



Ergonomics for Work-Life Balance: A Systematic Review

Abhijeet Ambesange, Akhila Chandrasekaran[✉], and Vincent G. Duffy

Purdue University, West Lafayette, IN 47906, USA
{aambesan, chand199, duffy}@purdue.edu

Abstract. In modern times, work has started bleeding outside of corporate offices. The notion of a routine nine-to-five at a designated desk or workstation has become limited with the advent of non-traditional work cultures and environments. Computers and cloud storage facilities have introduced several 24x7 operations. Organizations offer various levels of flexibility with respect to workload and work timings. COVID-19 moved a lot of jobs into peoples' homes— jobs that were considered impossible to perform from a remote location. In the face of all this, the working population continues to steadily grow older. This study aims to analyze the effects of traditional and non-traditional employment conditions on the present-day working population and Work-Life Balance (WLB). Also surveyed are some studies that offer solutions to common workplace ergonomic hazards, physiological as well as psychological. Content Analysis tools like maxQDA, VOS Viewer, CiteSpace and Google Ngram Viewer were used for this purpose.

Keywords: workplace · ergonomics · working population

1 Introduction and Background

The impact of ergonomics on WLB is a multifaceted area that encompasses various aspects of workplace design, human factors, and employee well-being. Research has indicated that the application of ergonomics can significantly influence the quality of work life, reduce musculoskeletal disorders, and enhance productivity. Furthermore, ergonomic conditions have been found to be effective in promoting employee happiness, satisfaction, and self-esteem in the workplace. The goal of ergonomics is to create safe, comfortable, and productive workplaces that take into account individuals' abilities and limitations, thereby contributing to a positive WLB.

Ergonomics plays a crucial role in mitigating age-related injuries and addressing obstacles faced by older workers in the workplace, thereby contributing to a more inclusive and supportive work environment. Additionally, ergonomic-driven workplace design and modifications have been highlighted as highly effective in determining appropriate work conditions, preventing workers' exposure to ergonomic risks, and accommodating medical restrictions, ultimately contributing to improved WLB.

Moreover, the incorporation of ergonomics training into office workplaces has been shown to enhance the effective use of work environments and knowledge workers'

sense of control and environmental satisfaction, thereby positively impacting WLB. Understanding the technical aspects of ergonomic applications can lead to changes in the office environment that favorably affect management's bottom line while reducing health hazards for employees, thus contributing to a healthier WLB.

Overall, the integration of ergonomics into workplace design and practices has the potential to significantly impact WLB by promoting physical well-being, job satisfaction, and a supportive work environment for employees across various industries and demographics.

2 Purpose of Study

The aim of this study is to understand the challenges faced by the employees of this day and age with regard to various parameters like the industry, age, the pandemic, etc. and explore lower management level solutions to bureaucratic measures. Job satisfaction has come to be analogous to WLB, and it has been known to improve productivity, hence, it is a lucrative area of study.

3 Data Collection

3.1 Textbook References

In the course IE 578 Applied Ergonomics, the text "Handbook of Human Factors and Ergonomics" (fourth and fifth editions) edited by Gavriel Salvendy and Waldemar Karwowski was used as the reference. This study has referred to the chapters 9: Emotional Design and 14: Workplace Design.

The chapter "Emotional Design" by Zhou, Ji, and Jiao (2021) discusses the significance of emotional design in web interfaces. It emphasizes the importance of creating designs that evoke positive emotions in users, leading to a more engaging and satisfying user experience. The chapter delves into the theoretical foundations of emotional design, such as the influential model proposed by Norman, and provides practical guidance on incorporating emotional elements into web design. Additionally, it explores the impact of emotional design on user behavior and decision-making, highlighting its relevance in creating successful and user-centric web interfaces.

On the other hand, the chapter "Workplace Design" by Smith and Johnson (2020) focuses on the ergonomic and human factors considerations in designing work environments. It covers various aspects of workplace design, including spatial layout, furniture, lighting, and environmental factors, with the aim of enhancing employee well-being, productivity, and satisfaction. The chapter emphasizes the importance of considering human factors in workplace design, such as anthropometry and user-centered design principles, to create work environments that promote health, safety, and efficiency (Marmaras & Nathanael, 2012).

