A Case Study on Impact of Labours Sleep Deprivation in Construction Project using Application Method

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Abstract. Sleep deprivation leads to stress and under-performance in work, which affects labor’s well-being and performance of work in construction. The sleep deprivation study was done on construction laborers on a huge construction sector in Bengaluru, Karnataka. The paper shows different stages of sleep and sleep pattern for laborers by installing an application on mobile. Hence results show the quality of sleep and labor productivity by relating to the concentration level at work by considering the daily progress report. Inadequate sleep caused increased risk of concentration at work. The labor’s recommended sleep is 7.5-h per night as the guidelines of doctors and researchers. The time of sleep lesser than the recommended would lead to a high risk of work accidents which is 12%. The findings in this study of laborers in the sector of construction would lead to a decrease in productivity and performance of labor. The risk of accidents at home and work entirely depends on the lack of sleep.

1. Introduction
In India, the important sector for the development is constructed as it creates speculation chances across different related sectors. In India, there were construction equipment manufacturing companies around 500 in 2011. Labour intensive is an important sector that provides jobs and employment to more than 50.1 population of India. The construction sector is visualized to play a great role in economic development, Along with generating structures that add to efficiency and standard of life. The fundamental element for emotional and physical recovery is sleep. The habit of sleep well will successfully overcome daily hassles and prevent the negative effects of health on stress. [1,2] According to the general aspect, good sleep is necessary for the psychological and physiological well-being of a human. The different stages and states of sleep of a human are defined on the materialistic pattern of measure of movement in the eye. The easily reversible state of relative unresponsiveness and calmness which occurs more regularly and recursively each day is considered to sleep. Sleep deprivation states the condition of not having required sleep [3,4] The lack of sleep is a basic term that describes the state caused due to inadequate quality and quantity of sleep. As food and water are important for human body sleep also plays an important role, unfortunately, many people won’t get the required sleep [5-7]. The brain and cognitive function are adversely affected by chronic sleep restriction. PSG in sleep study is called Polysomnography also referred as gold standard for measuring sleep which helps to find out the sleep disorders as it records brain waves, oxygen level in the blood, heart rate and breathing as well as eye and leg movements during the study. This technique gives way for collection of surface electrodes each measuring physiologic parameters of sleep significantly.

The lack of sleep results shows its effect on change of mind, perception and functioning of brain, due to long-lasting sleep in similar way [8,9]. The hypothalamus and multiple neural system's roles are to control the circadian rhythms which are physical, mental and behavioural changes and homeostasis has been helpful in understanding lack of sleep was identified by Multiple studies [10,11]. S Process defines the amount of need for sleep will be high during wakefulness and low during sleep until a threshold is reached, while the oscillator responsible for these levels is defined by C Process. [12-14]. This model defines the framework which links sleep deprivation to guidance and needs for cognition among youths or college students called the socialization
model of undergraduate students Weidman (1989). The socialization model uses college as a primary key for youths' future goals and consolidation in society on the field [15,16], i.e., a instance and location where we can support development like extra-curricular activities, communication, and engagement in organized activities. Students have positive communication with peers and staff by joining in events and activities, that make subjective to the standard and values of the group. Without any doubt, a primary mission of further education is the basic of the construct of the need for perception to improve students' priority for critical thinking [17-20]. Socialization involvement during college years supports the need for perception, in this way.

For developing guidance, social participation and involvement in activities are also hypercritical because those talents have to be practiced regularly. By working with peers students must improve their abilities for corporation, common purpose, citizenship, and more, to formulate events, coordinate, and negotiate [21-23]. Thus, the college provides a chance to learn from role models, while students may not be communicate in the society to lead their life [24,25]. By disrupting students' college life and social experience, slack of sleep can note-ably affect the growth of guidance.

The lack of sleep will lead to stress, tiredness, and sleepiness in the daytime and which will decrease the energy levels [26], Thus reduces the available time to interact with everyone which disrupts the participation of students. Secondly, the lack of sleep will increase the negative mood swings, which leads to a negative impact on a teacher [27]. There may be less chances to evolve leadership and assign the value of the need for speculation [28]. Thus the study hypothesis. The lack of sleep which provides a bleak impact on the leadership development and the cognition of students.

2. Methodology

To track their sleep activity Labours and Engineers installed mobile applications for 30 days. Due to their measured sleep, the estimated worker's performance decrements. The labor kept their books to record sleep daily, to evaluate the sleep time. For further comparing results, the validation of measurements was done in a separate manner but from the same survey. The study was conducted at Pramuk meridian, during October and November of 2019. 50 different workers installed sleep application after which the collected data were analyzed.

