%



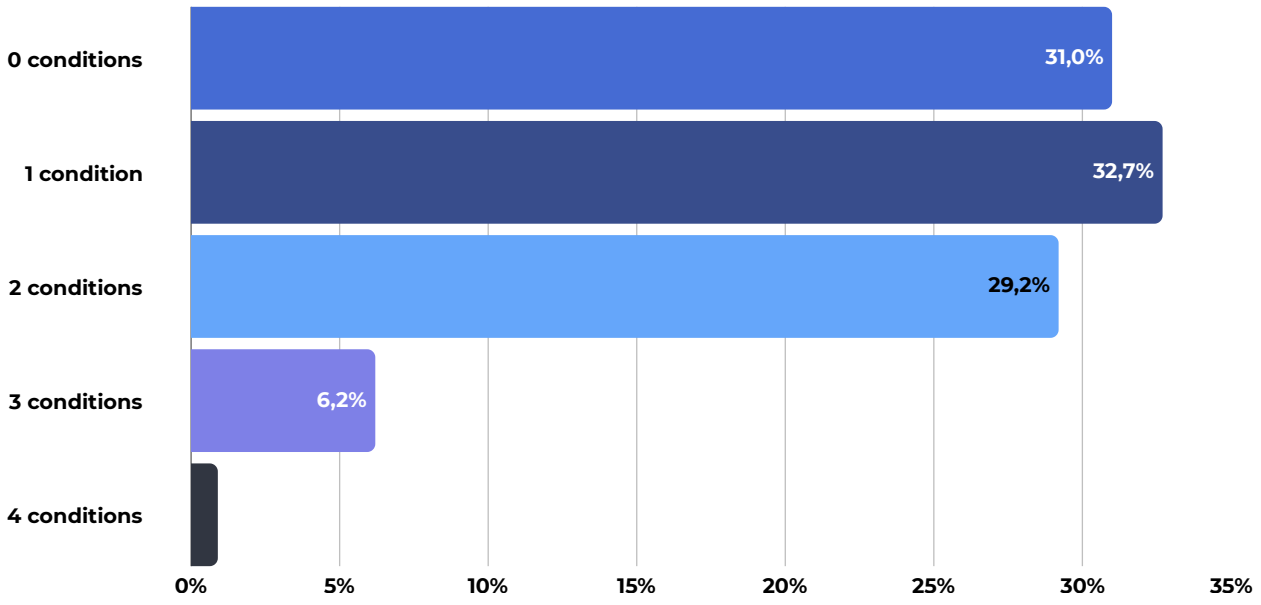
6.2 Clinical Significance

- **Bruxism (45.1%):** Nearly half of participants grind their teeth or experience jaw pain. High bruxism rates suggest chronic stress, sleep architecture disturbances, or possible obstructive sleep apnea (OSA). Dental and sleep medicine referral recommended.
- **Vivid Dreams/Sleep Paralysis (31.2%):** One-third report vivid dreams or paralysis upon waking, indicating REM sleep dysregulation. May reflect fragmented sleep architecture or anxiety-related sleep disturbance.
- **Restless Legs Syndrome (28.3%):** Over one-quarter experience RLS symptoms. Should prompt evaluation for iron deficiency, peripheral neuropathy, and medication effects. RLS significantly impairs sleep initiation.
- **Unintentional Dozing (8.8%):** Low prevalence of daytime sleep attacks suggests the population maintains wakefulness despite fatigue, possibly through hypervigilance or compensatory behaviors.

6.3 Co-morbidity Analysis

Number of Conditions	n	%	Mean Total Score
0 conditions	35	31,0%	60,5
1 condition	37	32,7%	62,9
2 conditions	33	29,2%	83,3
3 conditions	7	6,2%	90,4
4 conditions	1	0,9%	87,0

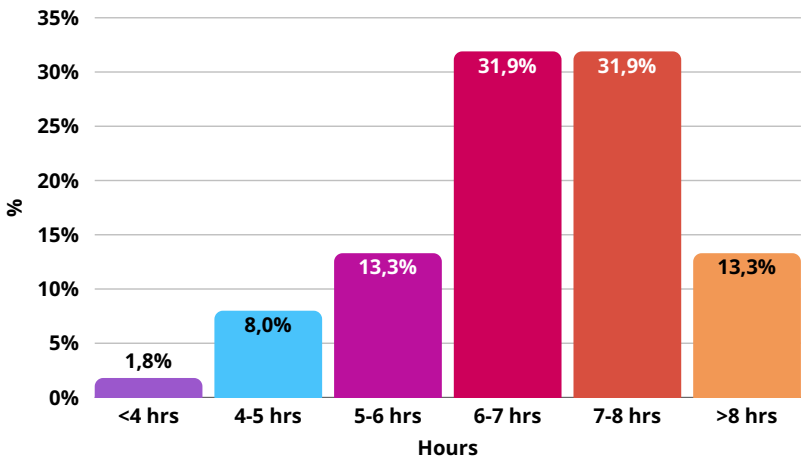
Key Finding: Participants with 2+ binary conditions show markedly elevated total scores (mean 83-90 vs. 60-63 for 0-1 conditions). The correlation between number of conditions and total score is highly significant ($r = 0.45$, $p < 0.001$).