In summary, the chapter on emotional design provides insights into creating emotionally engaging web interfaces, while the chapter on workplace design offers comprehensive guidance on designing ergonomic and user-centered work environments.

3.2 Methodology

Keywords and Search Strategy. Phrases like “ergonomics for work-life balance”, “effects of ergonomics on work-life balance”, and “ergonomics and work-life balance” were used to generate search results on platforms like Scopus, scite.ai, Google Scholar, Research Gate, Web of Science and Purdue Libraries. The obtained results were filtered to obtain recent articles in journals and publications relating to Ergonomics and Industrial Engineering. After going through the abstracts of the results in the first couple of pages, a new search phrase was used since abstracts are generally arranged in decreasing order of relevance (Figs. 1, 2 and 3).

The search results obtained are tabulated below (Table 1):

Table 1. Total number of articles generated in each source

Source	Number of Articles
Scopus	68
Scite.ai	268,761
Google Scholar	136,000
Research Gate	100
Web of Science	101
Purdue Libraries	5780

Documents by country or territory

Compare the document counts for up to 15 countries/territories.

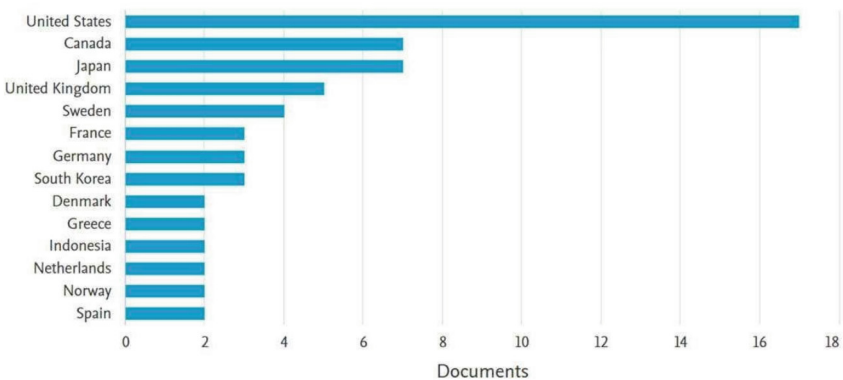


Fig. 1. Country wise number of publications

Concept Mapping. In order to create an organized visualization of ideas, VOS viewer and CiteSpace were used. A text file was imported into the VOS Viewer software from

Documents by subject area

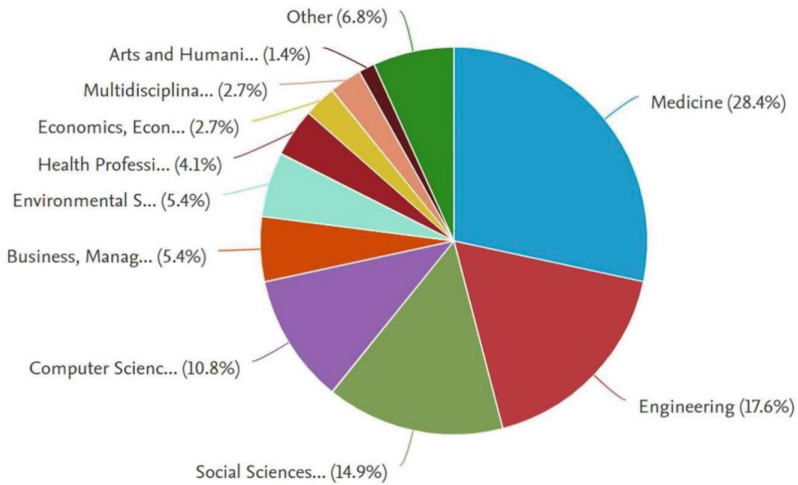


Fig. 2. Documents by subject area from Scopus

Documents per year by source

Compare the document counts for up to 10 sources.

