



UNIVERSIDADE CATÓLICA PORTUGUESA

SLEEPING HABITS AND JOB PERFORMANCE, A STUDY IN AGROTECHNOLOGY COMPANIES IN COLOMBIA

Dissertation submitted to Universidade Católica Portuguesa to
obtain a Master's Degree in Psychology in Business and
Economics

By

Estefanía García Luna

Faculty of Human Sciences

September 2023



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Abstract

Agrotechnology in Colombia promises to be the solution to the productivity problems of the agricultural sector, one of the main contributors to the country's economy. New companies are joining the market with employees who fulfill completely different roles and work different shifts. The objective of this research was to study their job performance through two factors, self-perception of productivity and job satisfaction, and to understand how these are related to their respective sleep habits, job and sociodemographic characteristics.

A survey composed of validated instruments (Overall Job Satisfaction, Self-perception of productivity, Pittsburg Sleep Quality Index, Insomnia Severity Index, Sleep Hygiene Index and Munich Chronotype Questionnaire) was applied to 105 employees of both sexes from different companies in the sector. Using Welch's ANOVA, it was found that job performance factors are different for each type of job and shift. It was also found a tendency for worse job satisfaction to reported poor sleep quality ($F = 3.456$; $p\text{-value} = 0.053$). Through Spearman's correlation, a negative correlation was found between sleep duration on free days and self-perceived productivity ($\rho = -0.192$, $p = 0.050$). Also, using a multiple linear regression, it was found that job satisfaction is positively affected by the perception of productivity, employee's type of shift and their sleep quality, while it decreases with higher age and sleep loss.

This concludes the need to apply differentiated strategies in the companies for these employees. In this way, recommendations are made focusing on their sleep-wake behavior seeking to promote the well-being of employees and, therefore, to improve performance in the companies of this important sector to the Colombian economy.

Keywords: Job satisfaction, self-perceived productivity, sleep quality, sleep deficit.

Resumo

A agrotecnologia na Colômbia promete ser a solução para os problemas de produtividade do sector agrícola, um dos principais contribuintes para a economia do país. Novas empresas estão a entrar no mercado com trabalhadores que desempenham funções completamente diferentes e trabalham em turnos diferentes. O objetivo desta investigação é estudar o desempenho laboral destes trabalhadores através de dois factores, a auto-perceção da produtividade e a satisfação no trabalho, e como estes se relacionam com os respectivos hábitos de sono e características laborais e sociodemográficas.

Para o efeito, foi aplicado um questionário composto por instrumentos validados (Satisfação global com o trabalho, Auto-perceção da produtividade, Índice de Qualidade do Sono de Pittsburg, Índice de Gravidade da Insónia, Índice de Higiene do Sono e Questionário do Cronótipo de Munique) a 105 trabalhadores de ambos os sexos a diferentes empresas do sector. Utilizando a ANOVA de Welch, verificou-se que os factores de desempenho profissional são diferentes para cada tipo de trabalho e turno. Verificou-se também que a satisfação no trabalho é tendencialmente inferior consoante o pior nível de qualidade do sono reportado ($F = 3.456$; $p\text{-value} = 0.053$). Através das correlações de Spearman, verificou-se uma correlação negativa entre a duração de sono nos dias de folga e a produtividade auto-percebida ($\rho = -0.192$, $p = 0.050$). De igual modo, através de uma regressão linear múltipla, verificou-se que a satisfação no trabalho é afetada positivamente pela perceção da produtividade, pelo tipo de turno e pela qualidade do sono, enquanto diminui com o aumento da idade e com o défice de sono.

Conclui-se assim a necessidade de aplicar estratégias diferenciadas nas empresas para estes colaboradores. Desta forma, são feitas recomendações que promovem um sono de qualidade o bem-estar dos colaboradores e, por conseguinte, procurando melhorar o seu desempenho nas empresas deste importante sector para a economia Colombiana.

Palavras chave: Satisfação no trabalho, produtividade auto-percebida, qualidade do sono, défice de sono.

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List of abbreviations

| | |
|-------|---|
| ANOVA | Analysis of Variance |
| CEO | Chief Executive Officer |
| GMPP | General Measure of Perceived Productivity |
| HR | Human Resources |
| ISI | Insomnia Severity Index |
| MCTQ | Munich Chronotype Questionnaire |
| MSF | Midpoint of Sleep on Free Days |
| MSFsc | Midpoint of Sleep on Free Days corrected for Sleep Debt on Workdays |
| MSW | Midpoint of Sleep on Workdays |
| OLS | Ordinary Least Squares |
| PSQI | Pittsburgh Sleep Quality Index |
| REM | Rapid Eye Movement |
| SD | Sleep Duration |
| SHI | Sleep Hygiene Index |
| SJL | Social Jetlag |
| SLOSS | Weekly Sleep Loss |
| SO | Sleep Onset |
| VIF | Variance Inflation Factor |
| WT | Wake-up Time |

Introduction

Latin America is characterized by its wealth of natural resources, including one-third of the world's freshwater resources and some of the highest quality land for agricultural production (Inter-American Development Bank, 2020). It is worth noting here that agriculture, defined as the production and marketing of crop and livestock products, is the foundation of the economic system of many of these countries (Fedesarrollo, 2013). This sector is an important source of employment, with 14% of the region's workforce engaged in agricultural activities (Food and Agriculture Organization of the United Nations, 2020).

Within this region is Colombia, the fourth largest nation in South America. With coastlines on the Pacific and Atlantic Oceans, the country has a privileged geographic location that is evident in its biodiversity and great climatic diversity, with productive and fertile lands thanks to its number of thermal soils (ProColombia, n.d.). In the last decade, the Colombian countryside has been consolidated as an engine of the national economy, which is reflected in the growth of the agricultural GDP (Ministry of Agriculture and Rural Development, 2018) and the number of jobs generated in the sector, representing 17% of the total labor force in the country (DANE, 2020).

The different crops of the country are protagonists in the daily consumption of Colombians and citizens of the world, thanks to exports and different tariff agreements with other countries, making the competitiveness of the sector mandatory. In addition to the above, according to the Food and Agriculture Organization of the United Nations (2020), Colombia can become one of the great food sources of the world, being one of the seven countries in Latin America with the greatest potential for the development of arable land.

However, the Colombian reality poses significant challenges to the development of this economic sector. These include challenges such as high poverty rates (DANE, 2022), high labor informality, lack of access to credit for farmers, violence that affects communities and

causes displacement from rural areas to cities, poor transportation infrastructure, as well as low access to internet, education and health services (Bloomberg, 2023).

The national government has set clear goals to address these issues; in fact, the current National Development Plan sets as a goal the transformation of the agricultural sector to produce more and better food through science, technology and innovation. Thus, the roadmap for the next four years establishes the need to organize agricultural production, since it is necessary to formulate, implement, follow up and evaluate the instruments of productive organization for planning agricultural production, identifying the best productive clusters and production alternatives that allow sustainable and inclusive territorial development. The government then intends to promote timely and simultaneous access to productive factors such as capital for financing, technology, agricultural extension, connectivity and complementary services for production (Plan Nacional de Desarrollo, 2023).

These guidelines include a commitment to investing in technology to promote industrialization processes and improve productivity in the sector. According to the Colombian presidency, "agricultural and agroindustrial production chains will be developed based on the adaptation and adoption of technologies for sustainable development" (Plan Nacional de Desarrollo, 2023, p. 127). Thus, agroindustrial technology transfer programs and activities will be strengthened, promoting the intensive use of data for crop and production monitoring and follow-up. All this will be the result of the adoption of digital technologies that will allow the transition to a knowledge-intensive agro-industrial economy, facilitating local productive transformation processes and the traceability of the performance of small production units.

This is where agrotechnology, or AgTech, comes into play. The term AgTech comes from the combination of technology and agriculture, and refers to the use of technologies such as blockchain, big data, robotics, artificial intelligence (AI), and biotechnology to analyze data extracted from farms, leading to further optimization of the agricultural sector (Ministry of Agriculture and Rural Development, 2018). The agricultural technology sector in Colombia has experienced significant growth in recent years. According to the latter, AgTech is gaining

a significant presence due to the increasing number of tools used to optimize the management of the agricultural sector, such as irrigation sensors, geographic information systems, and drones is increasing, so AgTech is acquiring a presence of great importance.

The characteristics of the current Agtech market in Colombia are focused on guidance systems, whose main objective is to reduce time to optimize the routes of machinery through the field; automation systems and robots that directly intervene in the tasks performed by the farmer, reducing the time and cost of human labor; remote sensing, which captures images using satellites, drones or aircraft; software tools that collect information as diverse as the state of the crop, the operation of machinery and the quality of the harvest (Ministry of Agriculture and Rural Development, 2019). In this way, the digitalization of agriculture opens up the possibility of improving productivity, reducing environmental impact, and promoting social inclusion in Latin America (Forbes, 2022).

Despite the efforts of governments, it should be recognized that in Colombia and the Latin American region in general, there are barriers to the expansion of AgTech, such as limited economic resources and the difficulty in accessing funds for digital companies (Castilleja et al., 2023), the lack of public-private synergies that leave private entrepreneurs alone to work on this expansion, access to the Internet and the low acceptance of technological solutions by users (Herrero, 2023). Nevertheless, in Colombia, there are different companies that have entered the market in recent years and have been recognized for their efforts and strategies. Companies such as Frubana, Petalii, Granos Andinos de Colombia, Waruwa, SiembraCo, Digital Fair Business, Amasar, Sioma, Midder, Alimentos Derivados de la Cana y Castilla Agricola, Advector, Agrapp, Agroune, Innterra and CurubaTech have been recognized by international portals such as Contxto (2020), Forbes (2022) and StartupPill (2023) for their diverse approaches to innovation in the AgTech industry, through ideas, new products and exceptional growth strategies, as well as management in social impact.

All of these companies in the industry have different approaches. While some focus on marketing and communication between customers and suppliers, others concentrate on installing measurement equipment on farms, others focus on collecting and investing capital,

and others focus on collecting data, analyzing data, or creating recommendations for producers (Ministry of Agriculture and Rural Development, 2018). Similarly, to respond to these functions, each company requires different types of employees, working in different shifts and fulfilling roles with very different characteristics from each other, to meet the needs of a sector that mixes traditional cultivation with new-generation technologies.

Considering this mix of roles within the sector, the motivation for this dissertation is the concern about the work performance of the employees of these companies, most of which have emerged in the last decade. Since this is such a new field, it is an opportune moment to study the different ways of making productive those who make the country's agricultural sector productive.

For this reason, this dissertation aims to study the work performance of workers in the AgTech sector in Colombia and how it is related to their shifts and type of work, their socio-demographic characteristics, and their sleep habits. Thus, to contribute to the literature on the subject and generate recommendations that can be applied by the companies themselves to promote the well-being of their employees, their management, and their results.

To develop the idea mentioned before, the following sections are organized as follows: first, a literature review will be presented on the relationship between the study variables, namely, job performance, job satisfaction, self-perception of productivity and sleep habits, as well as studies on the role of companies in the well-being of their employees, particularly from their sleep habits and their performance in the company. Second, the method of data collection and analysis is described. Thirdly, the results of this research will be presented and finally, the discussion of the findings and conclusions will be presented.

1. Literature review

This section will describe the studies that have been conducted on the topic under study. First, the definition of job performance in the literature and how it has been approached through productivity and job satisfaction will be discussed. Then, studies on how these variables are affected by employee well-being are described. Special emphasis is placed on the relationship found in the literature between sleep habits and job performance, and a compilation of studies on the role of human resources in this area is presented.

First, it is necessary to study the definition of the dependent variable of this study. At its core, employee job performance refers to the extent to which an employee's actions and results align with the organization's goals (Viswesvaran & Ones, 2000). It includes the completion of tasks and responsibilities, but also the quality, efficiency, and effectiveness with which these tasks are performed.

Campbell (1990) emphasized the multidimensional nature of job performance. He identified eight performance components, including job-specific task proficiency and non-job-specific task proficiency. These components reflect the different roles an employee may play in an organization, from performing core tasks to participating in training or innovation.

It's worth noting that performance is not an isolated metric; its ripple effects influence an organization's operational efficiency, rate of innovation, and ultimately its growth. For example, Pfeffer (1994) emphasizes that companies that adopt practices that enhance employee performance are likely to experience better financial results. Some other authors like Jiménez-Jiménez and Sanz-Valle (2011) highlight that employee performance, when coupled with a conducive organizational culture, can significantly drive innovation. Given that innovation often acts as a catalyst for business growth, the importance of nurturing and optimizing job performance becomes clear.

Beyond direct contributions, high levels of job performance among employees can enhance a company's reputation, paving the way for better market positioning and attracting top talent (Gatewood, Gowan, & Lautenschlager, 1993). This positive feedback loop, in which performance enhances reputation, which in turn attracts meritocratic talent, can lead to

sustainable organizational growth. That's why it could be understood that organizations seeking sustainable growth should therefore prioritize understanding, measuring, and promoting high levels of job performance among their employees.

Now, considering how job performance is a multifactorial concept is important to mention that there are different ways to measure or approach it, as this topic has garnered significant interest within organizational research. For example, factors such as job satisfaction often serve as robust predictors of job performance. In particular, Judge, Thoresen, Bono, and Patton (2001) found a significant relationship between job satisfaction and job performance in their meta-analysis, emphasizing the importance of a satisfied workforce.

In addition to satisfaction, an employee's self-perception of productivity can significantly influence actual performance. For instance, employees who perceive themselves as productive often exude greater confidence, leading to a positive feedback loop in which increased productivity increases overall job satisfaction and, in turn, performance. This relationship is highlighted in the work of Staw, Bell, and Clausen (1986), who found that positive self-perceptions and mood, which are closely linked to job satisfaction, play a central role in determining job performance. In essence, both job satisfaction and perceptions of productivity work in tandem to create a synergistic effect on an individual's overall job performance.

Brayfield and Crockett (1955) found that the correlation between job satisfaction and job performance was modest. However, their analysis became a foundational reference for subsequent studies because the idea that a satisfied worker is a productive worker, often referred to as the "happy-productive worker" thesis, has found support in several studies.

For example, Vroom (1964) posited in his work "Work and Motivation" that an employee's beliefs about his or her job can directly influence his or her performance. This was a critical departure from previous theories that viewed satisfaction and performance as independent. To provide a more complete understanding, Judge, Thoresen, Bono, and Patton (2001) conducted a meta-analysis and concluded that the relationship between job satisfaction and job performance is stronger than previously thought.

In their seminal paper, "Organizational Commitment, Job Satisfaction, and Turnover Among Psychiatric Technicians," Porter and Lawler (1968) argued that the relationship between job satisfaction and performance isn't linear, but rather depends on other factors such as perceived fairness and rewards. This provided a more nuanced perspective, suggesting that it's not just satisfaction, but the interaction of various factors that influence performance.

Other authors like Eisenberger, Huntington, Hutchison, and Sowa's (1986) research on perceived organizational support posited that employees who feel supported and valued are likely to exhibit improved job performance. The mechanism is that organizational support promotes job satisfaction, which in turn promotes greater commitment to job roles and tasks.

