Medicina y Seguridad del Trabajo (Internet)
https://revistas.isciii.es/revistas.jsp?id=MST

E-ISSN: 1989-7790
NIPO: 156240044

doi: 10.4321/s0465-546x2025000100005
Review Article

Effects of teleworking on workers' health: A systematic review

Efectos del teletrabajo en la salud de los trabajadores: una revisión sistemática

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Received: 18.02.2025
Accepted: 18.03.2025
Published: 31.03.2025

Authorship contribution

Conceptualization, I.M.G. and B.C.P.; methodology, I.M.G., B.C.P. and L.V.O., L.V.O. contribu-tion was only to be the tie breaker in the face of discrepancies of inclusion between the two main authors; validation, I.M.G. and B.C.P.; formal analysis, I.M.G. and B.C.P.; investigation, I.M.G. and B.C.P.; resources, I.M.G. and B.C.P.; data curation, I.M.G. and B.C.P.; writing—original draft preparation, I.M.G. and B.C.P.; writing—review and editing, I.M.G. and B.C.P.; visu-alization, I.M.G. and B.C.P.; supervision, I.M.G. and B.C.P.; project administration, I.M.G. and B.C.P. All authors have read and agreed to the published version of the manuscript.

Funding

This work did not receive any funding.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgment

We would like to thank Professor Dr. Alejandro Fernández Montero for encouraging us to con-tinue researching and Dr. Francisco Javier Sanz Valero for his corrections and recommendations regarding the methodology of systematic reviews. Finally, we would like to thank the Asociación Española de Especialistas de Medicina del Trabajo for the opportunity to present a poster derived from this work at the "I Congreso Internacional y XII Congreso Nacional de Medicina y Enfermería del Trabajo" (2022).

How to cite

Martínez Gárate I, Casal Pardo B, Valdés del Olmo L. Effects of teleworking on workers' health: A systematic review. Med Segur Trab (Internet). 2025;71(278):56-69. doi: 10.4321/s0465-546x2025000100005

https://doi.org/10.4321/s0465-546x2025000100005

Resumen

Introducción: El teletrabajo es una modalidad laboral emergente. En la actualidad, el 24% de la población lo realiza, lo que lo convierte en un modelo de trabajo cada vez más común con características y efectos únicos sobre la salud de los trabajadores.

Método: La literatura científica recuperada fue sometida a revisión sistemática a partir de las bases de datos Cochrane Library, EMBASE, MEDLINE (vía PubMed), Índice Bibliográfico Español en Ciencias de la Salud, Literatura Latinoamericana y del Caribe en Ciencias de la Salud, Medicina en Español, SCOPUS e Institute for Scientific Information-Web of Knowledge. Como descriptores se buscaron «teletrabajo», «ocupacional, grupos» y «salud, ocupacional» en el título, resumen y palabras clave. Los límites fueron los siguientes: 'humanos', 'adultos' y artículos originales.

Resultados: Se encontraron un total de 4.835 referencias. Tras aplicar los criterios de inclusión/exclusión, se seleccionaron 24 artículos: 15 son estudios transversales y nueve son estudios prospectivos de cohortes. La puntuación media de Strengthening the Reporting of Observational Studies in Epidemiology fue de 18,55.Los criterios de la Scottish Intercollegiate Guidelines Network arrojaron un grado de evidencia de 3 y una recomendación de D. La obsolescencia de las publicaciones fue moderada (semiperiodo Burton-Kebler: 3,00; índice de precios: 87,50%).

Conclusiones: Los artículos revisados presentaron un índice de obsolescencia adecuado. Sin embargo, sus grados de evidencia y recomendación impidieron de forma exhaustiva, asegurar la validez y fiabilidad de las observaciones realizadas. Existe una asociación entre el teletrabajo y los efectos sobre la salud física y mental, incluyendo mayores niveles de estrés, mala salud mental, mayor prevalencia de trastornos musculoesqueléticos y problemas visuales.

Palabras clave: teletrabajo; revisión sistemática; salud laboral.

Abstract

Introduction: Teleworking is an emerging working modality. At present, 24% of the population engages in it, making it an increasingly common work model with unique characteristics and effects on workers' health.

Method: The retrieved scientific literature was submitted for systematic review from the databases Cochrane Library, EMBASE, MEDLINE (via PubMed), Índice Bibliográfico Español en Ciencias de la Salud, Latin American and Caribbean Health Science Literature, Medicina en Español, SCOPUS and Institute for Scientific Information-Web of Knowledge. As descriptors, 'teleworking', 'occupational, groups' and 'health, occupational' were searched in the title, abstract and keywords. The limits were as follows: 'humans', 'adult' and original articles.

Results: A total of 4,835 references were found. After applying inclusion/exclusion criteria, 24 articles were selected: 15 are cross-sectional studies and nine are prospective cohort studies. The mean Strengthening the Reporting of Observational Studies in Epidemiology score was 18.55. The Scottish Intercollegiate Guidelines Network criteria yielded a degree of evidence of 3 and a recommendation of D. The obsolescence of publications was moderate (Burton–Kebler semiperiod: 3.00; price index: 87.50%).

