

Sleep habits of Goodville users from the USA

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ABSTRACT. Physical, cognitive, and psychological well-being are strongly correlated with better sleep. Good sleep quality involves obtaining enough sleep to maintain a satisfactory level of productivity and psychological comfort. People with shorter sleep durations are more likely to suffer from mental health problems and physical problems. Quality sleep is also influenced by bedtime and wake-up time. Mobile applications can be utilized to evaluate a wide range of sleep parameters. Goodville is a farm game that assesses and tracks various dimensions of emotional well-being, including sleep quality. Using the Goodville app, users can monitor their sleep duration and quality to maintain emotional health. A study was conducted to evaluate the sleep characteristics of Goodville users from the US population. Between December 2020 and October 2022, 7507 US users provided sleep data to Goodville.

The participants recorded the time they fell asleep and awoke. A median sleep characteristic was calculated from repeated trackings. Ages ranged from 12 to 67, with an average age of 38 (SD=12.71). There were 86% females, 12% males, and 2% other. The average sleep duration was 8.5 hours (SD=1.5). 76% of respondents reported sleeping between 7 and 9 hours, while 12% reported sleeping more than 9 hours. 12% of respondents reported insufficient sleep, and only 2% slept three to four and a half hours a night. The majority of respondents fell asleep between 23:00 and 24:00, with 9% going to bed between 22:02 and 23:00. For 23% of players, sleep began after 24:00, and 12% fell asleep after 3:00. 9% of participants went to bed early (before 20:00). The correlation between bedtime and sleep duration was moderately positive ($r=0.36$; $p<0.05$). Over half (57%) of players woke up between 8:00 and 9:00 a.m., with 21% waking up between 6:00 and 8:00 a.m. 13% woke up too late, and 9% woke up too early.

In general, Goodville users in the US sleep enough, which improves their physical and mental well-being. Nevertheless, the time of falling asleep and waking up does not entirely align with healthy sleep principles. Most respondents went to bed after 23:00, which is later than what is recommended for maintaining good health. Sleep duration tended to be longer when bedtime was later. More than half of respondents woke up later than 8:00 a.m., which may hamper their productivity.

Key words: Goodville, sleep duration, falling asleep, waking up, emotional well-being

An average person sleeps about a third of their lives, and getting a good night's sleep has a big impact on their productivity (Armand et al., 2021). There is a strong correlation between better sleep and better physical, cognitive, and psychological wellbeing (Barros et al., 2019). Having enough sleep to maintain a satisfactory level of productivity and psychological comfort is part of good sleep quality. Getting insufficient sleep at night is generally associated with daytime sleepiness, fatigue, depression, and poor work performance in the daytime (Chaput et al., 2018). There is a greater risk of mental health problems among individuals with shorter sleep durations (Braçe et al., 2022). In addition to mental health problems, sleep deprivation poses cardiovascular, respiratory, neurological, gastrointestinal, immunological, dermatological, endocrine, and reproductive health risks (Liew & Aung, 2021). As a result of sleep deprivation, the innate and adaptive immune parameters are altered, resulting in chronic inflammation and a greater risk of infectious/inflammatory diseases, such as cardiometabolic, neoplastic, autoimmune, and neurodegenerative illnesses (Garbarino et al., 2021). It is not only decreased sleep duration that poses health risks, but also prolonged sleep duration that can result in a number of health problems. The association between long sleep and an increased risk of all-cause mortality is highly suggestive. A number of studies (Gao et al., 2022) have demonstrated an association between long sleep and health outcomes such as stroke, dyslipidaemia, heart disease mortality, stroke mortality, and stroke development or death.

