Poor Sleep, Workplace Productivity, and the Associated Costs: A Systematic Review of the Literature

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Abstract

The aim of this literature review was to synthesize research findings that relate to the effect of poor sleep quantity on the workplace productivity of employees and the costs that are associated with this effect. 14 articles that met the criteria were used for this analysis. The findings of this paper indicate that (1) poor sleep exerts a large effect on the workplace productivity of employees since poor sleep is found to significantly lower the productivity in the workplace; (2) there are other occupational consequences of poor sleep, these are absenteeism, presenteeism and work accidents; (3) lowered workplace productivity due to poor sleep also leads to major costs, these costs can be viewed from two perspectives: The employers' perspective and the societal perspective; (4) there are certain measures organizations can implement to address the problem of poor sleep among their employees. A limitation of this research is the lack of generalizability of the findings. Furthermore, future research could look into the economic losses from an employers' perspective, and take in a non-Western point of view. In short, this research illustrates the importance of sleep in the workplace and shows the need to address the problem of poor sleep for both the employer and the employee.

Keywords: human resource management; poor sleep; insufficient sleep; workplace productivity; costs; economic losses

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Introduction

Sleep is a crucial biological function with important roles in recovery, energy conservation and survival. Moreover, sleep is also important for vital functions such as learning, memory, emotional regulation and cardiovascular functioning. In general, good sleep is critical for good health and overall quality of life (Mukherjee et al., 2015). The importance of sleep also becomes clear when looking at the relationship between daylight savings time and traffic accidents. The loss of one hour of sleep that is paired with the spring shift to daylight savings time enlarged the risk of accidents. Oppositely, the risk of traffic accidents was reduced after the fall shift from daylight savings time when an hour of sleep was gained (Meyer, Buschenfelde, & Lohse, 1996). Other results confirm that suicide rates rise in the weeks after the spring shift to daylight savings time, compared to the weeks after the fall shift from daylight savings time (Berk et al., 2008). Despite this importance, poor sleep has been a problem for a long time. In the nineties, sleep disorders were one of the problems most frequently encountered by clinicians (Lamberg, 1997). A more recent article on sleep habits of people living in Australia demonstrates that frequent sleep difficulties, daytime fatigue, and sleepiness are highly prevalent among Australians (20%-35%) (Hillman & Lack, 2013). The Centres for Disease Control and Prevention (CDC) in the United States even states that poor sleep has become a public health problem. According to research of the CDC, more than a third of the American adults are not getting sufficient sleep on a daily basis (Hafner, Stepanek, Taylor, Troxel, & van Stolk, 2017). However, insufficient sleep is not only seen as a problem in the United States, it equally concerns all other industrialized countries such as the United Kingdom, Canada, Japan and Germany (Hafner et al., 2017).

Sleep is often divided into two main components, sleep quantity and sleep quality. Sleep quantity refers to the amount of time spent asleep whereas sleep quality refers to how well a person slept (Pilcher, Ginter, & Sadowsky, 1997). Because quality of sleep can be categorized as subjective, this paper will focus on sleep quantity of employees as this is objectively measurable (Pilcher et al., 1997). Poor sleep can occur if insufficient time is allowed for it or if a disorder is in place that disturbs sleep quality (Hillman & Lack, 2013). Following the advice of The National Sleep Foundation, adult individuals should sleep seven to nine hours per night to prevent adverse outcomes and improve their well-being (Hirshkowitz et al., 2015).

According to Hafner et al. (2017), insufficient sleep is related to aspects of the modern 24/7 society such as psychosocial stress and excessive electronic media use (Hafner et al., 2017). It is only just now that researchers have begun to understand the far-reaching health and

social consequences of poor sleep and sleep disorders (Hillman & Lack, 2013). Sleeping insufficient can impact the occupational, medical, social and psychological functioning of adults (Swanson, Arnedt, Rosekind, Belenky, Balkin, & Drake, 2011). In the medical workforce sleep loss is associated with: Lapses in attention and inability to stay focused; reduced motivation; compromised problem solving; confusion; irritability; impaired communication; slowed or faulty information processing and judgement; diminished reaction times; indifference and loss of empathy (Hillman et al., 2018). Moreover, poor sleep has an unfavourable effect on physical health with higher chances of heart attacks, strokes, hypertension, obesity, diabetes, depression and mortality (Hillman et al., 2018).

Besides the effects of poor sleep as listed above, poor sleep also has an economic cost associated with it. This is due to its effect on health, safety, and productivity (Hillman et al., 2018). The study of Bolge et al. (2009), for example mentioned that individuals who sleep insufficient had a 13 per cent higher score for presenteeism (where presenteeism is defined as "impairment at work"/"reduced on-the-job effectiveness"), and a 10.3 per cent greater overall work productivity loss than good sleepers (Bolge, Doan, Kannan, & Baran, 2009, p. 421). Along with this, the study of Rosekind et al. (2010) found that compared with at-risk and good sleep groups, workers in insomnia and insufficient sleep groups had significantly lower productivity, performance and safety outcomes at work (Rosekind et al., 2010). According to Rosekind et al. (2010), it is estimated that fatigue-related productivity losses cost $1.967 per employee annually (Rosekind et al., 2010). The study of Hafner et al. (2017) even calculated that on an annual basis, the United States loses about 1.23 million working days due to insufficient sleep. This corresponds to about 9.9 million working hours (Hafner et al., 2017). As the length of our workdays increase and modern technology allows us to work at any given time during the day, it is needed to examine how these present-day work habits impact sleep and how sleep impacts work (Swanson et al., 2011). To look into the relationship between sleep and the occupational functioning of adults further, this paper will focus on the organizational and societal effects of poor sleep on workplace productivity, with in particular the economic costs that are associated with lowered productivity due to poor sleep. Also, this paper will provide interventions for organizations to address the problem of poor sleep.