Here it's possible to understand that measuring job performance using job satisfaction as an indicator remains a nuanced issue in organizational psychology and human resource management. Although job satisfaction and job performance are distinct constructs, they are closely related in many ways, leading researchers to consider job satisfaction as a potential predictor of performance outcomes.

In practice, organizations often use surveys that measure employee satisfaction in addition to performance evaluations to provide a more comprehensive view of performance. As Greenberg (2011) points out in "Behavior in Organizations," multi-rater assessments that combine self-reported job satisfaction with peer and supervisor ratings provide a more rounded approach to measuring performance.

Organizations may also consider longitudinal studies to track how changes in job satisfaction correlate with changes in performance measures. Some research, such as Wright and Cropanzano's (2000) paper, "Psychological Well-Being and Job Satisfaction as Predictors of Job Performance," has shown that increases in job satisfaction can predict subsequent improvements in job performance.

It's important to recognize the limitations of using job satisfaction as the sole measure of performance. As Spector (1997) points out in "Job Satisfaction: Application, Assessment,

Causes, and Consequences," the relationship between the two is affected by a variety of variables, including job roles, individual differences, and environmental factors.

Now, considering a factor like productivity, employee productivity in a business context is often defined as the efficiency with which an individual or group produces valuable outputs from given inputs. In essence, it serves as a ratio of output to input, reflecting the effectiveness of the workforce in translating resources, be they time, skills, or tools, into results. Robbins and Coulter (2007) articulate that worker productivity is not just about quantity, but also includes the quality of work.

This perspective emphasizes that while sheer output is important, the relevance, accuracy, and value of that output are critical to organizational success. As Sumanth (1985) points out in his research, productivity is a holistic measure that includes both effectiveness and efficiency. Thus, understanding and improving employee productivity is essential for organizations seeking sustainable growth and competitive advantage.

In his seminal work, Drucker (1991) posited that productivity is a direct representation of performance, particularly in roles where output can be measured quantitatively. This perspective is also supported by Campbell (1990) who, in his study of performance measurement, emphasized that task outcomes, a proxy for productivity, serve as the primary determinant of job performance.

The relationship between job satisfaction, perceptions of productivity, and an employee's job performance has attracted considerable interest in organizational research. Job satisfaction often serves as a robust predictor of job performance. In particular, Judge, Thoresen, Bono, and Patton (2001) found a significant relationship between job satisfaction and job performance in their meta-analysis, emphasizing the importance of a satisfied workforce.

In addition to satisfaction, an employee's self-perception of productivity can significantly influence actual performance. Employees who perceive themselves as productive often exude greater confidence, leading to a positive feedback loop in which increased

productivity increases overall job satisfaction and, in turn, performance. This relationship is highlighted in the work of Staw, Bell, and Clausen (1986), who found that positive self-perceptions and mood, which are closely related to job satisfaction, play a central role in determining job performance. In essence, both job satisfaction and perceptions of productivity work in tandem to create a synergistic effect on an individual's overall job performance.

Employee productivity in a business context is often defined as the efficiency with which an individual or group produces valuable outputs from given inputs. Now, it's necessary to understand that individual productivity is important because it contributes to group productivity, which leads to organizational productivity, but humans often operate on perception rather than reality (Castelle, 2017).

According to this last cited author, perceived productivity can be defined as "the attitudinal state of an individual derived from the perception that an environment exists that is conducive to the effective or efficient use of organizational resources and processes" and it's a concept that is not as popular in the literature as pure productivity (Castelle, 2017, p. 4).

A study by Bandura (1986) found that self-efficacy, which is closely related to self-perceptions of ability and productivity, has a strong correlation with work-related performance outcomes. This implies that employees who believe they are productive may be more proactive, take on challenging tasks, and persevere through obstacles. Similarly, Judge and Bono (2001) found that positive self-perceptions, which are linked to an individual's core self-evaluations, predict job performance.

In essence, the way employees perceive their own productivity can shape their approach to tasks and influence their overall performance in the workplace. It is also important to recognize that there are some limitations to the study of self-perception. Authors such as John and Robins (1994) explain how it can be biased because it can sometimes coincide with the perceptions of others, or even be positively distorted.

With these concepts in mind, it's important to understand how self-perceived productivity and job satisfaction can be improved. Training and skill-building opportunities

have been identified as strong enhancers of both self-efficacy and self-perceived productivity (Gist & Mitchell, 1992). Regular feedback, especially when constructive and specific, can also increase an employee's perception of productivity (Smither et al., 2005). Furthermore, the role of leadership in shaping these perceptions cannot be underestimated, as leaders who demonstrate trust and provide autonomy are associated with higher self-perceived productivity among employees (Zhang & Bartol, 2010).

The role of human resources (HR) is crucial in enhancing job satisfaction within an organization. Their functions and strategies are aimed at creating an environment conducive to employee well-being and motivation. For example, it's been identified that continuous learning opportunities are critical to employee growth and satisfaction.

Noe and Wilk (1993) emphasized the importance of training opportunities in influencing job satisfaction, noting that employees who perceive opportunities for skill enhancement and career advancement express greater job satisfaction. Other factors like feedback and performance appraisals can also have a significant impact on employee motivation and satisfaction. DeNisi and Kluger (2000) emphasized that effective feedback, when specific and constructive, increases an employee's clarity of job roles and satisfaction.

Specifically with regard to health and work-life balance, HR should ensure that a safe working environment is paramount to employee well-being and satisfaction. As Neal and Griffin (2006) note, a proactive approach to health and safety fosters a sense of trust and can lead to increased job satisfaction. This department should also implement policies that support work-life balance. In this area, authors such as Kossek, Valcour, and Lirio (2014) found a positive relationship between work-life balance initiatives and job satisfaction, highlighting the critical role of HR in this area.

Given this, the well-being of employees has been considered from many angles. Since the objective of this research is to assess it through their sleep habits, that's the approach that has been studied here in the literature. The influence of sleep on cognitive functions and thus on employee well-being is well documented. Stickgold (2005) examined the relationship between sleep and memory consolidation, suggesting that optimal sleep is essential for

cognitive processes such as learning, problem solving, and decision-making. Impaired cognitive function due to poor sleep can lead to increased stress and decreased job satisfaction, affecting overall well-being.

Several studies have attempted to understand the direct relationship between sleep disorders (such as insomnia and sleep apnea) and employee health. Leger et al (2008) found that individuals with insomnia reported increased absenteeism and decreased productivity, directly affecting their psychological and occupational well-being. Similarly, Peppard et al. (2013) found that untreated sleep apnea can lead to chronic fatigue, cardiovascular disease, and reduced life satisfaction.

The complex relationship between sleep and emotional well-being has also been a focus of research. Kahn et al (2013) found that disrupted sleep patterns are strongly correlated with mood disorders, including depression and anxiety. The cyclical nature of this relationship, in which poor emotional well-being can lead to disrupted sleep, further underscores its complexity.

From an organizational perspective, Barnes (2012) showed that poor employee sleep habits are directly correlated with decreased job performance, increased unethical behavior, and poor decision-making. Thus, employee well-being, as measured by sleep habits, has tangible implications for organizational health and productivity.

In this area, one of the most immediate and obvious effects of sleep quality is on cognitive performance. Memory, problem solving, decision-making, and attention span are all directly affected by sleep quality. Walker and Stickgold (2006) highlighted the role of sleep in memory consolidation, emphasizing that the REM (Rapid Eye Movement) phase of sleep helps integrate new knowledge with existing memories, facilitating learning. As a result, employees who get quality sleep have better problem-solving skills and a greater ability to learn new tasks.

In addition, impaired cognitive performance due to disrupted or insufficient sleep has ripple effects. Research by Lim and Dinges (2010) found that sleep deprivation can lead to a

decline in cognitive speed, accuracy, and overall productivity. Such deficits not only hinder an individual's performance, but can also lead to errors and accidents, especially in jobs that require precision and unwavering attention.

Beyond cognition, sleep significantly affects emotional regulation and interpersonal dynamics, both of which are critical in the workplace. Kahn-Greene et al (2007) found that sleep-deprived individuals have reduced emotional intelligence, diminished expressiveness, and impaired mood. This emotional dysregulation can lead to conflict, reduced team cohesion, and a decline in leadership skills.

In addition, employees who suffer from poor sleep quality often exhibit symptoms similar to burnout, including emotional exhaustion, depersonalization, and feelings of diminished personal accomplishment. These symptoms, as highlighted by Åkerstedt et al. (2015), can significantly reduce job satisfaction.

Job satisfaction and sleep quality are closely related. As noted above, Barnes (2012) found that sleep deprivation contributes to unethical behavior, decreased motivation, and general job dissatisfaction. Good sleep habits serve as a preventative measure to ensure that employees feel rejuvenated, motivated, and satisfied because Barnes' research also shows that well-rested employees have a more positive view of their job, colleagues, and work environment.

What's more, there's a positive feedback loop between job satisfaction and sleep. When employees are satisfied and less stressed about work, they typically experience better sleep quality, creating a virtuous cycle (Litwiller et al., 2017). From an organizational perspective, ensuring that employees maintain good sleep hygiene is not only a matter of individual well-being, but also has tangible organizational implications.

Swanson et al. (2011) found that organizations with well-rested employees experienced fewer sick days, lower turnover rates, and an overall positive work culture. In addition, the monetary cost of sleep-deprived employees is staggering. A study by the RAND Corporation (2016) estimated that sleep deprivation costs the U.S. economy up to \$411 billion

annually due to lost productivity. This underscores the importance for organizations to prioritize and even invest in policies that promote better sleep for their employees.

Now, it is also important to consider that employee well-being, and therefore performance, is also affected by other factors related to the contract or type of work that employees perform, so it is also important to mention characteristics such as shift and job characteristics. Different job roles have different levels of responsibility, autonomy, stress, and intrinsic or extrinsic rewards.

The job demands-resources model (Bakker and Demerouti, 2007) suggests that job demands that are not balanced by job resources can lead to burnout and reduced job satisfaction. On the other hand, jobs that provide autonomy, skill variety, task significance, and feedback tend to lead to higher job satisfaction, as emphasized by Hackman & Oldham's (1976) theory of job characteristics.

Shift work, especially rotating and night shifts, has been associated with a number of negative outcomes that may affect job satisfaction. These include disrupted circadian rhythms, sleep disturbances, health problems, and challenges in balancing work with social and family life. Several studies have highlighted the detrimental effects of night and rotating shifts on job satisfaction. For example, Costa (2003) found that rotating shifts, especially those involving night work, led to increased fatigue, sleep disturbances, and social and family disruptions, all of which contributed to decreased job satisfaction. Similarly, Presser (2003) found that unconventional shift schedules can strain family relationships and reduce overall life satisfaction.

However, not all findings about shift work are negative. Some workers may prefer nontraditional shifts because of higher pay, a quieter work environment, or alignment with personal schedules or responsibilities. Still, the overall trend suggests that unconventional shifts, especially when chosen out of necessity rather than preference, often correlate with lower job satisfaction (Nanda & Browne, 1977; Jaradat et al., 2017; Ingram, Murphy & Weinland, 2023).

HR's role in determining job characteristics is multifaceted and has a direct impact on both business results and employee satisfaction. One of HR's fundamental responsibilities is to design jobs that clearly define roles and responsibilities. Hackman & Oldham's (1976) "Job Characteristics Theory" emphasizes the importance of tasks that are meaningful, provide autonomy, and provide clear feedback to increase job satisfaction and performance.

Giving employees a sense of control over their tasks and processes can also lead to increased job satisfaction. As Morgeson and Humphrey (2006) found, autonomy is strongly related to job satisfaction, reduces strain, and improves job performance. Baltes et al. (1999) also found that flexible work arrangements had positive effects on employee well-being and job satisfaction so here it's possible to understand how HR can play a role in implementing policies that improve employee's work-life balance.

2. Methodology

As mentioned above, the objective of this research was to study job performance of employees in the AgTech sector and its relationship with their sleep habits, working conditions and characteristics. For this purpose, a cross-sectional study was designed to investigate the study variables. Job performance, as a dependent variable, is measured through job satisfaction and self-perception of each employee's productivity, while their sleep habits were studied through already self-report established indices.

In order to collect the necessary information, a questionnaire was prepared in Spanish that included different sections, each of them related to the study variables of this research (see Appendix A). Subsequently, the information collected was organized and analyzed. The questionnaire was developed on the Qualtrics platform and was distributed in the sector using the snowball sampling method, that is, an initial contact was made with the CEO of one of the AgTech companies in the country, and he sent the questionnaire to his employees and colleagues in other companies, and then they forwarded the questionnaire to other employees of other AgTech companies.

After agreeing to participate in the research through informed consent on the first page of the questionnaire, each employee answered the appropriate questions. It should be noted that each of these sections was constructed based on questionnaires that have already been validated in the literature. With this in mind, each of the sections, its specific objective and the corresponding references are explained below.

2.1 Personal data

To characterize the employees of the companies, we asked about their socio-demographic characteristics, such as age, sex, and household composition. They were also asked about their weekly physical activity. These questions, in addition to providing a profile of the workers in this industry, were of great methodological importance because they are relevant in the literature for the analysis of sleep habits and work performance.

Authors such as Redline et al. (2004) and Silva et al. (2019) have studied sex differences in sleep patterns, providing insights into potential differences between men and women. Similarly, authors such as Jean-Louis et al. (2000) have been studying the effects of sex for years, as well as the differences between different age populations in sleep duration and patterns. Also, with respect to healthy habits such as physical activity, authors such as Kuppermann et al. (1995) have found relationships between health-related quality of life and sleep problems, as well as work-related problems.

2.2 Job characteristics

Since this is a study of work performance, it is imperative to study the characteristics of each employee's role. To this end, we asked about the length of time each employee has worked in the company, the type of work each person performs, their schedule, and the modality in which they work.

This is particularly important as it has been shown that the behavioral cycles of shift workers are typically misaligned with their endogenous circadian system, which affects the sleep habits, well-being and health of these workers (Åkerstedt, 1988; Morris et al., 2017). In addition, one of the attractive features of the AgTech sector is the combination of completely different roles, so much so that it looks like completely different industries within the same company. Therefore, it is necessary to study the differences between the roles and their respective performance.

2.3 Job satisfaction

This variable, which is one of those that make up the dependent variable of the study of job performance, was collected through the "Overall Job Satisfaction" questionnaire developed by Warr, Cook and Wall (1979), which has been widely used in the literature (Heritage, Pollock & Roberts, 2015).

Here, we used the Spanish version proposed by the Spanish Ministry of Labor and Social Affairs (n.d.) to measure job satisfaction from the National Center for Working

Conditions. This scale was created to be completed by all types of workers and is designed to address both intrinsic and extrinsic aspects of working conditions. Intrinsic factors include aspects of job performance, such as recognition for job performance, responsibility, and opportunities for advancement, while extrinsic factors ask about employee satisfaction with aspects of company conditions, such as hours, pay, and physical working conditions.

2.4 Self-perception of productivity

For logistical reasons, productivity in this study was measured by self-perception of productivity. As mentioned in the literature review, this means that it is an individual's assessment based on his or her opinion and experience.