Conclusions: The articles review presented an adequate obsolescence rate. However, their degrees of evidence and recommendation impeded thoroughly, ensuring the validity and reliability of the observations made. There is an association between teleworking and physical and mental health effects, including higher stress levels, poor mental health, higher prevalence of musculoskeletal disorders and visual problems.

Keywords: teleworking; systematic review; occupational health.

https://doi.org/10.4321/s0465-546x2025000100005

Introduction

Telecommuting is the use of information and communication technology to work outside of the workplace. It often refers to the performance of work activity from the worker's private home[1].

Teleworking is considered to be an effective method to avoid interruptions of work activity and carry it through. It enables contracting companies to continue operations in the face of extreme weather events, terrorist attacks or pandemics that prevent workers from returning to their usual workplace. However, the particularities of teleworking require a prior agreement between employer and employee, as well as specific regulations.

According to the Statistical Office of the European Union (Eurostat), the estimated prevalence of teleworking among the active European working population was 5.8% as of December 2019[2]. The World Health Organization declared the beginning of a global pandemic of Sars-CoV2, a novel coronavirus, in early 2020. To address this crisis, the health authorities imposed mandatory confinement, except in primary sectors. Consequently, global companies were obliged to increase teleworking as a source of employment to sustain operations. In this context, the prevalence of teleworking increased, accounting for up to 50% of the active population, according to the Statistical Office of the European Union (Eurostat)[2].

After the end of the confinement, many workers continued to telework. Due to the pandemic, approximately 12.7% of workers in Europe teleworked regularly in 2021[2].

Hence, this study aims to analyse the current scientific literature on the impact of teleworking on workers' physical and mental health to conduct timely and focused monitoring of teleworkers' health and to identify areas where future research may be advantageous.

Methods

The retrieved articles were subjected to a methodical and critical analysis of the scientific literature.

Each database was searched from 1st December 2021 to 16th December 2022 (time of the latest update).

No search was conducted in the reference list of the recaptured studies to reduce the number of unincluded records.

The structure is based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) verification guide for systematic reviews[3,4].

All data were obtained by accessing the following databases on the Internet: Cochrane Library, EMBASE, MEDLINE (via PubMed), Índice Bibliográfico Español en Ciencias de la Salud (IBECS), Institute for Scientific Information (ISI)-Web of Science, Latin American and Caribbean Health Science Literature (LILACS), Medicina en Español (MEDES) and SCOPUS. Papers from PubMed Central were excluded to avoid articles pending publication.

The Thesaurus of Health Sciences Descriptors (DeCS) developed by the Latin American and Caribbean Centre for Information in Medical Sciences (BIREME) and its equivalence with the National Library of Medicine, the Medical Subject Headings (MeSH) and the bibliographic database EMBASE, were used to establish the search keywords.

The ultimate search equation for the MEDLINE database was developed by combining the three equations suggested for population, intervention and result using the Boolean connector 'AND'.

Population: '((“occupational groups”[MeSH]) OR (“occupational groups”[Title/Abstract]) OR (“occupational groups”[MeSH]) OR (“occupational groups”[Title/Abstract]) OR (“worker”[Title/Abstract]) OR (“workers”[Title/Abstract]) OR (“staff”[Title/Abstract]) OR (“employee”[Title/Abstract]) OR (“employees”[Title/Abstract]) OR (“labourer”[Title/Abstract]) OR (“labourer”[Title/Abstract]) OR (“personnel”[Title/Abstract]) NOT “minors”[MeSH] NOT “minors”[Title/Abstract] NOT “child”[MeSH] NOT “adolescent”[MeSH] NOT “child”[Title/Abstract] NOT “adolescent”[Title/Abstract] NOT “children”[Title/

Abstract] NOT “adolescents”[Title/Abstract] NOT “juvenile”[Title/Abstract] NOT (“animals”[MeSH] NOT “humans”[MeSH]) NOT (“animals”[Title/Abstract] NOT “humans”[Title/Abstract]))’

Intervention: ‘(“telecommuting”[Title/Abstract] OR “remote employment”[Title/Abstract] OR “remote job”[Title/Abstract] OR “remote work”[Title/Abstract] OR “remote working”[Title/Abstract] OR “telework”[Title/Abstract] OR “teleworking”[Title/Abstract] OR “telework”[Title/Abstract] OR “teleworking”[Title/Abstract] “teleworking”[MeSH] OR “working remotely”[Title/Abstract] OR “work from anywhere”[Title/Abstract] OR “telecommute”[Title/Abstract] OR “telecommuter”[Title/Abstract])’

Outcome: ‘(“health”[MeSH Terms] OR “health”[Title/Abstract] OR “healthful”[Title/Abstract] OR “healthfulness”[Title/Abstract])’

The following filters (limits) were used: ‘MEDLINE’, ‘human’ and ‘adult’.