The purpose of this study is therefore to examine the relationship between poor sleep quantity and its effect on workplace productivity and the economic costs of a firm or society relating to this effect. Given the high prevalence of sleep problems and sleep-related disorders (Rosekind et al., 2010), the research of this paper is relevant. Besides this, a healthy employee is a productive employee too, and getting sufficient sleep is crucial for good overall health

(Barnes & Watson, 2019; Mukherjee et al., 2015). The vital role of sleep on employee health and commercial success is often overlooked, this represents a blind spot in the literature (Barnes & Watson, 2019). In addition, this study can be relevant for organizations as well: With a deeper understanding of how (poor) sleep impacts productivity, more attention can be given to sleeping problems. This can benefit both the worker and the organization (Pilcher & Morris, 2020). Therefore the research question of this paper is: *What are the effects of poor sleep quantity on workplace productivity and what are the costs associated with this effect?*

Both sleep quantity and quality are important factors when considering how sleep impacts everyday functioning. Both of them can increase sleepiness at work and can negatively impact the performance and health of employees (Pilcher & Morris, 2020). Because this paper focusses on the effects of poor sleep quantity on productivity and the costs associated with this effect, poor sleep needs to be defined first. Various studies find that the sleep duration for adults with the lowest risk for adverse outcomes lies between seven and eight hours per night (Altman et al., 2012). The National Sleep Foundation also recommends that adults below the age of 65 get seven to nine hours of sleep every night (Hirshkowitz et al., 2015) Sleeping less than seven hours per night on regular basis is associated with unfavourable health outcomes. These outcomes can include: Gaining weight, diabetes, hypertension, heart disease and stroke, depression, and increased risk of death. Sleeping less than seven hours per night is frequently linked to increased pain, impaired performance, increased errors and greater risk of accidents (Watson et al., 2015). Furthermore, a lack of sleep has also been associated with lost productivity (Gingerich, Seaverson, & Anderson, 2017). Therefore, adults should sleep seven or more hours per night on a regular basis. Poor sleep is thus defined as sleeping less than seven hours per night (Watson et al., 2015). Productivity also needs to be defined. In the literature, productivity is defined as the following: "Productivity is the ratio of output to input for a specific production situation. Rising productivity implies either more output is produced with the same amount of inputs, or that fewer inputs are required to produce the same level of output" (Rogers, 1998, p.5). These changes in productivity due to poor sleep have costs associated with them (Rosekind et al., 2010).

Poor sleep and productivity

Poor or insufficient sleep leads to increased daytime fatigue (feelings of tiredness during the day). More daytime fatigue correlated with more absenteeism and presenteeism at work (Gingerich, et al., 2017). Thus, insufficient sleep is a major contributor to absenteeism and presenteeism. Absenteeism being workplace absence due to illness and presenteeism being a

sub-optimal work performance due to working while ill (Barnes & Watson, 2019). Short sleep-related absenteeism and presenteeism both reduce the productivity of workers (Barnes & Watson, 2019; Gingerich et al., 2017). Workers sleeping less than seven hours per night lose approximately six working days per year due to absenteeism and presenteeism when compared to workers sleeping the recommended seven to nine hours per night. As a result, these workers report on average a 2.4 per cent loss in productivity compared to those workers sleeping seven to nine hours per night (Barnes & Watson, 2019). Besides this, employees experiencing daytime fatigue have significant lower abilities in performing their work tasks which may lead to lowered productivity as well (Rosekind et al., 2010). Employees that sleep insufficiently were more likely to avoid social interaction with colleagues or supervisors at work, this avoidant behaviour leads to lowered productivity (Swanson et al., 2011). The cognitive effects of poor sleep are directly relevant to work outcomes. Firms spend a lot of resources on training their employees and actively encourage learning through formal and informal venues. Sleeping insufficiently impairs memory and learning, compromising the benefits of these training efforts (Barnes & Watson, 2019). Poor sleep also undermines efficiency in switching among tasks, increasing task switching costs and decreasing multitasking performance (Barnes & Watson, 2019).

Research on leaders and their subordinates indicates that sleep influences their working relationship (Guarana & Barnes, 2017). When leaders are sleep deprived, they express more hostility which undermines their subordinates' estimation of the quality of the working relationship (Barnes & Watson, 2019). Moreover, sleep-restricted leaders are less charismatic, less inspirational and less effective in displaying positive emotions when communicating with subordinates, lowering perceptions of the leaders' charisma (Barnes, Guarana, Nauman, & Kong, 2016). Thus, sleep-deprived leaders are less able to motivate and commit employees to their business mission, this is potentially devastating for business success (Barnes & Watson, 2019).

According to human capital theory, education and training are a form of investment that can benefit the organization (Nafukho, Hairston, & Brooks, 2004). In this view, employees are viewed as a form of capital which can lead to a competitive advantage for an organization (Nafukho et al., 2004). However, it is argued that human capital only leads to a competitive advantage when it is translated into actions that are beneficial for the firm (Barnes, Jiang, & Lepak, 2016). Looking at the effects of poor sleep on work outcomes highlights how it erodes the value of human capital within firms (Barnes & Watson, 2019; Barnes et al., 2016). Overall, sleep-deprived employees perform their work less productively, work less well together, make

poorer decisions and lead others less effectively (Barnes & Watson, 2019) As a result, work teams are less productive and effective when their members sleep poorly, eroding the value of their human capital. The breadth and depth of these effects are mostly underestimated by business leaders, provided they consider it at all (Barnes & Watson, 2019).

Method

This paper aims to synthesize research findings that relate to the effect of poor sleep on workplace productivity and the economic costs associated with this effect. In this section the study design is described first, after which the search strategy is explained, followed by the procedure and an analysis of the articles.

Study design

A systematic literature review was conducted to identify and evaluate existing academic literature to answer the research question of this paper. Systematic reviews are described to: "Efficiently integrate existing information and provide data for rational decision making. Furthermore, systematic reviews can establish whether research findings are consistent or whether findings vary significantly by particular subsets" (Mulrow, 1994, p. 597). The articles were collected through a digital search using pre-established search terms in various online databases. Articles that related to the topic of this research, poor sleep, workplace productivity and the costs associated with it, were selected. The key constructs are listed in the search terms paragraph below. Besides database searching, the snowball method was used to find additional articles. This method includes scanning through the reference lists of earlier found relevant articles to find other literature that can be used for this systematic literature review.