Compare sources and view CiteScore, SJR, and SNIP data

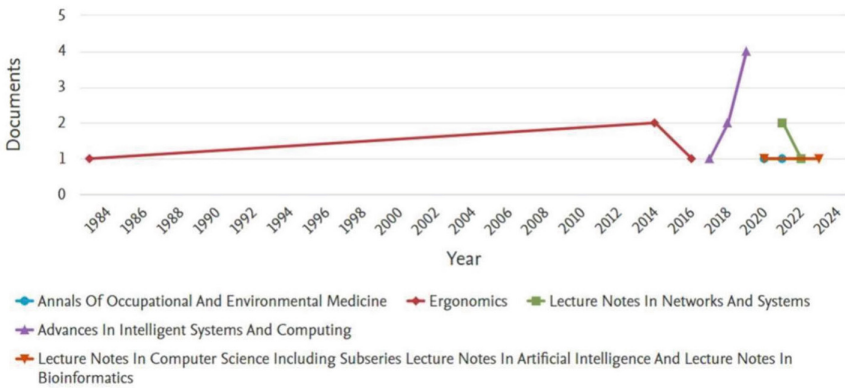


Fig. 3. Trend showing number of documents published per year by different sources

the Web of Science website, containing the titles of all the search results, citations, and authors. The below figure helps understand what keywords appear in the titles and how they relate to each other, thereby giving an idea of what all the publications indicate (Fig. 4).

Another tool used for this purpose is CiteSpace and is also undertaken by importing the text file into the software. The result is basically a grouping of articles based on

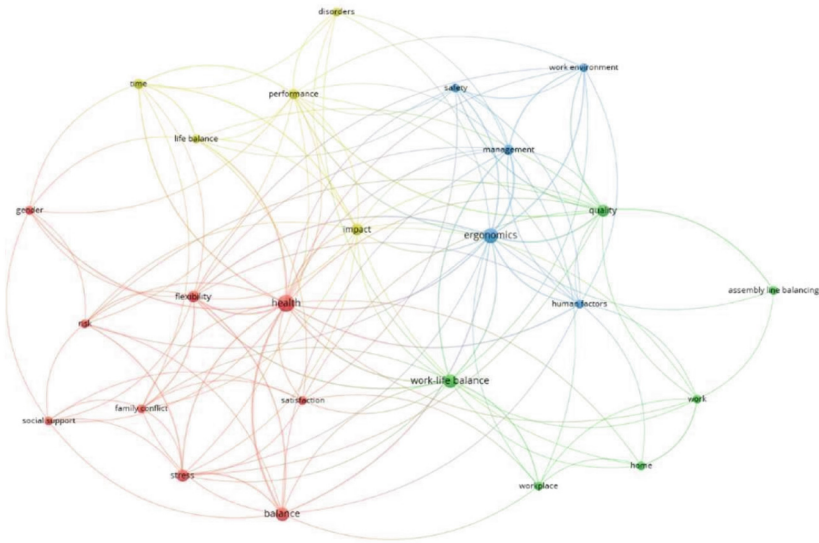


Fig. 4. Co-Occurrence Analysis using VOS Viewer

certain keywords. This, again, helps visualize the main patterns in scientific literature in this particular area (Fig. 5).



Fig. 5. Clusters Analysis of citations using CiteSpace

Trend Analysis. Two main tools were used to examine the trends within the topic: ergonomics and WLB, namely Google Ngram and Scopus. As the heading suggests, it is used to identify patterns and emerging subject areas (Fig. 6).

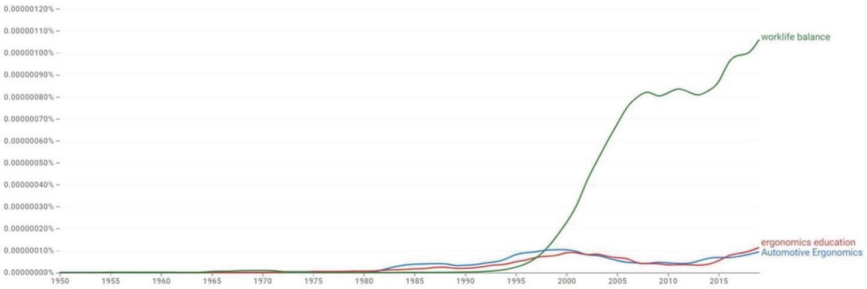


Fig. 6. Trend of WLB in comparison to ergonomics education and automotive ergonomics. It clearly shows the emergent and rising popularity of WLB.

The below trend diagram shows the trend in terms of number of publications with respect to the year of publication. This also demonstrates WLB as an emergent topic with rising popularity and publication (Fig. 7).