This equation was then applied to the other databases that were consulted, resulting in identical equations and filters.

The inclusion criteria of the study included original observational articles and relevant studies with comprehensive text, Figure 1.

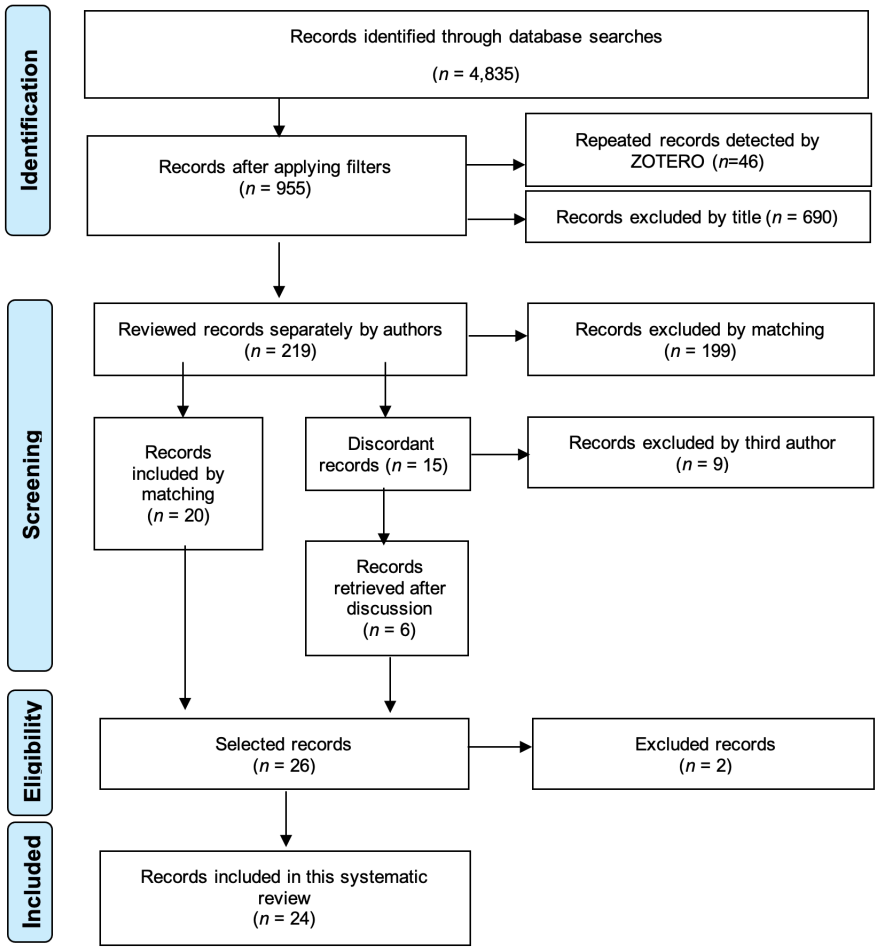

Figure 1. Flowchart of the identification and selection of articles

The exclusion criteria of the study included original papers (books, compilations and systematic reviews), articles that did not focus on the effects of teleworking on workers' health, studies with participants under the age of 18 years, duplicate articles in different databases or articles whose full text could not be revealed.

The articles were selected individually by the first and second authors, who then shared, compared and discussed their decisions. To consider the process valid, the concordance between them (Kappa index) has to be more than 0.60[5]. Discrepancies would be resolved by the third author if this criterion was met.

The first author, the year and country of publication, the design, the country where the study was conducted, the target population, the number of participants, the exposure period and duration, the measurement of the intervention and the exposure effect, other collected variables, results, conclusions and limitations were considered when organizing the articles.

The quality of the retrieved articles was assessed using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) criteria for reporting observational studies, which include 22 critical control points[6]. For each selected article, '1' or '0' points were assigned depending on whether it was present. If not applicable (NA), no score was assigned. When several points composed an item, they were evaluated independently, assigning the same weight to each one and calculating the average as the final score for that item. The total score may not exceed one point per ítem, Table 1.

The recommendations of the Scottish Intercollegiate Guidelines Network Grading Review Group (SIGN) [7] were used to objectively assess the degree of evidence and its level of commendation.

Table 1: STROBE punctuation of the reviewed studies.

