

# HUMAN SYSTEM INTEGRATION REPORT

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## **Moonstruck : How is our sleep affected by the moon ?**

### **1) Context and objectives**

The moon is the Earth's natural satellite. It is a rocky star that orbits the planet Earth. It was most likely formed by the impact of a huge asteroid with the Earth 4.5 billion years ago. The rotational period and revolutional period of the Moon around the Earth are completely coordinated. The Moon is therefore said to be in synchronous rotation with the Earth. This is why we always see the same side of the Moon when we look at it from Earth. As a result, the Moon has various phases, the most important of which is the Full Moon: A Full Moon is a lunar phase that occurs when the Sun, Earth, and Moon are almost aligned.

This indicates that on this date, the Moon rises when the Sun sets and sets when the Sun rises the next day. The Moon's side is totally lit, thus the term Full Moon. Every 29 days and a little more than 12 hours, there is a full Moon.

Yet, experts and their studies have demonstrated that the Moon has an impact on sleep. Many do lose sleep as the Moon changes phases, or they suffer from sleep problems. According to studies, one out of every five people suffers from sleep difficulties throughout the various phases of the Moon. These illnesses are explained by many variables and changes.

The human body goes through changes that alter its sleep cycle. In this sense, we seek to investigate the reasons for these fast and abrupt alterations and devise a viable way to avert these diseases.

Throughout our research, we want to achieve the following goals: We intend to do a research on the synchronization of our circadian rhythms with the moon cycles with a large population sample (100,000).

The researchers will work with sleep specialists to discover a link with explanations that will make the idea unfalsifiable.

Then we might consider whether a lunar calendar would be more suited to our natural demands.

## 2) The effects

For several years, the impact of the moon on sleep has been a topic of scientific interest - although with limited results - with research indicating that it can influence our sleep patterns in various ways. The following are a few of the consequences that have been linked to the moon's influence on sleep:

1- Reduce Sleep Quality: The moon's influence on sleep can have substantial effects, one of which being a potential decline in sleep quality. According to studies, when the moon is full or almost full, people typically sleep for shorter amounts of time and have more sleep interruptions.

2- Changes in Sleep Architecture: Changes in sleep architecture, or the various stages of sleep that humans experience each night, have also been related to the moon's impact on sleep. According to research, people tend to spend more time in the lighter stages of sleep and less time in deep sleep during a full moon.

3- Increased Sleep Deprivation: The moon's influence on sleep can also result in higher degrees of sleep deprivation. People may feel more exhausted and less awake during the day when their sleep is disturbed by the moon's influence, which can have a detrimental effect on their professional and personal lives.

4- Mood Shifts: The moon's impact on sleep has also been connected to mood swings. Due to the moon's influence, people who have trouble sleeping may be more likely to feel agitated, anxious, or depressed.

Last but not least, the moon's influence on sleep has been linked to an increased chance of accidents. Those who are sleep deprived or having sleep disturbances may be more prone to errors or mishaps when driving or performing other tasks that call for concentration and attention.

Overall, the moon's influence on sleep can have serious and far-reaching effects. While more study is required to completely comprehend the moon's impact on sleep, it is obvious that it can have a significant impact on our physical and emotional health.

### 3) Observations and study

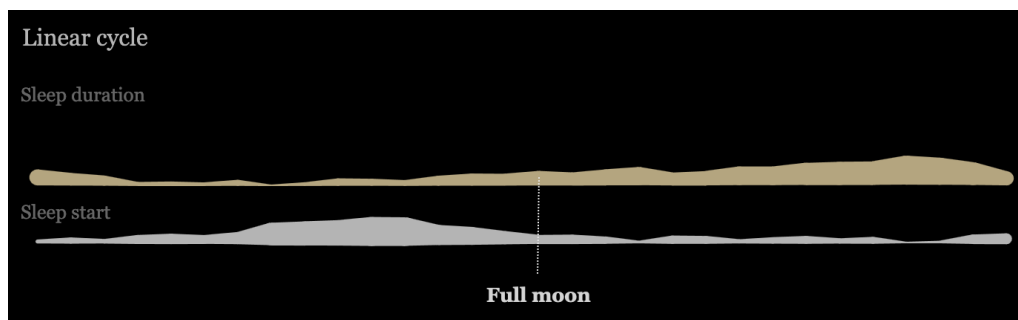
To better understand how the moon impacts our circadian rhythms, studies have been conducted, notably at the University of Washington, National University of Quilmes, and Yale University.