For this, factor 1 of the General Measure of Perceived Productivity (GMPP), which was implemented and validated by Castelle (2017) in her research "Perceived Productivity and Its Influence on the Relationship Between Organizational Climate and Affective Commitment", was used. This is because it is the factor specifically related to job performance, the variable of study of this dissertation.

2.5 Munich Chronotype Questionnaire (MCTQ)

This instrument was developed to assess an individual's chronotype. It's a self-rated scale to assess an individual's phase of entrainment on work and free days. This questionnaire has been widely used around the world and uses the midpoint between sleep on and sleep off days to assess chronotype (American Thoracic Society, 2023).

The original version of this questionnaire was developed by Roenneberg, Wirz-Justice & Merrow (2003) to understand the sleep times, self-reported light exposure, and self-assessed chronotypes of people, particularly workers, who they found were sleep deprived during the work week. For this research, the Spanish ultra-short version of the MCTQ was used (Ghotbi et al., 2020).

Variables obtained with the MCTQ were: Wake-up Time (WT), Sleep Onset (SO) for work and free days, the Midpoint of Sleep on Workdays (MSW), Midpoint of Sleep on Free days (MSF), Midpoint of Sleep on Free days corrected for the Sleep Debt on workdays (MSFsc), Weekly Sleep Loss (SLOSS), Sleep Duration (SD) for work and work free days and Social Jetlag (SJL) given by the absolute difference of the MSF and MSW.

2.6 Pittsburgh Sleep Quality Index (PSQI)

Self-perceived sleep problems have been associated with poorer health and health-related quality of life (Kuppermann et al., 1995). For this reason, it is necessary to assess the quality of sleep of workers. For this purpose, the PSQI, originally formulated by Buysse et al. (1989), was used, a questionnaire that has been used and validated worldwide. For this study, the Spanish adaptation of the questionnaire, validated since 1996 by Macías and Royuela, was used (Macías & Royuela, 1996).

This instrument is composed of 19 items to assess sleep quality over the past month. These items generate seven component scores ranging from 0 to 3: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication and daytime dysfunction. The component scores are summed up to a global score which ranges from 0 to 21, with increasing scores representing decreasing sleep quality. For scores above 5 individuals are considered by having poor sleep quality (Buysse et al., 1989).

2.7 Sleep Hygiene Index (SHI)

This instrument is a self-reported instrument designed to assess habits related to maladaptive sleep-related practices (Tonon et al., 2020). The SHI consists of 13 items; each person answers how often they perform a certain behavior on a 5-point Likert scale (rarely, sometimes, frequently, usually, and always). A higher total score indicates poorer sleep hygiene where the possible range of scores is 0-52 (Mastin, Bryson & Corwyn, 2006).

While it has been widely used in English-speaking populations, its translation and validation in other languages, including Spanish, may vary. Although there is no widely used version, the one studied by Prados et al. (2021) was used for this research.

2.8 Insomnia Severity Index (ISI)

Insomnia is a common problem in the workplace. Metlaine et al. (2005) conclude that the economic impact of insomnia is high due to its costs, not only because of employee absenteeism due to this factor, but also because of the higher rates of work accidents in insomniacs. These ideas give relevance to the topic and make the presence of this index in the questionnaire necessary. For this reason, the Spanish version of Fernandez-Mendoza et al. (2012) was used in this research.

The ISI consists of 7 items, each of them is rated on a 5-point Likert scale (0 to 4), and the total score can range from 0 to 28. The classification of the scores is as follows: 0-7 for no clinically significant insomnia; 8-14 for subthreshold insomnia; 15-21 for clinical insomnia (moderate severity); 22-28 for clinical insomnia (severe). A higher score indicates greater insomnia severity (Morin et al., 2011).

With the questionnaire described in this section, responses were collected from 105 employees in the AgTech sector in Colombia.

With these responses, statistical operations were applied to characterize the participants, study the distribution of the data collected and establish relationships between the variables using the statistical programs Stata 13, R (R Core Team, 2020), RStudio (Rstudio Team, 2020), and the tidyverse package (Wickham et al., 2019) to generate the respective models and graphs. Statistical significance was set at $p < 0.05$. These results will be described in the following section.

3. Statistical analysis and results

This section will present the results of the information collected using the methodology described above. It will be divided into three parts. First, the descriptive statistics of the information collected will be presented, which corresponds to the characterization of the employees who responded to the questionnaire, a summary of their socio-demographic characteristics and the characteristics of the type of work they have. This section also includes the frequency of the results of the variables related to sleep habits, self-perception of productivity and job satisfaction reported by the employees.

Secondly, the results obtained after comparing and relating the groups identified in the study variables through the application of Analysis of Variance (ANOVA) and the observation of correlations will be presented. Finally, a regression model constructed with the aim of explaining which variables can affect job satisfaction will be presented.

3.1 Descriptive statistics

A total of 105 AgTech employees responded to this questionnaire. As can be seen in Table 1, the average age of those who participated in this research is 32 ± 7 years old. It can also be seen that participation by sex was very similar, with 54 of them identifying as female (51%) and 51 as male (49%).

It was also found that only 20 of the participants live by themselves (19%), the rest of them live with friends, partners, children or other family members. Finally, it was found that 21 of the employees do not engage in any physical activity per week (19%) and most of them, 72, do not exercise more than four hours per week (69%).

Table 1*Descriptive statistics*

| | Minimum | | Maximum | | Media | | | | |
|----------------------------|---------------|-------------|---------------------|---------------------|---------------------------------|-------------|-----------|-----------|-----------|
| Age | 20 years old | | 51 years old | | 32 years old (± 7 years old) | | | | |
| | Female | | Male | | Another | | | | |
| Sex | 51% (54) | | 49% (51) | | 0% (0) | | | | |
| People with whom they live | By themselves | Parents | Couple, no children | Couple and children | Children, no partner | Others | | | |
| | 19% (20) | 19% (20) | 23% (24) | 6% (6) | 3% (3) | 30% (32) | | | |
| Weekly hours of exercise | 0 h | 1 h | 2 h | 3 h | 4 h | 5 h | 6 h | 7 h | +8 h |
| | 19% (20) | 17% (18) | 7% (7) | 9% (9) | 17% (18) | 10% (11) | 9% (9) | 3% (3) | 9% (9) |

Note. Summary of descriptive statistics from questionnaire answers. Frequencies are given in parenthesis.

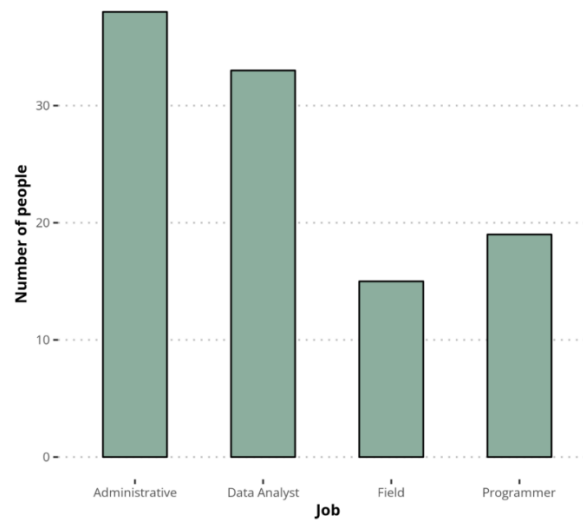
When the information on the type of work performed by employees was collected, four specific types of jobs were identified and are described below:

- Administrative jobs, which include those related to employee management and finance, accounting, and human resources.
- Field work, which includes work that requires traveling to farms and the field in general to monitor installed hardware and crops.
- Data analysis work, which includes all those who are responsible for analyzing the information collected from customers through various tools and preparing the corresponding reports for other areas of the company.
- Programming work, which includes all those responsible for developing software and digital tools.

With this classification, it was found that most of the employees who responded to the questionnaire work in the areas of administration and data analysis, with 36% and 32% respectively. On the other hand, 18% work in programming and 14% in the field (see Figure 1).

Figure 1

Type of job

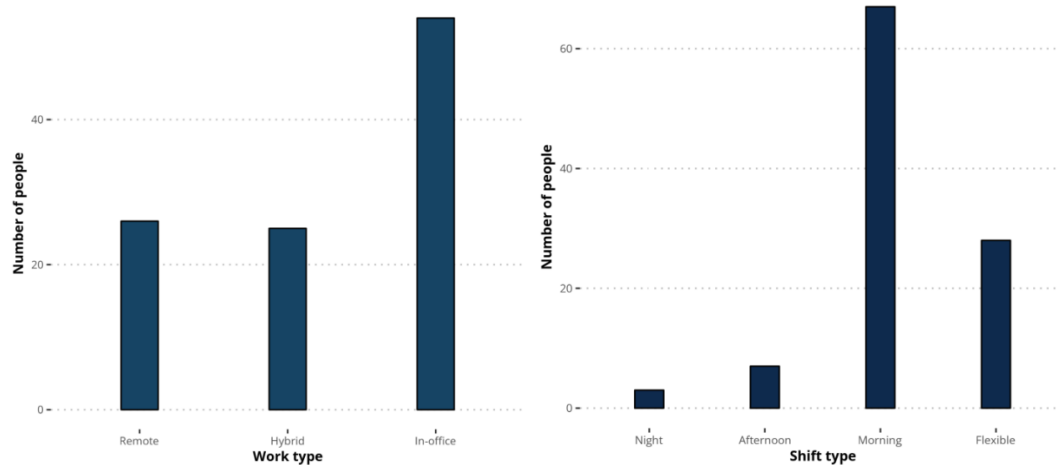


Note. Number of employees per type of job.

These employees also answered questions about the type of modality in which they work and the shift in which they work. Here it was found that 51% of these employees work in the office place, 24% of them work in hybrid mode and only 25% of them work remotely or from home. In terms of the shift they work in, most of them, almost 64%, work in the morning shift, followed by the flexible shift (27%). Seven percent work the afternoon shift, while only 3% of these employees work the night shift. This can be seen in Figure 2.

Figure 2

Work modality and shift type



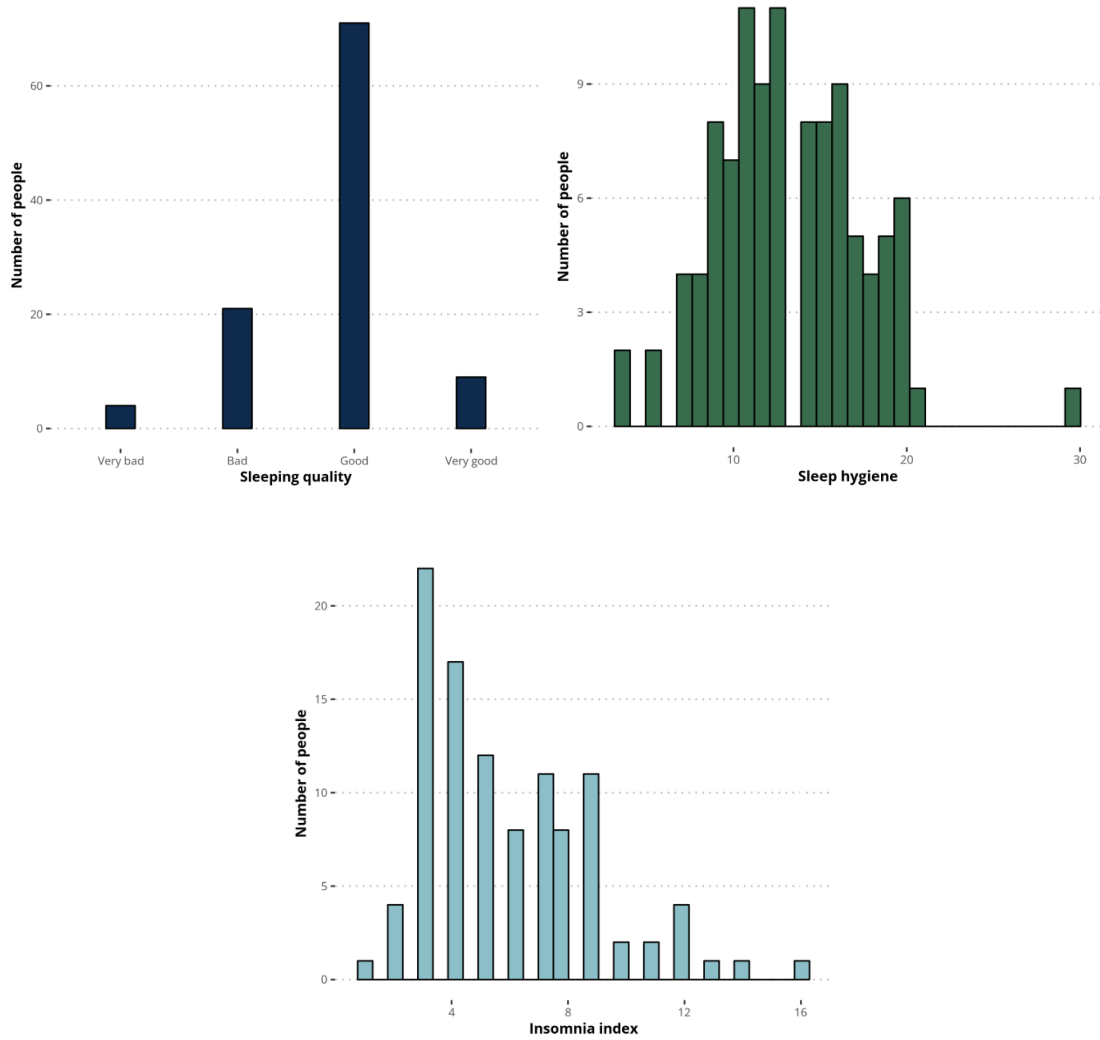
Note. Number of people per work mode (left panel) and shift type (right panel).

In terms of shift type, it was also found that while few of them work the night shift on a permanent basis, at least 36% of the respondents had worked the night shift or rotating shifts in the three months prior responding to the survey. On the other hand, it was also found that most employees had been with the company for less than two years, and that while at least 50% of employees worked five days a week, some participants worked up to seven days a week (see Appendix B).

When asked about sleep quality, self-reported sleep quality was found to be good. As shown in Figure 3, most employees rated their sleep quality as good or very good. Similarly, the SHI scores are concentrated in numbers below 20, and the ISI scores are concentrated between 0 and 7 and between 8 and 14, indicating no insomnia and sub-threshold insomnia, respectively. On the other hand, the PSQI had an average value of 9 with a standard deviation of 3.78.

Figure 3

Sleeping quality, Sleep Hygiene Index (SHI) and Insomnia Severity Index (ISI)



Note. Number of people per Sleeping quality score (upper left), SHI (upper right) and ISI (bottom).

To conclude this section of the descriptive statistics section, Table 2 presents the results for the dependent variables of this study: job satisfaction and self-perceived productivity.