Article (Reference)	Questionnaire score[b]																							
Author	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**TOTAL**	**%b**
Bertino *et al.*[8]	1	1	1	1	1	1	1	1	1	1	1	0.5	NA	0.5	1	0	1	1	1	1	1	0	18	86
El Kadri Filho *et al.*[9]	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	0	19	86
Elbogen *et al.*[10]	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	19	86
García–Salirrosas and Sánchez–Poma[11]	1	1	1	1	1	1	1	1	1	1	1	0	NA	0.5	1	0.3	0	1	0	1	0	1	15.8	75
Ghislieri *et al*[12]	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	0	1	19	86
Hallman *et al.*[13]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	1	19	86
Hao *et al.*[14]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	20	91
Izdebski and Manzur[15]	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	19	86
Kubo *et al.*[16]	1	1	0.5	1	1	1	1	1	1	1	1	1	NA	1	1	1	1	1	1	1	0	1	19.5	93

Article (Reference)	Questionnaire score[b]																							
Author	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	TOTAL	%b
Lundberg and Lindfors[17]	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	0	0	18	82
Miyake *et al.*[18]	1	1	1	1	1	1	1	1	1	1	1	0.6	1	0.5	1	0	1	1	1	1	1	1	20.1	91
Molino *et al.*[19]	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	20	91
Niu *et al.*[20]	1	1	1	1	1	0	1	1	0	0	1	1	1	1	1	1	1	0	1	1	0	1	17	77
Palma–Vasques *et al.*[21]	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	0	1	19	86
Pelissier *et al.*[22]	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	0	1	19	86
Peña Tellez *et al.*[23]	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	0	0	1	0	1	0	16	73
Perelman *et al.*[24]	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	19	86
Pirzadeh and Lingard[25]	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	0	0	1	18	82
Spinks[26]	1	1	1	1	1	1	1	0	0	1	1	0	1	1	1	1	0	1	0	0	1	1	16	73
Tolland and Drysdale[27]	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	19	86
Van Zoonen and Sivunen[28]	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	19	86
Widar *et al.*[29]	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	20	911
Wörhrmann and Ebner[30]	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	21	95
Zalat and Bolbol(31[]	1	1	1	1	1	1	1	0	1	0	1	0.4	NA	1	1	0.3	0	1	1	1	0	1	15.7	75

[a]0 = does not meet the item or any of its parts; 1 = fulfils the item in its entirety; 0 to 1 = partially fulfils the item; NA: Not applicable.

[b]Percentage of total compliance of items excluding those that do not apply (NA).

Results

In the aggregate, 4,835 references were recovered: Cochrane Library (*n* = 280, 6%), EMBASE (*n* = 568, 12%), IBECS (*n* = 14, <1%), LILACS (*n* = 76, 2%), MEDES (*n* = 11, <1%), PubMed (*n* = 274, 6%), SCOPUS (*n* = 116, 2%) and ISI-Web of Science (*n* = 3,492, 72%).

After applying filters, the number of references was decreased to 955. They began with the Cochrane Library (*n* = 0, 0%), then moved on to EMBASE (*n* = 137, 14%), IBECS (*n* = 14, 1%), LILACS (*n* = 76, 8%), MEDES (*n* = 11, 1%), MEDLINE via PubMed (*n* = 42, 4%), SCOPUS (*n* = 116, 12%) and ISI-Web of Science Core Collection (*n* = 559, 63%).

The results obtained were imported into the multiplatform programme ZOTERO, which detected 46 duplicate records and deleted them. Subsequently, the records were checked by title, with 690 articles rejected because their titles showed a lack of thematic relevance.

The remaining 219 records were reviewed individually by the first and second authors. There was an agreement of 71.46% ($p < 0.001$) between the two authors on the relevance of the selected studies. Twenty records were selected at random and 199 were rejected at random. Only 15 articles obtained a discordant verdict. A third author decided on the inclusion of six of them. Because the full text of two articles was unavailable, they were excluded. Therefore, 24 records were finally reviewed[8–31].

Following the PRISMA checklist for systematic reviews, the following flowchart was obtained[3,4]:

When using the STROBE questionnaire to evaluate the studies, the minimum score was 17 and the maximum score was 21. Its median value was 18.55. Only 9% of the variability of the STROBE score expressed as a percentage was explained by the rise of the years ($R^2 = 0.09$; $p = 0.17$). A linear trend was not observed. Even though evidence and documental quality are not the same, documental quality is required to obtain a minimum level of evidence.

Because the highest possible score differed between the 24 articles examined, percentages rather than absolute scores were used to determine the absence or presence of a linear trend, Table 1.

According to the SIGN criteria, this review presented 'evidence 3 (non-analytical studies, clinical observations and case series)'. Its recommended grade was D (levels of evidence 3 or 4 or extrapolation of studies rated as 2+)[7].

The characteristics and results of the reviewed articles are summarised in Table 2. Data extraction from included studies was performed manually by the two authors independently using double tables and the results were afterwards shared to avoid errors.

All reviewed papers were observational: nine cohort studies[13,14,20,25,26,28–30] and 15 cross-sectional descriptive studies[8–12,15–19,21–23,27,31]. The countries that contributed the most studies were Italy, with three[8,12,19] and Japan, with three[16,18,20].

According to the population size, Kubo *et al*.'s and Miyake *et al*.'s cross-sectional studies had the largest sizes, with 13,468 participants[16,18]. Widar *et a*l.'s cohort study had the smallest size, with 23 participants[29]. Individuals of both genders made up the samples for all of the studies. Spinks' sample included 86.5% of women[26]. Meanwhile, Peña Tellez *et al.*'s study included 85% of men[23]. Individuals' age in the selected studies was consistently older than 18 years old: Perelman *et al*.'s sample included workers between 50 and 65 year[24]. Tolland and Dryscale, for example, do not provide data according to gender or age[27].