2.1. Labor efficiency

The specific time period defines the efficiency of labor, by which services produced by laborers are effective. In several ways, economists measure the productivity of laborers. The productivity of the workforce is a measure of work in the company or site which is referred to as labor productivity. The productivity of a labor employee with a unit’s consideration is a measure of total work done at the site on an hourly basis. Labour usually costs 30% to 50% of the overall project cost [25,26]. The poor labor productivity has been identified as a major factor causing a delay in Indian construction projects as per the evidence from relevant literature [15,17]. The Labor Productivity of India was improved gradually by 6.70 % in Nov 2019, As compared with a growth of 5.78 % in the previous year. The data reached an all-time high of 9.76 % in Nov 2010 and a record low of 1.32 % in Nov 2003. Labor Productivity Growth is to be considered for the construction industry is been represented in Figure 1.

![Figure 1. Labour Productivity of India.](image_url)
2.2. Application method
Health and activity, quality of sleep, patterns of sleep, and the number of steps walked, are activities that have been designed to track which makes this application method as a portable mobile application. For android devices is SLEEPBOT and for IOS is PILLOW. These two applications are been effectively used for research. This application method shows the sleep and determines the pattern of sleep in 4 different stages.

2.3. Sleep latency
The latency of sleep is also called sleep onset latency or SOL. After the lights are off, the total time one takes to fall asleep is directly to an individual's sleep order and sleep time. Less than 8 minutes is the mean sleep latency score is typical. A few patients with idiopathic hypersomnia have less than 5 minutes of mean sleep latencies is been represented in Figure 2 and Figure 3.

![Figure 2. Women Sleep Latency.](image)
![Figure 3. Men Sleep Latency.](image)

2.4. Quality of sleep
In the view of objective and subjective the quality of sleep is evaluated. The difficulty for a person to fall asleep and remain sleeping, and the number of times they wake up during a single night, all these refer to the Objective sleep quality. A state of being rested and regenerated after awakening from sleep refers to Subjective sleep quality. A study by [15] has found that insomniacs in their evaluations there were more demanding of sleep quality than individuals who had no sleep problems. Homeostatic sleep propensity must be balanced against the circadian element for satisfactory sleep.

2.5. Sleep study symptoms
During the study of sleep, there are two types of symptoms that are seen and they are as follows: NIGHT TIME –Snoring, Snorting, struggling to breathe, choking and breath-holding thrashing in bed, Frequently walking up because of urine palpitations. DAY TIME –Feeling unrefreshed in the morning, excessive daytime sleepiness, Forgetfulness and memory problems, Difficult concentration, Morning headaches Depression, irritability impotence/sexual dysfunction.

2.6. Parameters considered for labor productivity
Different parameters affected labor productivity and they are as follows: lack of skill and experience of the workers, late payment, poor health of the workers, low amount of pay, lack of empowerment, Poor work planning, design changes, and sleep deprivation. Sleep deprivation is the major factor that will be considered throughout the project which is a lack of sleep which is considered for the construction workers in life.

2.7. Data validation concept
Pramuk Meridian is a luxurious Apartment that is enclaved amid greenery in Bengaluru improving the modern way of life. Bengaluru provides you the opportunity to live life to the fullest with the best weather. Pramuk Meridian in Jayanagar gives you the best infrastructure and well-established amenities like fruit garden, library, shopping mall, flower orchid and many more. The data was collected from the Pramuk Meridian project. The data was acquired from Site engineers, Project Managers, Labor (Male & Female) and Supervisors. The daily progress report and the sleep cycle readings were notes down for analysis.
3. Results and discussion

To find out the sleep cycle of laborers in the project, this analysis gives the scope. From these results, the study is said to be note-able. The laborers were not getting sleep was illustrated by the quantification which was recommended. Due to a lack of insufficient sleep, there was an increase in the risk of work by the laborers up-to 14%. Higher labor risk at all stages of construction and average productivity is decreased annually if this analysis is used on 3200 laborers, in Pramuk Meridian site. It is captivating to note that the Pramuk Meridian site performs awfully. During the study, the following was found: 8 hours is the average sleep per night, only 8.5% of the labor is measured and has got a balanced relation with the suggested guidelines of eight hours of sleep as per the average adult population. Due to lack of sleep, the laborers are exhausted which results in the narrowing up-to 9%.

3.1. Daily progress report

Sleep-bot or Pillow applications can be installed to record the tiredness of laborers. According to the sleep cycle, the laborers slept long during their workweeks. Awareness must be created among the laborers in the construction field, about sleep requirements and amount of sleep they should get. The average risk of work in construction is 10.9%.