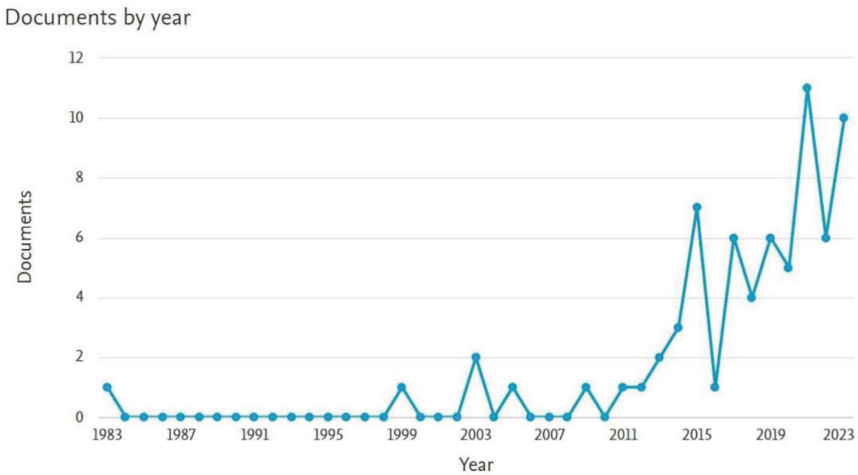


Fig. 7. Trend of publications from Scopus

4 Discussion and Conclusions

4.1 Content Analysis

Out of the 23 articles chosen, the following represents the number of studies that examined each location (Fig. 8).

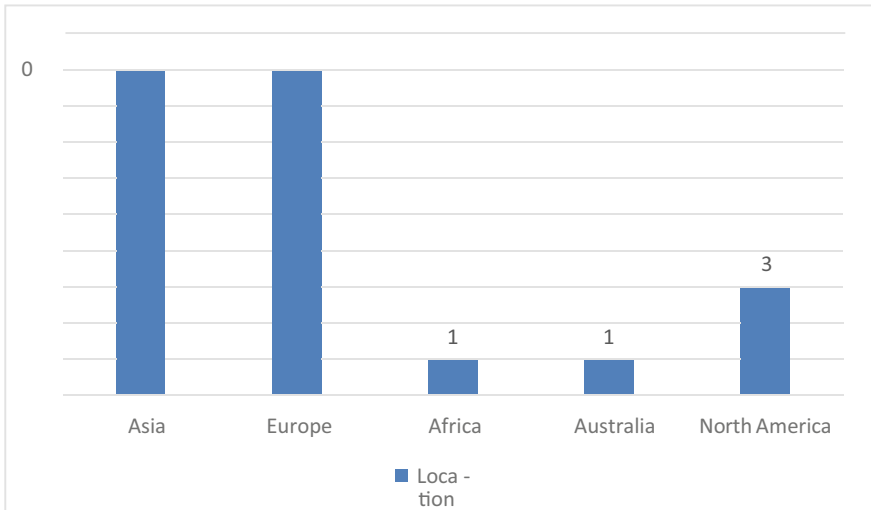


Fig. 8. Articles chosen by location

Six of the chosen studies alluded to remote work and the perceived effects of it are shown in the below chart (Fig. 9).