Japan was the country of origin for four studies[16,18,20,26], Italy for three[8,12,19] and Sweden for the remaining three[13,17,29]. Half of the samples were from Europe[8,12,13,15,17,19,22,24,27–30]. The remaining six came from Asia[14,16,18,20,26,31], five from America[9–11,21,23] and one from Australia[25].

According to the Burton–Kebler Index, the selected articles had a 3-year obsolescence. The price index was at 87.50%. The year with the highest number of publications was 2021[8,12,13,15,16,20–22,24,25,28,30,31].

The obtained articles had adequate obsolescence. Only three have been published in the last 5 year[17,26,27]. The rest were all been published over the last 4 year[8–16,18–25,28–31].

https://doi.org/10.4321/s0465-546x2025000100005

Table 2: Description of the reviewed articles.

Author, Country, Year	Study type	Population Number of subjects	Exposure	Outcome	Results and conclusions	STROBE (%)
Bertino *et al*. Italy,2021[8]	Cross-sectional study	Italian teleworkers *n* = 804	Telework evaluation, replication and routine initiated due to COVID 19	Prevalence of specific psychiatric symptoms (stress, anxiety, depression, sleeping disturbances) (DASS-21)	'Telework itself did not seem to be directly associated with increased psychiatric symptoms but insomnia, depression, anxiety and stress were significantly higher among teleworkers in 'educational and research' occupations'(8). 'Authorities should promote adequate measures to guarantee a healthy approach to teleworking'(8).	19 (86%)
El Kadri Filho *et al*. Brazil, 2022[9]	Cross-sectional study	Teleworkers of a Brazilian labour judiciary unit. *n* = 55	Telework specifically because of the need for social isolation due to COVID 19	Ergonomic risk, the psychosocial factors and the occurrence of musculoskeletal symptoms	'The ergonomic risk factors indicated inadequate working conditions at the homes during the COVID-19 pandemic'(9). 'With the continuity of teleworking, companies must pay attention to the working conditions with a view to preventing musculoskeletal problems'(9).	19 (86%)
Elbogen *et al*. EEUU, 2022[10]	Cross-sectional study	American teleworkers. *n* = 902	Quantity of videoconferencing in the past 3 months	Zoom Fatigue (perceived stress, isolation and depression associated with videoconferencing at work)	'Videoconferencing at work may engender stress, social isolation and emotional exhaustion, which could adversely impact mental health, work productivity and quality of life'(10).	19 (86%)
García–Salirrosas and Sánchez–Poma Perú,2020[11]	Cross-sectional study	University professors who teach in the telework modality inPeru *n* = 110	Ergonomic risk factors (working in front of a computer: hours/day and days/week)	Prevalence of musculoskeletal disorders (Kuorinka Nordic questionnaire)	'There is a high prevalence of musculoskeletal disorders in university teachers, mainly in the dorsal-lumbar spine and neck; and there is an association of these disorders with ergonomic risk factors such as prolonged posture and long working hours'(11).	15.8 (75%)
Ghislieri *et al*. Italy, 2021[12]	Cross-sectional study	Teleworkers *n* = 211	Telecommuting: Stress and overtime	Family–work conflict	Cognitive demands and technological overload and invasion are potential predictors of work–family conflicts. ($p = 0.05$) Rest time decreases due to teleworking ($p < 0.05$) It is important to monitor teleworkers to reduce the risk of work–family conflicts ($p < 0.01$)	19 (86%)
Hallman *et al*. Sweden, 2021[13]	Cohort study	White-collar workers working from home. N1 = 27	Days working from home during the COVID-19 pandemic	Physical behaviours using one wearable triaxial accelerometer	'Days working from home during the COVID-19 pandemic in Sweden were associated with longer duration of sleep than days working at the office while physical behaviours during work and leisure did not change markedly. This behavioural change may be beneficial to health'(13).	19 (86%)