Sleep duration does not have a standard mandatory criteria for all people. The data suggests there is no "magic number" for sleep duration. As of today, it has been established (Chaput et al., 2018; Hirshkowitz et al., 2015) that an adequate amount of sleep depends on an individual's age and stage of life. Based on the National Sleep Foundation's recommendations (Hirshkowitz et al., 2015), newborns should sleep 14 to 17 hours, infants between 12 and 15 hours, toddlers between 11 and 14 hours, preschoolers between 10 and 13 hours, and school-aged children between 9 and 11 hours. In teens, 8 to 10 hours of sleep is recommended, 7 to 9 hours for young adults and adults, and 7 to 8 hours for older adults. Based on the above criteria, adults over the age of 17 should sleep at least 7 hours a night. Sleeping less than this amount increases the risk of obesity, diabetes, high blood pressure, coronary artery disease, strokes, mental distress, and death from all causes (Liu et al., 2016). Unfortunately, many people do not have an adequate amount of sleep. About 30% of U.S. adults sleep less than 7 hours per

night, and 50–70 million suffer from chronic sleep disorders (Liu et al., 2016; McKnight-Eily et al., 2008). COVID-19 significantly worsened sleep problems. During the pandemic, most reports (Neculicioiu et al., 2022) have highlighted contrasting sleep health outcomes. Sleep duration was reported to be longer, but sleep quality and sleep timing were affected as well. The prevalence of sleep deficiencies has been reported in patients with acute and long COVID despite not being among the most common symptoms during the acute or persistent phases (Kim et al., 2021; Neculicioiu et al., 2022).

In addition to sleep duration, bedtime and wake-up time play a role in quality sleep (Chaput et al., 2018). In general, research findings suggest that late sleep timing and irregular sleep schedules may negatively impact health. A consistent bedtime and wake-up time with earlier sleep timing, on the other hand, are positively associated with health (Chaput et al., 2020). Although sleep duration has been extensively studied, very little research has been done on evaluating bedtimes and wake up times in the general population. Hence, it is imperative to collect data not only on sleep duration but also on the time of falling asleep and waking up. A complete picture of the quality of sleep among representatives of the population can be obtained by collecting such data from large samples.

The advent of modern technology has paved the way for the widespread utilization of mobile applications for the assessment and tracking of sleep parameters, thereby providing individuals with a convenient and accessible means of monitoring various dimensions of their emotional well-being, including sleep characteristics (Lecomte et al., 2020). One such application is Goodville, a farm-themed game that incorporates a comprehensive module for analyzing sleep parameters. With the Goodville app, users are empowered to meticulously monitor both the quality and duration of their sleep, thus enabling them to proactively manage their emotional well-being. The app features a user-friendly interface, allowing players to easily record the time of falling asleep and waking up in a specialized sleep quality section (Figure 1) for a comprehensive analysis of their sleep data.

The current study was designed to investigate the temporal sleep characteristics of Goodville users within the US population. Specifically, the objective of the study was to gain a comprehensive understanding of the sleep patterns of Goodville players, inclusive of the duration of sleep, bedtime, and waking time.

The study was based on a survey methodology that collected data on the temporal sleep characteristics of Goodville users. The data collected included answers to key

questions aimed at eliciting information on the sleep habits of the participants, including the average duration of sleep, bedtime, and waking time.



Figure 1. Interface for tracking sleep time in Goodville

The study utilized the Goodville sleep module to gather sleep data from 8000 US users between December 2020 and October 2022. Participants in the study were instructed to track the times they fell asleep and woke up, with a wide range of checks per respondent recorded, ranging from 1 to 661. Over the course of the study, a total of 1861801 observations were recorded, with sleep being rated by the majority of players approximately 10 times, with a median number of trackings recorded at 3. In order to accurately evaluate the sleep characteristics of the participants, the median time sleep characteristics were calculated for repeated trackings. The age range of participants was between 12-67, taking into consideration outliers, with the average age of the players being 38 years and a standard deviation of 12.71. The gender distribution of participants was 86% female, 12% male, and 2% other. To ensure the validity of the sleep data collected, the Grubb test was utilized to form sleep duration indicators for outliers, leading to the exclusion of data from 493 players from further analysis. As a result, the sleep data from 7507 users was included in the evaluation of sleep characteristics.