7. Sleep Architecture Analysis

7.1 Hours Slept Per Night

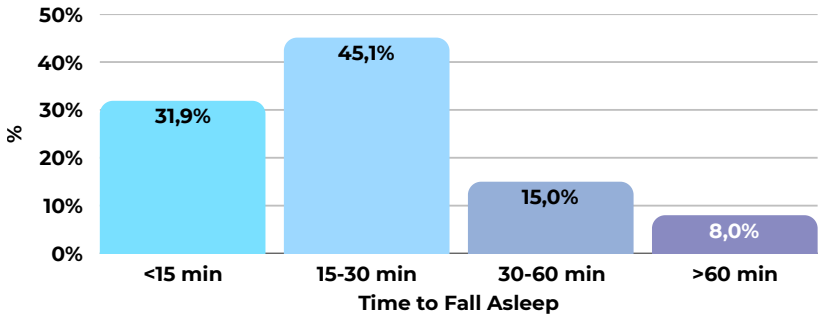
Hours	n	%
<4 hrs	2	1,8%
4-5 hrs	9	8,0%
5-6 hrs	15	13,3%
6-7 hrs	36	31,9%
7-8 hrs	36	31,9%
>8 hrs	15	13,3%



Interpretation: The majority (63.7%) report 6-8 hours of sleep, within normal ranges. However, sleep quantity does not equal sleep quality: high symptom scores despite adequate duration suggest non-restorative sleep.

7.2 Sleep Onset Latency

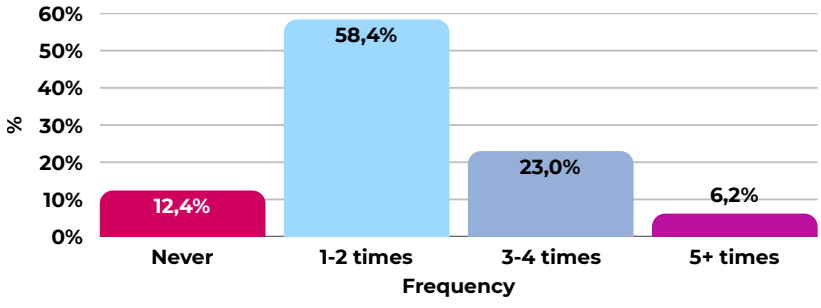
Time to Fall Asleep	n	%
<15 min	36	31,9%
15-30 min	51	45,1%
30-60 min	17	15,0%
>60 min	9	8,0%



Interpretation: Most participants (77%) fall asleep within 30 minutes, which is a normal range. The 23% with prolonged sleep onset (>30 min) represent clinical insomnia candidates.

7.3 Night Awakenings

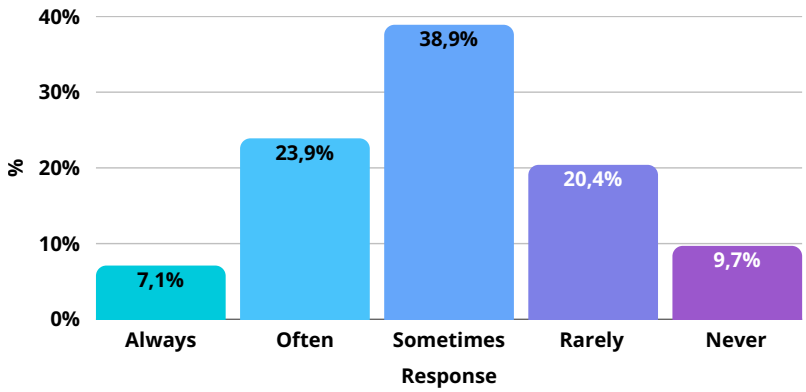
Frequency	n	%
Never	14	12,4%
1-2 times	66	58,4%
3-4 times	26	23,0%
5+ times	7	6,2%



Interpretation: Sleep fragmentation is common, with 87.6% experiencing at least some night awakenings. The 29.2% with 3+ awakenings may have sleep maintenance insomnia or other underlying disorders.

7.4 Feeling Refreshed on Waking

Response	n	%
Always	8	7,1%
Often	27	23,9%
Sometimes	44	38,9%
Rarely	23	20,4%
Never	11	9,7%



Interpretation: Only 31% of participants feel refreshed at least often upon waking. Nearly 70% experience non-restorative sleep, the core dysfunction in this population.

7.5 Social Jet Lag Analysis

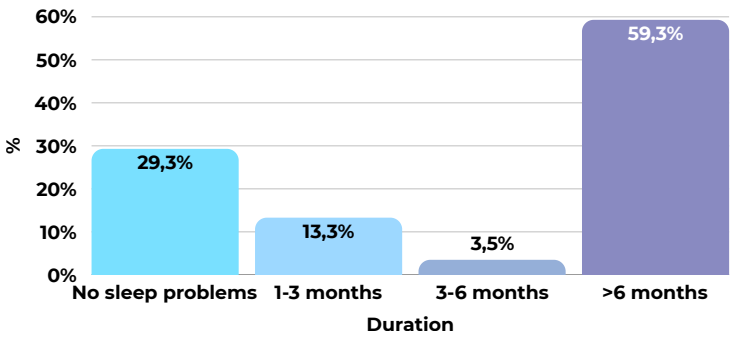
Metric	Mean Shift
Bedtime shift (weekend vs. weekday)	+0.63 hours
Waketime shift (weekend vs. weekday)	+0.98 hours

Interpretation: Participants go to bed ~40 minutes later and wake ~1 hour later on weekends, indicating mild social jet lag. This circadian misalignment may contribute to Monday fatigue and overall sleep dysfunction.