Hao *et al*. China, 2022[14]	Cohort study	Chinese workers. *N1* = 940	Forced work from home	Unpleasant, Busy and Spiritless measured using Depression Anxiety Stress Scale-21(DASS-21)	'Working from home was associated with worse mental health in men, but not among women (…). Mental health was worse among those in higher job positions for both men and women'(14).	20 (90.91%)
Izdebski and Manzur. Poland, 2021[15]	Cross-sectional study	Polish teleworkers *n* = 3000	Work activity: Type of work and changes in employment status	Intensity and degree of deterioration of mental health	Risk factors for mental health deterioration: female sex ($p < 0.001$), teleworking ($p = 0.05$)	19 (86%)
Kubo *et al*. Japan, 2021[16]	Cross-sectional study	Japanese teleworkers *n* = 13468	Weekly teleworking frequency during Covid-19 pandemic	Dietary habits: Skip breakfast; eat alone, junk food consumption	Telecommuting > 4 days per week is associated with worse eating habits that lead to an increase in obesity, overweight and an increase in cardiovascular risk factors Strategies are needed to help teleworkers to maintain healthy dietary habits and encourage physical exercise	19.5 (93%)
Lundberg and Lindfors. Sweden,2002[17]	Cross-sectional study	Highly educated white-collar workers at a Swedish government authority. *n* = 27	Teleworking from home	Psychophysiological reactivity and catecolamines, cortisol and blood pressure	'Blood pressure was significantly higher during work at the office than when teleworking. (…) It was assumed that the lower cardiovascular arousal during telework is due to different work tasks and that elevated epinephrine levels are caused by continued work after normal working hours'(17)	18 (82%)
Miyake *et al*. Japan, 2022[18]	Cross-sectional study	Japanese teleworkers *n* = 13468	Remote work (days per work)	Loneliness and job stress (JCQ)	'Participants who worked remotely 4 or more days per week were more likely to report feeling lonely (…) (adjusted OR = 1.23, 95% CI: 0.99–5.84, P = 0.066)'(18). 'To reduce loneliness and the risk of associated mental health problems, high-frequency remote workers should interact (…) using the information and communication technology developed for this purpose'(18)	20.1 (91%)
Molino *et al*. Italy, 2020[19]	Cross-sectional study	Italian workers *n* = 749	Overload, invasion and technological complexity	Work overload, family-work conflict, mental stress	Workload and teleworking are verified as creators of technostress ($p < 0.01$) Interventions are needed to prevent the negative consequences of technology	20 (91%)
Niu *et al*. Japan, 2021[20]	Cohort study	Employees of BackTech Inc. *N1* = 86 *N2* = 1597 *N3* = 213	Telecommuting: Frequency, environment, workplace ergonomics and satisfaction	Health effects: smoking, physical activity, sleep, alcohol intake, family-work conflict	During the pandemic, teleworkers experienced: physical symptoms ($p < 0.01$), increased alcohol consumption ($p < 0.01$), tendency to depression and anxiety ($p < 0.01$), increased work–family conflicts, stress and health concerns ($p < 0.01$)	17 (77%)
Palma. Vasquez *et al*. Chile, 2021[21]	Cross-sectional study	Teachers *n* = 278	Telecommuting > 50% of time	Poor mental health	The sociodemographic and work context must be taken into account when studying mental health. It is important to regularise working hours to be able to plan work	19 (86%)
Pelissier *et al*. France, 2021[22]	Cross-sectional study	Administrative teleworkers *n* = 474	Telecommuting: Job category, stress and mental overload	Anxiety symptoms	The implementation of teleworking should be accompanied by technical and business support to reduce stress levels.	19 (86%)