Table 2*Job satisfaction and self-perceived productivity*

| | Average | Intrinsic satisfaction | | Extrinsic satisfaction | |
|-----------------------------|-----------------|------------------------|-----------------|------------------------|-----------------|
| Job satisfaction | 3.76 (±0.74) | 3.71 (±0.28) | | 3.81 (±0.26) | |
| | Average | Field | Data Analyst | Programmer | Administrative |
| Self-perceived productivity | 4.08 (±0.52) | 4.12 (±0.38) | 3.94 (±0.55) | 4.03 (±0.47) | 4.33 (±0.53) |

Note. Summary of average results for the dependent variables, in parenthesis are represented the standard deviation values.

Job satisfaction, which can take a value between 1 and 5, had an average value of 3.76 reported by employees, with no major differences between the intrinsic and extrinsic components of this variable. On the other hand, self-perception of productivity, which can also take values between 1 and 5, was found to be around 4 for all types of employment, with administrative workers considering themselves to be the most productive.

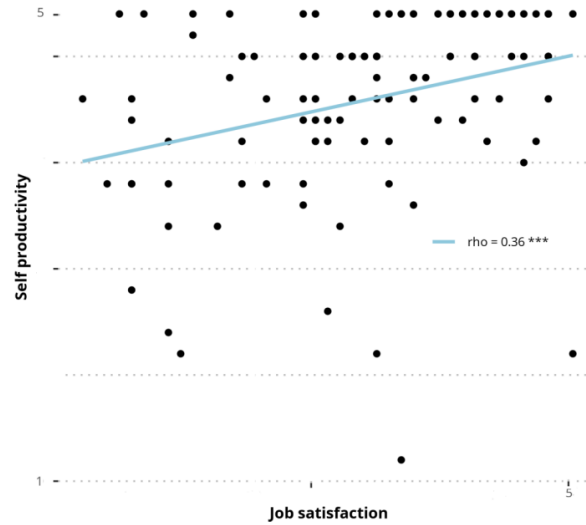
3.2 Relationships between variables

First of all, it is necessary to mention that the normality of the variables has been evaluated and some of them are not normally distributed, so all the correlations presented below are Spearman correlations. Also, the most appropriate method for comparing variances between these variable means is Welch's ANOVA (Moder, 2010). The results of applying these methods are presented below.

First of all, as shown in Figure 4, the dependent variables through which job performance was defined, i.e. job satisfaction and self-perceived productivity, were found to be positively correlated ($S = 122799$, $p\text{-value} = 0.000$, $\rho = 0.363$).

Figure 4

Job satisfaction and self-productivity

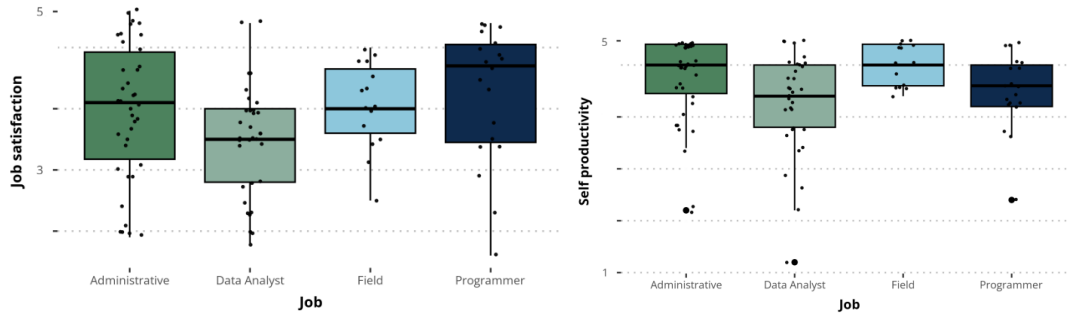


Note. Correlation between study variables.

Now, comparing job satisfaction by job type, it was found that mean satisfaction differs by job type, with programmers being the most satisfied (Welch's ANOVA results: $F = 2.962$; $p\text{-value} = 0.041$). Similarly, it was found that mean productivity differs by job type, with administrators perceiving themselves to be the most productive (Welch's ANOVA results: $F = 5.531$; $p\text{-value} = 0.002$). This is shown in Figure 5.

Figure 5

Job satisfaction and self-perceived productivity by type of job

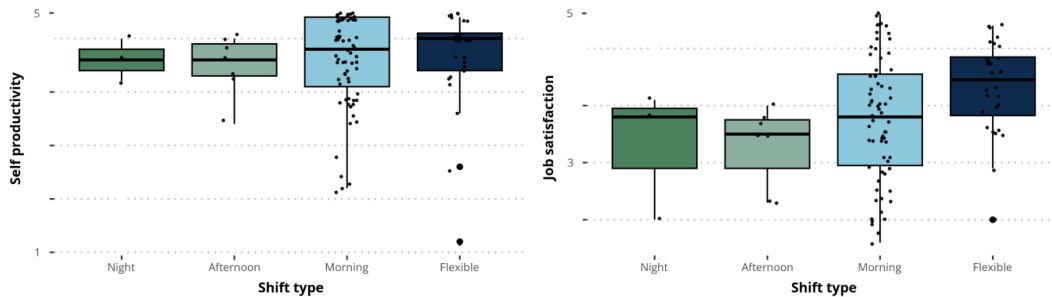


Note. Comparison of dependent variables by type of job.

It was also found that employees reported differences in their perceptions of productivity and job satisfaction depending on the type of shift, but not all of them were significant. As shown in Figure 6, mean productivity does not differ by work shift (Welch's ANOVA results: $F = 0.128$; $p\text{-value} = 0.941$), while mean satisfaction does differ by work shift, with those with flexible shifts feeling more satisfied (Welch's ANOVA results: $F = 4.145$; $p\text{-value} = 0.048$).

Figure 6

Job satisfaction and self-productivity by shift



Note. Comparison of dependent variables by shift.

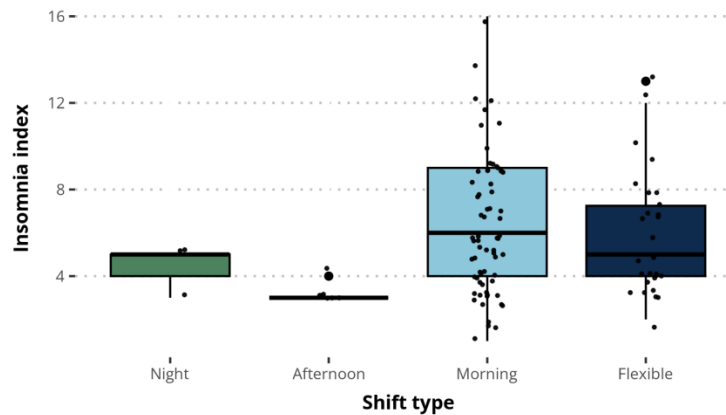
Other comparisons were made but were not found to be significant. For example, average productivity does not differ according to sleep quality (Welch's ANOVA results: $F =$

3.080; p-value = 0.069). It was also found that there is no significant correlation between job satisfaction and insomnia ($S = 185967$, p-value = 0.715, $\rho = 0.036$), nor between self-perceived productivity and insomnia ($S = 214376$, p-value = 0.258, $\rho = -0.111$).

On the other hand, continuing with the sleep indices, it was found that the mean insomnia rate differed according to the work shift, being lower for employees working the afternoon shift (Welch's ANOVA results: $F = 23.323$; p-value = 0.000). This can be seen in Figure 7.

Figure 7

Insomnia per shift

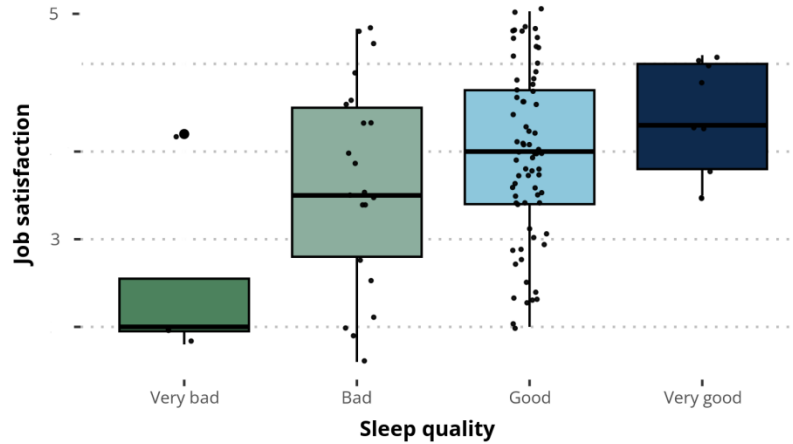


Note. Comparison of ISI per shift.

It was also found a tendency that mean job satisfaction differed according to reported sleep quality (Welch's ANOVA results: $F = 3.456$; p-value = 0.053), as shown in Figure 8. Similarly, a significant positive correlation was found between age and productivity ($S = 151354$, p-value = 0.027, $\rho = 0.215$) and between working hours and job satisfaction ($S = 151300$, p-value = 0.027, $\rho = 0.215$). The latter figures can be found in Appendix B.

Figure 8

Job satisfaction by reported sleep quality



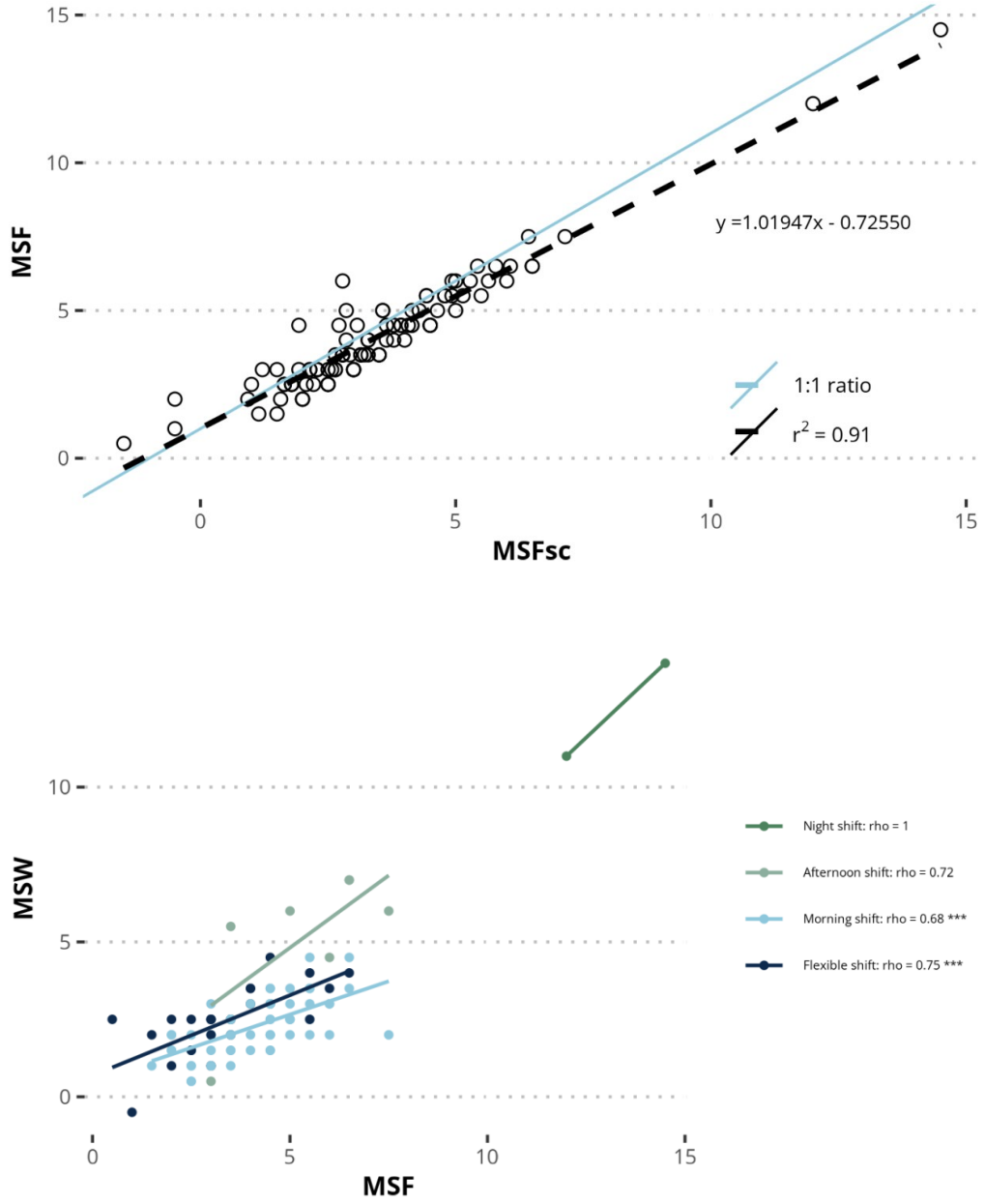
Note. Comparison of job satisfaction by reported sleep quality.

It is worth mentioning that after applying Welch's ANOVA, the Games-Howell post-hoc test used to compare all possible combinations of group differences was applied. Within the results of this test, it should be mentioned that the only significant combinations were those corresponding to the self-perception of productivity reported by the data analysts and the self-perception of productivity reported by the field workers ($p_{\text{adj}}=0.003$) which was higher for the latter; the job satisfaction reported by the people on the morning shift and the flexible shift ($p_{\text{adj}}=0.038$), higher for the latter, and the job satisfaction reported by the people on the afternoon shift and the flexible shift ($p_{\text{adj}}=0.031$), also higher for the latter mentioned.

With respect to the MCTQ variables, it is worth noting that there is a positive and significant correlation ($p\text{-value} < 0.01$) between MSW and MSF for morning shift and flexible shift, which can be interpreted as individuals maintaining a relatively consistent sleep schedule across both workdays and free days (See Figure 9). It can also be noted that on average the SLOSS per week was $2\text{h}15\text{m} \pm 2\text{h}16\text{m}$) and the values identified for the SJL were on average $1\text{h}34\text{m} \pm 0\text{h}58\text{m}$.

Figure 9

Midpoint of sleep

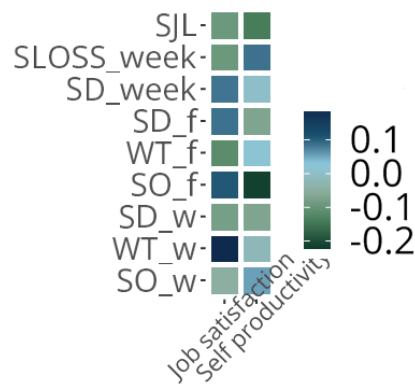


Note. MSW vs MSF.

Finally, this section will present the exercise carried out to evaluate the correlation between the variables assessed by the MCTQ, namely SJL, SLOSS, SD, WT and SO in work and free days, and the dependent variables of this study, job satisfaction and self-perceived productivity. Figure 10 shows the heat map of these correlations. On the right is the reference value for the displayed colors of these correlations. Here, only the correlations between job satisfaction and SLOSS (p-value = 0.0132, rho = -0.2424) and between self-perceived productivity and SD on free days (p-value = 0.0507, rho = -0.1921) were found to be significant.

Figure 10

Heatmap



Note. Heatmap between MCTQ variables and dependent variables.