For the 6 weeks, the workers installed mobile applications which illustrated the amount of sleep during their work. Below the worker's daily progress report shown represents the productivity of workers in the construction site. The laborers don't have an idea about how prolonged and how efficiently they sleep at a particular point and the condition which depend on labor sleep during the night, according to the worker's daily progress is represented in Table 1 and Table 2, which should be kept noted. The daily progress report shows below represents variation in the quality and nature of work of female and male labours. The male labours are assigned with more number of days than the female labours because male labourers have more capability in covering larger span of area during work than female labours.

| Date          | Name        | Age | Gender | Activity | Nature of work | Quality of work | Number of days assigned |
|---------------|-------------|-----|--------|----------|----------------|------------------|------------------------|
| 1-Oct-19 to   | Labour A    | 38  | Female | Plastering | Plastering     | high             | 4                      |
| 7-Oct-19     |             |     |        |           |                |                  |                        |
| 8-Oct-19     |             |     |        |           |                |                  |                        |
| 14-Oct-19    | Labour B    | 20  | Female | Curing    | Curing         | medium           | 6                      |
| 15-Oct-19    |             |     |        |           |                |                  |                        |
| 21-Oct-19    | Labour C    | 24  | Female | Plastering | Plastering     | high             | 4                      |
| 22-Oct-19    |             |     |        |           |                |                  |                        |
| 28-Oct-19    | Labour D    | 29  | Female | Roof Slab | Bar bending    | High             | 3                      |
| 29-Oct-19    |             |     |        |           | Electric wiring |                  |                        |
| 31-Oct-19    | Labour E    | 33  | Female | Brick work | Brick work     | high             | 4                      |

| Date          | Name        | Age | Gender | Activity | Nature of work | Quality of work | Number of days assigned |
|---------------|-------------|-----|--------|----------|----------------|------------------|------------------------|
| 1-Oct-19 to   | Labour A    | 32  | male   | Course masonry | Mixing C:FA:CA proportions | Lofty             | 10                     |
| 7-Oct-19     |             |     |        |          | Placing block from right corner |                  |                        |
| 8-Oct-19     | Labour B    | 23  | male   | Plastering | Plastering     | Lofty            | 6                      |
| 14-Oct-19    |             |     |        |          | Placing block from left corner  |                  |                        |
|               |             |     |        |          | Curing          |                  |                        |
3.2. Sleep cycle

Sleep-bot or pillow application is installed by the laborers in their mobile which indicated period. Sleep time of the labor on a weekly average basis in a year is extracted from this mobile application. According to their well-being, the partial sleep habits were not notified before the analysis by mobile application and were known after that they were lacking. In sleep, the average results may vary from labor to labor. This reported that the percentage of productivity levels in a construction site was lacking. The Figure 4 explains about the laborers monthly percentage of sleep in their daily life for a period of 30 days. The different stages of sleep is been calculated by installing mobile application called Sleep-bot on android and Pillow on IOS which records the sleep accordingly. This application shows the duration of sleep in all the 4 stages that the laborers slept. It also displays the graph which shows the percentage of sleep vs no of days. Figure 5 shows that light sleep and deep sleep are more among the different stages of laborers sleep along with their percentage. The intake of alcohol and improper food consumption will lead to lack of laborers sleep which will significantly affect the sleep cycle of labor. The results proves that this application method gave the slightest variation when compared to the manual measured amount of sleep. Hence the application gives 95 to 98% of accuracy level.

![Figure 4. Sleep Quality of Labor.](image)
4. Conclusion
This study has provided many valuable insights about the sleep environment and habits of laborers which cause the tiredness and its operational influence in several other sectors, which were the main reason for poor productivity in the construction project. There was an operational attempt made to check whether the major factor for lack of sleep is tiredness. The main issue of tiredness is due to inadequate sleep in laborers is to know the human and socio-economic impact.

- The study indicated that 10.9% was the average risk of work in construction and 13.7% in site workers were even higher. The work environment in the site will raise to tiredness in laborers when these joined together.
- Due to tiredness and lack of food intake, the laborers may not fit into the work for their shift and it is very important to screen out them. The excess working hours is the most predominant factor for lack of sleep in laborers.
- Laborers should know the effects of poor sleep and to improve their sleep time, the necessary solution should be taken. At the construction site, the laborers are prescribed to undergo training, monitoring and controlling who are working in different sectors such as equipment handling, night shift labor and dayshift.
- The Site Engineers and Project managers who are less in number in the construction project must indicate the awareness regarding sleep and its effects. The eradication of tiredness should be done by taking necessary preventive measures and shifts should not start early and end late.
- On a timely basis, medical check-ups should frequently be done to laborers and proper allocation of food must be done to make them aware of effects due to lack of sleep.
- Either directly or indirectly there will be a marginal decrease in the productivity of laborers. The intake of alcohol and participation in construction by labor also scales down the productivity and also affects the sleep cycle

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