https://doi.org/10.4321/s0465-546x2025000100005

Author, Country, Year	Study type	Population Number of subjects	Exposure	Outcome	Results and conclusions	STROBE (%)
Peña Tellez *et al.* Brazil, 2022[23]	Cross-sectional study	Brazilian technology teleworkers *n* = 116	Teleworking	Oral and systemic health, oral hygiene habits, musculoskeletal pain, physical exercises and emotional state.	'The prevalence of painful musculoskeletal symptomatology manifested in 100% of workers predominantly found in the cervical region (53%).(…).In general, low frequency of physical activity and inadequate conditions for home work performance were corroborated(…).It is necessary to adopt strategies to preserve the integral health of these professionals'(23).	16 (73%)
Perelman *et al*. Portugal, 2021[24]	Cohort study	European workers between 50 and 65 years *N1* = 7065	Working setting (home or usual place)	Worsening feelings of sadness and depression, feelings of anxiety and nervousness, sleeping difficulties and feelings of loneliness.	'Teleworking from home was significantly associated with a worsening of mental health symptoms(…). Nevertheless, no significant association was found with any of the health outcomes except for anxiety feelings. However, the increased anxiety feelings among teleworkers were not greater than the one observed among non-teleworkers'(24).	19 (86%)
Pirzadeh and Lingard. Australia, 2021[25]	Cohort study	Australian construction workers. *N1–N7* = 18–151	Telecommuting: Number of hours and location	Health and well-being: mental health, physical activity, dietary habits, work–family conflict	A correlation was found between satisfaction with work–life balance and: feeling of pressure ($p < 0.05$), interference of work in social life ($p < 0.001$), sense of belonging ($p < 0.05$), working hours ($p < 0.05$). It is convenient to consider job satisfaction and create opportunities to improve work–family balance when designing teleworking strategies.	18 (81.81%)
Spinks Japan, 2002[26]	Cohort study	Home-based teleworkers in Tokyo *N1* = 672	Teleworking	Incidence, treatment and impact of medical symptoms and safety measures.	'Stiff shoulders and eye strain were present on the 54 and 53% of the participants'(26). 'Regular rests breaks was the most frequent measure adopted (63%) followed by correct lightning (24%)'(26).	16 (73%)
Tolland and Drysdale. Great Britain, 2002[27]	Cross-sectional study	Scottish clinical psychologists *n* = 161	Working from home duration, environment and organizational support	Physical and emotional well-being and motivation	'Fatigue, stress, anxiety, loneliness, isolation, aches/pains in back and headaches or migraines.were the most common complaints'(27). 'The most common reasons not to use measures were feeling no need (34%) and lack of financial resources (22%)'(27). 'There should be increased access to occupational health assessments and provision of ergonomic furniture'(27)	19 (86%)
Van Zoonen and Sivunen. Finland, 2021(28)	Cohort study	Finish workers *N1* = 5452	Frequency of teleworking. Use of technology	Perception of isolation. Psychological stress	The use of technology can help organizations and companies combat the feeling of isolation while the simultaneous increase in teleworking increases the feeling of isolation. ($p < 0.001$)	19 (86%)
Widar *et al.* Sweden, 2021(29)	Cohort study	Teachers or researchers *n* = 23	Number of days per month teleworking	Stress: salivary cortisol, physical activity, heart rate, parasympathetic activity	Workers presented higher parasympathetic activity during telework tan during office work, which may indicate greater relaxation during telework ($p < 0.001$)	20 (91%)
Wöhrmann and Ebner. Germany, 2021(30)	Cross-sectional study	Highly qualified German workers n = 9165	Telecommuting: number of hours, relationship with coworkers, work interruptions	Health: headache, tiredness, sleep issues	Telecommuting increases overtime work ($p < 0.001$) The quality of labour relations is diminished in teleworkers ($p < 0.01$) Teleworking is related to psychosomatic health. ($p < 0.001$)	21 (95%)
Zalat and Bolbol Saudi Arabia, 2021(31)	Cross-sectional study	Saudi Arabian teleworkers *n* = 413	Teleworking	Health problems associated with telework: musculoskeletal, work-related stress, sleeping disorders, vision problems, poor mental health, chronic diseases and feelings of isolation	'Telework associated health problems included musculoskeletal (78%), work-related stress (66%) and visual problems (47%)'(31). 'All teleworkers with reported health problems showed significantly more perceived fatigue and less recuperation'(31). 'More than half of the participants recommended continuing teleworking post-COVID-19 due to its benefits on their working and social life'(31).	15.7 (75%)

Most workers exposed to telework were from the business, educational or technological sector. Only Pirzadeh and Lingard's[25] study was not. Its population was formed by Australian construction workers.

Only 13 studies included teleworkers as the target population[8–11,13,16–18,23,26,27,31]. Spinks[26] was the only cohort study.

The exposition to telework was measured as its weekly frequency in 14 of the 24 reviewed studies[8,11,16,18,20–22,25–31]. In those cases, self-completed questionnaires were used for data collection, except in Ghislieri *et al*.[12], Izdebski and Manzur[15] and Molino *et al*.[19], where it was measured indirectly.

García–Salirrosas and Sánchez–Poma collected data for the highest exposure time: 12 months[11].

Most of the studies revealed significant associations between telework and negative effects on health. Therefore, two large blocks were distinguished: physical effects[9,11,13,16,17,23,26,27,29,31] and psychological effects[8,10,12,14,15,18–22,24,25,27,28,30,31]. Only Tolland and Dryscale[27] and Zalat and Bolbol[31] evaluate both.

Self-completed questionnaires and general and specific indices and scales were used to assess mental health. Thirteen of the 24 articles focused on teleworking and poor mental health showed a significant association[8,10,14,15,18,20–22,24,27,30,30,31], particularly between teleworking and anxiety[8,20,24,27] and depression[8,20]. A poor sleep quality was also associated with the previous[8,12,21,25]. Furthermore, an association with emotional exhaustion[10,27,31], isolation[10,18,20,27], stress[8,10,20,27,31], particularly technostress[19] and an increase in work and family conflicts was established[20].

Validated and non-validated self-report questionnaires were used to assess the relationship between teleworking and physical health effects[9,11,13,16,17,23,26,27,29,31]. Musculoskeletal problems were the most important negative effects described[9,11,23,26,27], particularly neck and back pain[11,23,26,27], followed by visual problems[26,31]. Teleworking was shown to be associated with higher blood pressure[17], poor dietary habits[16], increased alcohol consumption[20] and inadequate physical activity[17,20].

Discussion

A significant association between telework and negative effects on employees' health is established. There is an association between teleworking and higher levels of stress[8,10,18,22,25,27,28,31], poor mental health[8,14,20–22,24,27], higher prevalence of musculoskeletal disorders[11,20,23,26,27,31] and vision problems[26,31].

According to the recommendations and objectives of a systematic review[32], this review synthesises 24 original articles in which the negative effects of teleworking on workers' health are directly or indirectly investigated[8–31].

Significant differences in the proportion of citations obtained from the various databases were unexpected. The results were double-checked. A higher number of citations were obtained from the most prolific databases. The fact that ISI-Web of Science has common citations with the other databases also contributed to the results.

