Review Article

Ergonomics and telework: A systematic review

Thiago Allan Marques de Macêdo[a], Eric Lucas dos Santos Cabral[a,*], Wilkson Ricardo Silva Castro[a], Clodoaldo Carneiro de Souza Junior[a], João Florêncio da Costa Junior[a,b], Felipe Martins Pedrosa[a], Aleson Belo da Silva[a], Veder Ralf Fernandes de Medeiros[a], Ricardo Pires de Souza[a], Marco Antônio Leandro Cabral[a] and Francisco Soares Másculo[c]

[a]*Department of Production Engineering, Technology Center, Universidade Federal do Rio Grande do Norte, Natal, RN, Brazil*
[b]*School of Applied Social Sciences, Education, Arts and Humanities, Universidade Potiguar (UnP) Laureate, Natal, RN, Brazil*
[c]*Department of Production Engineering, Technology Center, Universidade Federal da Paraíba, João Pessoa, PB, Brazil*

Abstract.
BACKGROUND: Telework has been widely studied by public and private organizations; however, in ergonomics, studies that focused on this topic are still sporadic.
OBJECTIVE: Thus, this article endeavours to systematize the qualified scientific research related to ergonomics and teleworking to determine the main benefits and disadvantages and to identify the main issues addressed by authors.
METHODS: A thorough research was conducted in the Scopus/Embase and Web of Science databases for this review. The following descriptors were used for the cataloguing of articles: "teleworking", "telecommuting", "telecommuters", "home office", "ergonomics" and "human factors". 36 studies were selected.
RESULTS: The study highlights four relevant questions in the scientific literature: a) where is the discussion of these themes consolidated; b) what are the main descriptors related to the discussion; c) which journals and conferences establish a scientific debate on the topic; and d) what are its main advantages and disadvantages.
CONCLUSIONS: Results suggest that telecommuting can be a valuable tool for balancing professional and family life, which helps to improve the well-being of workers; however, several factors can influence the overall remote working experience which leads to the need for companies to adopt unique strategies reflecting their unique situation.

Keywords: Teleworking, human factors, telecommuting, flexible working, home office

1. Introduction

Ergonomics has two general objectives: the first one refers to organizations and their performance such as efficiency, productivity and quality. The second objective is people-centred, focusing on safety, health, and comfort. Furthermore, ergonomics also emphasizes the fundamental understanding of people

*Address for correspondence: Eric Lucas dos Santos Cabral, M.Sc., Department of Production Engineering, DEP/UFRN, Av. Sen. Salgado Filho, 3000, Universidade Federal do Rio Grande do Norte, 59072-970, Natal/RN, Brazil. Tel./Fax: +55 84 3086 0204; E-mail: ericlucascabral94@gmail.com.

as well as their interactions and applications in order to improve these interactions [1, 2].

It is possible to argue that a positive change in productivity is intrinsically linked to the conditions of safety and comfort that organizations provide for their members. This conception can be associated with the development of new information and communication technologies (ICT) that contributed to bringing innovation to work organization such as teleworking, telemarketing and remote teamwork through communication using computers and mobile devices [3].

Telework, also known as remote work, is gaining popularity and becoming a common feature in the market due not only to advances in digital technology, but also the changing attitudes towards where and when work should be performed and how performance should be measured.

To clarify the discussion about the topic, telecommuting is defined as the organization and/or execution of tasks performed away from the central offices or production facilities of organizations for a certain period in pre-established work schedules. To this end, information and communication technologies (ICT) are used to establish communication between employees and to respond to the demands of the organization remotely [4–7].

Ergonomics research has not yet focused on the phenomenon of teleworking, such as the study of home office ergonomics. Thus, questions about the responsibility to ensure optimal ergonomic conditions in the home office are still not addressed [3]. However, teleworking is already identified as a significant issue for future research in ergonomics [8].

Due to the importance of such topic, public and private organizations have studied teleworking and flexible working arrangements. The empirical results from these studies show that teleworking is not only beneficial to individuals and their organizations, but to society as a whole [9].

Studies developed in the United States, India and Southeast Asia (especially in Malaysia) utilizing the National Health Interview Survey (NHIS), Cornell Musculoskeletal Discomfort Questionnaire and Rapid Upper Limb Assessment (RULA) protocols indicate that office workers can develop musculoskeletal disorders associated with age, sex and Body Mass Index, including demographic, occupational and psychosocial factors; which could compromise the quality of working life of these professionals, demanding an ergonomics oriented intervention to provide adequate comfort in their work activities. This group of workers, given the regular use of information systems that allow remote work, could potentially benefit from telework as a new socio-technical system to promote life quality at work [10–12].

The concepts of Quality of Working Life (QWL) and work-life balance are not new; a definition has already been made explicit in terms of techniques and approaches used to improve work, such as job enrichment, empowerment, self-managed teams, and work management committees [13, 14]. The expansion of QWL includes workplace resources that can affect employee productivity and satisfaction, such as compensation systems, workflows, management styles, and the physical work environment [15]. This article aims to develop systematization of qualified scientific research related to ergonomics and teleworking in order to determine the main benefits and disadvantages commonly found, as well as to identify the main issues addressed associated to productivity, performance and comfort in the execution of labour activities.

2. Methodology

Scopus/Embase and Web of Science were reviewed initially on March 26, 2018 and once again on November 16, 2018; no date restriction was established to the articles found during research. Table 1 presents the keywords used for the systematic review.

In order to ensure an in-depth research, besides the terms "teleworking" also "telecommuting", "telecommuters" and "home office" were utilized. In relation to ergonomics, the term "human factors" was also utilized. Figure 1 clarifies the methodological path described in this research to select articles for review.

Table 1
Descriptors utilized for database search.