3.3 Regression analysis

Considering the previous results and the relevance that the variable job satisfaction had in the previous statistics, a regression analysis was carried out in which it was possible to observe how sociodemographic, work and sleep habits characteristics could explain this component. Thus, a model was built to study the aforementioned.

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \varepsilon$$

Where Y: job satisfaction; β_1 : self-perceived productivity; β_2 : age; β_3 : sleep quality; β_4 : sleep loss per week; β_5 : PSQI result; β_6 : shift; ε : error term.

Since the dependent variable is continuous, taking values between 1 and 5, an Ordinary Least Squares (OLS) for this multiple linear regression model is fitted to obtain the coefficient results (Montero, 2016). Here, within the independent or explanatory variables, the types of data used should be considered for the appropriate reading of the coefficients. Age, PSQI score, and number of hours of sleep loss per week are discrete variables. Self-perceived productivity is a continuous variable while the variable sleep quality (1=very poor; 2=poor; 3=good; 4=very good) is ordinal and shift (4=flexible; 3=mornings; 2=afternoons; 1=nights) is a categorical variable. The results are presented in Table 3.

Table 3

Multiple Linear Regression

Dependent variable: *Job satisfaction*

| Independent variables | Estimated coefficient |
|-----------------------------|-----------------------|
| Self-perceived productivity | 0.585*** (0.119) |
| Age | -0.016* (0.009) |
| Sleep quality | 0.484*** (0.112) |
| Sleep loss per week | -0.056** (0.027) |
| PSQI | 0.039** |

| | |
|-------|---------|
| | (0.018) |
| Shift | 0.255** |
| | (0.098) |
| R^2 | 0.382 |

Note. Multiple linear regression results. The coefficients of the explanatory variables are marked according to their significance, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

In order to assess the robustness of the results, the Variance Inflation Factor (VIF) was used to verify that there was no multicollinearity. The Breusch-Pagan test was also used to verify that there was no heteroscedasticity in the residuals, and the normality of the distribution of the residuals was checked to conclude these findings are reliable (Wooldridge, 2010). These results are presented in Appendix C.

The explanatory variables included were all significant. It is noteworthy that the percentage of the variation in job satisfaction that is explained by this model is 38% (p-value F-test < 0.01). It should also be noted that self-perception of productivity was included among the dependent variables.

Thus, for every one unit increase in self-perceived productivity and sleep quality, job satisfaction increases by 0.58 and 0.48, respectively. Similarly, for every unit increase in the PSQI score, job satisfaction increases by 0.039 and for every unit increase in sleep loss and age, the dependent variable decreases by 0.05 and 0.01, respectively. Regarding the type of shift, it is found that the increase in the category, considering that the highest categories are the morning and flexible shifts, increases the value of job satisfaction. These results and the consideration of these variables for the model will be discussed in the following section.

4. Discussion

This section discusses the results presented in the previous section. To do so, it is necessary to remember that the objective of this research is to study the job performance of employees in the AgTech sector in Colombia and to understand how it is related to their sleep habits, their socio-demographic characteristics and those of their jobs.

With this in mind, it is important to begin by pointing out that the sample was balanced in terms of the sex of the employees (almost 50% each), and in terms of age, the employees were within a young adult population (32 years \pm 7), according to the definition of age categories of the Colombian National Administrative Department of Statistics (DANE, 2018).

Also, most of the employees who participated in this research work from the office and in the morning shift, so the results for the parameters of modality and shift should be read with this in consideration. These majorities correspond to the reality of the Colombian market, since most of them work in person and in the morning shift, but the data of the hybrid and remote modality exceeds the national statistics where less than 8% of the working population develops their work activities from home (DANE, 2023).

This may be due to the type of industry being evaluated, as companies in the Agtech sector are mostly startups that present different models for workers (Forbes, 2021). This explains the openness to change and dynamism in these new companies, where recommendations can be made for better employee performance. In the same way, the average time that employees have been in each company is only two years, which confirms how new the sector is in Colombia.

With these considerations about the sample, the results of the employees' sleep habits can now be discussed. In general, those who participated in the research reported a good sleep quality. This self-perception of sleep quality is also consistent with some of the results of the index questionnaires used. The SHI reflects a concentration of scores within the lowest values (0-20), which accounts for good sleep hygiene habits, which include practices such as maintaining consistent bed-on and bed-off times, good bed and sleep environment, minimizing daytime naps, avoiding caffeinated beverages before bedtime, and avoiding emotionally and

cognitively stimulating activities before bedtime (Stepanski & James, 2003; Seun-Fadipe et al., 2018).

For its part, the ISI score resulted in the absence or low presence of insomnia problems (Fernandez-Mendoza et al., 2012). The PSQI, on the other hand, presents a value of 9, which means there is a presence of potential sleep difficulties or disorders (Buysse et al., 1989). Here, the discrepancy between the self-reported sleep quality and the PSQI results could be explained through self-report biases.

For instance, the current mood and emotional state of the person who's answering the questionnaire may affect the result, someone who feels good on a particular day might remember their sleep as being better than it objectively was; also some cultural and social factors may impact, because people's beliefs about what constitutes a "good sleep" might be influenced by cultural norms, leading to discrepancies between self-perception and standardized assessments (Åkerstedt et al., 1994; Krystal & Edinger, 2008; Harvey & Tang, 2012).

These results of good sleep habits and sleep quality can be evaluated within the environmental hypotheses of sleep, which suggest that people's chronotypes depend on environmental factors such as latitude, temperature, and photoperiod of the country or city they live in (Horzum et al., 2015; Randler & Rahafar, 2017). These studies support the idea that people living near the equator tend to be more morning people, as is the case in Colombia and as is the case in this sample.

The MCTQ variables are also consistent with the sleep habits described above. The positive and significant correlation between MSW and MSF for morning and flexible shift workers indicates that individuals tend to maintain a stable sleep pattern regardless of whether it's a workday or a day off (Ghotbi et al., 2020). This consistency suggests that their chronotype is aligned with their daily commitments and lifestyle choices.

It is important to note that one of the groups mentioned above has a flexible schedule that allows the employees to work at times that suit their preferences and internal timing. This

is particularly relevant because it can provide lots of benefits for the employees and the companies. For instance, when work shifts align with an individual's circadian rhythm, there is typically better sleep quality and duration (Dijk & Czeisler, 1995), there's an optimization of cognitive performance processes like attention, decision-making, and memory (Schmidt et al., 2007), and this can lead to other positive aspects like improved mood and reduced irritability as well as reduced risk of various health issues, including metabolic disorders, cardiovascular diseases, and even certain cancers (Boivin & Boudreau, 2014; Kecklund & Axelsson, 2016).

The morning shift also seems to share this alignment between preferences and work shift. As it was mentioned before, this can match the previous literature on the topic because even when it's essential to consider the broader context and lots of factors influencing chronotype, there's evidence to suggest that equatorial populations, like Colombians, might lean more towards morningness. In fact, locations near the Equator experience more consistent day lengths throughout the year with earlier sunrises which may promote a more stable circadian rhythm and may naturally predispose individuals in these areas to wake up earlier and, therefore, be more morning-oriented (Roenneberg, Kumar & Mellow, 2007; Borisenkov, 2011; Duarte et al., 2014).

In addition to the above, working in accordance with one's internal clock can positively impact social and family life, contributing to a better work-life balance and to improve well-being (Presser, 2000; Barnes & Wagner, 2009). Considering these reasons and the fact that social structures, particularly in Western societies, often favor morning chronotypes (Czeisler, 2013; Wittmann et al., 2006), the morning shift and the flexible shift may be the best shift types for the employees according to the results found for this sector.

On the other hand, as shown in the results, SJL and SLOSS per week were positive and low. This reflects the degree to which each employee's routine matches his or her preferred sleep schedule; one could say that their biological clocks and their social commitments are relatively in sync. Nevertheless, it is important to remember that the number of employees in the sample who work the night shift or who have had rotating shifts in recent months is minimal, so the effect of these employees on variables such as SJL and SLOSS is not large.

Now, as justified in the literature review, the approach to the dependent variable of this research, job performance, was done through two variables, job satisfaction and self-perceived productivity in the methodological design. This decision was made due to the logistical possibilities at the time of this study. Although the initial objective of this research was to obtain key performance indicators to measure the productivity of each employee in the companies and make them comparable, due to time and company schedules, it was not possible to obtain this information. For this reason, we resorted to variables that were perceived and reported by the employees themselves who answered the questionnaire.

After collecting the information, it was found that the variable of self-perceived productivity was not conclusive in the case of this research, because the results were very homogeneous and high in all cases. This reaffirms that although perceived productivity is not a new term used in the literature, it is still a concept that is constructed and operationalized in these work performance contexts (Castelle, 2017).

This phenomenon of perceived productivity has been discussed in the psychological literature and may be normal due to the positive distortion that people may have of their own performance (John & Robins, 1994). Because of this and the results of the relationships between variables, the multiple regression analysis and conclusions of this paper focus on job satisfaction as a proxy for job performance.

As shown, both job satisfaction and self-perceived productivity were different for each type of job. Although this is a small sample, it shows that administrative workers are those who consider themselves to be more productive and also those who report higher job satisfaction. They are also the ones with the highest average age (34 years) and, together with field employees, the ones who have been with the company the longest.

These results are important and open the door to a discussion on the types of contracts in companies and the stability in companies in relation to types of work and socio-demographic characteristics. For example, different studies have shown that people become less satisfied as their tenure increases, but their satisfaction increases with age (Dobrow & Ganzach, 2014). In these scenarios, the role of human resources in balancing the burnout of

employees and keeping them motivated despite their tenure in the organization becomes relevant, as well as strategies to engage the organizational culture for new employees in the organization become important in terms of job satisfaction.

Now, regarding the type of shift, significant differences are found, especially between morning shift workers and flexible workers, and between flexible workers and the afternoon shift. Again, it should be noted that it is difficult to draw conclusions for the evening shift due to the sample size. This is consistent with the literature, as flexibility in determining work schedules has been associated with higher levels of job satisfaction and job performance (Golden & Veiga, 2005). Furthermore, according to a report by the Society for Human Resource Management (SHRM, 2019), flexible work arrangements are directly related to higher employee engagement and lower turnover intentions.

Shift differentiation is highly relevant to this analysis, and therefore the results of sleep habits are analyzed based on this variable. As shown, shift type was found to be relevant to reported levels of insomnia and sleep quality problems, key variables in the study of work performance (Swanson et al., 2011). This leads to one of the most important results of this analysis: job satisfaction, which is a proxy for job performance, is affected by reported levels of insomnia and sleep quality, and these vary according to the type of shift the employee holds.

At this point, it was decided that the dependent variable in the multiple regression analysis approach would be job satisfaction. Now, considering that within the relationship of the variables studied in the results section, a significant correlation was found between job satisfaction and self-perception of productivity, it was decided to include the latter as an explanatory variable in the model. This idea is supported by authors such as Judge, Boudreau, and Bretz (1994), who point out that employees who perceive themselves as productive often feel more engaged in their tasks and believe that their roles are important within the organizational framework.

As Amabile and Kramer (2011) say, the most important determinant of a good day at work, as perceived by employees, is making meaningful progress or being productive. Our

research reinforces this idea, in that when individuals believe they are being productive and making meaningful contributions at work, it fosters a sense of accomplishment, competence, and worth, all of which are determinants of job satisfaction.

As shown in the previous section, similar to self-perception of productivity, the quality and quantity of sleep significantly affect the dependent variable, as in the studies by Kupperman et al. (1995) and more recently by Litwiller, Snyder, Taylor, and Steele (2017). Consistent with this, the results of the present study show that increased sleep loss is negatively related to the dependent variable. Other findings were not as intuitive as the above. For example, one would expect that a higher score on the PSQI would correspond to lower job satisfaction by accounting for poorer sleep quality, but at this point it is important to remember the possible bias mentioned above.

It was also found that the increase in the age of the participants decreases the value of job satisfaction, as it is known that older workers sometimes show reduced abilities in areas requiring rapid cognitive processing, this can lead to decreased performance, especially in jobs requiring high levels of physical activity or rapid decision-making (Ng & Feldman, 2008), characteristics required in the profiles of the types of work studied in the Colombian Agtech industry.

In addition, older workers may face challenges in adapting to rapidly changing technological environments such as this one, and may also face ageism in the workplace, where older workers feel discriminated against. All of this can reduce job satisfaction and commitment, as Posthuma and Campion (2009) point out. Thus, all of these findings emphasize the need to differentiate the strategies used by companies to promote the well-being and good job performance of employees in this industry.

As a limitation it is necessary to recognize that a sample of 105 observations may be small to capture the reality of a sector in which more than 45 companies have been created in Colombia (Startups, 2022) and in which other international companies also operate.

In addition to the above, the convenience sampling method used here, Snowball, did not allow controlling for having a significant sample for each type of work within the sector at the time of collection. Snowball sampling is known to be less dependent on a reference sample, but it is still suitable for finding hard-to-reach targets (Naderifar, Goli & Ghaljaie, 2017), as happened in this case. Despite this, within the sample, the four types of work central to the research were recognized, which, within the definitions of the Ministry of Agriculture (2018), can summarize most of the tasks that occur in the sector.

5. Conclusions and recommendations

This research aimed to understand the variables that can affect job performance of employees in the AgTech industry in Colombia. In addition to the attempt to contribute to the literature on the subject, important practical findings resulted from this study.

As in previous studies, it was found that job satisfaction can be influenced by different factors. In this particular case, these explanatory variables included the perception of productivity and the work habits of the employees. Also, as in the literature, it was found that the strength of this association can vary depending on individual and organizational factors.

In this sense, it is recommended that future studies examine performance with a productivity measure that is already parameterized in companies. This could help to obtain results that directly affect the metrics by which each company measures its results in terms of employee habits. Likewise, a study with a larger sample, covering more types of jobs in the sector or more participants for each one of the shifts could make a difference in the study of this industry.

Among the most relevant findings of this research, the difference in job satisfaction for each of the shifts and the positive relationship that this variable presented with sleep quality stand out. For this reason, the role of HR becomes relevant within the objective of improving the work performance of employees.

According to our findings, one way to improve this variable is to focus on the sleep-wake behavior of workers. HR departments in these companies should develop strategies that prioritize employee well-being, including factors such as work-life balance, sleep hygiene training for workers, job design, and supportive management.

This type of recommendation is not uncommon, as it has been recognized that organizations with well-rested employees also have better results and an overall positive work culture. For instance there have been cases in other countries, where companies invest large sums of money to increase the amount of sleep hours their employees get as a strategy to improve their performance and well-being (BBC, 2016).

As organizations continue to recognize the importance of a motivated and satisfied workforce, they should take a holistic approach to job satisfaction. By doing so, they can promote a virtuous cycle in which job satisfaction contributes to improved job performance, ultimately benefiting both employees and the organization as a whole.

Therefore, it can be concluded that through thoughtful job design, feedback systems, training programs, and flexibility, HR departments in Colombian AgTech companies can help strike the delicate balance between achieving organizational goals and fostering a satisfied and engaged workforce with proper sleep habits.

