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A Study on the Relationship Between Employee Productivity and Digital Device Usuage with Sleep Duration as a Mediator

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ABSTRACT

This study examines the relationship between digital device usage and employee productivity, with sleep duration as a mediating variable. As digital devices have become integral to modern workplaces, concerns have grown regarding their adverse effects on employee well-being and performance. Drawing on existing literature in occupational health and sleep medicine, this study proposes and tests a mediation model in which excessive digital device usage disrupts sleep, which in turn reduces employee productivity. Primary data was collected from 150 employees across various industries using a self-constructed, five-point Likert scale questionnaire. The data was analysed using reliability analysis, descriptive statistics, correlation, regression, and mediation analysis via SPSS and PSPP. Results indicate that digital device usage has a significant negative effect on both sleep duration ($R^2 = 0.26$, $\beta = -0.51$) and employee productivity ($R^2 = 0.38$, $\beta = -0.61$), while sleep duration positively predicts productivity ($R^2 = 0.40$, $\beta = 0.64$). When both variables were considered together ($R^2 = 0.52$), sleep duration was confirmed as a significant mediator. These findings suggest that organisations should promote digital discipline, healthy sleep habits, and work-life balance initiatives to improve employee performance and well-being.

Keywords: Digital device usage, employee productivity, sleep duration, mediation analysis, occupational health, workplace well-being

1. INTRODUCTION

The modern-day digital device has evolved and entered the modern world in such a way that it is now impossible to think of it as separate from the world. The majority of the workplaces in the present world are now fully incorporated into the digital world, and jobs are now more efficient and easier to do. But, as is the case in all things, the digital device has a dark side, and the most worrying aspect is the effect it has on productivity, sleep, and health.

The often ignored effects of excessive digital device usage include its impact on sleep. Studies in occupational health and sleep medicine have confirmed that excessive usage of digital devices before going to sleep reduces the production of melatonin and delays circadian rhythmicity, resulting in a decrease in both the duration and quality of sleep . As the employees spend more time using digital devices after working hours, there is no division between work hours and personal hours; hence, they become

vulnerable to chronic sleep disruptions. The usage of digital devices in the daytime and bedtime was found to be associated with sleep, increasing the risk of short sleep duration, long sleep onset latency, and sleep deficiency (https://doi.org/10.1136/bmjopen-2014-006748)(1).

In addition, the surge in the number of employees working from home and the rise of hybrid working arrangements in response to the COVID-19 pandemic has further fueled the issue of employee dependency on digital devices, making it a pressing issue for organisations seeking to maintain employee productivity and well-being. However, without empirical support for the mediating effect of sleep, organisations are not theoretically informed to address the issue. This study aims to fill the gap by proposing and testing a mediation model for the relationship between digital device usage and employee productivity through sleep disruption.

In this regard, the introduction of the mediating variable of disrupted sleep provides a more detailed and mechanistic understanding of how digital behavior impacts performance outcomes. The results of this study are of direct relevance to human resource managers, occupational health professionals, and management in organisations. For instance, if the impact of digital device usage on reduced employee productivity via disrupted sleep is established, it would be legitimate for organisations to implement measures to counteract this effect.

2. LITERATURE REVIEW

2.1 Digital Device Usage and its Impact on Employees

The integration of digital devices in the modern workplace has significantly altered the way employees communicate and manage their daily workload. Though these devices have undoubtedly contributed significantly to the efficiency of the workplace, recent studies have highlighted the negative effects of these devices on the well-being and productivity of employees. The most impactful of these negative effects is the disruption caused by the constant connectivity that these devices demand. (10.1016/J.JSIS.2020.101595.)

It has also been established in the study by Tams et al. (2020) that mobile technologies have significantly increased the number of work-related interruptions that employees face, especially during their non-working hours. More critically, the study established that employees often lack the autonomy to respond to the numerous work-related interruptions that come their way, which further exacerbates the stress that employees face in their line of work. The lack of autonomy in the use of devices often makes the stress experienced by employees inproportionately large, thus affecting their work output in a detrimental way(10.3917/SIM.203.0009.)

Besides the interruptions, digital technology has the simultaneous effect of producing a double impact on the individual. A study undertaken in a large French organisation has shown that mobile technology is first experienced by the employee as providing resources that are beneficial to their well-being. However, the same technology has the independent effect of producing techno-overload, which is the feeling of being swamped by the demands of technology itself, and techno-invasion, which is the invasion of personal time and private life by digital technology (Loup, Maurice & Rodhain, 2020). This shows that the benefits of digital technology are inescapably linked to its costs, and the longer the individual is exposed to the demands of technology, the more their stress levels are increased, although beyond the organisation's capacity to measure.(10.1108/INTR-09-2019-0385.)