Research key words	Research date	Research field
"Teleworking" AND "Ergonomics"	26/03/2018 e 16/11/2018	Article Title, Abstract, Keywords
"Telecommuting" AND "Ergonomics"	26/03/2018 e 16/11/2018	Article Title, Abstract, Keywords
"Human factors" AND "Teleworking"	26/03/2018 e 16/11/2018	Article Title, Abstract, Keywords
"Home Office" AND "Telecommuting"	26/03/2018 e 16/11/2018	Article Title, Abstract, Keywords
"Home Office" AND "Telecommuters"	26/03/2018 e 16/11/2018	Article Title, Abstract, Keywords

```
┌─────────────────────────────┐        ┌─────────────────────────────┐
│   Scopus Database: 72       │        │   Web of Science: 12        │
└─────────────────────────────┘        └─────────────────────────────┘
              │                                        │
              ▼                                        ▼
┌───────────────────────────────────────────────────────────────────┐
│              Total of articles evaluated: 84                       │
└───────────────────────────────────────────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐        ┌─────────────────────────────┐
│ Screening based on title and│───────▶│ Excluded by title, abstract │
│       abstract:57           │        │ and unavailability of the   │
│                             │        │     full text: 27           │
└─────────────────────────────┘        └─────────────────────────────┘
              │
              ▼
┌───────────────────────────────────────────────────────────────────┐
│              After first screening: 57                             │
└───────────────────────────────────────────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐        ┌─────────────────────────────┐
│  Full text evaluated for    │───────▶│ Excluded after reviewing    │
│      elegibility: 48        │        │     full text: 9            │
└─────────────────────────────┘        └─────────────────────────────┘
              │
              ▼
┌───────────────────────────────────────────────────────────────────┐
│              After the second screening: 48                        │
└───────────────────────────────────────────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐        ┌─────────────────────────────┐
│ Papers that provided the    │───────▶│ Papers excluded for not     │
│ necessary information after │        │ providing the necessary     │
│ reading full text: 36       │        │ information in the full     │
│                             │        │ text: 12                    │
└─────────────────────────────┘        └─────────────────────────────┘
              │
              ▼
┌───────────────────────────────────────────────────────────────────┐
│              Total of papers suitable for research: 36             │
└───────────────────────────────────────────────────────────────────┘
```
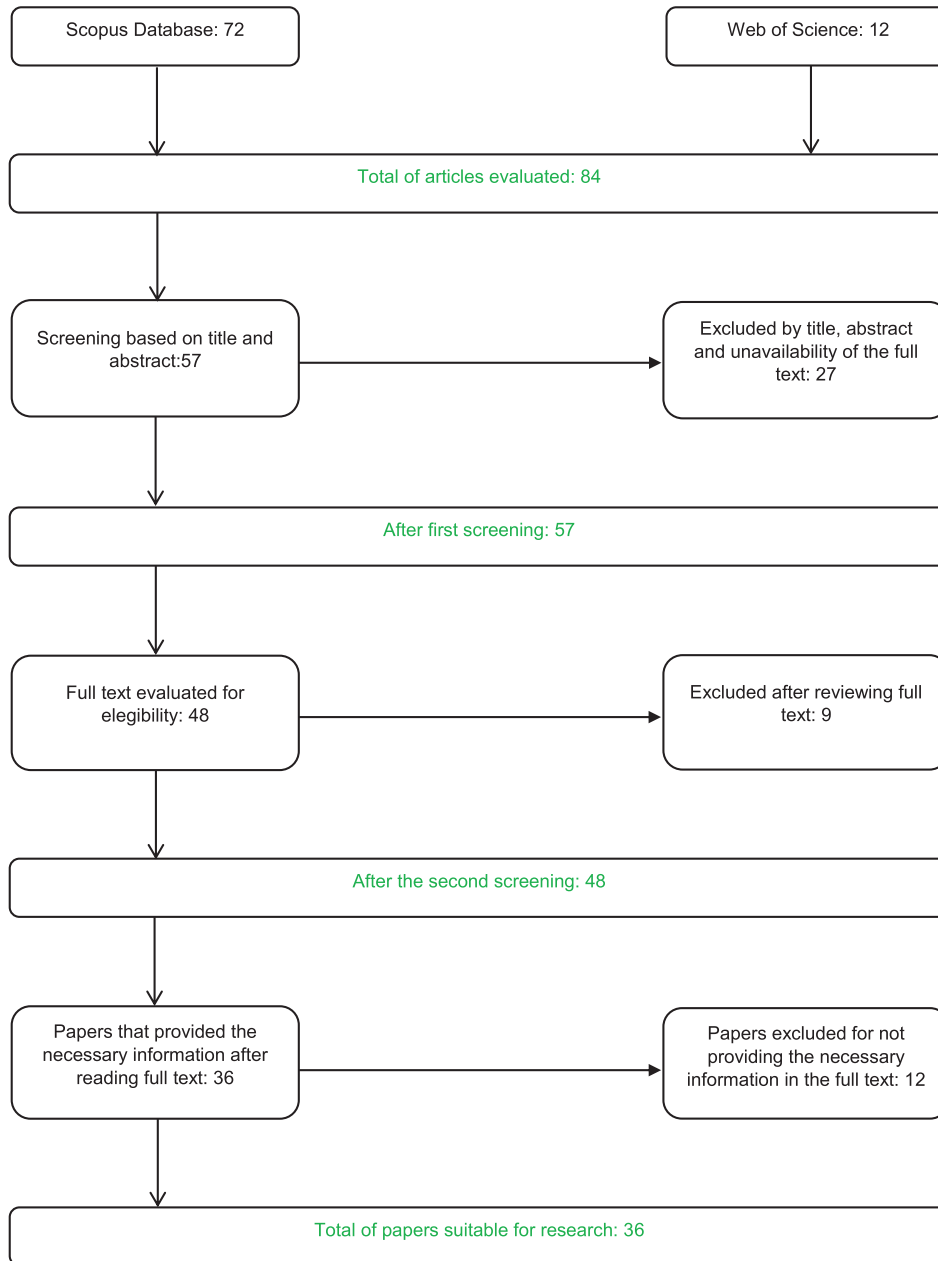
Fig. 1. Methodological course for selection of articles.

Titles and abstracts were independently reviewed by three different researchers. For this study, the Science Direct database was not analysed because it is indexed to Scopus. Google Academics was also not considered due to the authors' preference for peer-reviewed databases.