References

- Amabile, T. M., & Kramer, S. J. (2011). The power of small wins. *Harvard business review*, 89(5), 70-80.
- American Thoracic Society (2023). Sleep related questionnaires: MCTQ. From: <https://bit.ly/44UBvZr>
- Åkerstedt, T. (1988). Sleepiness as a consequence of shift work. *Sleep*, 11(1), 17-34.
- Åkerstedt, T., Hume, K. E. N., Minors, D., & Waterhouse, J. I. M. (1994). The subjective meaning of good sleep, an intraindividual approach using the Karolinska Sleep Diary. *Perceptual and motor skills*, 79(1), 287-296.
- Åkerstedt, T., Nordin, M., Alfredsson, L., Westerholm, P., & Kecklund, G. (2015). Predicting changes in sleep complaints from baseline values and changes in work demands, work control, and work preoccupation—The WOLF-project. *Sleep Medicine*, 16(4), 453-460.
- Bakker, A.B., & Demerouti, E. (2007). The job demands-resources model: State of the art. *Journal of Managerial Psychology*, 22(3), 309-328.
- Baltes, B. B., Briggs, T. E., Huff, J. W., Wright, J. A., & Neuman, G. A. (1999). Flexible and compressed workweek schedules: A meta-analysis of their effects on work-related criteria. *Journal of Applied Psychology*, 84(4), 496
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall, Inc.
- Barnes, C. M. (2012). Working in our sleep: Sleep and self-regulation in organizations. *Organizational Psychology Review*, 2(3), 234-257.
- Barnes, C. M., & Wagner, D. T. (2009). Changing to daylight saving time cuts into sleep and increases workplace injuries. *Journal of Applied Psychology*, 94(5), 1305.
- BBC. (2016). La compañía que les paga a sus empleados por dormir. From: <https://t.ly/hlkm0>

Bloomberg. (2023). Más del 70% de la gente que vive en el campo colombiano se considera pobre. From: <https://t.ly/D78FM>

Boivin, D. B., & Boudreau, P. (2014). Impacts of shift work on sleep and circadian rhythms. *Pathologie Biologie*, 62(5), 292-301

Borisenkov, M. F. (2011). Latitude of residence and position in time zone are predictors of chronotype and social jetlag in adolescents. *Biological Rhythm Research*, 42(6), 467-474.

Brayfield, A. H., & Crockett, W. H. (1955). Employee attitudes and employee performance. *Psychological Bulletin*, 52(5), 396-424.

Buysse, D. J., Reynolds III, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry research*, 28(2), 193-213.

Campbell, J. P. (1990). Modeling the performance prediction problem in industrial and organizational psychology. *Handbook of industrial and organizational psychology*, 1(2), 687-732.

Castelle, K. M. (2017). An investigation into perceived productivity and its influence on the relationship between organizational climate and affective commitment. Old Dominion University.

Castilleja, L., Gutiérrez, P., Laura, L.F., & Serrudo, L.F. (2023). Apostar por la agricultura para lograr una diversificación productiva. <http://dx.doi.org/10.18235/0004920>

Contxto (2020). Agtech from Colombia. From: <https://contxto.com/en/market-map/agtech-colombia-2020/>

Costa, G. (2003). Shift work and occupational medicine: an overview. *Occupational Medicine*, 53(2), 83-88.

Czeisler, C. A. (2013). Perspective: Casting light on sleep deficiency. *Nature*, 497(7450), S13-S13.

DANE. (2018). Juventud en Colombia. From: <https://bit.ly/3RtzIYm>

DANE. (2020). Mercado laboral From: <https://bit.ly/3ZvAZjK>

DANE. (2022). Pobreza multidimensional. From: <https://bit.ly/45VWGvr>

DANE. (2023). Encuesta Pulso Social. From: <https://bit.ly/3PnUHZR>

DeNisi, A. S., & Kluger, A. N. (2000). Feedback effectiveness: Can 360-degree appraisals be improved? *Academy of Management Executive*, 14(1), 129-139.

Dijk, D. J., & Czeisler, C. A. (1995). Contribution of the circadian pacemaker and the sleep homeostat to sleep propensity, sleep structure, electroencephalographic slow waves, and sleep spindle activity in humans. *Journal of Neuroscience*, 15(5), 3526-3538.

Dobrow, S. R., & Ganzach, Y. (2014). Job Satisfaction over time: A longitudinal study of the differential roles of age and tenure. In *Academy of Management Proceedings* (Vol. 2014, No. 1, p. 13905). Briarcliff Manor, NY 10510: Academy of Management.

Drucker, P. (1991). *The New Productivity Challenge*. Harvard Business Review.

Duarte, L. L., Menna-Barreto, L., Miguel, M. A. L., Louzada, F., Araújo, J., Alam, M., ... & Pedrazzoli, M. (2014). Chronotype ontogeny related to gender. *Biological Rhythm Research*, 45(2), 275-286.

Eisenberger, R., Huntington, R., Hutchison, S., & Sowa, D. (1986). Perceived organizational support. *Journal of Applied Psychology*, 71(3), 500-507.

Fedesarrollo. (2013). *Políticas para el desarrollo de la agricultura en Colombia*. ISBN: 978-958-57092-8-7

Fernandez-Mendoza, J., Rodriguez-Muñoz, A., Vela-Bueno, A., Olavarrieta-Bernardino, S., Calhoun, S. L., Bixler, E. O., & Vgontzas, A. N. (2012). The Spanish version

of the Insomnia Severity Index: a confirmatory factor analysis. *Sleep medicine*, 13(2), 207-210.

Food and Agriculture Organization of the United Nations. (2020). Employment indicators. From: <https://shorturl.at/euwE7>

Forbes. (2021). Cinco razones para trabajar en una StartUp. From: <https://shorturl.at/bgw39>

Forbes. (2022). Expertos aseguran que digitalización del agro aumenta productividad en Latinoamérica. From: <https://bit.ly/45G1y87>

Gatewood, R. D., Gowan, M. A., & Lautenschlager, G. J. (1993). Corporate image, recruitment image, and initial job choice decisions. *Academy of Management Journal*, 36(2), 414-427.

Ghotbi, N., Pilz, L. K., Winnebeck, E. C., Vetter, C., Zerbini, G., Lenssen, D., ... & Roenneberg, T. (2020). The μ MCTQ: an ultra-short version of the Munich ChronoType Questionnaire. *Journal of biological rhythms*, 35(1), 98-110.

Gist, M. E., & Mitchell, T. R. (1992). Self-efficacy: A theoretical analysis of its determinants and malleability. *Academy of Management Review*.

Golden, T. D., & Veiga, J. F. (2005). The impact of extent of telecommuting on job satisfaction: Resolving inconsistent findings. *Journal of management*, 31(2), 301-318.

Granados, R. M. (2016). Modelos de regresión lineal múltiple. Granada, España: Departamento de Economía Aplicada, Universidad de Granada.

Greenberg, J. (2011). *Behavior in Organizations*. Pearson Education.

Hackman, J. R., & Oldham, G. R. (1976). Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance*, 16(2), 250-279.

Harvey, A. G., & Tang, N. K. (2012). (Mis) perception of sleep in insomnia: a puzzle and a resolution. *Psychological bulletin*, 138(1), 77.

Heritage, B., Pollock, C., & Roberts, L. D. (2015). Confirmatory factor analysis of Warr, Cook, and Wall's (1979) Job satisfaction scale. *Australian Psychologist*, 50(2), 122-129.

Herrero, Oscar (2023). Retos al desarrollo agtech en Latam: 5 claves para un abordaje de futuro. From: <https://www.agtechapps.com/desarrollo-agtech-latam/>

Horzum, M. B., Randler, C., Masal, E., Beşoluk, Ş., Önder, İ., & Vollmer, C. (2015). Morningness–eveningness and the environment hypothesis—A cross-cultural comparison of Turkish and German adolescents. *Chronobiology International*, 32(6), 814-821.

Ingram, W., Murphy, K. S., & Weinland, J. (2023). The moderating effect of hotel shift work on the relationship between employee work engagement and job satisfaction. *Journal of Human Resources in Hospitality & Tourism*, 22(2), 239-265.

Inter-American Development Bank. (2020). “Panorama del ecosistema agrotecnológico para los pequeños agricultores de América Latina y el Caribe”. From: <https://bit.ly/3Pmpfvb>

Jaradat, Y. M., Nielsen, M. B., Kristensen, P., & Bast-Pettersen, R. (2017). Shift work, mental distress and job satisfaction among Palestinian nurses. *Occupational Medicine*, 67(1), 71-74.

Jean-Louis, G., Kripke, D. F., Ancoli-Israel, S., Klauber, M. R., & Sepulveda, R. S. (2000). Sleep duration, illumination, and activity patterns in a population sample: effects of gender and ethnicity. *Biological psychiatry*, 47(10), 921-927.

Jiménez-Jiménez, D., & Sanz-Valle, R. (2011). Innovation, organizational learning, and performance. *Journal of Business Research*, 64(4), 408-417.

John, O. P., & Robins, R. W. (1994). Accuracy and bias in self-perception: individual differences in self-enhancement and the role of narcissism. *Journal of personality and social psychology*, 66(1), 206.

Judge, T. A., Boudreau, J. W., & Bretz, R. D. (1994). Job and life attitudes of male executives. *Journal of Applied Psychology*, 79(5), 767.

Judge, T. A., & Bono, J. E. (2001). Relationship of core self-evaluations traits—self-esteem, generalized self-efficacy, locus of control, and emotional stability—with job satisfaction and job performance: A meta-analysis. *Journal of Applied Psychology*, 86(1), 80-92.

Judge, T. A., Thoresen, C. J., Bono, J. E., & Patton, G. K. (2001). The job satisfaction-job performance relationship: A qualitative and quantitative review. *Psychological Bulletin*, 127(3), 376-407.

Kahn-Greene, E. T., Killgore, D. B. S., Kamimori, G. H., Balkin, T. J., & Killgore, W. D. S. (2007). The effects of sleep deprivation on symptoms of psychopathology in healthy adults. *Sleep Medicine*, 8(3), 215-221.

Kahn, M., Sheppes, G., & Sadeh, A. (2013). Sleep and emotions: Bidirectional links and underlying mechanisms. *International Journal of Psychophysiology*.

Kecklund, G., & Axelsson, J. (2016). Health consequences of shift work and insufficient sleep. *BMJ*, 355.

Kossek, E. E., Valcour, M., & Lirio, P. (2014). The sustainable workforce: Organizational strategies for promoting work-life balance and well-being. In *Work and Wellbeing* (pp. 295-318). Psychology Press.

Krystal, A. D., & Edinger, J. D. (2008). Measuring sleep quality. *Sleep medicine*, 9, S10-S17.

Kuppermann, M., Lubeck, D. P., Mazonson, P. D., Patrick, D. L., Stewart, A. L., Buesching, D. P., & Filer, S. K. (1995). Sleep problems and their correlates in a working population. *Journal of general internal medicine*, 10, 25-32.

Leger, D., Guilleminault, C., Dreyfus, J. P., Delahaye, C., & Paillard, M. (2008). Prevalence of insomnia in a survey of 12,778 adults in France. *Journal of Sleep Research*.

Lim, J., & Dinges, D. F. (2010). A meta-analysis of the impact of short-term sleep deprivation on cognitive variables. *Psychological Bulletin*, 136(3), 375.

Litwiller, B., Snyder, L. A., Taylor, W. D., & Steele, L. M. (2017). The relationship between sleep and work: A meta-analysis. *Journal of Applied Psychology*, 102(4), 682.

Macías, J. A., & Royuela, A. (1996). The Spanish version of the Pittsburgh Sleep Quality Index. *Informaciones psiquiátricas*, 146(4), 465-72.

Mastin, D. F., Bryson, J., & Corwyn, R. (2006). Assessment of Sleep Hygiene Using the Sleep Hygiene Index. *Journal of Behavioral Medicine*, 29(3), 223–227.

Metlaine, A., Leger, D., & Choudat, D. (2005). Socioeconomic impact of insomnia in working populations. *Industrial health*, 43(1), 11-19.

Ministry of Agriculture and Rural Development (2018). El agro colombiano se consolidó como el motor de la economía nacional. From: <https://bit.ly/45TMa7D>

Ministry of Agriculture and Rural Development (2019). Política Agropecuaria y de Desarrollo Rural 2018 – 2022. From: <https://bit.ly/3PGsxe1>

Moder, K. (2010). Alternatives to F-Test in One Way ANOVA in case of heterogeneity of variances (a simulation study). *Psychological Test and Assessment Modeling*, Volume 52, 2010 (4), 343-353.

Morin, C. M., Belleville, G., Bélanger, L., & Ivers, H. (2011). The Insomnia Severity Index: psychometric indicators to detect insomnia cases and evaluate treatment response. *Sleep*, 34(5), 601-608.

Morgeson, F. P., & Humphrey, S. E. (2006). The Work Design Questionnaire (WDQ): developing and validating a comprehensive measure for assessing job design and the nature of work. *Journal of Applied Psychology*, 91(6), 1321.

Morris, C. J., Purvis, T. E., Mistretta, J., Hu, K., & Scheer, F. A. (2017). Circadian misalignment increases C-reactive protein and blood pressure in chronic shift workers. *Journal of biological rhythms*, 32(2), 154-164.

Naderifar, M., Goli, H., & Ghaljaie, F. (2017). Snowball sampling: A purposeful method of sampling in qualitative research. *Strides in development of medical education*, 14(3), 1-6.

Nanda, R., & Browne, J. J. (1977). Hours of work, job satisfaction and productivity. *Public Productivity Review*, 46-56.

Neal, A., & Griffin, M. A. (2006). A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels. *Journal of Applied Psychology*, 91(4), 946.

Ng, T. W., & Feldman, D. C. (2008). The relationship of age to ten dimensions of job performance. *Journal of applied psychology*, 93(2), 392.

Noe, R. A., & Wilk, S. L. (1993). Investigation of the factors that influence employees' participation in development activities. *Journal of Applied Psychology*, 78(2), 291.

Peppard, P. E., Young, T., Barnet, J. H., Palta, M., Hagen, E. W., & Hla, K. M. (2013). Increased prevalence of sleep-disordered breathing in adults. *American Journal of Epidemiology*.

Pfeffer, J. (1994). Competitive advantage through people. *California management review*, 36(2), 9.

Plan Nacional de Desarrollo (2023). Bases-Plan Nacional de Desarrollo –PND. From: <https://bit.ly/45f0w1X>

Porter, L. W., & Lawler, E. E. (1968). Managerial attitudes and performance.

Posthuma, R. A., & Campion, M. A. (2009). Age stereotypes in the workplace: Common stereotypes, moderators, and future research directions. *Journal of management*, 35(1), 158-188.

Prados, G., Chouchou, F., Carrión-Pantoja, S., Fernández-Puerta, L., & Pérez-Mármol, J. M. (2021). Psychometric properties of the Spanish version of the Sleep Hygiene Index. *Research in Nursing & Health*, 44(2), 393-402.

Presser, H. B. (2000). Nonstandard work schedules and marital instability. *Journal of Marriage and Family*, 62(1), 93-110.