The results of this study showed that the average sleep duration among Goodville users in the US was 8 and a half hours, with a standard deviation of 1.5. A visual representation of this data is presented in Figure 2, which illustrates the distribution of sleep duration among the respondents. The majority of the participants, 88%, reported spending more than 7 hours sleeping each night. The largest group, 76%, reported sleeping 7 to 9 hours per night, while a smaller group of 12% reported sleeping more than

9 hours. Conversely, 12% of the respondents reported insufficient sleep, with only 2% reporting sleeping between three to four and a half hours per night. No users reported sleeping less than three hours or more than fifteen hours per night.

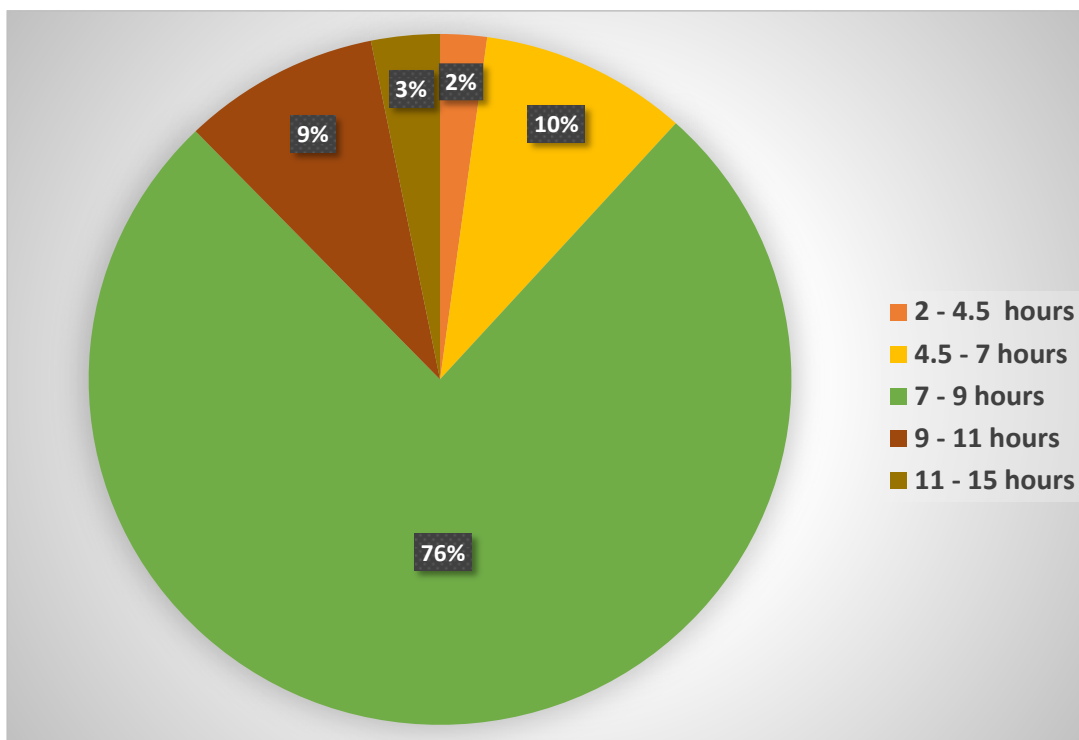


Figure 2. Distribution of Goodville players across sleep duration ranges

In terms of bedtime, the results showed that more than half of the respondents fell asleep between 23:00 and 24:00, as illustrated in Figure 3.