The present review has systematized the following indicators from the studies chosen for evaluation and which were available in the databases as a full text: authors, year of publication, periodical or conference proceedings, JCR (Journal Citation Report) and SJR (Scimago Journal Rank) of the journal or conference proceedings, summary, keywords, research methods, country in which the publication was developed, advantages and disadvantages of teleworking, in addition to providing a space for the reviewers who authored this study to make additional observations (sometimes the limitations of the studies analysed).

During the review process of the full texts, some studies were excluded because they did not meet the following indicators: (1) exposition of the advantages and disadvantages related to telework and (2) presentation of the research development location. It should be emphasized that the quality of the methodology was not a determining factor for the exclusion of studies returned by the research. At the end of the selection process, 36 scientific articles met the established requirements and were completely revised.

3. Results

Throughout the evaluation of the results acquired from the keywords presented in the methodology,

there was evidence that the discussion of ergonomics and telework is consolidated in the United States and Europe and a key subject of debate in prominent specialized journals that discuss engineering, psychology, and workers' health and safety. Figure 2 shows the countries in which the work of this systematic review was published.

It is possible to perceive a growing interest in research related to telework in Latin American countries, especially in Brazil; given that the conceptual changes about the different ways of work organization is related not only to changes in the dynamics of work aimed at increasing productivity, but also to the need of preserving the bonds between employees and employers, especially in Brazil wherein the labour law is strictly enforced in order to discipline this rela-
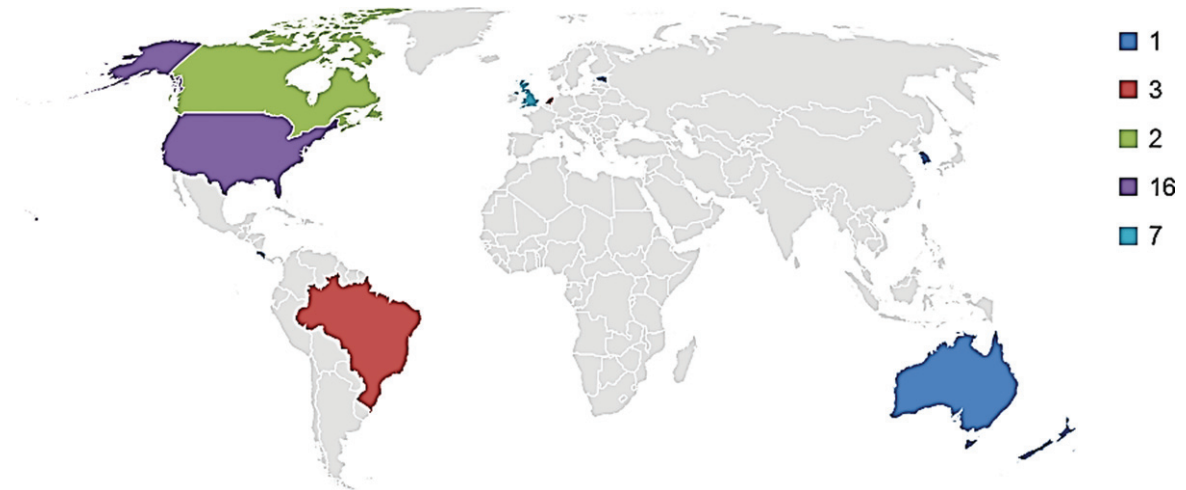
Fig. 2. Number of publications by countries (systematized articles).
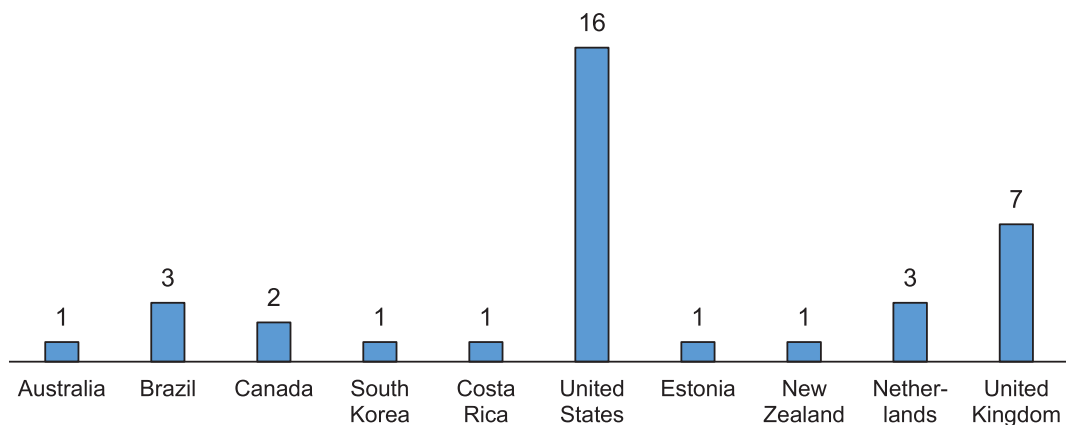
Fig. 3. Distribution by countries of publications systematized in the review.

tionship. In Fig. 4 it is possible to see a schematic representation of the main keywords that are related to the subjects mentioned and were identified in the databases.

The terms "telework", "telecommuting" and "ergonomics" are the ones with the greatest number of references. To a lesser extent, studies on "job satisfaction", "sociotechnical systems" and "flexible working" are also evidenced. As a result of this, it is possible to identify a convergence amongst specialists who study these issues on two interdependent points: a) the ever growing flexibility on labour relations imposed by the teleworking regime and b) the need of adequacy of work conditions, without alienating the worker from the perceived labour bonds.

Following such trend, conferences and qualified journals of high impact have been a breeding ground for scientific debate on the subject of the present review. Table 2 lists the journals and conferences whose articles are cited in the current work and their respective indicators. Figure 5 shows the journals that provided the evaluated works as complete texts for systematization and their respective citation frequencies in this study.

All the journals presented in Table 2 and Fig. 5 have a multidisciplinary scope, which reinforces the idea that there is a wide range of professionals and researchers interested in understanding telework and its implications. In Table 3, it is found a synthesis of the advantages and disadvantages identified in some of the works systematized in the present research. It could contribute to the scientific understanding of the consequences of adopting Telework, whether within the workers' professional or personal sphere.