The study was carried out in different places, from rural to urban areas, on Indigenous communities in Argentina and students in Seattle. The goal was to study the effects of the moon on sleep, whether there was access to artificial light or not.

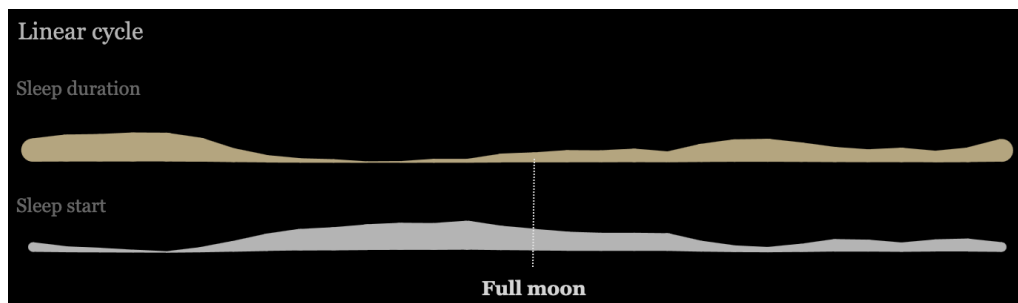
There were 98 people from the Indigenous communities (3 communities with different access to light), and 464 college students from Seattle.

The results showed that for both, the days preceding the full moon affected their sleep. The time of sleep varied during the different cycles of the moon, being the shortest the days preceding the full moon. Also, everyone went to bed later. The figures below show the decrease in sleep durations and the delays in sleep start in both urban and rural communities.

#### Urban community



#### Rural community



We can see on the figures that the effects are present for both urban and rural samples but, as there is more access to light in the urban zone, they are less pronounced.

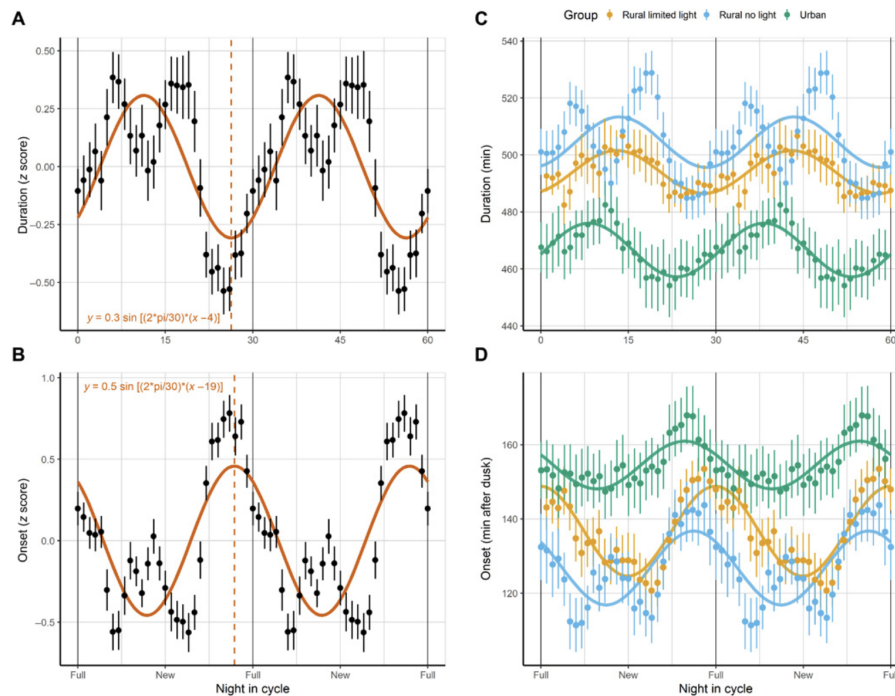


Figure in Science Advances

This figure, coming from the same study, shows the variations of time before going to bed during the moon cycles (bottom) and the variations of duration of sleep (top). We also see the difference between the urban, rural with limited light and rural no light groups and how the effects of the moon are less intense in urban areas.

#### 4) Causes

The moonlight is one of the causes of these variations in our circadian rhythms. As a matter of fact, the moonlight during the days preceding the full moon, allows activities to go on after the sun goes down. It can explain why in rural areas, the phenomenon is observed, in absence of artificial light. The phenomenon is also observed in the urban areas, where artificial light causes delay in bedtime. Why? The study emits the hypothesis that it is an innate adaptation, inherited from our ancestors. They followed the cycles of the moon to rhythm their sleep. As the moon was brighter approaching the full moon day, they could stay later to continue their activities, such as hunting and fishing.