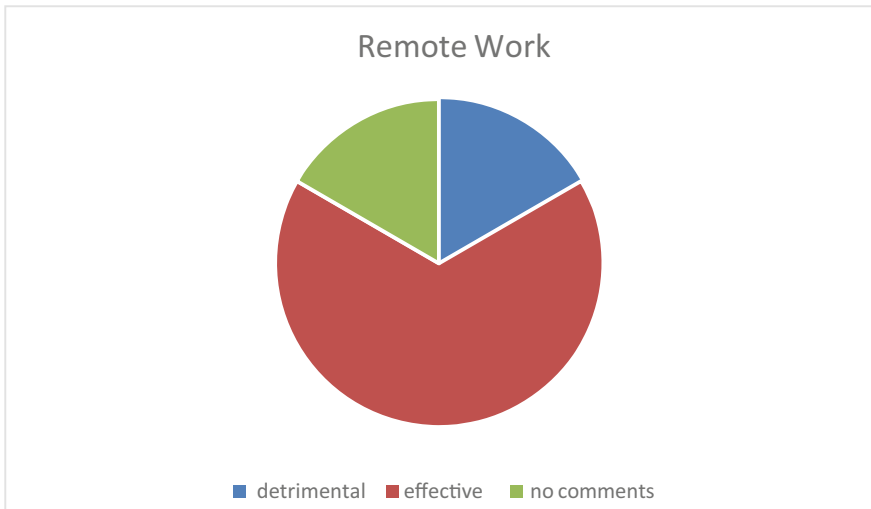


Fig. 9. Remote work according to chosen publications

Four articles inspect the effects of COVID-19 on the WLB of remote working employees.

Figures 10 and 11 show the number of studies based on their types.

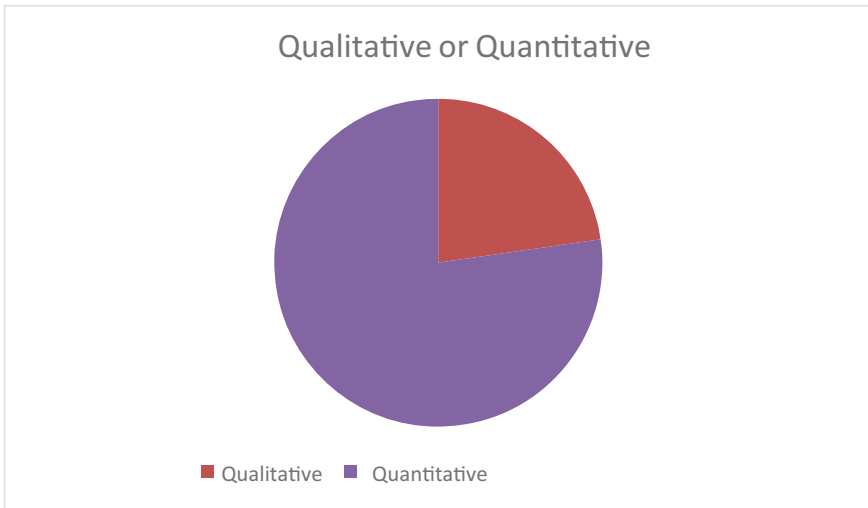


Fig. 10. Number of Qualitative versus Quantitative studies based on their results

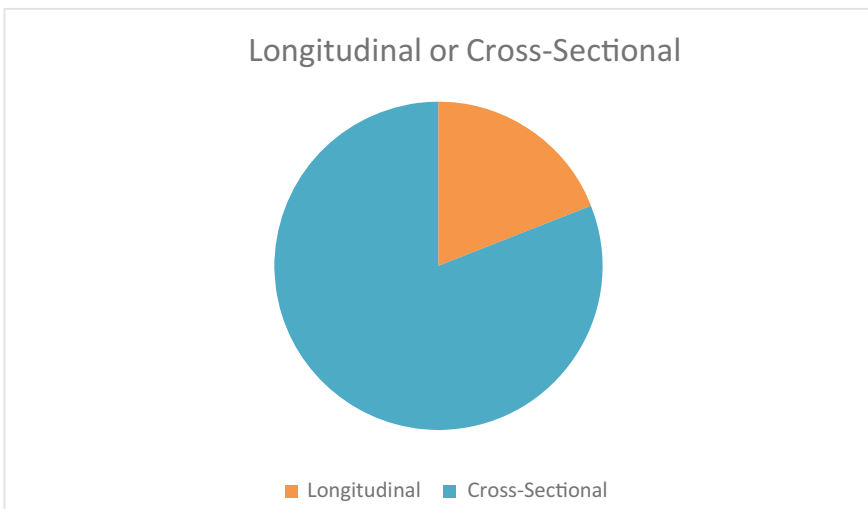


Fig. 11. Number of Longitudinal versus Cross-Sectional studies based on their methodology

The wordcloud below generated using maxQDA analyzes the content of the chosen publications and points out the commonly occurring terms. This helps understand the most pertinent ideas of the literature synthesized (Fig. 12 and Table 2).