Search strategy

Search terms

Initially, Google Scholar was utilized to take a first sample of what types of articles were available on the topic of this research. Based on this first sample and the research question, various key constructs were identified in order to find appropriate literature. Articles were scanned for these constructs and they were added to the list if they seemed relevant for this research. These key constructs were:

1. *Sleep:* sleep, sleep loss, poor sleep, poor sleep quality, poor sleep quantity, sleep deprivation, bad sleep, insufficient sleep, fatigue, inadequate sleep, impaired sleep

2. *Productivity*: productivity, workplace productivity, productivity loss, decreased productivity, impaired productivity
3. *Costs*: economic costs, organizational costs, economic impact, workplace costs, company costs, enterprise costs, business costs

Databases

The online databases of Ebscohost, Google Scholar and WorldCat Discovery were used because these databases are easily available and allow to widely search for scholarly literature.

Selection criteria

Articles were considered for this review if they satisfied to the following criteria: (1) The article was written in English; (2) the type of study was empirical, either of a qualitative or quantitative design or was a literature review; (3) the article was published between 1995 and 2020; (4) the study measured the effect of poor or insufficient sleep on workplace productivity and/or the costs associated with this productivity loss; (5) the articles were published in journals targeting occupational health, psychical health, sleep, economics and management such as: Journal of Occupational and Environmental Medicine, Journal of Sleep Research, American Journal of Health Promotion, Journal of Clinical Sleep Medicine and Organizational Behaviour and Human Decision Processes. To maintain the focus on the occupational consequences of poor sleep, studies with a primary focus on other occupational consequences were excluded from the present review. Articles were also excluded if they only focussed on the importance of sleep and did not include the productivity or cost aspects.

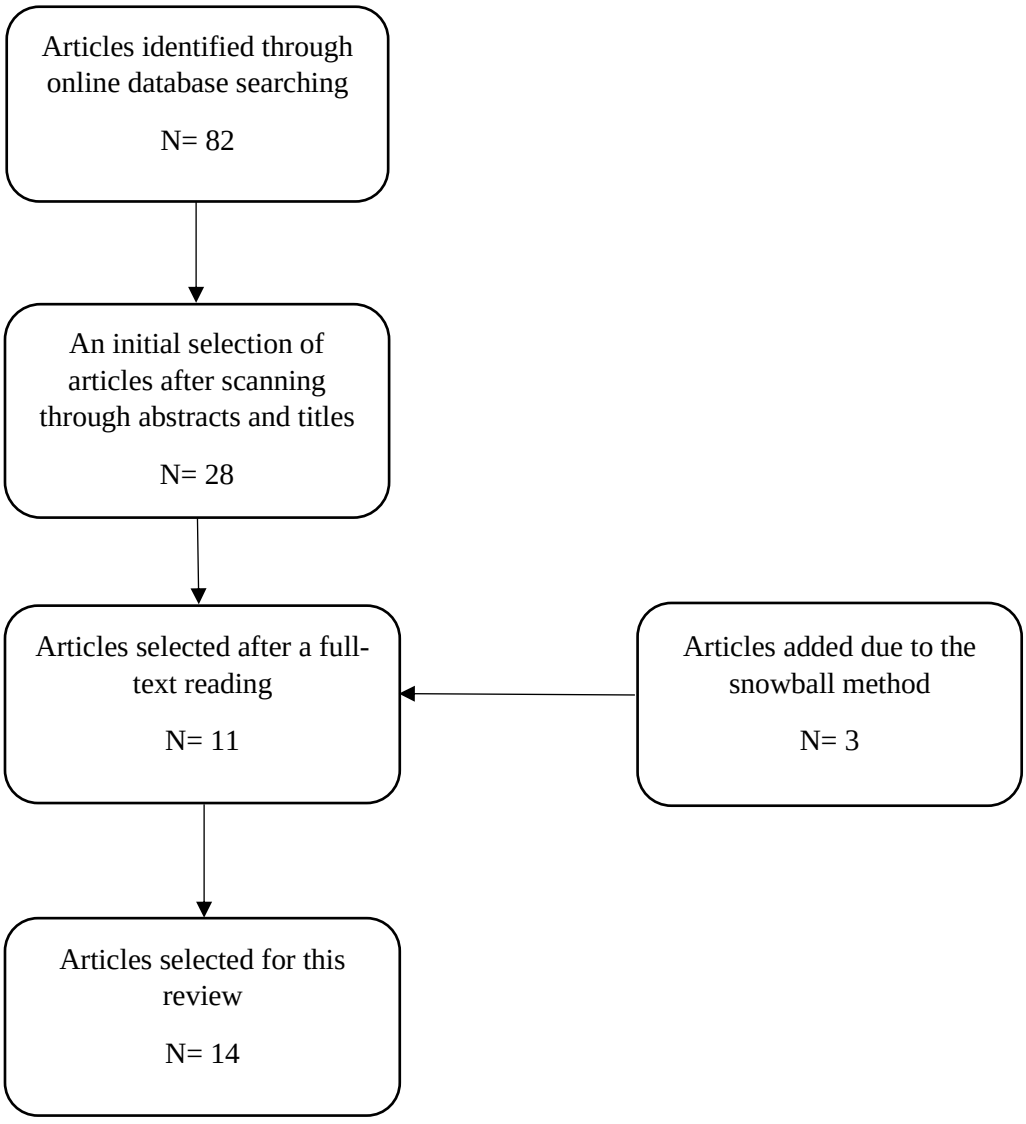
Procedure

Search procedure

The first step in identifying possible studies that satisfied the selection criteria involved the reading of the titles and abstracts of the articles that were found in the computerized search. Articles that did not satisfy the inclusion criteria or did not seem relevant for this research were rejected. Articles that did seem relevant and met the inclusion criteria were read in detail to establish a fit with the topic of this study. This procedure of database searches and the screening of titles and abstracts resulted in 28 articles for this review. After a full-text reading, 11 articles remained relevant. Three more articles were included in this study using the snowball method. The fourteen articles that were identified for this review are a mix of reviews and quantitative studies, one article adopted both qualitative and quantitative design. Most of the articles were

written in Western or industrialized societies and were published in or before 2010, except for one article. A total of six articles concern the economic costs for countries or employers that are associated with impaired sleep. The rest of the articles discuss the consequences of sleep deprivation for employee health and occupational functioning. Almost all the articles call for HR and employers to incorporate sleep education into their organizations.