4. Discussions

The discussion is centred on the use of protocols that assess the evaluation of the respondents' perception in relation to teleworking practices in tele-service organizations. The previously reported results suggest that part-time telecommuters experience better emotional and motivational outcomes on the days that they work from home than on the days when they work in the office.

Time flexibility and reduction of displacement and air pollution correspond to 30.51% of the mentioned advantages, this last convenience, besides bringing benefits to the employee who will avoid long distances and stress in traffic, contributes to the reduction of environemnet pollution, which is part of a socially responsible management practice. Isolation and conflict between work and family life correspond to 43.10%, of the cited disadvantages, being quoted
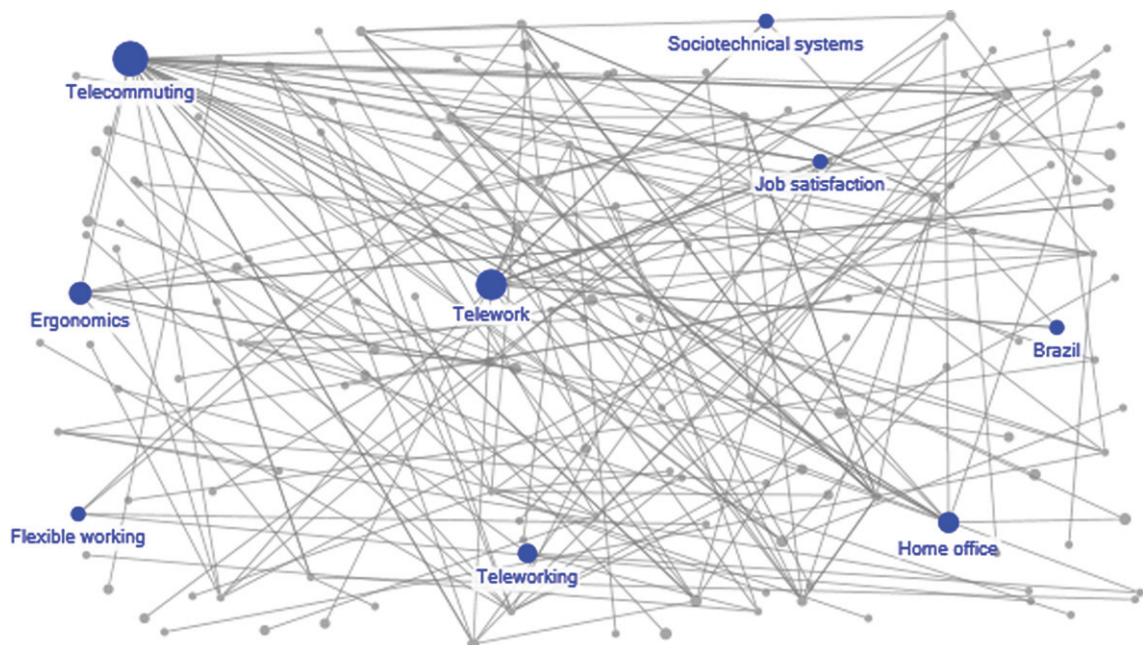

Fig. 4. Keywords found in the database research.

Table 2

Journal Citation Report and Scimago Journal Rank on the journals referred in the present review

| Journal and Conference Proceedings	JCR	SJR
Journal of Organizational Behaviour	4.229	3.15
Internet Research	3.868	1.64
European Journal of Cultural Studies	1.326	0.82
Academia Revista Latino Americana de Administración	–	0.18
Journal of Happiness Studies	1.986	0.83
Work – A Journal of Prevention, Assessment and Rehabilitation	0.902	0.53
Public Organization Review	–	0.36
The Psychologist-Manager Journal	–	0.35
Personnel Review	1.395	0.59
Journal of Organizational Behaviour	4.229	3.15
New Technology, Work and Employment	–	0.89
Canadian Public Administration/Administration Publique du Canada	0.786	0.34
Applied Ergonomics	2.435	1.07
Transportation Research Part A	3.026	1.94
Scientific Annals of Economics and Business	–	–
Revista de Administração Pública	–	0.29
Revista de Administração de Empresas	–	0.29
Caderno EBAPE	–	–
Facilities	–	0.5
Journal of Corporate Real Estate	–	0.37
Computers in Human Behaviour	3.536	1.55
Facilities	–	0.5
Journal of Vocational Behaviour	3.052	1.69
International Journal of Industrial Ergonomics	1.429	0.79
Journal of Safety Research	2.394	1.15
Proceedings of SPIE - The International Society for Optical Engineering	–	0.23
International Journal of Life Cycle Assessment	4.195	1.27
New Technology, Work and Employment	–	0.89
Environmental Science & Technology	6.653	2.54
Journal of Business and Technical Communication	0.75	0.87
International Journal of Manpower	0.661	0.36
Communications of the ACM	3.063	0.71
Information Management & Computer Security	–	–
Proceedings of ACM SIGCPR/SIGMIS- Conference on Computer Personnel Research	–	–
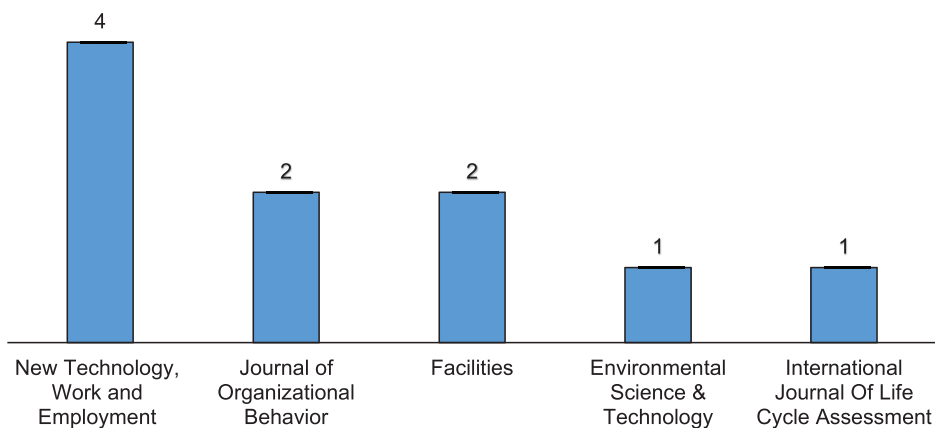
Fig. 5. The most cited journals in the systematic review (full papers).

virtually by all authors; amongst the observations presented; one way to avoid their occurence is to understand the worker's profile and the their needs, in order to be able to see if teleworking will be beneficial to the employee and, consequently, to the employer.