4.2 Insights

The advent of remote working has brought significant changes to the landscape of work life, which has led organizations and individuals to re-evaluate traditional work-related

Table 2. Lexical term analysis conducted using maxQDA. This provides a foundation for easing the literature survey task.

Word	Word length	Freque... ▼	%	Rank
work	4	2307	2.94	1
health	6	711	0.91	2
study	5	702	0.90	3
al	2	630	0.80	4
et	2	628	0.80	5
worker	6	473	0.60	6
high	4	471	0.60	7
use	3	408	0.52	8
age	3	406	0.52	9
employee	8	396	0.51	10
hour	4	387	0.49	11
risk	4	373	0.48	12
factor	6	366	0.47	13
time	4	366	0.47	13
job	3	364	0.46	15
burnout	7	333	0.43	16
shift	5	323	0.41	17
life	4	314	0.40	18
model	5	312	0.40	19

and ergonomic principles can increase efficiency, but it is important to be oriented in the psychological and social aspects of remote work. Finding a balance between functional demands, individual preferences and well-being is critical for organizations striving to create a sustainable and supportive telecommuting environment.

Article 3 discusses the complex dynamics of different work schedules through latent class analysis and highlights important implications for work-life balance. The identification of six different types of work schedules shows that flexibility combined with regular working hours significantly contributes to both subjective health and work-life balance. This finding suggests that organizations that promote flexible schedules within a standardized framework can create an environment that promotes employee well-being. On the other hand, the analysis shows the adverse effects of extended working hours, even when accompanied by flexibility. Rigid schedules that offer less control are considered acceptable as long as they avoid extended working hours. The overall message

is clear: a balanced approach combining flexibility with reasonable working hours is essential to optimize employee health and work-life balance.

Article 14 shifts the focus to the specific context of hospital nurses, providing insight into the impact of changing schedules on different aspects of their lives. The study shows a significant difference between clockwise (CW) and counterclockwise (CCW) rotation schedules. Nurses on CW rounds reported sleeping more hours during their shift and feeling more rested at the start of their shift than their CCW counterparts. Importantly, CCW rotation nurses expressed the perception that work has a greater impact on their private lives, interfering with family and social relationships. This highlights the complex interplay between rotation orientation and the general well-being of nurses and highlights the need for healthcare organizations to consider the nuances of shift scheduling to mitigate potential negative effects and promote a healthier work-life balance for nursing staff.

Article 19 provides valuable insights into the impact of different work shifts on work-life balance, highlighting the links between evening, Saturday and Sunday work and different aspects of well-being. The results show that evening work is associated with a significantly increased risk of poor work-life balance, highlighting the potential challenges individuals face when their work extends into the evening hours. In addition, the study identifies a link between Saturday work and poor work-life balance and accidents at work, suggesting a possible strain in personal and professional life during weekends. Similarly, Sunday work is associated with poor work-life balance and work-related health problems, indicating that working on a traditional day off can upset people and their ability to maintain a healthy balance between work and personal life.

These findings have significant implications for organizations and decision makers seeking to improve work-life balance. Employers may need to review evening, Saturday and Sunday working hours as they are aware of the potential negative impact on employees and their general well-being. Preventive measures, such as providing alternatives or accommodation for those working less frequent days, can help create a more supportive work environment. In addition, the study emphasizes the importance of awareness of the potential health effects of non-traditional working hours and emphasizes the need for a comprehensive workplace policy that prioritizes employee well-being and work-life balance, even across sectors. Which require longer or unusual working hours.

Musculoskeletal disorders (MSDs) present a major challenge to work-life balance, as evidenced by the reviews in Articles 4 and 13. Article 4 highlights the prevalence of SLEs in the upper body, particularly in the neck, shoulders, and hands, indicating the physical burden that work-related stressors can place on workers. The mention of intervention training to reduce stress suggests a proactive approach to mitigate the impact of these disorders on employees. By addressing the root causes of TULE and providing targeted training, organizations may be able to improve the well-being of their work-force and thereby promote a healthier work-life balance. In addition, the emphasis on reducing absenteeism highlights the possibility of mitigating the negative effects of STDs not only on individuals and their physical health, but also general work ability and productivity.