Figure 1. Flowchart literature selection



The articles that were selected for this literary analysis underwent a structured review. The following details were recorded to construct Table 1: (1) author(s); (2) year published; (3)

the purpose of the research; (4) research method; (5) location of study; (6) results; (7) implications.

Findings

This section will report and synthesize the findings of this systematic review. The first part of this section will focus on the effect of poor sleep on workplace productivity. The second part will add the topic of costs to this effect. In conclusion, a table is presented with interventions for employers against the problem of poor sleep in the workplace. An overview of the findings of the relevant articles can be found in Table 1.

Table 1. Overview of the findings from the key articles

Author(s)/ year published	Research purpose	Method	Location	Results	Implications
Barnes & Watson (2019)	To address the effect of sleep on employee health, performance and workplace relationships.	Review	-	Conclusion: Healthy sleep is good for business.	Shaping the workplace environment to create better conditions for employees to get the sleep that they need will benefit businesses.
Burton et al. (2017)	To examine health risks, medical conditions, and workplace economic outcomes associated with self-reported hours of sleep among employees.	QN	United States	The best health and economic outcomes are associated with individuals who sleep eight hours per night. These individuals have the lowest average number of health risk factors and the smallest productivity losses.	Employers and other organizations should incorporate sleep education into their overall health and wellness strategy.
Gingerich et al. (2017)	To examine the relationship between sleep habits and employee productivity.	QN	United States	The least productivity loss occurred with employees who sleep eight hours per night. More daytime fatigue correlated with more absenteeism and presenteeism.	Organizations should consider addressing sleep habits that may be negatively impacting productivity.
Grandner (2018)	To assess the costs associated with sleep loss and the effects of poor sleep quality on health and performance.	Review	-	Alongside health consequences, insufficient sleep in workplace settings is related to workplace injuries, absenteeism, presenteeism/productivity loss, and health-care costs.	Workplace health programs should recognize and address the importance of sleep.

Hafner et al. (2017)	The study examines the economic burden of insufficient sleep across five different OECD countries.	QN + QL	Germany, Japan, Canada, United States, United Kingdom	Poor sleep has potential adverse effects on health, well-being and productivity. These consequences of insufficient sleep have far-reaching economic consequences.	Awareness needs to be raised about the adverse effects of inadequate sleep. Figures need to be provided for policy- and decision-makers, along with recommendations and potential solutions.
Hillman et al. (2018)	To estimate the economic cost of poor sleep in Australia.	QN	Australia	Inadequate sleep has an economic cost relating to its effect on health, safety and productivity. These costs are substantial.	-
Hillman & Lack (2013)	This article considers the prevalence and economic impact of sleep problems in Australia.	Review	Australia	Poor or inadequate sleep is very common among Australians, this is associated with large financial and non-financial costs. The greatest financial costs seem to be non-medical costs related to productivity losses and risk of accidents.	Measures should be taken to address the sleeping problems of Australian adolescents and adults.
Kucharzyk et al. (2012)	To summarize the effects of insomnia symptoms on occupational performance.	Review	Multiple industrialized countries	The study outcomes reported that insomnia symptoms: Are consistently associated with absenteeism; increase accident risk in the workplace; reduce subjectively experienced workplace productivity; inhibit career progression and can degrade job satisfaction.	The occupational dysfunctions associated with sleep symptoms may include both aspects of absenteeism and presenteeism. Clinicians need to be aware of this and of the significant risks poor sleep can cause in the workplace.
Marklund et al. (2019)	The aim was to evaluate workability and productivity among dentists and to identify gender differences and associations with sleep, stress and reported frequent pain.	QN	Multiple	Productivity loss among dentists was associated with poor sleep quality, a high amount of stress, and multi-site pain.	Preventive actions at the workplace of dentists should focus on minimizing the risks of high, persistent stress, poor sleep quality and work-related pain.

Overman (1999)	To raise awareness about the consequences of sleep deprivation and to encourage HR to address this problem.	Review	-	Poor sleep diminishes worker's productivity, which has tremendous economic consequences.	To avoid sleep-deprived workers, HR needs to address this problem and needs to go beyond the measures that are already taken.
Park (2018)	This research aims to identify the relationship between sleep quality and nurse productivity.	QN	South Korea	Poor sleep quality may lead to lower nurse productivity. Sleep disturbances and subjective sleep quality were found to be significant predictive factors of nurse productivity.	Nurse leaders and executives should consider measures to improve nurses' sleep quality, this will enhance nurse productivity.
Pilcher & Morris (2020)	To examine how sleep habits and workplace behaviours relate to each other.	Review	Multiple	Sleep deprivation negatively affects a large range of employee performance, health, and well-being issues.	Human resources and employees should emphasize the impact of sleep and sleep habits on organizational and individual productivity and safety. Sleep is an important concern for HR.
Rosekind et al. (2010)	To assess the impact of sleep disturbances on work performance/productivity.	QN	United States	Compared with at-risk and good-sleep groups, insomnia and insufficient sleep groups had significantly lowered productivity, performance, and safety outcomes. Sleep disturbances contribute to reduced employee productivity at a high cost to employers.	This article mentions several interventions employers and employees can take to address workplace sleepiness.
Yang et al. (2018)	To examine the relationship between sleep symptoms and work productivity in a diverse community sample.	QN	-	Sleep duration, insomnia, sleepiness, and snoring were all related to decreased work productivity. Among sleep symptoms, insomnia demonstrated the greatest impact on work productivity.	Sleep should be considered an important element in workplace health.