The teleworking situation reinforces the self-image of responsible, committed, independent and autonomous professionals/individuals; for the youngsters, it can also represent an opportunity for professional maturity. The reduction of direct

Table 3
Advantages and disadvantages of teleworking

Article	Advantages	Disadvantages
Telework: Conditions that have a positive and negative impact on the work-family conflict [16]	Individuals work on average 1.8 hours longer than the normal working time. They find less interference of the work active in the family nucleus and work fewer additional hours per week. Telecommuting improves the organization of the work rhythm avoiding conflicts of the individual with the family.	Little flexibility with schedule. Having other people at home during teleworking has a negative impact on the family's time and may exhaust teleworkers.
Are Women Happier When Their Spouse is Teleworker? [17]	Women are happier when they or their spouses are telecommuters, since there is allocation of housework. Teleworkers can contribute more to domestic chores, improving well-being.	Men who telecommute spend more time on household chores. Women are more likely to report that family responsibilities are shared, contributing to the possible decrease in the performance of the male telecommuter in their work activities.
Do Teleworkers Possess Higher Levels of Public Service Motivation? [18]	Federal workers who telecommuted frequently (work remotely 4 to 5 days per week) reported higher levels of PSM (Public Service Motivation). Frequent teleworkers reported high levels of PSM compared to those working less than 1 day per week.	Frequent telecommuters did not report higher PSM levels than telecommuting employees 2 to 3 days per week.
Overcoming Telework Challenges: Outcomes of Successful Telework Strategies [19]	Reduction of traffic problem and air pollution; Social benefits, draw of diversified workforce; higher productivity; less absenteeism; lower turnover rate; greater commitment and organizational performance; reduced indirect benefit costs and lower real estate costs.	The lack of face-to-face communication that contributes to the identification of non-verbal signals; Interdependence of teamwork, so there is a need for team members to be available to each other and coordinate in ways that generate overall team effectiveness; There is also the challenge of managing and monitoring the performance of the teleworker.
From anxiety to assurance: Concerns and outcomes of telework [20]	The teleworking experience is generally positive and that pre-telecommuting concerns have not materialized in the experience of teleworkers. This study shows that telecommuting can benefit both the employee and the employer in many ways.	Women telecommuters, especially those with dependent children or who spend more than 50% of their work hours at home, sales and telecommuters marketing. Were more likely to report the disadvantage of reduced visibility and career development as a result of telecommuting.
Teleworking: benefits and pitfalls as perceived by professionals and managers [21]	There are fewer distractions typical of the workplace. The house proved to be a better working environment than the office. Teleworkers get better performance because of their ability to work without interruptions. Teleworker experience more satisfaction and less stress.	Teleworking may not be practical for many forms of production where physical presence is necessary for effort coordination. Teleworking has possible disadvantages and problems in the individual society relationship, such as isolation and exclusion of teleworkers from other members of society. Communication factors such as body language, gestures may not be present, impairing communication efficiency.
When control becomes a liability rather than an asset: Comparing home and office days among part-time teleworkers [22]	Improvement in emotional and motivational results such as: increased concentration, reduced stress, and job satisfaction.	The beneficial effect of working at home on the need for recovery is reversed, and the days at home are no longer relaxed.
Social support in the workplace between teleworkers, office-based colleagues and supervisors [23]	Escape route for employees who did not like the social environment of the office. Moving away from negative or non-essential relationships, developing interactions with other teleworkers. Groups that do not identify themselves are avoided.	To fully understand the way in which teleworkers perform their work, it is necessary to take into account the complex, dynamic and evolutionary relationship between teleworkers, their managers and colleagues-based office.
Remixing work, family and leisure: teleworkers' experiences of everyday life [24]	For some teleworkers, leisure time was facilitated by temporal flexibility and relative freedom of monitoring and supervision, since they completed assigned tasks and billable hours.	Teleworking had little effect on the reorganization of the sex distribution of domestic tasks. For many of the women, and especially for those with children at home, personal leisure has been diminished or unchanged.

(*Continued*)

Table 3
(*Continued*)