8. Chronicity and Impact

8.1 Duration of Sleep Problems

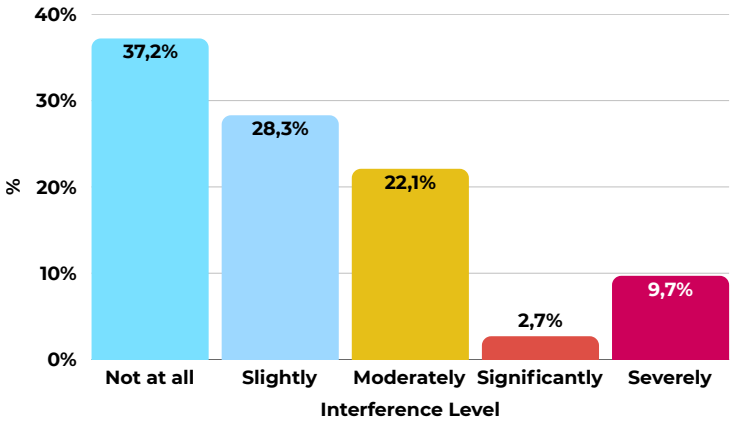
Duration	n	%
No sleep problems	27	29,3%
1-3 months	15	13,3%
3-6 months	4	3,5%
>6 months	67	59,3%



Interpretation: Among those with sleep problems, the vast majority (59.3%) have experienced them for over 6 months, meeting criteria for chronic insomnia disorder.

8.2 Daily Life Interference

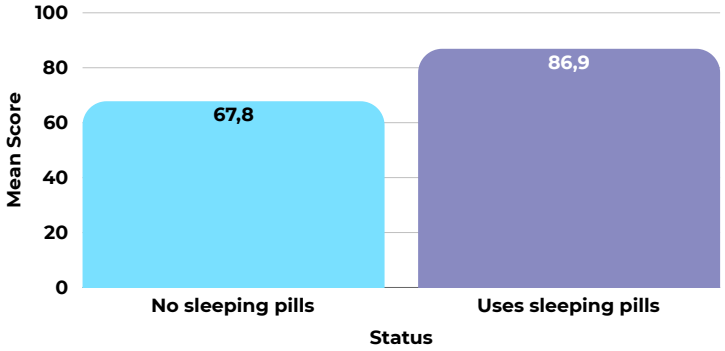
Interference Level	n	%
Not at all	42	37,2%
Slightly	32	28,3%
Moderately	25	22,1%
Significantly	3	2,7%
Severely	11	9,7%



Interpretation: While 37% report no interference, over 62% experience some degree of daily life impact. The 12.4% with significant-to-severe interference represent priority cases for intervention.

8.3 Sleeping Pill Usage

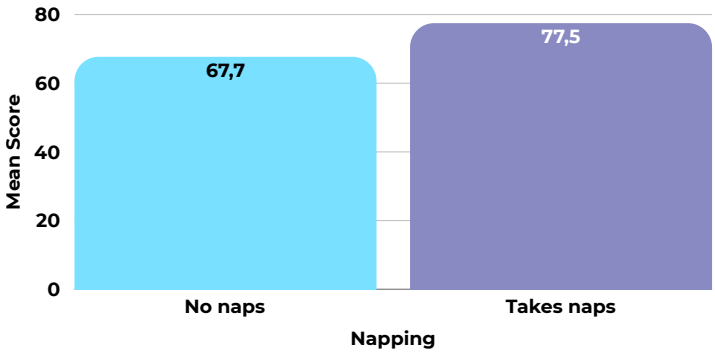
Status	n	Mean Score
No sleeping pills	100	67,8
Uses sleeping pills	13	86,9



Interpretation: Participants using sleeping pills have substantially higher total scores (86.9 vs. 67.8), reflecting more severe underlying sleep dysfunction. Medication dependence may also contribute to score elevation.

8.4 Napping Behavior

Napping	n	Mean Score
No naps	86	67,7
Takes naps	27	77,5

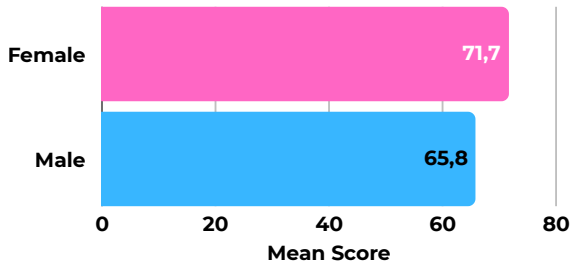


Interpretation: Nappers show higher scores, suggesting napping may be a compensatory behavior for inadequate nighttime sleep rather than a healthy practice in this population.