Note: Research method: Quantitative (QN); Qualitative (QL)*

As it was already mentioned in the introduction, sleep is essential for human functioning, but still a lot of people experience sleeping difficulties (Mukherjee et al., 2015). These sleeping

problems can potentially cause occupational dysfunctions among employees (Kucharczyk, Morgan, & Hall, 2012). The significance of work-sleep relationships is widely demonstrated in the literature. However, the impact of inadequate sleep on occupational performance has been researched far less (Kucharczyk et al., 2012). Therefore, this paper attempts to show the economic costs related to lowered productivity due to poor sleep from a societal and an employers' perspective.

Occupational consequences of poor sleep

Absenteeism and Presenteeism

Poor sleep leads to numerous dysfunctions among employees in the workplace. Two of these that are mentioned often in the literature are absenteeism and presenteeism. Out of the fourteen key articles, ten of the studies selected for this review covered the topics of presenteeism and absenteeism. In most studies, absenteeism was defined as: 'Workplace absence due to illness' and presenteeism was defined as: 'A suboptimal work performance due to working while being ill' (Barnes & Watson, 2019, p. 113). According to the literature, poor sleep is a major contributor to absenteeism and presenteeism (Gingerich et al., 2017; Grandner, 2018). Secondly, sleep-deprived workers are more likely to be absent from work due to sickness. As for presenteeism, sleep-deprived workers are associated with reduced performance while being at work, which leads to an efficiency loss (Hafner et al., 2017). It is found that employees getting the least sleep have the highest percentage of presenteeism when compared to other workers (Burton et al., 2017). One study made a comparison between insomniac employees and good sleeping employees. This comparison showed that the insomniac employees were more than twice as likely to report absenteeism due to illness over a month (Kucharczyk et al., 2012). Similarly, it is reported that poor sleep is significantly associated with workplace absence and the likelihood of entering long term sick leave (>90 days) (Kucharczyk et al., 2012). The study of Rosekind et al. (2010) even found that employees suffering from sleep deprivation were absent from work an average of 11.5 days annually (Rosekind et al., 2010). Moreover, according to the research of Pilcher & Morris (2020), sleep deprivation is also related to absenteeism, as employees who report more daytime sleepiness are significantly more likely to take work absences, are more likely to arrive late, or to leave earlier (Pilcher & Morris, 2020). Although absence from work could be explained by looking at the relationship between sleep and illness, intentional absenteeism should also be considered. Poor sleep could predict unethical behaviours in the workplace, therefore employees could be absent without being ill (Pilcher & Morris, 2020).

Impaired occupational productivity due to absenteeism or presenteeism was addressed in three studies. All of these studies reported that absenteeism and presenteeism have adverse effects on workplace productivity. For instance, Short sleep related absenteeism and presenteeism were found to reduce workplace efficiency, and therefore the productivity (Barnes & Watson, 2019). Workers who sleep less than six hours per night, lose approximately six working days annually due to absenteeism and presenteeism. As a result, these workers report on average a 2.4% loss in productivity compared to those workers sleeping between seven and nine hours per night (Barnes & Watson, 2019). The empirical findings of the study of Hafner et al. (2017) also suggest that workers sleeping less than six hours per night report on average a 2.4% point higher productivity loss due to absenteeism and presenteeism than employees sleeping between seven to nine hours per night (Hafner et al., 2017). Additionally, an internet survey of Bolge et al. (2009) concluded that people with insomnia had a 13% higher score for presenteeism and a 10.3% greater overall work productivity loss than good sleepers (Bolge et al., 2009; Kucharczyk et al., 2012). In this study workplace productivity was assessed using the WPAI (work productivity and activity impairment questionnaire) (Kucharczyk et al., 2012).

Work accidents

Another consequence of poor sleep that can lead to lowered productivity and was frequently discussed in the literature are work accidents and injuries due to inadequate sleep. A total of five studies were identified which concerned work accidents as a result of impaired sleep. According to the literature, it is known that sleep loss leads to workplace injuries and accidents (Grandner, 2018). Compared with workers who receive enough sleep, those workers who report excessive daytime sleepiness because of disturbed sleep are more prone to accidents and injuries, both on and off the job (Rosekind et al., 2010). In one of the studies, sleep is increasingly linked to motor vehicle crashes, industrial disasters and occupational accidents and injuries (Burton et al., 2017). Additionally, in a large scale population survey (n = 69,584) an increased chance of work injury was reported for employees with a poor sleeping pattern (Kucharczyk et al., 2012). Overall, employees that are not well-rested have more workplace accidents than well-rested employees (Barnes & Watson, 2019).

Besides workplace accidents, several studies uniformly report that poor sleep in itself leads to lowered productivity. The study of Park et al. (2018), which was conducted among Korean clinical nurses, reveals that sleep disturbances and poor subjective sleep quality were significantly associated with lower nurse productivity (Park et al., 2018). The outcome of this study is in line with the report of Rosekind et al. (2010), which states that groups with sleep

problems had significantly worse productivity and performance outcomes than other groups (Park et al., 2018; Rosekind et al., 2010). The study of Rosekind et al. (2010) was conducted among employees of American corporations. Similarly, the article of Overman (1999) agrees that there is a performance cost to being fatigued, it states that: "Tired employees are more vulnerable to make mistakes and less likely to find a better way of doing a task. They miss opportunities for improvement, which increases productivity costs" (Overman, 1999, p.2). Likewise, sleep duration (both short and long), insomnia, sleepiness and snoring were all associated with lowered work productivity. Among these sleep symptoms, insomnia was identified as having the greatest impact on work productivity (Yang et al., 2018). Lastly, a quantitative study among dentists demonstrated productivity loss in terms of decreased workability. It indicated that decreased workability was associated with poor sleep quality (Marklund, Mienna, Wahlström, Englund, & Wiesinger, 2019).