Does teleworking affect managing for results and constructive feedback? A research note [25]	Teleworkers were no less likely to receive feedback than non-teleworkers. Frequent telecommuters were neither more nor less likely to receive constructive feedback.	Research has suggested that constructive feedback is given to "teleworkers" through information technology and, as a result, does not have the same richness as feedback given in conventional work contexts, and may lead to misinterpretations.
Telework: When Your Job is on the Line [26]	Teleworker support was perceived as a positive influence on satisfaction and reduction of stress. Receiving only minimal specific support for telecommuting suggests that it is very influential and important for the effectiveness of telecommuting.	The negative effects are observed where the intensity of telecommuting exceeds two or three days per week, such as social isolation and stress level.
The role of organisational support in teleworker wellbeing: A socio-technical systems approach [27]	The weekly traveling times of domestic teleworkers are 15 minutes shorter than for non-teleworkers. For individuals working at home three or more times per week this result appears to be driven by substantially shorter weekly travel times (approximately 60 min).	Teleworking can be effective by reducing commuting, but only for very high teleworking frequencies (more than 3 days per week).
Home telework and household commuting patterns in Great Britain [28]	With remarkable experience, the workplace becomes less important. The employer can provide information on telecommuting and favour the decision, allowing telework, which in turn helps to prolong the employment of senior specialists.	Some people feel more stress with telecommuting. Importance of meeting others face to face with different experiences to transfer knowledge. Keeping older employees in work activities requires advanced ICT learning programs.
Impact of Telework on the Perceived work Environment of older workers [7]	Self-image of responsible, committed, independent and autonomous professionals. Professional maturation for younger. Reduction of direct supervision, support / infrastructure of the organization. Greater autonomy, responsibility, opportunity to show professional competence.	Hours worked in excess, transfer of costs, isolation and invasion of the family space.
Teletrabalho: subjugação e construção de subjetividades [29]	Flexible schedules and avoid commuting to work. More pleasant work environment, increased productivity and reduced amount of time.	Discontentment over supervision and trainings of time management, organization, computer systems and communication. Isolation, risk of overwork, difficulty in self-motivation, and conflict between work and family life.
Organização e satisfação no contexto do teletrabalho [30]	Less need for displacement, distraction and cost; greater freedom and flexibility; better working environment; freedom to choose clothes; ease to perform household chores. Better quality of life; activities of personal interest.	Isolation; increased working hours; lack of support; impossibility of absence due to illness; difficulty in career progression; raising and transferring costs with energy and domestic infrastructure and other resources previously available in the office.
Percepções dos indivíduos sobre as consequências do teletrabalho na configuração home-office: estudo de caso na Shell Brasil [31]	Productivity, Effectiveness. Retention, Reduction of stress, decreased displacement, Less absenteeism, Freedom, Family interaction, Greater personal control.	Isolation; Loss of team feedback and technical support; Difficult to provide training, control, monitoring and support. Tension in the home environment; Coping alone with technical problems; Inadequate for organizations that need social interaction.
Teleworking: an assessment of socio-psychological factors [32]	Higher concentration, lower interruptions at home; More productivity and reduced working time; Greater autonomy of the worker; Reduction of traffic congestion, displacement and time; Flexibility with working time and private life.	Feeling of never being free because of work and private life, and difficulty in reconciling them properly. You may lose contact with co-workers. Limited liaison with the organization; Increase workload for telecommuters.
Tomorrow's offices through today's eyes: Effects of innovation in the working environment [33]	Flexibility, autonomy, family environment, quality of life, saves the commuting of great distances.	Personal isolation due to the flexibility and autonomy of the worker; Less time for interaction. Lack of an efficient management model for workers.
An approach of multidisciplinary criteria for modeling alternatives of flexible working [34]	Higher level of job satisfaction, support for work-personal life balance. Flexibility for people with limiting physical condition. Home officing reduces time spent dislocating.	Occurrence of numerous social interactions can result in limited periods of undisturbed time. Family distractions, limitations in technology and house size. Professional isolation, distinction between private time and working time.

(*Continued*)

Table 3
(*Continued*)

Places for multi-locational work – opportunities for facilities management [35]	Reducing costs, increasing work performance, job satisfaction and motivation, increasing job retention, improving stress caused by workload and increased career opportunities.	Propensity to mix employment with housework. Flexibility can have organizational and personal implications. Negative impact on social networks, decrease in teamwork and resentment on the part of those who do not telework.
Does it matter where you work? A comparison of how three work venues (traditional office, virtual office, and home office) influence aspects of work and personal/family life [36]	Increased availability of medical / hospital practice spaces, quality of life and increased employee satisfaction. Even with cost due to setting up a home office, you can globally reduce space costs and utilities.	Survey of questions about employers' liability in these work environments. OSHA will not conduct inspections at the employee's home offices, won't hold employers responsible or expect them to conduct an inspection in the workplace.
Ergonomics concerns and the impact of healthcare information technology [37]	Reduction of time and travel to work; Greater interaction with the family; Decision making due to preference in working alone; Flexibility of schedules.	Inadequate home space; adoption of inappropriate posture; Complaints like sore / tired eyes / pain in the neck and sore wrists are common. Reports of a higher incidence of work-related discomfort.
The effects of ergonomics training on the knowledge, attitudes, and practices of teleworkers [38]	Productivity increase; Employee retention; Absenteeism and expenses can be reduced; Reduction of transportation costs; Monetary benefits for society with telework programs; Possibility to work even when you are sick.	As companies reduce their expenses, employee-related costs go up. However, when accounting for the decrease in transportation-related costs, favourable savings can be observed for the employee as well.
External air pollution costs of telework [39]	Reduction of operational costs of organizations; Flexible working hours; New job opportunities with the help of internet connection.	Decreased teamwork; Increased susceptibility to diseases because they spend a lot of time at home; Teleworking is often confused with similar work arrangements.
Three generations of Telework: New ICTs and the (R)evolution from Home Office to Virtual Office [40]	Variability in working hours; Reduction of the environmental impacts related to transportation and travel on days of telecommuting.	Domestic impacts increase significantly offsetting the reduced impacts on the company. The relative contribution of each component is different for the two types of pollutants and can vary from one to the other with the effect of telecommuting.
Energy-Related Emissions from Telework [41]	Work flexibility, collaborating electronically and running your business with mobile phones and laptops. You can join people from the same area to discuss topics. Interaction, feedback, trust, references, learning, collaboration.	The freedom to work anywhere often means isolation, inability to build trust and relationships with others, and opportunities for collaboration and networking.
Working Alone Together: Coworking as Emergent Collaborative Activity [42]	Possibility of working for older professionals, women with young children or workers with disabilities and whose verbal language is slow and difficult to understand. More egalitarian and diversified workplace.	Isolation; Need for computational and creative problem-solving skills; More efforts to promote older workers in this role.

supervision, as well as the supporting infrastructure provided by the organization result in more autonomy, increased responsibility and further opportunities to demonstrate performance and value.

Flexible working hours and the possibility of avoiding commuting have a positive influence on the balance between family and work life. The results of our review show that work intensified, but this is done in a more pleasant environment, which helps to increase productivity.

Notably, amongst workers with high levels of control of working time, labour requires a higher degree of concentration and may be associated with a greater need for recovery on home office days, as well as on working days. As a result of this, the beneficial effect of working at home on the need for recovery is reversed, and the days at home are no longer relaxing. An ideal level of control of working time on days at home may prove to be more effective in buffering the effect of labour demand. Overall, the articles consulted suggest that employers should consider the conditions under which the benefits of part-time telecommuting can be maximized.