9. Gender Differences

9.1 Total Score Comparison

Gender	n	Mean	Median	SD
Female	81	71,7	79,0	23,1
Male	32	65,8	64,0	22,0

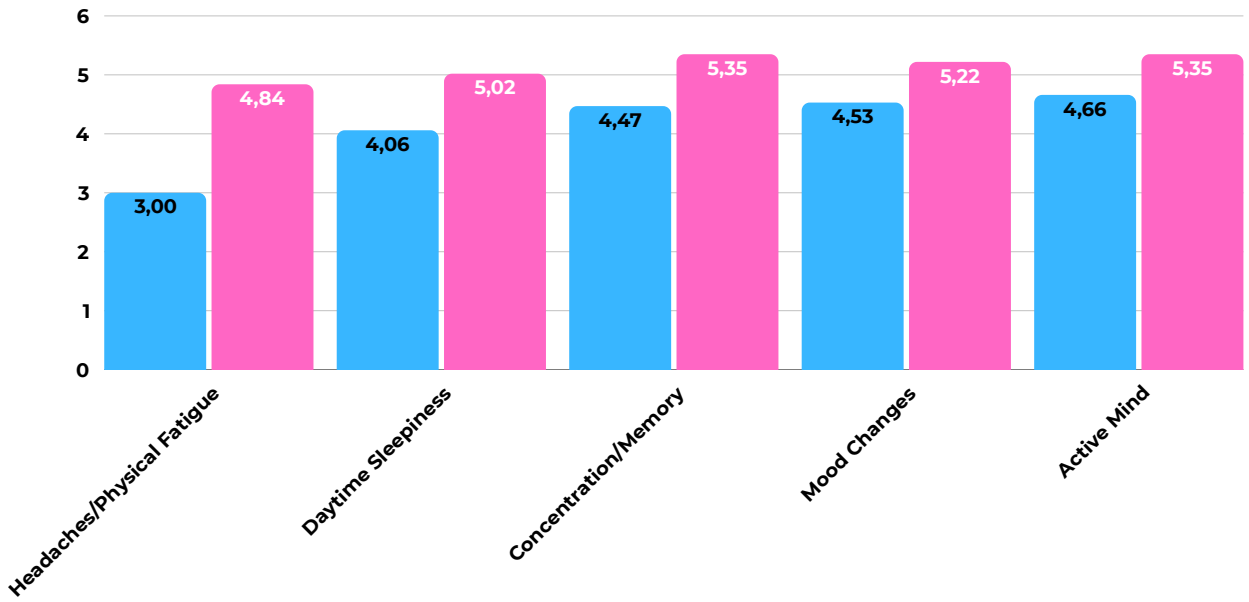


Statistical Test: t = 1.23, p = 0.222 (not significant)

While females show numerically higher scores, the overall difference does not reach statistical significance.

9.2 Symptom-Level Gender Differences

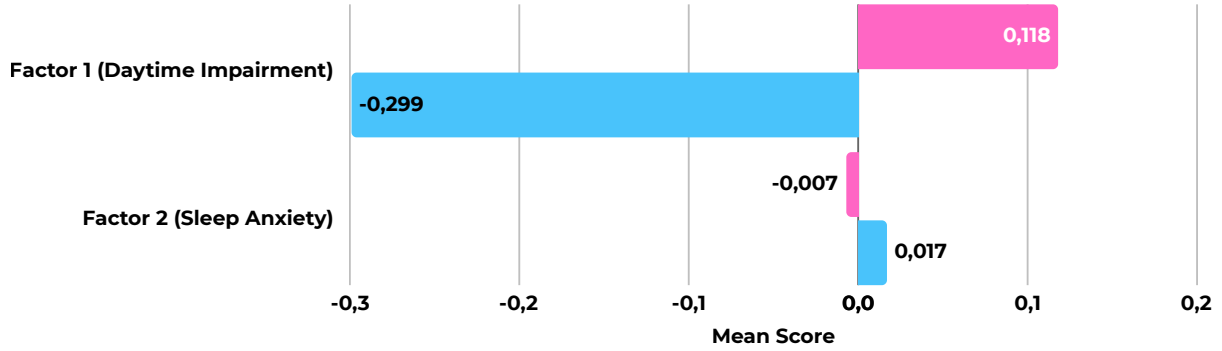
Symptom	Female Mean	Male Mean	Difference	Significance
Headaches/Physical Fatigue	4,84	3,00	1,84	p < 0.05 *
Daytime Sleepiness	5,02	4,06	0,96	NS
Concentration/Memory	5,35	4,47	0,88	NS
Mood Changes	5,22	4,53	0,69	NS
Active Mind	5,35	4,66	0,69	NS



Key Finding: Females report significantly higher headaches and physical fatigue than male, the only statistically significant symptom difference.

9.3 Factor Score Gender Differences

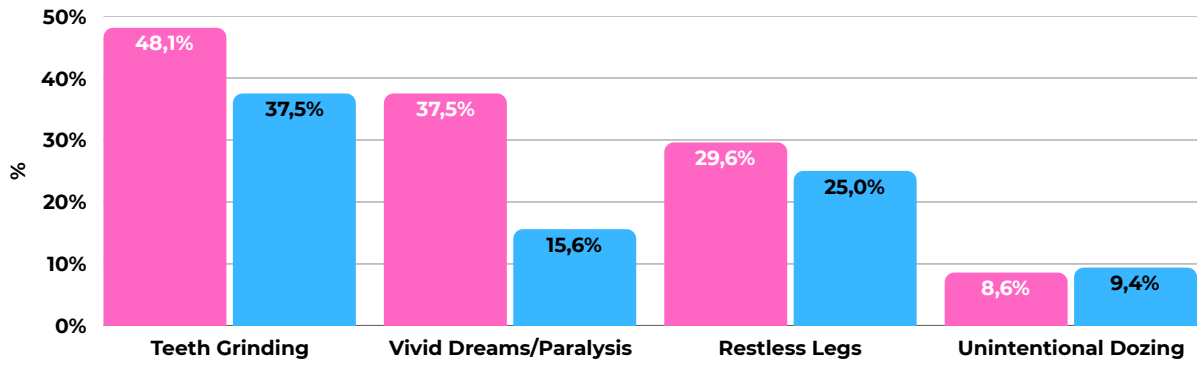
Factor	Female Mean	Male Mean	p-value
Factor 1 (Daytime Impairment)	0,118	-0,299	0,030*
Factor 2 (Sleep Anxiety)	-0,007	0,017	0,9



Key Finding: Females score significantly higher on Factor 1 (Daytime Functional Impairment), suggesting they experience more pronounced physical and cognitive consequences of sleep disruption.