Sleep and costs

Sleep-related impaired work performance continues to be a significant cost burden on the individual worker, on the employer, and the health care system (Kucharczyk et al., 2012). In this section, the costs that are associated with lowered productivity due to poor sleep are addressed. Two of the studies addressed this topic from an employers' perspective, whereas the other four studies addressed it from a societal perspective. First of all, this paper will focus on the employer's perspective on poor sleep and costs.

The study of Rosekind et al. (2010) is one of the papers that address the cost burden on employers due to poor sleep among its employees. Specifically, this paper focusses on employer costs related to productivity changes, this was estimated through the Work Limitations Questionnaire (Rosekind et al., 2010). This study assessed the costs of poor sleep for employees of four different US companies, based on the salary figures provided by each company, the study estimated the mean annual cost per employee (expressed in US dollars) of sleep-disturbance-related at-work productivity loss (Rosekind et al., 2010). The participants of the study were divided into four main categories: Insomnia, insufficient sleep, at risk, and good sleep. The findings suggest that the costs were greatest for employees with insomnia, namely $3.156 per employee annually (Rosekind et al., 2010). For the insufficient sleep group, the mean costs were estimated $2.796 per employee annually, and for the at risk group it was $2.319 per employee annually. As expected, the good-sleep group had the lowest mean figure, $1.293 per employee annually. This study also extended the cost calculations of productivity loss to the total workforce of the four companies. It was estimated that work productivity loss due to

insomnia, insufficient sleep, and sleep disturbances would reach a total cost of $54 million per year (Rosekind et al., 2010). Besides this, Rosekind et al. (2010) also calculated the costs relating to absenteeism among employees with poor sleep. These costs were estimated at €1.472 per year (Rosekind et al., 2010). Apart from the study of Rosekind et al. (2010), no other article in this review estimated costs for specific companies. The study of Hillman et al. (2018) however, estimated the total cost of sleep related absenteeism and presenteeism for employers in Australia. The results indicate that the cost for sleep related absenteeism is around $1.73 billion, whereas the cost for sleep related presenteeism amount to a total of $4.63 billion (Hillman et al., 2018).

More information on the total costs of poor sleep can be found for countries in itself. When comparing the four articles that focus on this societal perspective, several distinctions can be mentioned. Firstly, the costs of poor sleep are examined for different countries. Whereas the article of Hafner et al. (2017) examines the economic burden of insufficient sleep for the countries Canada, Japan, Germany, the UK, and the US, the articles of Hillman et al. (2018), and Hillman & Lack (2013) focus on the costs of poor sleep in Australia. Secondly, how the costs are expressed is different among the articles. The paper of Grandner (2018) for instance, expresses the costs of poor sleep in health care costs, while Hafner et al. (2017) express it in terms of lowered GDP (Gross Domestic Product), and Hillman et al. (2018) express it in overall costs of poor sleep. Lastly, the data collection methods differ among the articles. Whereas the articles of Hillman et al. (2018), Hillman & Lack (2013), and Hafner et al. (2017) have used surveys and datasets for their data collection, the article of Grandner (2018) relied on previous research to gather data.

In the paper of Hafner et al. (2017), the economic cost of poor sleep is examined across five countries in terms of lost GDP and lowered labour productivity. The paper adopts an analytical approach in which the effect of poor sleep is translated into the supply of effective labour units that workers contribute to the economy. This labour supply is affected through productivity related mechanisms (Hafner et al., 2017). The findings of the economic analysis of this report suggest that lower productivity levels and higher mortality risks related to poor sleep can result in considerable economic losses to modern economies (Hafner et al., 2017). For example, the economic predictions state that the US sustains the highest annual economic loss (between $280 billion and $138 billion) this amount is associated with a 2.28% loss in GDP. Respectively, the loss of GDP for Japan, the UK, Germany and Canada is 2.92%; 1.86%; 1.56%; and 1.35%. Poor sleep among their populations cost Japan, Germany, Canada, the US, and the UK around $680 billion of economic output every year (Hafner et al., 2017). Aside

from this research, the paper of Grandner (2018) examined health care costs as a result of poor sleep (Grandner, 2018). The study demonstrated that poor sleep quality was associated with approximately 3.400 to 5.200 additional dollars spent per person on healthcare. When the sleep quality of individuals worsened after one year, health care costs increased even more (Grandner, 2018). Hillman et al. (2017) divided the estimated overall costs of inadequate sleep in Australia into financial and non-financial costs. Financial costs are the costs associated with health care, productivity losses, and non-medical work- and vehicle accident costs. Non-financial costs are costs due to a loss of well-being (Hillman et al., 2017). The overall cost of inadequate sleep in Australia in 2016-2017 was $45.21 billion. The financial costs component consisted of $17.88 billion, while the non-financial costs were estimated at approximately $27.33 billion (Hillman et al., 2017). Lastly, the study of Hillman & Lack (2013) only calculated the costs of sleep disorders in Australia, other costs relating to poor sleep were not taken into account. The economic impact of sleep disorders illustrates a financial cost of $5.1 billion per year for Australia (Hillman & Lack, 2013).

Sleep and HR

Poor sleep negatively affects individuals through unfavourable effects on their health, well-being and productivity, which also makes it costly for employers due to lost working time from their employees. Therefore, solving the problem of insufficient sleep is beneficial for individuals, employers and the wider society (Hafner et al., 2017). Nearly all the articles selected for this review concluded with the fact that more awareness should be given to the problem of poor sleep at work. Several articles also included measures that companies, and especially HR can take to address this problem. This section will focus on these interventions for employers to improve the productivity and well-being of their employees due to a good quantity and quality of sleep. Below, in Table 2 an overview is given of the interventions that were named in the articles.

Table 2. Overview of the interventions

Article	Intervention(s)
Barnes & Watson (2019)	Businesses would do well to create a corporate culture valuing sleep. This is best accomplished by the implementation of Workplace Health Promotion Programs (WHPPs). These programs are focused on sleep-wellness and fatigue management to optimize employee health. According to Barnes & Watson (2019), absenteeism and presenteeism costs fall about $2 for every $1 spent on WHPPS.