Furthermore, the brightness of the full moon may interfere with the body's generation of melatonin, a hormone that helps regulate sleep, as light exposure affects the circadian rhythm. The moon appears as a dazzling, fully lighted disk in the night sky when it is full because it reflects sunlight. The amount of ambient light may rise as a result, making it more challenging for people to sleep.

## 5) Future vision

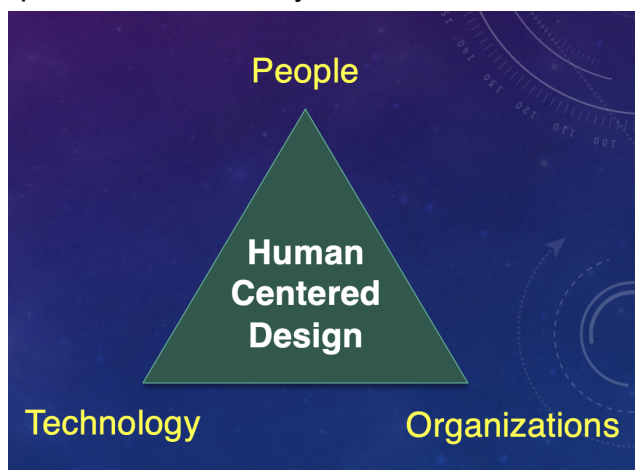
In some countries, the moon plays an important part in the culture. For example, in the Chinese calendar, the moon determines the dates of some traditional holidays and festivals. The Chinese calendar is a lunisolar calendar, which means that it is based on both the cycles of the sun and the phases of the moon. One of the most important holidays in the Chinese calendar is the Mid-Autumn Festival, which takes place on the 15th day of the 8th lunar month, which typically falls on a full moon day.

Also, The Islamic calendar is a lunar calendar, which means the start and end of the lunar month are determined by the sighting of the new moon. In Saudi Arabia, the sighting of the new moon is used to determine the start of the Islamic month of Ramadan, which is the ninth month of the Islamic calendar.

In Thailand, the full moon of the twelfth lunar month (usually in November) is celebrated as Loy Krathong, a festival where people float small boats made of banana leaves, candles, and flowers on rivers and lakes to pay respects to the water goddess.

So, can the moon take a place in our culture and society that will make our life better ?

We did a TOP model for our study. Our study will be conducted on a large population sample (100k) with researchers that will collaborate with sleep experts and moon specialists. The study will last at least 3 entire moon cycles.



Technology: We will use connected watches that will analyze the circadian rhythm of the people. Then, we will use a data collection tool, and make an algorithm that will link the cycles of the moon with our circadian rhythm.

People: We will ask people at the beginning of the study to pay attention to the possible links between the moon cycles and their circadian rhythms. After the end of each moon cycle, we will do surveys to ask them how they were impacted. This data will be collected.

Researchers and experts will collaborate and associate their knowledge to analyze the results and understand the causes.

Organizations: The study will be led by using the data collected, analyzing it, and drawing irrefutable conclusions about the link between the moon and our sleep patterns. It can be interesting to use KPIs to evaluate the gaps and errors in the results.

This study is centered on the human, and his well being as our circadian rhythm impacts our concentration, our mood and relationships and our lifestyle in general.

We also did a TOP model to analyze a future vision on how our circadian rhythms will adapt naturally to the moon cycles, especially in urban areas. What could be solutions after understanding why and how we are exactly impacted ?

Technology: We can use our smartphones to be alerted of the moon cycles. Knowing when the full moon is coming soon, we can be more aware and take measures to sleep better and avoid discomfort during these days.

There can also be intelligent lighting that automatically adapts when the night falls, and makes our environment more natural. This way, our circadian rhythms will adapt naturally to the cycles of the moon.

People: People involved are the whole population and how they are willing to have a better lifestyle. We also take into consideration bosses hiring people during the night and every person whose lifestyle is affected by night working.

Organizations: The process is quite individual as it belongs to anyone to choose how they want to adapt their lifestyle.

There can be rules on hiring people during the night.

To conclude, the study conducted by the three American universities showed evidence that our circadian rhythm is correlated to the moon cycles. However, we plan to do a study on a much bigger sample, to confirm these observations. Then, researchers and experts can understand the causes of these phenomena.

If the results show a clear correlation, we can share the results with the world and start wondering how our society could adapt and come back to a more natural lifestyle.

Sources:

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