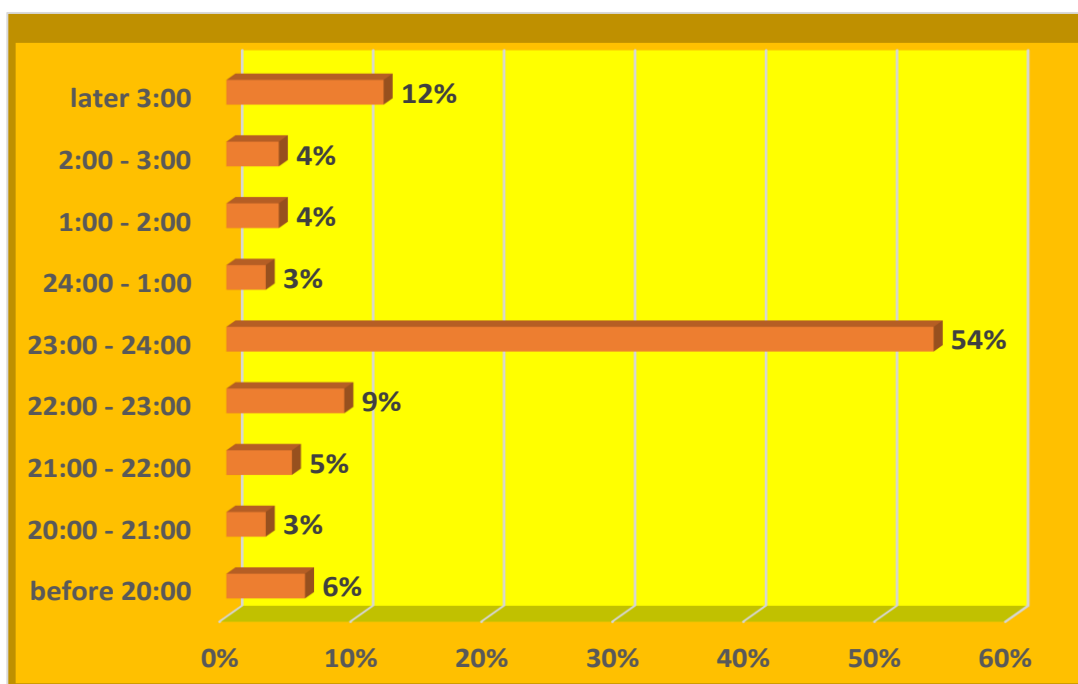


Figure 3. Distribution of respondents across bedtimes

A relatively small proportion of the participants, 9%, reported going to bed between 22:00 and 23:00, while 23% reported going to bed after 24:00. 12% of the respondents reported going to bed after 3:00, and 9% reported going to bed before 20:00. The analysis found a moderately positive correlation between bedtime and sleep duration, with a correlation coefficient of $r=0.36$ and a p -value of <0.05 .

Finally, the results of the wake-up time examination are presented in Figure 4. The histogram shows that more than half of the participants, 57%, woke up between 8:00 and 9:00 a.m.