Burton et al. (2017)	Employers and HR should educate their employees on techniques to achieve optimal sleep quality and duration.
Grandner (2018)	Work health interventions should address sleep and other dimensions of health such as diet, physical activity and stress. Workplace health initiatives should promote the idea that sleep is not unproductive time. Rather, sleep is an investment that has been shown to improve productivity.
Hafner et al. (2017)	Employers should recognize the importance of sleep and its adverse outcomes and play a role in the promotion of it. Also, employers should provide facilities that help employees with sleep hygiene and discourage the increased use of electronic devices for their employees.
Overman (1999)	Employers should understand the costs and recognize the symptoms of fatigue. They can adopt plans that help employees cope with lifestyle demands. The role of HR is to talk to the workforce about how poor sleep affects their productivity and to not make employees feel guilty about needing more sleep.
Pilcher & Morris (2020)	This research suggests that changes in behaviour due to sleep loss should be considered during personnel recruitment & selection (for example when hiring individuals for shift work). This will result in human resources mitigating future personnel problems by screening for individual responses to sleep loss and sleepiness in the workplace.
Rosekind et al. (2010)	The article lists some steps employers and employees can take to address poor sleep in the workplace. One of them is workplace flexibility, this means allowing more flexible work start and end times. Furthermore, allowing for adequate rest between work periods and workplace activities may help to increase unwinding and, in turn, sleep quality. Lastly, employers can also educate their workers about the importance of sleep and how to effectively manage sleep loss.

Discussion and Conclusion

This literature review aimed to identify and synthesize existing research on the effect of poor sleep on employee workplace productivity and the costs associated with this effect. This section will reflect on the findings and answer the research question. Although it is investigated that sleep is an essential biological function, the vital role of sleep for employees is rarely being noticed (Barnes & Watson, 2019). This review identified several occupational consequences of poor sleep that became evident from the literature, the first one being absenteeism and presenteeism. Poor sleep was identified as a major contributor to both absenteeism and

presenteeism (Gingerich et al., 2017; Grandner, 2018). Poor sleep was found to be related to absenteeism because of the relationship between poor sleep and sick leave and late arrivals and early departures (Hafner et al., 2017; Kucharczyk et al., 2012; Pilcher & Morris, 2020). Intentional absenteeism due to poor sleep should also be considered as poor sleep can lead to unethical work behaviours (Pilcher & Morris, 2020). Moreover, poorly sleeping workers are associated with reduced performance at work because they work at a sub-optimal level. This leads to lowered efficiency (Burton et al., 2017). Absenteeism and presenteeism were reported to lead to impaired productivity in the workplace, they both reduce the efficiency of workers, and therefore the productivity is lowered (Barnes & Watson, 2019).

Work accidents were recognized as a second occupational consequence of poor sleep. As was mentioned in the literature, sleep loss makes workers more vulnerable to accidents and injuries in the workplace. This is due to a reduced attention span as a result of tiredness (Grandner, 2018; Kucharczyk et al., 2012; Rosekind et al., 2010). Lastly, poor sleep was found to be a major contributor to impaired workplace productivity in itself. This can be explained through the Human Capital Theory. Poor sleep erodes the value of human capital that is present in organizations because human capital only leads into a competitive advantage when it is translated into actions that are beneficial for the firm (Barnes, Jiang, & Lepak, 2016). It is due to poor sleep that workers are less productive and effective, wasting available human capital (Barnes & Watson, 2019). The current findings also suggest that poor sleep among workers leads to tremendous costs for employers and countries due to productivity changes and sleep related absenteeism and presenteeism (Hillman et al., 2018; Rosekind et al., 2010). According to Rosekind et al. (2010), the costs for absenteeism were estimated at €1.472 annually (Rosekind et al., 2010). Whereas Hillman et al. (2018) indicated that the costs for sleep related absenteeism and presenteeism in Australia in the years 2016-2017 was around $1.73 billion and $4.63 billion respectively (Hillman et al., 2018). The societal costs of poor sleep were addressed in terms of increased health care spending and lowered GDP. It was found that poor sleep among their populations costs Japan, Germany, Canada, the US, and the UK around 680 billion dollars of economic output per year (Hafner et al., 2017). However, because of the different conceptualizations of the costs of poor sleep and the limited information available about these costs in the literature, no exact number can be ascribed to the costs of poor sleep.

A sensible conclusion to draw from this literary review therefore is that poor sleep is consistently associated with absenteeism, presenteeism, work accidents, and lowered productivity among workers in the scholarly literature. Furthermore, it can be concluded that poor sleep represents a major economic burden on both employers and the wider society. Thus,

more attention should be given to poor sleep among workers and more interventions should be implemented.

Limitations

While the present review on the effect of poor sleep quantity on workplace productivity and the costs associated with this effect generated valuable insights, several limitations have to be taken into consideration. As the current review is a small literature study, the generalizability of the findings can be limited because they may not be generalizable to other groups or populations (Ali & Yusof, 2011). Also, it is important to acknowledge that this review may not have exhausted all the relevant and available articles on this topic. Second, this literature review is written from a Western point of view. As most of the research of the articles in this review was conducted in Western countries, it should be considered that the outcomes in non-Western countries can differ because of different perceptions and attitudes non-Western cultures might have regarding sleep and work productivity. Third, as the articles selected for this review were, in most cases, written quite recently, chances are that other relevant articles on this topic are still being written or have not been published yet. Fourth, some of the articles that were used in this review relied on self-reported hours of sleep for their analyses. This self-reported data can mislead empirical analyses because of the deviation between the self-reported values and the true values (Bauhoff, 2011). Lastly, only one relevant article was found on the costs of poor sleep for firms (employers' perspective). Due to the limited information regarding this perspective, the findings related to the cost of poor sleep on the employers' side might have reduced generalizability

Directions for future research

The findings from this review open up to various directions for future research. First, for future research, the influence of the cultural context should be considered. To extend the research on this topic, other articles should include a non-Western point of view. Secondly, Because only one relevant article was found for the economic losses of a firm due to poor sleep, future research can look into the employers' perspective to expand the research on this topic. Building on the finding of this review that the costs of poor sleep are considerably large, but no exact number can be ascribed to these costs, provides room for other studies to examine how much these costs exactly are. Because the articles in this review have conceptualized the costs of poor sleep in different ways, e.g. health care costs and GDP, and because of the two different perspectives, it is hard to get a clear picture of what the exact costs of poor sleep are. For future research, greater conformity in the conceptualization of the costs of poor sleep could help solve

this. Furthermore, as this review focused for a great deal on absenteeism, presenteeism and work accidents as occupational consequences of poor sleep, more research can be done on other occupational consequences of poor sleep to enlarge the field of study.