However, the effects of stress do not end there. The results of Karimikia et al.'s (2021) meta-analytic review of 52 empirical studies revealed that ICT use in the workplace is significantly related to adverse

outcomes such as burnout and anxiety, which affect employees' performance in a direct manner. What is interesting in the results is that even though job autonomy is generally considered to be positively related to employees' job performance, in the case of ICT use, more job autonomy is actually related to adverse outcomes in the same way as other factors. This challenges simplistic managerial views and requires a more sophisticated understanding of the role of the use of digital devices in enabling and disrupting productive work in the first place..(https://doi.org/10.1016/j.jsis.2020.101595)

2.2 Digital Device Use and Sleep Disruption

The relationship between mobile device use and sleep disruption has attracted growing scholarly attention, with a substantial body of evidence confirming that how and when people use their devices has meaningful consequences for sleep quality and duration. High mobile phone use has been identified as a risk factor for sleep disturbance, and sufficient sleep and recovery are well-established predictors of both physical and psychological well-being across age groups (Roberts, Roberts & Duong, 2009).

The prospective evidence is particularly compelling. Thomée, Härenstam, and Hagberg (2011) used a large-scale longitudinal study of 4,156 young adults aged 20-24 years, who were followed up for one year, to investigate the association between mobile phone use, sleep disturbances, and symptoms of depression. High levels of mobile phone use were significantly associated with sleep disturbances and symptoms of depression. Importantly, the study also examined qualitative aspects of mobile phone use, such as demands for availability and stress associated with accessibility, which was associated with stress, sleep disturbances, and symptoms of depression for women, with high levels of stress associated with high accessibility of mobile phones for both men and women. These findings are of particular interest in the workplace, as constant connectivity and demands for availability are common.

Device usage prior to bedtime has also been identified as particularly disruptive. Joshi (2022) found that both unstructured leisure activities involving cell phone usage prior to bedtime and device usage for accessing emotionally charged content serve as indirect pathways for diminished psychological well-being. Furthermore, it was identified that both instances of device usage prior to bedtime did not directly influence psychological well-being; rather, it was mediated solely through sleep disruption. This is similar to the logic of mediation that is presented in this study and serves as theoretical support for the notion that sleep disruption is the mediator for performance outcomes.

Collectively, this evidence suggests that the risk of digital device use for sleep health is not simply a volume of screen time effect, but also a pattern and timing effect, as well as a psychological effect of constant connectivity. The issue that remains to be explored more fully is how this entire chain of effects from device use to sleep disturbance then impacts employee productivity in the professional environment, which is the focus of the current study

2.3 Employee Productivity

Productivity, in the broad sense of an employee's capacity to accomplish tasks efficiently, meet performance standards, and maintain cognitive arousal levels over the course of the working day, is affected by an array of behavioural, environmental, and physiological factors. Of these, the quality of sleep appears to be one of the most significant yet least appreciated determinants of employee productivity.

In their exhaustive review, Pilcher et al. (2020) examined the relationship between sleep and organisational behaviour, and found that sleep deprivation is negatively related to a broad range of employee performance outcomes, including vigilance, motivation, workplace accidents, decision-making, and performance on complex cognitive tasks. The authors observe that nearly 30% of working adults in the United States report an average night's sleep of less than six hours, and that managers and enterprise

workers are among the most sleep-deprived, sparking "serious implications" for productivity and performance. Significantly, the authors' review suggests that the negative effects of sleep deprivation are not confined to the individual, but spill over into the group and organisational levels.

In the individual domain, the financial implications of the productivity loss caused by sleep deprivation are significant. Using longitudinal employee wellness data, researchers found that increased levels of sleep disturbance were significantly related to reduced employee performance in multiple areas, such as time management, mental requirements, and output quality (Swanson et al., 2015). The same study found that the cost to organisations, in the form of indirect costs, is an estimated $150 billion, as employees' lack of sleep leads to reduced productivity. The importance of sleep as an organisational issue, as opposed to an individual health issue, is thus highlighted.

The relationship between the use of digital devices and the reduction in productivity is also well documented. Duke and Montag (2017) found that smartphone addiction was moderately and significantly related to reduced productivity, as measured by reduced time spent working without interruption and increased hours spent working due to smartphone addiction. This is consistent with the interruption overload literature reviewed earlier and suggests that the addiction is the primary cause, as opposed to the device being the actual cause.

The Ward et al.'s (2017) study showed that simply having a smartphone on a desk, even if it was face down and silent, significantly impaired cognitive capacity for individuals undertaking complex tasks. The impact on cognitive capacity was not due to individuals using the devices, but rather because of the cognitive capacity consumed by individuals subconsciously fighting the temptation to check them. It is arguably an alarming finding for businesses and workforces at large, where the prevalence of digital devices may be quietly impacting worker productivity even without individuals using them.

Overall, this body of literature would appear to illustrate a compounding impact between digital device usage and worker productivity, where digital device usage causes worker sleep patterns to be disrupted, and this, in turn, causes a reduction in cognitive resources for workers to be productive. While this phenomenon has been examined separately in existing literature, this study seeks to combine it under a single mediation model to determine whether worker sleep disruption is a key factor in how digital device usage impacts worker productivity.