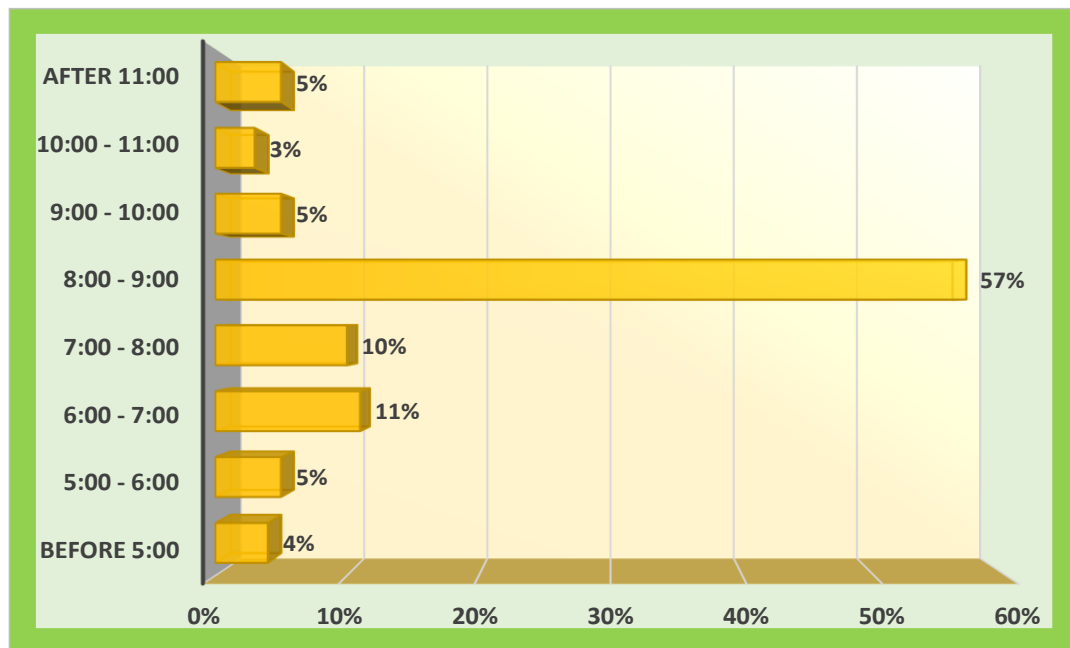


Figure 4. Player distribution across wake-up time

A smaller group, 21%, reported waking up between 6:00 and 8:00 a.m. The remaining participants reported either waking up too late, with 13% reporting waking up after 9:00 a.m., or waking up too early, with 9% reporting waking up before 6:00 a.m.

The results of our study regarding the sleep patterns of Goodville users in the US indicate that most users do not exhibit symptoms of sleep deprivation, as a majority reported sleeping for a minimum of seven hours a night. Our research also revealed that more than half of the respondents typically go to bed between the hours of 23:00 and 24:00. This bedtime may be considered late in light of recent research data (Nikbakhtian et al., 2021), which suggests that the optimal time for adults to fall asleep is between 22:00 and 23:00. However, only 9% of Goodville users in the US reported choosing to fall asleep within this recommended range. A significant portion (12%) of respondents reported going to bed after 3:00 a.m., which may have negative consequences for both

their physical and emotional health. Our findings also demonstrated a moderate correlation between bedtime and sleep duration, suggesting that a late bedtime may result in longer sleep. This prolonged sleep, in turn, may have a deleterious impact on both physical and mental health.

With regard to wake-up time, more than half of the respondents reported awakening after 8:00 a.m. This late awakening may have several detrimental effects, including decreased productivity, weight gain (Olds et al., 2011), and an increased risk of heart disease (Yan et al., 2021). When evaluating the impact of wake-up time on health and well-being, it is important to consider both bedtime and sleep duration. However, it is not considered to be healthy to awaken past 9:00 a.m. after a seven-hour sleep. There may be a small percentage of respondents who have a long-standing habit of waking up late and who woke up after 10:00 a.m., but this habit is not recommended as it may predispose individuals to the aforementioned health conditions. Only 20% of the respondents reported waking up between 6:00 a.m. and 8:00 a.m., which provides sufficient time to maintain productivity and optimal health throughout the day.

In conclusion, the results obtained from the study regarding the sleep patterns of Goodville users in the US demonstrate that the majority of respondents are getting adequate amounts of sleep. This is essential for the maintenance of both physical and mental well-being. Despite this, the bedtimes and wake-up times of the majority of respondents do not align with what is considered optimal for healthy sleep. The findings indicate that the majority of respondents go to bed after 23:00, which is beyond the recommended bedtime for ensuring optimal health. This can lead to longer sleep durations and negatively impact physical and mental health. Additionally, the study showed that over half of the respondents wake up after 8:00 a.m. This time of awakening is considered to be beyond the recommended time frame for maximizing productivity and maintaining good health. The results of this study highlight the importance of considering both bedtime and sleep duration for ensuring optimal physical and mental health, as well as the impact of wake-up time on overall well-being. The study also highlights the importance of using effective tools and methods, such as mobile apps, to track and monitor sleep habits in large populations. The ability to gather and analyze data on a large scale can help to further understand sleep patterns and behaviors, and potentially inform evidence-based interventions aimed at promoting better sleep health for individuals and communities.

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