Practical implications

Some practical implications can be identified from the findings of this review. To start with, evidence from this research suggests that poor sleep has a substantial effect on the productivity of workers. This effect should be recognized by both workers and their employers. Besides the effect poor sleep has on productivity, high costs are associated with this effect. It is of importance that the cost aspect is also identified by employers and employees, as this aspect is mostly overlooked. Focussing on the effect of poor sleep on productivity and on the cost aspect is proven to be beneficial for both the worker and the organization. To conclude, this literature review provided some measures for organizations to implement to address the problem of poor sleep. Organizations or HR should (1) educate their employees on the importance of sleep and the adverse outcomes of poor sleep; (2) incorporate workplace health interventions aimed at sleep and other dimensions of employee health and provide facilities that help employees with sleep and lifestyle demands; (3) allow flexible working times and unwinding for employees.

From the interview, that is summarized in Appendix 1, it also became apparent that improvements should be made to improve the sleep quality and quantity of employees. In the interview, no direct evidence was found for absenteeism, presenteeism and accidents at work as a result of poor sleep. However, the interviewee did think that poor sleep could be an important cause of these forms of impairment at work. Educating employees on sleep is often mentioned in the literature as an intervention to address the problem of poor sleep, in the interview this intervention was also mentioned. The interviewee mentioned sleep education in the form of a sleeping course for employees. Furthermore, the company in question also implemented a sustainable employability budget for their employees as an intervention. This specific intervention was not mentioned in the literature. The intervention of flexible working times was also discussed, but was not seen as a feasible intervention by the interviewee due to the time it would cost to implement such a system.

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Appendix 1

Interview Summary

Within this research, an interview was conducted to discuss the outcomes of this review along with potential HR interventions. The person that was interviewed is Eky Simon, HR manager at Prevermo Group. Prevermo Group is an overarching holding of four companies. The primary objective of Prevermo is focussing on sustainable employability of employees. In total, 270 employees are active at Prevermo Group. The strategy of Prevermo Group is finding solutions in the field of preventions, absenteeism and labour mobility, which are all aimed at increasing productivity and the overall well-being of employees. Below, A transcript is provided with the most important questions of the interview.

Interviewer: To what extend are you/Prevermo familiar with the effect of poor sleep on the productivity of employees?

Interviewee: Every year, a PMO research is conducted among our employees. PMO, as we call it, is a preventive medical examination on the physical and mental well-being of our employees. The diverse tests and questionnaires of this research allow us to see what the state is of the sustainable employability of the employees. One section of the PMO also focusses on sleep quality and quantity. From this research, it was concluded that sleep needs some attention.
When comparing the scores of sleep to a benchmark, we saw that our scores lie below that benchmark, thus some improvements can be made in that area.

Interviewer: Do you notice something about your employees when they had a bad night of sleep?

Interviewee: That is difficult for me to say because I cannot see the employees in all the four companies, so perhaps a line manager can better answer this question. What I can see from the results of our research is that the best sleep was found among one company where the average age of the employees is relatively the lowest, and where there is the least emotional strain. The worst sleep was measured in another of the four companies, where the employees are relatively older and the most emotional strain was measured. I think that there is a connection between these things, but I cannot make conclusions about it because we did not yet research it.

Interviewer: One of the outcomes of this research is that poor sleep is a contributor to absenteeism and presenteeism, do you notice absenteeism and presenteeism in your company?

Interviewee: I cannot really say something about that. When I see someone being tired at work and engaging in presenteeism or absenteeism, I cannot tell if poor sleep is the cause of that. We have to do some research about this first in order to make statements about it.

Interviewer: Another outcome of this research is that poor sleep can lead to accidents and injuries in the workplace, did something similar ever happen at Prevermo?

Interviewee: No, thankfully no accidents or injuries ever happened at Prevermo as far as I know. Perhaps this is different for other companies, in a production company for example, I can imagine that more accidents can occur because of poor sleeping employees.

Interviewer: Do you think that for poor sleeping employees an actual lower level of productivity can be measured?

Interviewee: I personally believe that that is the case, but we never measured this so I cannot conclude it. To measure productivity, the WAI (workability index) is included in the PMO research, but I cannot tell if poor sleep leads to a lower WAI score.

Interviewer: Has Prevermo already implemented some interventions that address poor sleep among employees?

Interviewee: In the companies with the highest rates of insomnia we have implemented a sleep course for all the employees. This course is voluntary. Besides this, we have a sustainable employability budget, which employees can spend every year. With this budget, employees have for example bought a wake-up light or sleepbuds to improve their sleep. We also try to educate employees on sleep. An assumption that we for example frequently heard from our employees was that some of them drank a glass of red wine before going to bed because this would improve their sleep quality. In my presentation, I told them that alcohol actually deteriorates your sleep quality.

Interviewer: Did Prevermo already notice some effects of these interventions?

Interviewee: Within the companies where the highest rates of insomnia were measured, we can see that the sleep quality has indeed gone up, but it is hard to totally assign this effect to the sleep course because of other factors that could possibly also have to do something with this (like emotional strain or workload).

Interviewer: In this research, other possible interventions for organizations are mentioned. One of them is providing employees with flexible work times, do you think this is a good intervention?

Interviewee: In my opinion, it is a good intervention and I certainly believe that this can help with for example absenteeism and the overall sleep quality of employees. The only thing is that I think it is quite difficult to implement, as it costs a lot of time to adopt such a flexible work system.