3. METHODOLOGY

This study uses quantitative research approach relating digital device usage, employee productivity and sleep duration with sleep duration as mediating variable. The quantitative approach is being used here as we can perform statistical analysis between the different variables and how they are related. The study aims to to test the predefined hypotheses between the relationship of the following variable digital device usage, sleep duration and employee productivity. The study was based on primary data which was collected using self constructed questionnaire developed from existing literature and the answers where taken inform of a 5 point likert scale measuring 1 as strongly disagree and 5 as strongly agree, the questionnaire includes 4 sections section A being demographic detail, section B as Digital Device Usage, section C as Sleep Duration and section D as Employee Productivity. The sample size for the test is 150 respondents who are employees from various industries. The study includes following variable and digital device usage, dependent variable and sleep duration which are the independent , dependent and mediating variable accordingly.

The collected data was analysed using SPSS and PSPP the following test performed on the data. Cronbacch's alpha test to check the consistency and reliability, descriptive statistics to summarise the data, correlation statistics to examine relationships, Regression analysis to test the impact of variable, Mediation analysis to assess indirect effects. The collected data was made into CSV file and entered into PSPP and SPSS. The study ensured all respondents participated voluntarily.

4. DATA ANALYSIS AND INTERPRETATION

The data from the hundred and fifty employee are collected and analysed. Statistical techniques like reliability analysis, descriptive statistics, correlation and regression were used to test the relationship. Between digital device usage, sleep duration and employee productivity.The cronbach's alpha value for all variables are above 0.9 given in table 1 showing high level of internal consistency between the questionnaire. This shows that the questionnaire is reliable.

Variable	No of item	Cronbach's alpha
Digital device usage	6	0.93
Sleep duration	6	0.94
Employee productivity	5	0.93

TABLE 1: Cronbach' Alpha test

Variable	Mean	Std. deviation
Digital device usage	3.31	0.74
Sleep duration	2.84	0.78
Employee productivity	3.07	0.78

TABLE 2: Descriptive Statistics

Variable	Correlation	Significance
Digital usage & productivity	-0.613	0
Digital usage & sleep	-0.510	0
Sleep & productivity	0.636	0

TABLE 3: Correlation Analysis

Table 2 mean score indicates digital device usage among respondents sleep duration is low compared to employee productivity which is at moderate level. The use of digital device has a negative relationship with both sleep duration and employee productivity as shown in Table 3. Sleep duration has a positive relationship with productivity.

HIGH DEVICE USAGE ➡ LESS SLEEP

LESS SLEEP ➡ LOWER PRODUCTIVITY

Through regression analysis the following was found $R^2 = 0.38$, $\beta = -0.61$, $p = 0.000$ Digital device usage significantly reduces employee productivity, showing 38% of the variance. $R^2 = 0.26$, $\beta = -0.51$, $p = 0.000$ the digital device usage has significant negative effect on sleep duration. $R^2 = 0.40$, $\beta = -0.64$, $p = 0.000$ the sleep duration has a positive effect on employee productivity. $R^2 = 0.52$, digital $\beta = -0.39$, sleep $\beta = 0.44$ when both variables are brought into consideration digital usage affects productivity negatively while sleep affects productivity positively. They results show us that sleep duration mediates the relationship between digital device usage and and employee productivity.the digital usage directly impacts productivity, also impacts productivity indirectly through sleep making sleep a perfect mediator.

5. CONCLUSION

The study has given the following conclusion and they are as follows digital device usage has a negative impact on employee productivity showing that increased use of digital devices leads to distraction, reduced focus and lower efficiency in completing tasks, it was also found that the digital device usage has negative impact on sleep duration. Excessive usage of mobile devices during night or late hours contributes to reduced sleep.

Sleep duration has a positive effect employee productivity showing that people with better sleep tend to perform their jobs more efficiently and effectively also they tend to maintain higher levels of concentration. The study revealed that sleep duration acts a mediator the relationships between digital device usage and employee productivity both directly and indirectly through its impact on sleep

Based on he findings the company should advise the following to their employee to increase their productivity

- Controlled device usage
- Digital discipline
- Promote healthy sleeping habits
- Awareness program
- Work life balance initiative

The take away for manager from this is would be to see how digital device usage has impacted employee productivity and sleep. managers can also implement adequate rest can lead to improved employee productivity. By recognising the role of sleep in enhancing the performance we can help organisations promote a healthier work space and cycle giving new policies which aims to reduce excessive device usage and and giving employee adequate sleep to function ad perform well

The study has also its own form of limitation such as the sampling method was convenience sampling, the response for the data were self reported making the reports biased. This study highlights the importance of balanced digital device usage and adequate sleep in improving employee productivity, offering valuable insights for both individuals and organizations.