Presser, H. B. (2003). *Working in a 24/7 economy: Challenges for American families*. Russell Sage Foundation.

ProColombia (n.d.) Así es la geografía colombiana. From: <https://t.ly/u0IIIf>

R Core Team (2020). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.

RStudio Team (2020). *RStudio: Integrated Development for R*. RStudio, PBC, Boston, MA URL <http://www.rstudio.com/>.

Rahafar, A., Randler, C., Díaz-Morales, J. F., Kasaeian, A., & Heidari, Z. (2017). Cross-cultural validity of morningness-eveningness stability scale improved (MESSi) in Iran, Spain and Germany. *Chronobiology International*, 34(2), 273-279.

RAND Corporation (2016). *Why sleep matters — the economic costs of insufficient sleep: A cross-country comparative analysis*. RAND Corporation.

Redline, S., Kirchner, H. L., Quan, S. F., Gottlieb, D. J., Kapur, V., & Newman, A. (2004). The effects of age, sex, ethnicity, and sleep-disordered breathing on sleep architecture. *Archives of internal medicine*, 164(4), 406-418.

Robbins, S. P., & Coulter, M. (2007). *Management*. Pearson/Prentice Hall.

Roenneberg, T., Kumar, C. J., & Mellow, M. (2007). The human circadian clock entrains to sun time. *Current Biology*, 17(2), R44-R45.

Roenneberg, T., Wirz-Justice, A., & Mellow, M. (2003). Life between clocks: daily temporal patterns of human chronotypes. *Journal of biological rhythms*, 18(1), 80-90.

Seun-Fadipe, C. T., Aloba, O. O., Oginni, O. A., & Mosaku, K. S. (2018). Sleep hygiene index: psychometric characteristics and usefulness as a screening tool in a sample of Nigerian undergraduate students. *Journal of Clinical Sleep Medicine*, 14(8), 1285-1292.

Silva, A., Narciso, F. V., Rosa, J. P., Rodrigues, D. F., da Silva Cruz, A. Â., Tufik, S. & ... De Mello, M. T. (2019). Gender differences in sleep patterns and sleep complaints of elite athletes. *Sleep Science*, 12(4), 242.

Schmidt, C., Collette, F., Cajochen, C., & Peigneux, P. (2007). A time to think: circadian rhythms in human cognition. *Cognitive Neuropsychology*, 24(7), 755-789.

Smither, J. W., et al. (2005). The validity of qualitative measures as indicators of performance improvement. *Human Performance*.

Society for Human Resource Management. (SHRM). (2019). Trends and Forecasting. From: <https://bit.ly/3PIq9Ua>

Spanish Ministry of Labor and Social Affairs (n.d.). NTP 394: Job satisfaction: general satisfaction scale. From: <https://bit.ly/3t7KN79>

Spector, P. E. (1997). *Job Satisfaction: Application, Assessment, Causes, and Consequences*. SAGE Publications.

StataCorp. 2013. *Stata Statistical Software: Release 13*. College Station, TX: StataCorp LP

Startups. (2022). Colombia, un laboratorio vivo para las AgTech y BioTech de Latam. From: https://t.ly/o_jOJ

StartupPill (2023). 11 Best Colombia AgTech Startups – The Future of Farming. From: <https://t.ly/27fE1>

Staw, B. M., Bell, N. E., & Clausen, J. A. (1986). The dispositional approach to job attitudes: A lifetime longitudinal test. *Administrative Science Quarterly*, 31(1), 56-77.

Stepanski, E. J., & Wyatt, J. K. (2003). Use of sleep hygiene in the treatment of insomnia. *Sleep medicine reviews*, 7(3), 215-225.

Stickgold, R. (2005). Sleep-dependent memory consolidation. *Nature*, 437(7063), 1272-1278.

Sumanth, D. J. (1985). *Productivity Engineering and Management: Productivity Measurement, Evaluation, Planning, and Improvement in Manufacturing and Service Organizations*. McGraw-Hill.

Swanson, L. M., Arnedt, J. T., Rosekind, M. R., Belenky, G., Balkin, T. J., & Drake, C. (2011). Sleep disorders and work performance: findings from the 2008 National Sleep Foundation Sleep in America poll. *Journal of sleep research*, 20(3), 487-494.

Tonon, A. C., Amando, G. R., Carissimi, A., Freitas, J. J., Xavier, N. B., Caumo, G. H., ... & Hidalgo, M. P. (2020). The Brazilian-Portuguese version of the Sleep Hygiene Index (SHI): validity, reliability and association with depressive symptoms and sleep-related outcomes. *Sleep Science*, 13(1), 37.

Viswesvaran, C., & Ones, D. S. (2000). Perspectives on models of job performance. *International Journal of Selection and Assessment*, 8(4), 216-226.

Vroom, V. H. (1964). *Work and motivation*. Wiley.

Walker, M. P., & Stickgold, R. (2006). Sleep, memory, and plasticity. *Annual Review of Psychology*, 57, 139-166.

Warr, P., Cook, J., & Wall, T. (1979). Scales for the measurement of some work attitudes and aspects of psychological well-being. *Journal of occupational Psychology*, 52(2), 129-148.

Wickham et al., (2019). Welcome to the tidyverse. *Journal of Open Source Software*, 4(43), 1686, <https://doi.org/10.21105/joss.01686>

Wittmann, M., Dinich, J., Merrow, M., & Roenneberg, T. (2006). Social jetlag: misalignment of biological and social time. *Chronobiology international*, 23(1-2), 497-509.

Wooldridge, J. M. (2010). *Introducción a la econometría: un enfoque moderno*. Thomson Learning. *Econometrica* 47:1287-1294

Wright, T. A., & Cropanzano, R. (2000). Psychological well-being and job satisfaction as predictors of job performance. *Journal of Occupational Health Psychology*, 5(1), 84-94.

Zhang, X., & Bartol, K. M. (2010). Linking empowering leadership and employee creativity. *Journal of Applied Psychology*.

Appendix

Appendix A

Qualtrics Questionnaire

El objetivo de la siguiente encuesta es recolectar información sobre sus hábitos de sueño y su percepción de algunos aspectos laborales. Los datos serán usados solo con fines académicos. Esta encuesta es totalmente anónima y no tomará más de diez minutos completarla. Si acepta participar, presione el botón para comenzar.

I. Datos personales

- Nombre : respuesta de texto
- Edad: respuesta de número
- Sexo: femenino/masculino/prefiere no declarar
- ¿Con quién vive en su casa?: solo/con sus padres/con sus hijos sin una pareja/con su pareja sin hijos/con su pareja e hijos/ otro
- (Si respondió sí a vivir con sus hijos) ¿Con cuántos de sus hijos vive en su casa?
- ¿Cuál es la edad de los hijos con los que vive en su casa?
- Frecuencia de actividad física (horas por semana): 0-100

II. Trabajo

- Ocupación: respuesta de texto
- Tiempo en la empresa: #meses, #años
- ¿Qué modalidad de trabajo posee?: Trabaja desde casa/Trabaja en la oficina/ Híbrido
- ¿Qué tipo de horario posee? (Seleccione el que mejor se ajuste): Flexible (manejo mi propio horario) /Diurno 8 am- 5 pm/ Tarde 4 pm- 1 am / Noche 10 pm – 7am

III. Satisfacción en el trabajo

En una escala de 1 a 5, donde 1 es muy insatisfecho y 5 es muy satisfecho, cómo

calificaría los siguientes aspectos de su trabajo actual.

- Condiciones físicas del trabajo
- Libertad para elegir su propio método de trabajo
- Sus compañeros de trabajo
- Reconocimiento que obtiene por el trabajo bien hecho
- Su superior inmediato
- Responsabilidades asignadas
- Su salario
- La posibilidad de utilizar sus capacidades
- Relación entre los directivos y los demás empleados
- Sus posibilidades de avanzar en la jerarquía de la empresa
- El modo en que su empresa está gestionada
- La atención que se presta a las sugerencias que hace
- La variedad de tareas que realiza en el trabajo
- Su estabilidad en el empleo

IV. Autopercepción de productividad

En el último mes

- Soy capaz de concentrarme en el trabajo
Siempre/Frecuentemente/A veces/ Raras veces/ Nunca
- Siento que realizo muchas tareas en mi trabajo
Siempre/Frecuentemente/A veces/ Raras veces/ Nunca
- Ofrezco un alto nivel de calidad en mi trabajo
Siempre/Frecuentemente/A veces/ Raras veces/ Nunca
- Tomo la iniciativa en el trabajo
Siempre/Frecuentemente/A veces/ Raras veces/ Nunca
- Comprendo mis objetivos laborales
Siempre/Frecuentemente/A veces/ Raras veces/ Nunca
- Realizo eficazmente mis tareas laborales
Siempre/Frecuentemente/A veces/ Raras veces/ Nunca

- Creo que soy productivo en el trabajo
Siempre/Frecuentemente/A veces/ Raras veces/ Nunca
- Puedo contribuir a los objetivos de mi organización
Siempre/Frecuentemente/A veces/ Raras veces/ Nunca

V. Munich Chronotype Questionnaire (MCTQ)

En la próxima sección se le harán preguntas concernientes a su conducta de sueño-vigilia en los días laborables y no laborables. Estime un promedio de conducta de sueño “normal” en las últimas 6 semanas cuando fue capaz de cumplir sus rutinas habituales.

- He trabajado de noche o por turnos en los últimos tres meses. Si/ No
- Habitualmente, trabajo ____ días/semana.

Responda todas las siguientes preguntas incluso si usted no trabaja o trabaja 7 días por semana. No olvide indicar si es AM o PM.

En los días laborables...

- Normalmente me duermo a las ____:____ AM/PM (NO cuando se acuesta)
- Normalmente me despierto a las ____:____ AM/PM (NO cuando se levanta de la cama)

En los días no laborables cuando no uso la alarma...

- Normalmente me duermo a las ____:____ AM/PM (NO cuando se acuesta)
- Normalmente me despierto a las ____:____ AM/PM (NO cuando se levanta de la cama)

VI. Pittsburg Sleep Quality Index (PSQI)

Las siguientes cuestiones solo tienen que ver con sus hábitos de sueño durante el último mes. En sus respuestas debe reflejar cual ha sido su comportamiento durante la mayoría de los días y noches del pasado mes.

- Durante el último mes, ¿cuál ha sido, normalmente, su hora de acostarse?
- ¿Cuánto tiempo habrá tardado en dormirse, normalmente, las noches del último mes?

Menos de 15 min

Entre 16-30 min

Entre 31-60 min

Más de 60 min

- Durante el último mes, ¿a qué hora se ha levantado habitualmente por la mañana?
- ¿Cuántas horas calcula que habrá dormido verdaderamente cada noche durante el último mes?
- Durante el último mes, cuántas veces ha tenido usted problemas para dormir a causa de:
 - a) No poder conciliar el sueño en la primera media hora:
 - Ninguna vez en el último mes
 - Menos de una vez a la semana
 - Una o dos veces a la semana
 - Tres o más veces a la semana
 - b) Despertarse durante la noche o de madrugada:
 - Ninguna vez en el último mes
 - Menos de una vez a la semana
 - Una o dos veces a la semana
 - Tres o más veces a la semana
 - c) Tener que levantarse para ir al servicio:
 - Ninguna vez en el último mes
 - Menos de una vez a la semana
 - Una o dos veces a la semana
 - Tres o más veces a la semana
 - d) No poder respirar bien:
 - Ninguna vez en el último mes
 - Menos de una vez a la semana
 - Una o dos veces a la semana
 - Tres o más veces a la semana
 - e) Toser o roncar ruidosamente:
 - Ninguna vez en el último mes
 - Menos de una vez a la semana
 - Una o dos veces a la semana

Tres o más veces a la semana

f) Sentir frío:

Ninguna vez en el último mes

Menos de una vez a la semana

Una o dos veces a la semana

Tres o más veces a la semana

g) Sentir demasiado calor:

Ninguna vez en el último mes

Menos de una vez a la semana

Una o dos veces a la semana

Tres o más veces a la semana

h) Tener pesadillas o malos sueños:

Ninguna vez en el último mes

Menos de una vez a la semana

Una o dos veces a la semana

Tres o más veces a la semana

i) Sufrir dolores:

Ninguna vez en el último mes

Menos de una vez a la semana

Una o dos veces a la semana

Tres o más veces a la semana

j) Otras razones. Por favor descríbalas:

Ninguna vez en el último mes

Menos de una vez a la semana

Una o dos veces a la semana

Tres o más veces a la semana

· Durante el último mes, ¿cómo valoraría en conjunto, la calidad de su sueño?

Muy buena

Bastante buena

Bastante mala

Muy mala

- Durante el último mes, ¿cuántas veces habrá tomado medicinas (por su cuenta o recetadas por el médico) para dormir?

Ninguna vez en el último mes

Menos de una vez a la semana

Una o dos veces a la semana

Tres o más veces a la semana

- Durante el último mes, ¿cuántas veces ha sentido somnolencia mientras conducía, comía o desarrollaba alguna otra actividad?

Ninguna vez en el último mes

Menos de una vez a la semana

Una o dos veces a la semana

Tres o más veces a la semana

- Durante el último mes, ¿ha representado para usted mucho problema el tener ánimos para realizar alguna de las actividades detalladas en la pregunta anterior?

Sí/No/Ningún problema

- ¿Duerme usted solo o acompañado?

Solo

Con alguien en otra habitación

En la misma habitación, pero en otra cama

En la misma cama

VII. Índice de Higiene del Sueño

- En las noches me acuesto (o voy a la cama) a diferentes horas.

Siempre/Frecuentemente/A veces/ Raras veces/ Nunca

- Una hora antes de ir a dormir realizo ejercicio físico.

Siempre/Frecuentemente/A veces/ Raras veces/ Nunca

- Consumo alcohol, tabaco o café cuatro horas antes de ir a la cama.

Siempre/Frecuentemente/A veces/ Raras veces/ Nunca

- Me voy a dormir sintiéndome estresado, molesto, triste o nervioso.

Siempre/Frecuentemente/A veces/ Raras veces/ Nunca

- Utilizo mi cama para otra cosa aparte de dormir o tener relaciones sexuales. (por ejemplo mirar televisión, leer, comer, estudiar, etc.)

Siempre/Frecuentemente/A veces/ Raras veces/ Nunca

- Mi cama no es confortable para ayudarme a dormir

Siempre/Frecuentemente/A veces/ Raras veces/ Nunca

- Mi dormitorio no es confortable para ayudarme a dormir. (hay mucha luz, mucho calor o frío, mucho ruido, etc.)

Siempre/Frecuentemente/A veces/ Raras veces/ Nunca

- Realizo alguna actividad que me pueda mantener despierto o alerta antes de dormir. (p.ej.: sacar cuentas, hacer crucigramas, estudiar, etc.)

Siempre/Frecuentemente/A veces/ Raras veces/ Nunca

- Ingiero alimentos dos horas antes de ir a dormir.

Siempre/Frecuentemente/A veces/ Raras veces/ Nunca

- Uso algún tipo de ayuda (que no sean medicinas) para poder dormir.