9.4 Binary Indicator Gender Differences

Condition	Female	Male
Teeth Grinding	48,1%	37,5%
Vivid Dreams/Paralysis	37,5%	15,6%
Restless Legs	29,6%	25,0%
Unintentional Dozing	8,6%	9,4%

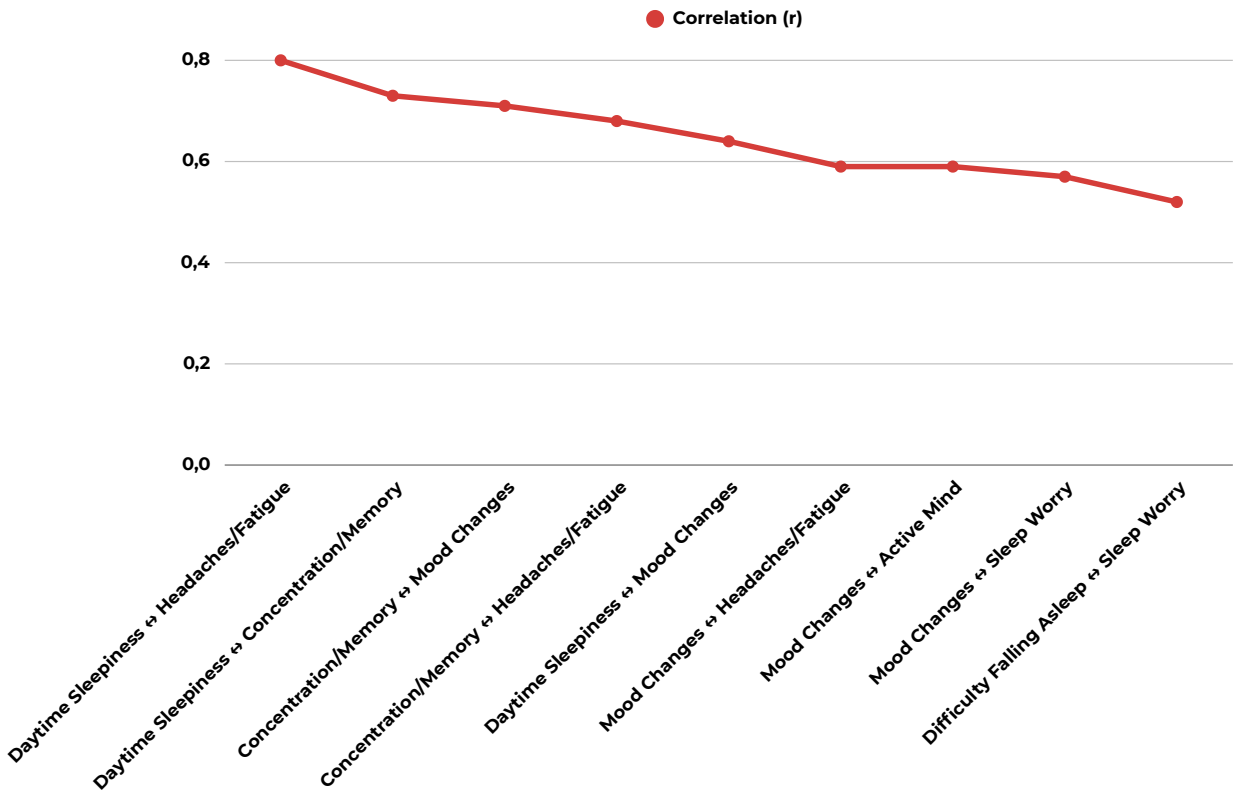


Key Finding: Females show substantially higher rates of vivid dreams/sleep paralysis (37.5% vs. 15.6%), suggesting potential differences in REM sleep dynamics.

10. Strongest Correlations

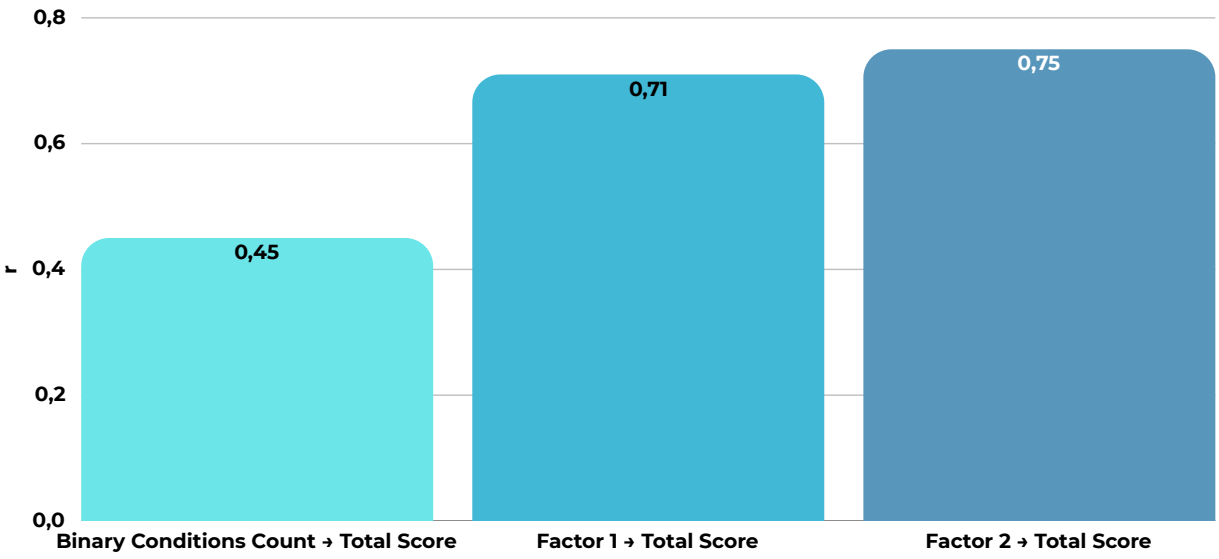
10.1 Inter-Symptom Correlations

Symptom Pair	Correlation (r)
Daytime Sleepiness ↔ Headaches/Fatigue	0,80
Daytime Sleepiness ↔ Concentration/Memory	0,73
Concentration/Memory ↔ Mood Changes	0,71
Concentration/Memory ↔ Headaches/Fatigue	0,68
Daytime Sleepiness ↔ Mood Changes	0,64
Mood Changes ↔ Headaches/Fatigue	0,59
Mood Changes ↔ Active Mind	0,59
Mood Changes ↔ Sleep Worry	0,57
Difficulty Falling Asleep ↔ Sleep Worry	0,52



10.2 Key Predictive Relationships

Relationship	r	p-value	Variance Explained
Binary Conditions Count → Total Score	0,45	< 0.001	20%
Factor 1 → Total Score	0,71	< 0.001	50%
Factor 2 → Total Score	0,75	< 0.001	56%



10.3 Interpretation

The strongest correlations form a "daytime dysfunction cascade": poor sleep leads to fatigue, which impairs concentration, which affects mood, which creates physical symptoms like headaches, a self-reinforcing cycle.