Criticisms of teleworking are basically directed at the excess of working hours without considering the mental load of work, the transfer of costs, the isolation of the workers and the impact on their social life and the question of the invasion of family space by work.

The discourse of entrepreneurship itself, according to the authors consulted, is able to accommodate the issues of overwork and cost transfer.

The current research present two main limitations: (1) Notwithstanding the pacific points on the scientific literature about the positive and negative aspects of teleworking, it seems that there are an almost unlimited number of factors that may change research results on this subject such as economic, social, psychological, cultural, technological and biological. Workers and organizations may react very differently to teleworking based on those factors, rendering generalizations as mere rhetorical mechanisms. For instance, the very relationship that remote workers have with their families may, to a certain extent, dictate if their remote working experience is positive or not, which is beyond the scope of any ergonomic study. (2) With the current pressures on remote work and social distancing placed by the Corona Virus pandemic, it is impossible to evaluate as of now if any likely changes will be a reflex of contingencies that should be reversed once society goes back to a normal state, or if the transformations will be deeper and, thereby, permanent; changing the very paradigms that guide our basic understanding about remote work.

The COVID-19 outbreak may be a force for permanent change on telework and overall work relations as much as other mega forces such as technological disruptions in communication and the very globalization of the economy.

5. Conclusions

Future research can explore the impact of telecommuting in other areas of life, including health, job satisfaction, job performance, operational cost reductions for both workers and organizations, social and ecological impact. The present study showed that telecommuting can be a valuable – yet not infallible – tool for balancing work and family life, which helps to allocate work more evenly to couples and improves their well-being. However, it is necessary more in-depth future researches on the topic, considering personal, business and social spheres.

Acknowledgments

Conflict of interest

None to report.

References

[1] Falzon P. Ergonomia. São Paulo: Editora Edgar Blucher; 2007.

[2] De Croon E, Sluiter J, Kuijer PP, Frings-Dresen M. The effect of office concepts on worker health and performance: a systematic review of the literature. Ergonomics [Internet]. 2005;48(2):119-34. Available from: https://www.tandfonline.com/doi/full/10.1080/00140130512331319409

[3] Carayon P, Smith MJ. Work organization and ergonomics. Appl Ergon [Internet]. 2000;31(6):649-62. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0003687000000405

[4] Melo PC, de Abreu e Silva J. Home telework and household commuting patterns in Great Britain. Transp Res Part A Policy Pract [Internet]. 2017;103:1-24. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0965856416300283

[5] Gajendran RS, Harrison DA. The good, the bad, and the unknown about telecommuting: Meta-analysis of psychological mediators and individual consequences. J Appl Psychol [Internet]. 2007;92(6):1524-41. Available from: http://doi.apa.org/getdoi.cfm?doi=10.1037/0021-9010.92.6.1524

[6] Hunton JE, Norman CS. The Impact of Alternative Telework Arrangements on Organizational Commitment: Insights from a Longitudinal Field Experiment. J Inf Syst [Internet]. 2010;24(1):67-90. Available from: http://aaajournals.org/doi/10.2308/jis.2010.24.1.67

[7] Arvola R, Tint P, Kristjuhan Ü, Siirak V. Impact of Telework On the Perceived Work Environment of Older Workers. Sci Ann Econ Bus [Internet]. 2017;64(2):199-214. Available from: http://content.sciendo.com/view/journals/saeb/64/2/article-p199.xml

[8] Bentley TA, Teo STT, McLeod L, Tan F, Bosua R, Gloet M. The role of organisational support in teleworker well-being: A socio-technical systems approach. Appl Ergon [Internet]. Elsevier Ltd; 2016;52:207-15. Available from: http://dx.doi.org/10.1016/j.apergo.2015.07.019

[9] Caillier JG. Do Teleworkers Possess Higher Levels of Public Service Motivation? Public Organ Rev [Internet]. 2016;16(4):461-76. Available from: http://dx.doi.org/10.1007/s11115-015-0318-y

[10] Shariat A, Cardoso JR, Cleland JA, Danaee M, Ansari NN, Kargarfard M, et al. Prevalence rate of neck, shoulder and lower back pain in association with age, body mass index and gender among Malaysian office workers. Work [Internet]. 2018;60(2):191-9. Available from: https://www.medra.org/servlet/aliasResolver?alias=iospress&doi=10.3233/WOR-182738

[11] Ma CC, Gu JK, Charles LE, Andrew ME, Dong RG, Burchfiel CM. Work-related upper extremity musculoskeletal disorders in the United States: 2006, 2009, and 2014 National Health Interview Survey. Work [Internet]. 2018;60(4):623-34. Available from: https://www.medra.org/servlet/aliasResolver?alias=iospress&doi=10.3233/WOR-182770

[12] Singh H, Singh LP. Musculoskeletal disorders among insurance office employees: A case study. Work [Internet].

2019;64(1):153-60. Available from: https://www.medra.org/servlet/aliasResolver?alias=iospress&doi=10.3233/WOR-192978

[13] Cherns A. Perspectives on the quality of working life. J Occup Psychol [Internet]. 1975;48(3):155-67. Available from: http://doi.wiley.com/10.1111/j.2044-8325.1975.tb00311.x

[14] Davis AG, Strong PM. Working without a Net: The Bachelor as a Social Problem. Sociol Rev [Internet]. 1977;25(1):109-30. Available from: http://journals.sagepub.com/doi/10.1111/j.1467-954X.1977.tb00281.x

[15] Cummings TG, Worley CG. Organization development and change. Mason, OH: Thomson South-Western; 2005.