Article 13 expands the debate by linking poor work-life balance to increased work-related injuries and musculoskeletal pain. The study highlights a broader perspective, noting that research on work-life balance is still limited in some regions, such as Korea,

compared to Europe and the United States. The association between longer working hours and an increased risk of occupational accidents emphasizes the importance of scheduling working hours to maintain a healthy work-life balance. In addition, the recognition that employees who are dissatisfied with their lives have a higher risk of accidents at work highlights the link between mental well-being and physical health. This shows that considering work-life balance is crucial not only to prevent MSDs, but also to reduce the risk of occupational accidents, highlighting the need for comprehensive wellness programs.

Counterintuitive to logical belief, Article 24 has uncovered that the work-from-home culture is not as attractive as it is advertised to be. It tends to lock people in their houses, dealing with family while also juggling work which actually heightens stress.

In short, it can be stated that the impact of musculoskeletal diseases on work-life balance is profound and affects not only physical health, but also general job satisfaction and job security. Addressing these issues requires a holistic approach that includes targeted interventions, ergonomic improvements, and a focus on employees' psychological well-being. Organizations that prioritize the prevention of sexually transmitted diseases and the promotion of a healthy work-life balance are likely to create a more sustainable and supportive work environment for their employees.

4.3 Summary

To summarize, it can be stated that the research project on the topic "Ergonomics for the balance of work and family life" learns about the multifaceted impact of ergonomic aspects in the evolving landscape of modern working life. Examining the dynamics of telecommuting in Articles 1, 9, 16, and 23 highlights the transformative potential of telecommuting as operational information systems and cloud resources increase efficiency. However, constant connectivity and 24x7 operations emphasize the delicate balance needed to prevent potential tensions from intruding into personal life. Article 3 supports this narrative by underscoring the importance of flexible schedules with reasonable working hours to optimize both subjective health and work-life balance.

The complex relationship between shift work and work-life balance illuminated by Articles 14 and 19 adds to the precision of our understanding. The particular challenges faced by healthcare workers, especially nurses, in managing shift schedules and the potential stress caused by evening, Saturday and Sunday work highlight the need for tailored measures. This knowledge is invaluable to organizations looking to create supportive practices that meet the diverse needs of their workforce, especially in industries that require non-traditional work hours.

The research project also looks at physical well-being through the lens of musculoskeletal disorders according to Sects. 4 and 13. The prevalence of upper body TUL conditions such as neck, shoulder and forearm discomfort highlights the need for targeted interventions. Intervention training to reduce stress and the link between poor work-life balance and increased work-related accidents underscore the importance of comprehensive wellness programs. These programs, as proposed in Article 13, must consider the broader context of employee satisfaction, and recognize the complex relationship between mental well-being and physical health.

In the current environment where remote work has become more common, ergonomic policy appears as a key factor in shaping the future of work. In the light of this research project, organizations and decision-makers have the opportunity to proactively plan work environments that contribute to the overall well-being of employees. By implementing ergonomic principles, promoting flexible schedules, and considering the diverse needs of the workforce, organizations can foster a stimulating work culture that increases job satisfaction, reduces absenteeism, and ultimately promotes a harmonious work-life balance. As the world continues to evolve, the importance of ergonomics in navigating the complexities of modern work cannot be overstated, making it a critical aspect for the work of the future.

5 Strengths and Limitations

The main strength of this project is that it has a very good mix of literature from all over the world. Also, there are a good number of longitudinal studies that monitor the effects of the solutions they suggest on their subjects' WLB. In addition to this, 20 of the 25 references were published in the last five years, making this study very up to date.

The limitations of this study have to be that most of the reference articles related mainly to desk jobs and not physical labor; and even the ones that did had a very low sample size. Also, only four of the studies provide qualitative data. While the bulk of quantitative data does help test and confirm something, qualitative data is what helps learn and understand the results thus obtained.

6 Future Work

The literature devoted to ergonomics for WLB is quite few and far between. As Jiang & Duffy (2021) suggests, the results can be applied in other fields as well, namely education and automation. COVID-19 caused educational institutions to resort to remote instruction and this caused lowered levels of motivation among students. Controllers who oversee automations tend to get fatigued and miss malfunctions during human monitoring. It is a lucrative avenue to explore – ergonomic changes to improve the delivery of online instruction and effectiveness of human monitoring of automation.

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