Discussion

Why Sleep Matters in EHS: The Central Mediator

Sleep is not merely another symptom in electromagnetic hypersensitivity, it is the biological system most vulnerable to electromagnetic disruption and the primary mediator through which EMF exposure translates into symptomatic illness.

In our cross-survey analysis of the complete cohort (n=94 who completed all three surveys), the sleep-symptom correlation (r=0.638) emerged as the strongest relationship in the entire census dataset, substantially exceeding the direct correlation between EMF exposure habits and symptoms (r=0.400). This positions sleep disruption not as a consequence of EHS, but as a central mechanism driving the syndrome.

The biological rationale is robust. Nighttime represents a period of profound vulnerability:

- **Melatonin production**, dependent on darkness and suppressed by both blue light and electromagnetic fields, orchestrates cellular repair, immune surveillance, and neurological restoration
- **The glymphatic system**, responsible for clearing metabolic waste from the brain, operates primarily during deep sleep, disruption impairs this essential detoxification
- **Autonomic balance shifts toward parasympathetic dominance during healthy sleep;** EMF exposure may maintain sympathetic activation, preventing restorative rest
- **Cortisol rhythms normally reach their nadir during early sleep**; elevated nocturnal cortisol from EMF exposure fragments sleep architecture

When this nocturnal recovery window is compromised, the downstream consequences cascade through every physiological system, explaining why sleep dysfunction predicts symptom burden more strongly than exposure itself.

The Core Discovery: Non-Restorative Sleep

The most significant finding from Survey C challenges a common assumption about sleep problems in EHS. This population does not primarily suffer from inability to sleep, they suffer from sleep that fails to restore.

The paradox in numbers:

- 63.7% report sleeping 6-8 hours per night (within normal range).
- Yet only 31% wake feeling refreshed.
- 77% fall asleep within 30 minutes (normal sleep onset).
- But 87.6% experience night awakenings.

The sleep is occurring, but it is not performing its regenerative function.

This pattern (adequate quantity with inadequate quality) is the hallmark of environmentally-disrupted sleep. Unlike primary insomnia (difficulty initiating sleep) or obstructive sleep apnea (mechanical airway obstruction), environmentally-mediated sleep dysfunction often preserves gross sleep metrics while impairing the microstructure of restorative sleep phases.

Standard sleep duration recommendations ("get 7-8 hours") miss the point entirely for this population. The intervention target is sleep quality, not quantity, and that requires addressing the environmental factors disrupting restorative function.

The Daytime Cascade: From Sleep to Symptoms

Factor analysis identified two dimensions underlying the Survey C symptom profile:

- **Factor 1: Daytime Functional Impairment (28.6% variance)**

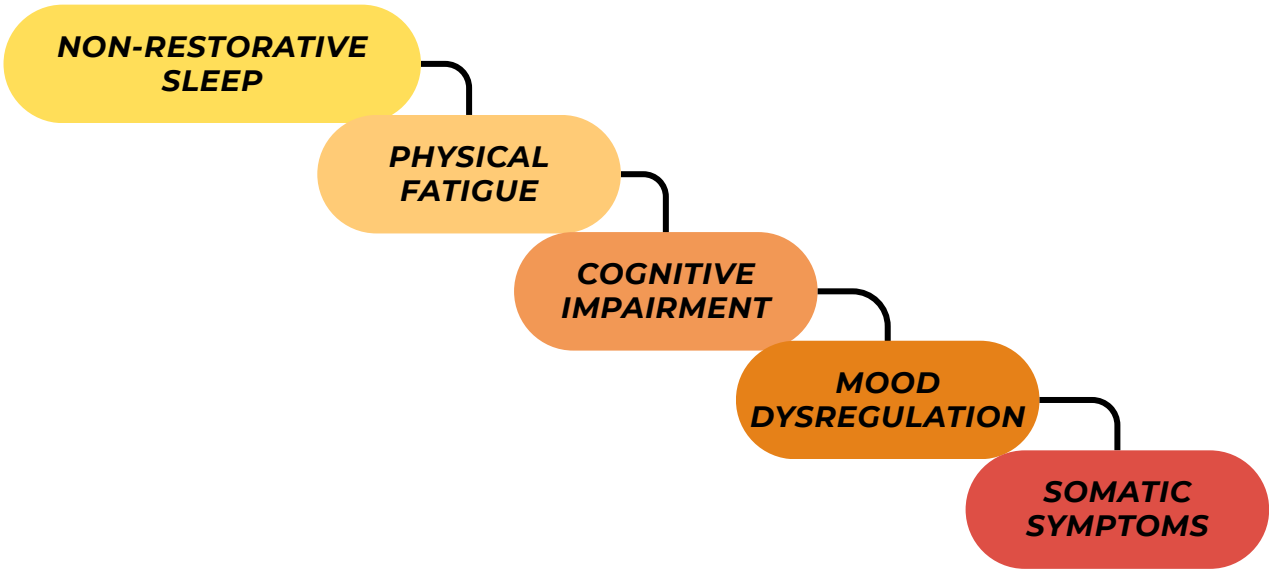
Fatigue, concentration problems, mood changes, headaches.