[16] Solís MS. Telework: conditions that have a positive and negative impact on the work-family conflict. Acad Rev Latinoam Adm [Internet]. 2016;29(4):435-49. Available from: https://www.emerald.com/insight/content/doi/10.1108/ARLA-10-2015-0289/full/html

[17] Giovanis E. Are Women Happier When Their Spouse is Teleworker? J Happiness Stud [Internet]. 2018;19(3):719-54. Available from: http://link.springer.com/10.1007/s10902-017-9847-0

[18] Caillier JG. Do Teleworkers Possess Higher Levels of Public Service Motivation? Public Organ Rev [Internet]. 2016;16(4):461-76. Available from: http://dx.doi.org/10.1007/s11115-015-0318-y

[19] Greer TW, Payne SC. Overcoming telework challenges: Outcomes of successful telework strategies. Psychol J [Internet]. 2014;17(2):87-111. Available from: http://doi.apa.org/getdoi.cfm?doi=10.1037/mgr0000014

[20] Maruyama T, Tietze S. From anxiety to assurance: concerns and outcomes of telework. Pers Rev [Internet]. 2012;41(4):450-69. Available from: http://www.emeraldinsight.com/doi/10.1108/00483481211229375

[21] Baruch Y. Teleworking: benefits and pitfalls as perceived by professionals and managers. New Technol Work Employ [Internet]. 2000;15(1):34-49. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/1468-005X.00063

[22] Biron M, van Veldhoven M. When control becomes a liability rather than an asset: Comparing home and office days among part-time teleworkers. J Organ Behav [Internet]. 2016;37(8):1317-37. Available from: http://doi.wiley.com/10.1002/job.2106

[23] Collins AM, Hislop D, Cartwright S. Social support in the workplace between teleworkers, office-based colleagues and supervisors. New Technol Work Employ [Internet]. 2016;31(2):161-75. Available from: http://doi.wiley.com/10.1111/ntwe.12065

[24] Hilbrecht M, Shaw SM, Johnson LC, Andrey J. Remixing work, family and leisure: teleworkers' experiences of everyday life. New Technol Work Employ [Internet]. 2013;28(2):130-44. Available from: http://doi.wiley.com/10.1111/ntwe.12010

[25] Caillier JG. Does teleworking affect managing for results and constructive feedback? A research note. Can Public Adm [Internet]. 2013;56(4):638-54. Available from: http://doi.wiley.com/10.1111/capa.12043

[26] Scholtz JC. Telework: When your job is on the line. In: CHI '97 extended abstracts on Human factors in computing systems looking to the future - CHI '97 [Internet]. New York, New York, USA: ACM Press; 1997. p. 107. Available from: http://portal.acm.org/citation.cfm?id=268986.268992

[27] Bentley TA, Teo STT, McLeod L, Tan F, Bosua R, Gloet M. The role of organisational support in teleworker well-being: A socio-technical systems approach. Appl Ergon [Internet]. 2016;52:207-15. Available from: http://dx.doi.org/10.1016/j.apergo.2015.07.019

[28] Melo PC, de Abreu e Silva J. Home telework and household commuting patterns in Great Britain. Transp Res Part A Policy Pract [Internet]. 2017 Sep;103:1-24. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0965856416300283

[29] Costa ISA. Teletrabalho: subjugação e construção de subjetividades. Rev Adm Pública [Internet]. 2007;41(1):105-24. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-76122007000100007&lng=pt&tlng=pt

[30] Tremblay D-G. Organização e satisfação no contexto do teletrabalho. Rev Adm Empres [Internet]. 2002;42(3):54-65. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0890623812000706

[31] Barros AM, Silva JRG da. Percepções dos indivíduos sobre as consequências do teletrabalho na configuração home-office: estudo de caso na Shell Brasil. Cad EBAPEBR [Internet]. 2010;8(1):71-91. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1679-39512010000100006&lng=pt&tlng=pt

[32] Ward N, Shabha G. Teleworking: an assessment of socio-psychological factors. Facilities [Internet]. 2001;19(1/2):61-71. Available from: https://www.emeraldinsight.com/doi/10.1108/02632770110362811

[33] Vos P, van der Voordt T. Tomorrow's offices through today's eyes: Effects of innovation in the working environment. J Corp Real Estate [Internet]. 2002;4(1):48-65. Available from: https://www.emerald.com/insight/content/doi/10.1108/14630010210811778/full/html

[34] Vasconcelos P, Furtado E, Pinheiro PR. An approach of multidisciplinary criteria for modeling alternatives of flexible working. Comput Human Behav [Internet]. 2015;51:1054-60. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0747563215002976

[35] Kojo IVI, Nenonen S. Places for multi-locational work - opportunities for facilities management. Facilities [Internet]. 2015;33(1/2):20-37. Available from: https://www.emerald.com/insight/content/doi/10.1108/F-05-2013-0043/full/html

[36] Hill EJ, Ferris M, Märtinson V. Does it matter where you work? A comparison of how three work venues (traditional office, virtual office, and home office) influence aspects of work and personal/family life. J Vocat Behav [Internet]. 2003;63(2):220-41. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0001879103000423

[37] Hedge A, James T, Pavlovic-Veselinovic S. Ergonomics concerns and the impact of healthcare information technology. Int J Ind Ergon [Internet]. 2011;41(4):345-51. Available from: http://dx.doi.org/10.1016/j.ergon.2011.02.002

[38] Harrington SS, Walker BL. The effects of ergonomics training on the knowledge, attitudes, and practices of teleworkers. J Safety Res [Internet]. 2004;35(1):13-22. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0022437503000859

[39] Kitou E, Horvath A. External air pollution costs of telework. Int J Life Cycle Assess [Internet]. 2008;13(2):155-65. Available from: http://link.springer.com/10.1065/lca2007.06.338

[40] Messenger JC, Gschwind L. Three generations of Telework: New ICTs and the (R)evolution from Home Office to Virtual Office: Discovery Service para Universidad ICESI. 2016;195-208. Available from: http://eds.a.ebscohost.com/eds/pdfviewer/pdfviewer?vid=9&sid=1a4962f5-aea5-4135-8b5b-9696c32f466b%40sessionmgr4008

[41] Kitou E, Horvath A. Energy-Related Emissions from Telework. Environ Sci Technol [Internet]. 2003;37(16): 3467-75. Available from: https://pubs.acs.org/doi/10.1021/es025849p

[42] Spinuzzi C. Working Alone Together. J Bus Tech Commun [Internet]. 2012;26(4):399-441. Available from: http://journals.sagepub.com/doi/10.1177/1050651912444070