More than 99% of the initial registrations were rejected. The predominant reason is because the topic is irrelevant. There was an adequate concordance in the decision to eliminate the papers and a third person to resolve the tie-breaker. The lack of a larger number of relevant articles implies a limitation for this review. However, its documentary correction is positive, although it cannot be ruled out due to publication bias. The lack of studies on teleworking effects should be studied in the future.

Only databases are used to search for evidence. It excludes grey literature and the bibliography of the records obtained. Publication bias may have caused an overestimation of the true relationship between teleworking and teleworkers' health.

The price index was high. More than 85% of the included articles had been published in the last 5 year. The median age of the analysed references was 3 year (Burton–Kebler Index). More than 90% of the included studies use samples from 2021 and 2022. The obsolescence is appropriate and consistent with the existing global evidence. The COVID-19 pandemic may have acted as a confounding or even modifying variable, leading to an overestimation of the negative effects of teleworking, particularly on mental health[8–10,12–16,18,20–25,28–31]. The inability to conclude causality is the most commonly described

limitation, as 67% of the studies were cross-sectional[8–12,15–19,21–23,27,30,31]. Despite possible causal mechanisms and significant results, we cannot confirm or rule out the existence of causality due to the lack of articles found. More prospective cohort studies are thus needed in this regard.

There is heterogeneity in measuring the variable exposure (teleworking) between the different studies[29]. These characteristics promote the emergence of bias and represent a limitation for the present review. This should be a warning to occupational health for future studies to develop and evaluate a telework measuring tool.

Teleworking is associated with its worsening mental health[14,21,24]. The previous study revealed that teleworkers had significantly higher frequency of emotional exhaustion[10,27,30,31] and a feeling of social isolation[10,27,28]. Pirzadeh and Lingard[25] also describe grading. The time sequence supported by studies, such as Niu *et al*.'s or Pirzadeh and Lingard's is committed to affirming causality[20,25]. Neither the identification of anxiety and depression symptoms using scales nor clinical examinations[8,14,18,22] nor the brief period of evolution studied[14,15,24] contribute.

Teleworking is also associated with an objectified change of the relationships between teleworkers and their colleagues[10,21,25,27,28,30]. These results are consistent with those described by Lenguita and Miano[34] and Van Zoonen and Sivunen, who represent grading[28]. There were no association measures provided and even if there were, the true cause of isolation may be these conflicts. Telework is a mere modifier of the effect.

Stress is found to be higher among teleworkers as well[8,10,18,22,25,27,28,31]. The need to improve technology at home involves the integration of professional and personal lives. Technological problems may also occur, impeding a correct work activity. This specific type of stress is known as technostress and it is almost exclusively found in teleworkers[19,29]. According to Pirzadeh and Lingard[25], the increased stress among remote workers is not significant. The cause could be that their samples have low statistical power. According to Widar *et al*.[29], teleworking is associated with a increased parasympathetic activity. Stress is significantly associated with psychosocial factors caused by increasing isolation, fear and uncertainty during the COVID-19 pandemic[35]. Studies should be conducted outside of the pandemic period.

A relationship between teleworking and poor sleep quality or insomnia is also described[8,20,21,25,29,30]. These results are consistent with what is known about sleep disturbances and mental health[36,37] and findings among non-teleworkers[38]. Hallman *et al*.[13] revealed that teleworkers sleep longer hours. Anxiety could be the cause of poor sleep quality. However, this association has been demonstrated to be influenced by the pandemic context[39]. Sleep disturbances are most likely an effect-modifying factor causing an overestimation of mental health disturbances in teleworkers.

Regarding physical consequences, teleworking is associated with a higher prevalence of musculoskeletal disorders, particularly neck and back pain[11,20,23,26,27,31]. This is consistent with previous studies[40]. The main reason given is inadequate ergonomic conditions[9,27]. Better ergonomic conditions improve but not eliminate musculoskeletal disorders linked to office work.

Visual problems[26,31], headaches and migraines[27,30] were also significantly higher among teleworkers. Working longer hours, not adopting preventive measures and having an inappropriate viewing distance are all significantly related to eye and visual problems associated with computer use, not only in teleworkers[41]. There is biological plausibility.

Health effects resulting from prolonged teleworking exposure are not examined due to the short follow-up of the samples in cohort studies[13,14,20,24,26,28,29] or non-reversible or chronic effects that may persist after their retirement are studied.

Conclusions

A significant association between telework and negative effects on employees' health is established. However, the degree of evidence and recommendation does not allow to fully ensure the validity and reliability of the observations made. Furthermore, due to the type of studies found, none of the articles quantify this association or conclude causality. More studies are therefore needed in this regard. Pro-

spective cohort studies with higher statistical power, a common quantification of telework exposure, a common and validated mental health determination outside the pandemic period and further studies regarding musculoskeletal and visual disorders should be made. This knowledge is necessary to design specific health surveillance protocols and detailed preventive strategies affecting groups, such as women or temporary workers.

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