- **Factor 2: Sleep Initiation/Maintenance Anxiety (25.2% variance)**

Sleep worry, active mind, difficulty falling asleep, night awakenings.

The critical finding is that Factor 1 (the daytime consequences) explains more variance and loads more heavily on total score than Factor 2 (the nighttime complaints).

The syndrome is not primarily about difficulty falling asleep or staying asleep. It is about sleep that fails to restore, followed by a predictable cascade of daytime dysfunction:



The correlations within Factor 1 support this cascade model:

- **Daytime sleepiness ↔ Headaches/fatigue:** r = 0.80
- **Daytime sleepiness ↔ Concentration/memory:** r = 0.73
- **Concentration/memory ↔ Mood changes:** r = 0.71

This cascade maps precisely onto the top symptoms identified in Survey B:

- **Fatigue:** 5.94/10 (rank #1)
- **Concentration problems:** 5.15/10 (rank #2)
- **Nervousness:** 5.13/10 (rank #3)
- **Insomnia:** 5.08/10 (rank #4)
- **Irritability:** 4.95/10 (rank #5)

Survey C reveals that these are not independent symptoms, they are downstream consequences of sleep that fails to perform its regenerative function. The EHS symptom profile documented in Survey B is, in substantial part, a sleep deprivation syndrome.

The Exposure-Sleep Link

Survey A (n=283) documented the behavioral exposure patterns that may drive the sleep dysfunction quantified in Survey C:

Sleep technology habits (Survey A findings):

- 60.8% keep phones active and accessible during sleep
- 33.2% use screens to fall asleep
- 51.6% check phones during the night
- 37.4% charge phones beside the bed
- 23.3% sleep with phones under pillow or very close

The correlation structure: Given these high-risk exposure patterns, we examined the relationship between Survey A and Survey C . The cross-survey analysis (n=94 complete cohort) found that the direct path from EMF exposure to symptoms (r=0.400) is weaker than the path from sleep to symptoms (r=0.638). Yet EMF exposure correlates with sleep (r=0.286), and sleep correlates powerfully with symptoms.

This pattern suggests sleep mediates the relationship between EMF exposure and symptoms.

Why Females Bear Greater Burden

Women comprise 82.7% of the Moderate sleep dysfunction category despite representing 71.7% of the overall sample. This disproportionate burden aligns with Survey B findings (71.6% female) and the broader EHS epidemiological literature reporting 60-80% female prevalence.

Several mechanisms may explain this gender disparity:

- **Hormonal factors:** Estrogen and progesterone influence sleep architecture, and the hormonal fluctuations of menstrual cycles, perimenopause, and menopause disrupt sleep stability. Several participants in Survey C mentioned menopausal symptoms in their open-text comments. Women may be more vulnerable to additional environmental sleep stressors when hormonal sleep regulation is already challenged.
- **Symptom expression:** The statistically significant finding that women report higher headaches and physical fatigue (Factor 1) may reflect genuine biological differences in how sleep deprivation manifests, or differences in symptom awareness and reporting thresholds.
- **Autonomic sensitivity:** Emerging evidence suggests women may have heightened electromagnetic sensitivity due to differences in autonomic nervous system regulation and potentially higher oxidative stress responses, though this remains an active research area.
- **Clinical implications:** Sleep interventions in EHS populations should be particularly attentive to female-specific factors:
  - Hormonal status assessment (perimenopausal symptoms).
  - Iron studies (relevant to the 28.3% with restless legs—women have higher RLS prevalence).
  - The documented higher rates of vivid dreams/paralysis (37.5% vs. 15.6% in males) suggesting REM dysregulation.

The Co-Morbidity Signal: Sleep System Under Stress

The high prevalence of secondary sleep conditions—bruxism (45.1%), vivid dreams/sleep paralysis (31.2%), restless legs syndrome (28.3%)—and their strong correlation with total score ($r=0.45$, $p<0.001$) deserves careful interpretation.

These are not random co-occurrences. Each condition reflects a specific form of sleep architecture disruption:

Bruxism (45.1%)

Nocturnal teeth grinding indicates sympathetic hyperactivation and sleep-stage transition abnormalities. Its remarkably high prevalence (nearly half the sample) suggests chronic stress-state sleep where the nervous system remains partially activated rather than achieving the parasympathetic dominance essential for restorative rest.

Critically, bruxism is also a clinical marker for obstructive sleep apnea (OSA). The high bruxism prevalence warrants systematic sleep apnea screening in this population.

Vivid dreams and sleep paralysis (31.2%)

These phenomena indicate REM sleep dysregulation, either REM intrusion during wake transitions (paralysis) or heightened REM activity and recall (vivid dreams). They suggest fragmented sleep architecture where sleep stages don't progress through normal cycles.

The substantially higher prevalence in females (37.5% vs. 15.6%) may reflect hormonal influences on REM regulation.

Restless legs syndrome (28.3%)

RLS drives sleep-onset insomnia through uncomfortable sensations that compel movement. It reflects dopaminergic dysfunction often linked to iron deficiency—ferritin levels below 50 ng/mL can trigger or exacerbate RLS even when technically "normal."

The 28.3% prevalence warrants systematic iron studies (ferritin, transferrin saturation, TIBC) in affected individuals. This is a treatable contributor to sleep dysfunction that may be overlooked if attributed solely to EMF exposure.

The unifying pattern

These conditions are not independent disorders co-occurring by chance. They are different manifestations of a sleep system under chronic stress—potentially from electromagnetic exposure disrupting the normal neurological regulation of sleep.

The Completion Paradox Revisited

Survey C's participation pattern reflects the "Completion Paradox" identified in the integrated census analysis: participants with more severe dysfunction were less likely to complete all three surveys.

