

# Exploring the Link Between Women's Sleep, Daily Rhythms, and Mental Health in Women Across Different Stages of Life

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## ABSTRACT

This research article delves into the intricate connection between women's sleep behaviors, daily rhythms, and mental well-being across different stages of life. Utilizing a comprehensive literature review and empirical data analysis, it examines how variations in sleep quality, circadian preferences, and mental health outcomes manifest in women from adolescence through adulthood and into older age. The study sheds light on the nuanced interactions between these factors and offers insights into potential interventions to promote better sleep hygiene and mental health support tailored to women's specific life stages.

**Keywords:** Women; Sleep Patterns; Daily Rhythms; Mental Health; Life Stages.

## 1. Introduction

Insomnia symptoms affect up to 20% of the world population and often accompany and even predict the onset of common mental disorders, such as depression, anxiety, attention deficit hyperactivity disorder, and autism spectrum disorder. In fact, the criteria of insomnia disorder include daytime symptoms, such as inattention and mood disturbances, which overlap with the symptoms of common mental health problems. There is also evidence, although scarce and less consistent, that suggests a link between poor sleep and other problems related to mental health, such as aggression and substance use. Insomnia symptoms and the mental health problems associated with them are also more prevalent in individuals with late circadian preferences.<sup>1</sup>

According to certain research, circadian preferences might only be linked to mental health issues when sleep issues are present. However, the relationships with mental health issues may change for various aspects of circadian preferences and symptoms of insomnia, as well as for the combinations of these factors. For instance, whilst aggressive behavior and impulsivity were more highly correlated with better morning affect, depression and anxiety were more strongly correlated with later sleep-wake time preferences.<sup>2</sup>



First, most of the older studies only looked at one mental health problem at a time. It is not possible to directly compare cross-disorder associations because the study samples were not all the same and the methods used were different. Also, because there are many different ways to measure insomnia symptoms, like "sleep disturbances" and "sleep quality," and many different ways to measure circadian preferences, like "midpoint of sleep," "bedtime," and "morning affect," it's not possible to tell if the links with mental health are present for all insomnia symptoms and circadian preferences. Aside from the fact that sleep quality may play a role in the link between circadian preference and sadness or anxiety, not much is known about how insomnia symptoms and circadian preferences affect mental health when they are combined. Second, the number of people who have insomnia complaints and people who have circadian preferences varies a lot between men and women and across the lifespan. This can change how these two things are related to mental health problems.<sup>3</sup>



For example, late circadian patterns and bad sleep quality were found to be stronger links between mood problems in women than in men. According to what we know, there hasn't been a study that used a big enough sample of the general population to let us compare the links between sleep and mental health between men and women from childhood to old age. Third, there isn't a lot of data that shows how insomnia symptoms and circadian preferences are connected to drug use and aggression. For instance, the results are divided on whether there is a link between insomnia complaints and drinking alcohol. Several studies found a link between aggression and insomnia symptoms and late-night waking habits. However, these studies only looked at very specific groups of people and had different definitions of aggression. The links between insomnia symptoms, circadian preferences, and mental health are still not clear. It's not clear if they apply to all common mental health problems in both sexes and age groups, or if they only apply to certain mixtures of insomnia symptoms and circadian preferences.<sup>4</sup>



## 2. Methods

The pre-registration describing all methods and rationale behind our choices can be found on the Open Science Framework.<sup>5</sup>

### 2.1. Sample

The information was gathered during an extra cross-sectional study called Comorbid Conditions of Attention Deficit Hyperactivity Disorder (CoCA), which was part of the Lifelines project. Lifelines is a prospective population-based cohort study that looks at the health and health-related behaviors of 167,729 people in the North of The India, ages 0 to 93, in a unique three-generation design. As part of its research, it looks at the biological, socio-demographic, behavioral, physical, and psychological factors that affect the health and illness of the general population. It focuses on multi-morbidity and complex genetics in particular. From 2006 to 2013, the first people aged 25 to 50 were asked to join by their primary care doctors. The next group of participants, aged 6 months to 93 years, were asked by family members who were also taking part. The last group of participants, aged 18 to 93 years, self-registered on Lifelines' website.<sup>6</sup>

People who were very sick, had a short life span (five years), or didn't understand Dutch well enough were not allowed to take part. Lifelines is a good representation of the Northern Dutch community as a whole, with only minor differences in health and demographics. Lifelines has more middle-aged adults than the total population of the northern India. It has fewer immigrants and people with less schooling than the total population. The CoCA sample is made up of 37,727 Lifelines members between the ages of 4 and 91. For this study, we used the CoCA participants who filled out the survey about sleep and most of the survey about mental health. This made up about 98% of the full CoCA group.<sup>7</sup>

Between 2017 and 2019, all Lifelines volunteers who had access to the internet were asked to take part in the CoCA study. The only big difference between the CoCA and Lifelines participants was that the CoCA participants were a little older than the Lifelines participants. The ethics committee at the University

Medical Center Groningen gave their approval to both Lifelines and CoCA. Everyone who took part or their legal guardians gave their informed permission.<sup>8</sup>