Siempre/Frecuentemente/A veces/ Raras veces/ Nunca

VIII. Insomnia Severity Index

- Por favor califique la severidad actual (últimas dos semanas) de tus problemas de insomnio: Ninguna/Leve/Moderado/Severo/Grave

- a. Dificultad para iniciar el sueño
- b. Dificultad para mantenerse dormido
- c. Despertarse más temprano de lo deseado

- ¿Qué tan satisfecho está con su patrón de sueño actual?

Muy satisfecho/ satisfecho/ neutral /insatisfecho / muy insatisfecho

- ¿A qué grado consideras que tu problema de sueño interfiere con tu funcionamiento diario?

Nada/un poco/algo/mucho/demasiado

· Qué tan notorio crees que es tu problema de sueño en afectar tu calidad de vida

Nada/un poco/algo/mucho/demasiado

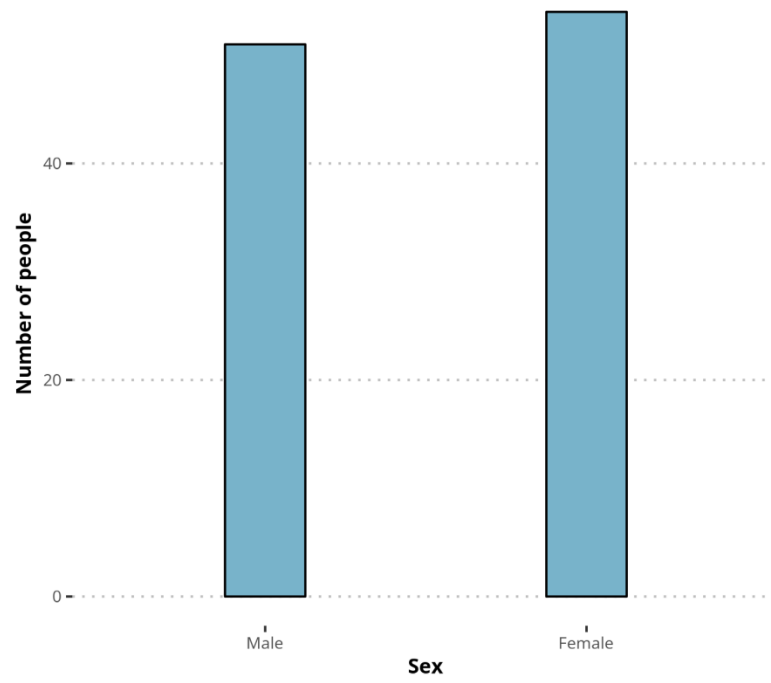
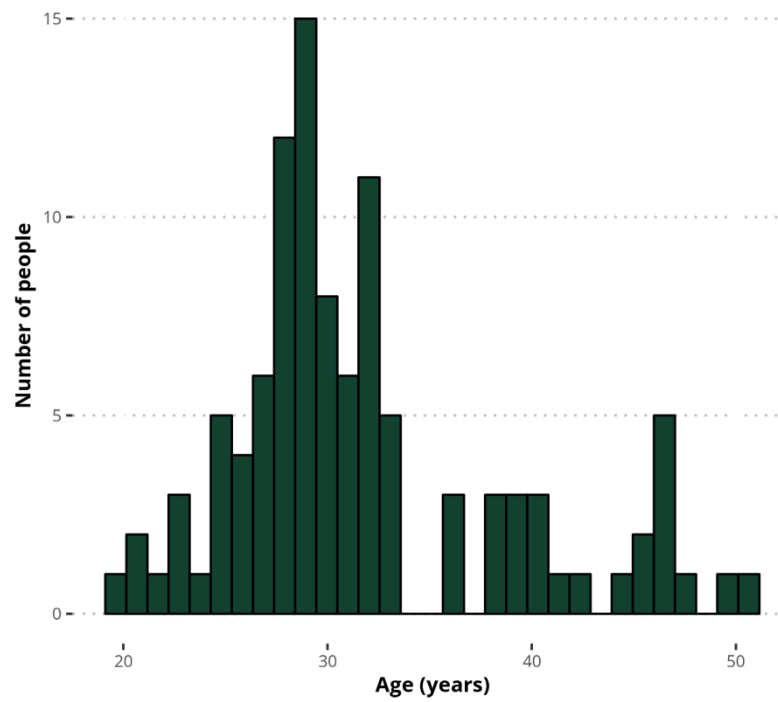
· ¿Qué tan preocupado/estresado estás acerca de tu problema de sueño?

Nada/un poco/algo/mucho/demasiado

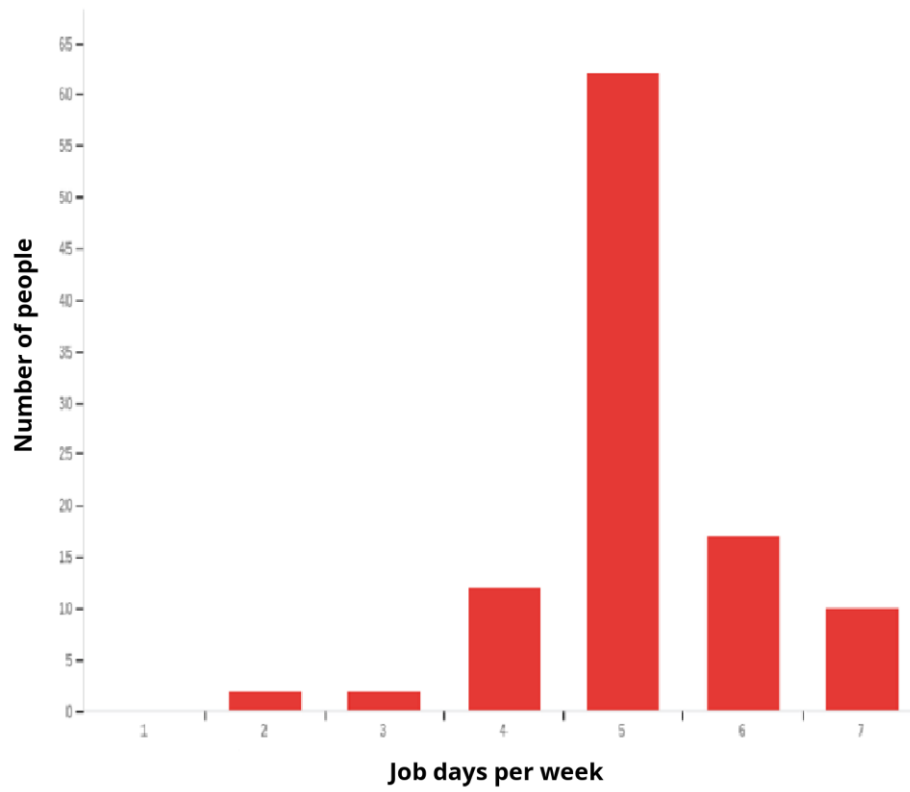
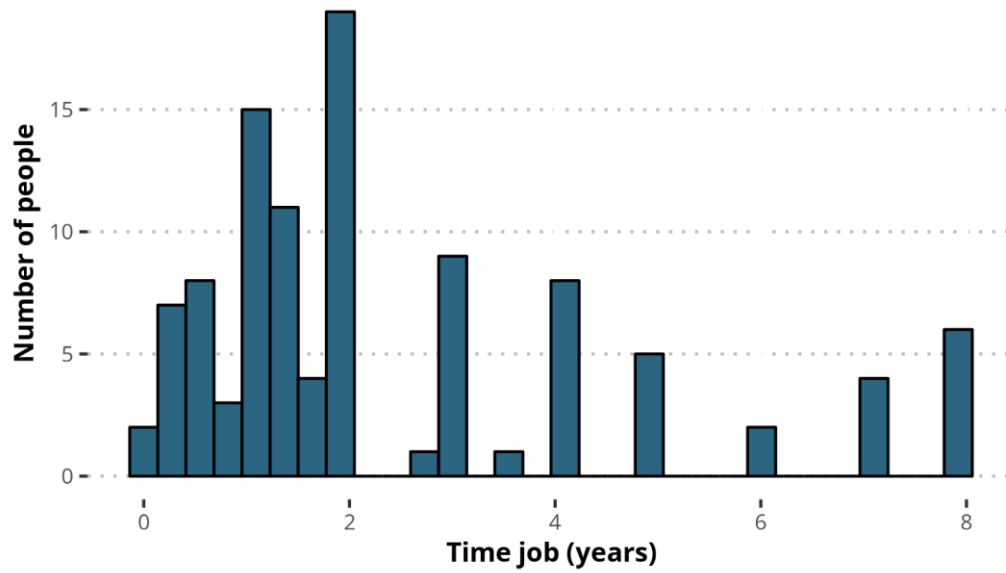
¡Gracias por completar esta encuesta!

Appendix B

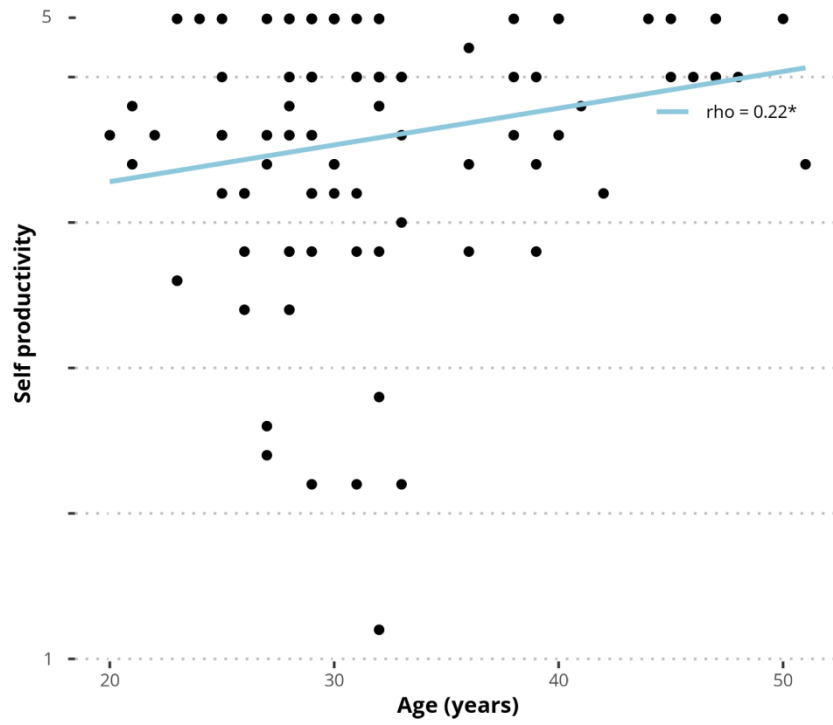
Socio-demographic characteristics: age and sex distribution

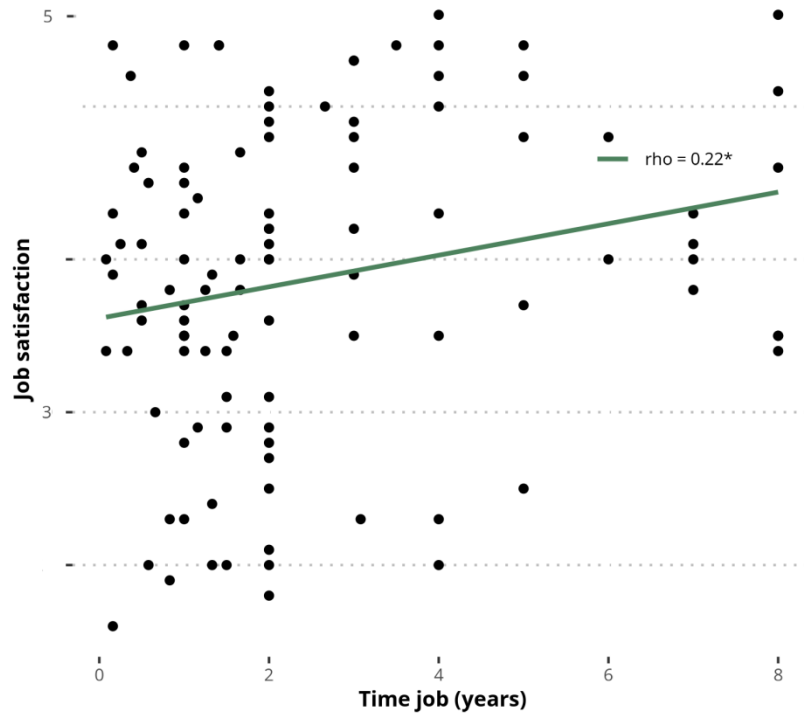


Job characteristics: time in job and number of workdays per week



Relationship between variables: correlation between age and self-perceived productivity; correlation between years at work and job satisfaction.





Appendix C

Multicollinearity, homoscedasticity and normality test of residuals from multiple linear regression

```
. estat vif
```

| Variable | VIF | 1/VIF |
|--------------|------|----------|
| pittsburg | 1.50 | 0.666565 |
| sleeping_q~y | 1.48 | 0.676998 |
| SLOSS_week | 1.14 | 0.875867 |
| Productivity | 1.11 | 0.896879 |
| age | 1.10 | 0.912907 |
| shift | 1.09 | 0.919900 |
| Mean VIF | 1.24 | |

```
. hettest
```

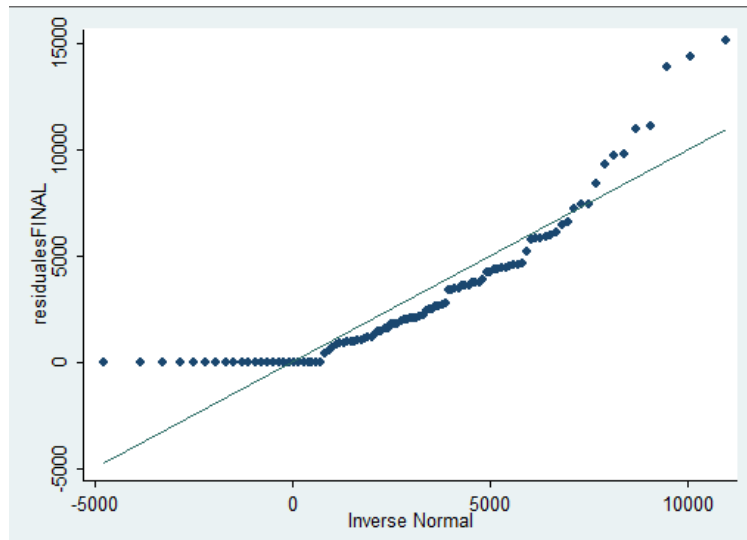
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of Job_sat

chi2(1) = 1.66
Prob > chi2 = 0.1979

```
. swilk residualesFINAL
```

Shapiro-Wilk W test for normal data

| Variable | Obs | W | V | z | Prob>z |
|--------------|-----|---------|--------|-------|---------|
| residuales-L | 104 | 0.83208 | 14.326 | 5.918 | 0.00000 |



```
. histogram residuales, normal  
(bin=10, start=-5.5083008, width=1517.1282)
```