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The data

- Those who completed only Survey C (n=31 out of 171 single-survey completers) showed sleep scores 29% higher than those who completed all three surveys.
- Survey C showed the largest completion gap of any survey (+29% vs. +15% for Survey B and +10% for Survey A).

Why sleep problems create the largest gap

Severe sleep disruption impairs precisely the capacities required to complete lengthy assessment protocols:

- Cognitive function for understanding questions
- Energy and stamina for sustained effort
- Concentration for accurate responses
- Motivation and follow-through capacity

Implications

The 113 participants who completed Survey C represent a subset with sufficient functional capacity to sustain assessment. True population burden is likely higher.

Adjusted estimate: If the complete-cohort mean (70.0) underestimates true population burden by ~20-25%, the adjusted population mean would be approximately 84-88 points, shifting the population centroid from the Mild into the Moderate category. Our finding that "47.8% require professional evaluation" is likely conservative; the true proportion may exceed 55-60%.

Implications for the EFEIA Protocol

Survey C validates the EFEIA Protocol's positioning of sleep assessment as the "physiological bridge" between lifestyle exposure (Survey A) and symptoms (Survey B).

For assessment: Survey C identifies which individuals require sleep-specific evaluation beyond general EHS assessment. The 47.8% in Moderate-Severe categories warrant:

- Polysomnography (especially if bruxism present—OSA screening).
- Iron studies (if restless legs symptoms).
- Comprehensive sleep medicine evaluation.
- Not merely electromagnetic hygiene counseling.

For intervention prioritization: The correlation structure suggests the following hierarchy:

1. Bedroom EMF remediation (addresses the exposure-sleep link).
2. Sleep hygiene optimization (addresses behavioral factors).

3. Medical evaluation (addresses underlying disorders like OSA, RLS).
4. Daytime EMF reduction (addresses direct symptom triggers).

For progress monitoring: Because sleep responds relatively quickly to environmental changes (often within days to weeks) Survey C serves as the optimal instrument for evaluating intervention effectiveness. Changes in sleep scores following EMF remediation provide the most sensitive early marker of treatment response.

Limitations

- **Self-selection bias:** Participants interested in EHS may have higher baseline sleep dysfunction.
- **Self-report measures:** No polysomnographic validation of sleep architecture.
- **Cross-sectional design:** Cannot establish causation between EMF exposure and sleep problems.
- **No control group:** Cannot compare to general population or non-EHS-concerned individuals.
- **Language differences:** Possible cross-cultural variation in symptom reporting
- **Small subgroups:** Some demographic categories (e.g., obese, severe) have limited sample sizes.

Conclusion

Principal Findings

1. **Sleep dysfunction is pervasive and severe.** 47.8% of participants experience moderate-to-severe sleep disturbance (scores ≥75/163), with 59.3% reporting chronic problems exceeding 6 months. This is established, clinically significant sleep dysfunction requiring systematic intervention.
2. **The core problem is non-restorative sleep, not sleep deprivation.** Despite 63.7% reporting adequate sleep duration (6-8 hours), only 31% wake feeling refreshed. The sleep is occurring but failing to perform its regenerative function: the signature pattern of environmentally-mediated sleep disruption.
3. **Daytime consequences drive the symptom burden.** Factor analysis reveals that Daytime Functional Impairment (fatigue, cognitive dysfunction, mood changes, headaches) explains more variance than Sleep Initiation/Maintenance Anxiety. The EHS symptom profile documented in Survey B (fatigue, concentration problems, nervousness, irritability) represents the downstream cascade of non-restorative sleep.
4. **Sleep disorders cluster together, suggesting shared mechanisms.** 45% have bruxism, 31% have vivid dreams/paralysis, 28% have restless legs. Those with 2+ conditions score dramatically higher, and the number of conditions correlates strongly with total score (r=0.45). These are different expressions of a sleep system under chronic environmental stress.
5. **Women bear disproportionate burden.** Females comprise 82.7% of the Moderate category, show significantly higher Factor 1 scores (daytime impairment), and report substantially higher rates of vivid dreams/paralysis. This gender disparity mirrors Survey B and the broader EHS literature, suggesting hormonal and autonomic factors warrant investigation.

The Sleep-EHS Connection

Survey C findings support a mechanistic model positioning sleep as the critical mediator between EMF exposure and EHS symptoms:

The correlation structure across surveys is consistent with this model:

- **Habits → Sleep:** r=0.286 (weak direct effect)
- **Sleep → Symptoms:** r=0.638 (strongest correlation)
- **Habits → Symptoms**: r=0.400 (moderate, likely mediated through sleep)

This has profound implications: interventions targeting sleep may be more effective than interventions targeting EMF exposure directly, because sleep sits at the critical bottleneck where exposure translates into illness.

Final Statement

Survey C reveals that sleep dysfunction in the EHS population is not a peripheral symptom, it is the central mechanism through which electromagnetic exposure appears to generate illness. The finding that nearly half of participants experience moderate-to-severe sleep dysfunction, predominantly characterized by non-restorative sleep despite adequate duration, positions sleep as the primary intervention target.

The practical implication is clear: in EHS management, fix the sleep first. The bedroom electromagnetic environment represents the most critical exposure window, and sleep quality provides the most sensitive marker of treatment response. For the 47.8% with moderate-to-severe dysfunction, this requires professional sleep medicine evaluation alongside electromagnetic assessment.

Survey C completes the triadic framework of the EHS Global Census, providing the physiological bridge between exposure (Survey A) and symptoms (Survey B). Together, these three surveys establish the quantitative foundation for evidence-based EHS assessment and targeted intervention, moving the field from subjective report toward measurable, reproducible evaluation.

EHS GLOBAL CENSUS 2025
Survey C: **Sleep Disorders**

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