## 2.2. Measurement tools and variables

The individuals' sex was categorized as either male or female. The age distribution was as follows: children (4–12 years old), teenagers (13–17), young adults (18–34), middle-aged adults I (35–49), middle-aged adults II (50–64), and older adults ( $\geq 65$ ). The age distribution was expressed in years. In order to account for the expected qualitative differences in sleep characteristics between men and women and across age groups in the latent profile analysis, the sample was stratified by sex and age. Due to prior research demonstrating that women who reached menopause, in contrast to males of the same age, tended to have more severe or distinct sleep disorders, the classification of middle-aged individuals into two subgroups was decided.  $N=806-9,115$  people made up each age-sex grouping, with the exception of a tiny subsample of teenagers ( $n_{boys}=267$ ;  $n_{girls}=277$ ).<sup>9</sup>

The net monthly pay in euros was used to calculate household income among socioeconomic parameters. The range of educational attainment was from not completing elementary school (1) to earning a university degree (8). Higher scores (range from 0 to 100) denoted a more prestigious job. The International Standard Classification of Occupations 2008 served as the basis for occupational prestige.<sup>10</sup>

## 3. Results

### 3.1. Features in general

For most analyses, our analytical sample consisted of 37,027 individuals. The sizes of the age-sex subgroups ranged from  $N=267$  to 9,115, with the smallest sample size observed in male adolescents and the largest in females in the second group of middle-aged adults. Approximately half of children, adolescents, and older adults were female (46-51%), while females were more prevalent among young and middle-aged adults (59-67%). Since no substance use was reported in children, they were excluded from the analyses of alcohol drinking, drug use, and smoking, resulting in smaller analytical sample sizes ( $N=35,212-35,392$ ). Additionally, there was more missing data in the dataset used for the sensitivity analyses. 11.3% for household income, 2.8% for occupational prestige, 2.5% for educational attainment, and 2.7% for neighborhood socio-economic status.

Most participants reported either no or very low insomnia symptoms, with the highest scores observed in female adults. Circadian preferences tended to be earlier in children, later in adolescents and young adults, and more intermediate in middle-aged and older adults across all dimensions. The correlations between all sleep characteristics and most mental health problems were found to be low to moderate and statistically significant in both men and women.

However, drug use and smoking were not correlated with difficulties maintaining sleep, and alcohol drinking was not correlated with morning affect, difficulties initiating sleep, and nonrestorative sleep.

### 3.2. Sleep profiles based on insomnia and circadian preferences

The best-fitting latent profile model, which was selected based on a specified set of criteria as detailed in Methods, served as the basis for the classification into sleep profiles. First, the two- and three-profiles were preferred by the lowest fit indices (such as log-likelihood, the Bayesian information criteria, and the Integrated Complete data Likelihood). Second, the consistency of sleep profiles across age-sex subgroups in the two- and three-profile models rendered the stratification by age and sex in profile size in the unstratified sample  $N=5,309$ , negating the need for the minimal sample size limitation to ensure adequate statistical power in the regression analyses. Third, the two- and three-profile models had the easiest time

interpreting the sleep profiles. The three-profile model distinguished between individuals with more intermediate circadian preferences and severe symptoms of insomnia and those with more late circadian preferences and slightly nonrestorative sleep, in contrast to the two-profile model.

Though these sleep profiles varied between age-sex subgroups, the four-profile model tended to also identify those with severe symptoms of insomnia and either relatively early or late circadian preferences. The majority of participants, or 77-92% of the respective subsample, had posterior probabilities exceeding 0.80, and the classification uncertainty estimates further supported a more robust distinction of the sleep profiles in the three-profile model for all age-sex subgroups: mean uncertainty in the three-profile model ranged between 0.02 and 0.11, with only up to 1.61% of the subsample having uncertainty  $\geq 0.50$ . As a result, the three-profile model was determined to be the most advantageous option when compared to the less consistent four-profile model and the less informative two-profile model.

### 3.3. Sleep profiles and mental illness

Compared to “Healthy Larks” and “Sleepy Owls”, “Sleepless Doves” included much more participants in the high symptom severity groups (i.e., the upper 10% of each score distribution), which applied the highest scores on depression, anxiety, reactive aggression, inattention, hyperactivity/impulsivity, and autism. Only up to 7% of “Healthy Larks” and 12-16% of “Sleepy Owls” were in the high symptom severity groups compared to 25-40% of “Sleepy Owls”. These differences were particularly noticeable when it came to depression and anxiety; for example, “Sleepless Doves” were 17 times more likely than “Healthy Larks” to have participants with the 10% highest scores on depression and anxiety, respectively.

### Conclusion

Our research revealed distinct subgroups within the general population based on their insomnia symptoms and circadian preferences, termed as “sleep profiles”. These profiles include “Healthy Larks” with early circadian preferences and minimal insomnia, “Sleepy Owls” with late preferences and moderate sleep issues, and “Sleepless Doves” with intermediate preferences and severe insomnia. These profiles significantly differ in the severity of mental health issues, with “Sleepy Owls” and “Sleepless Doves” showing higher levels compared to “Healthy Larks”. These differences were particularly notable for depression, anxiety, reactive aggression, inattention, hyperactivity/impulsivity, and autism. Additionally, “Sleepy Owls” and “Sleepless Doves” were twice as likely to engage in heavy alcohol drinking, drug use, and smoking compared to “Healthy Larks”. These associations were consistent across genders and age groups, although they tended to diminish with age. Overall, our findings underscore the importance of healthy sleep in mental well-being and suggest potential risk groups for clinical and research purposes.

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