The impact of digital technology on the physical health of Older Workers: Protocol for a Scoping Review

Jeroen J A Spijker, Hande Barlın, Diana Alecsandra Grad, Yang Gu, Aija Klavina, Nilufer Korkmaz Yaylagul, Gunilla Kulla, Eda Orhun, Anna Sevcikova, Brigid Unim, Cristina Maria Tofan

Submitted to: JMIR Research Protocols
on: April 25, 2024

Table of Contents

The impact of digital technology on the physical health of Older Workers: Protocol for a Scoping Review

Jeroen J A Spijker[1] PhD; Hande Barl?n[2] PhD; Diana Alecsandra Grad[3] MPH; Yang Gu[4] MSc; Aija Klavina[5] PhD; Nilufer Korkmaz Yaylagul[6] PhD; Gunilla Kulla[7] PhD; Eda Orhun[8] PhD; Anna Sevcikova[9] PhD; Brigid Unim[10] PhD; Cristina Maria Tofan[11, 12] PhD

[1]Centre d'Estudis Demogràfics Bellaterra ES
[2]Department of Economics Gebze Technical University Gebze TR
[3]Department of Public Health Faculty of Political, Administrative and Communication Sciences Babe?-Bolyai University Cluj-Napoca RO
[4]Department of Work, Employment, Management & Organization University of Leicester Leicester GB
[5]Department of Rehabilitation Riga Stradins University Riga LV
[6]Gerontology Department, Faculty of Health Sciences Akdeniz University Antalya TR
[7]Department of Health and Caring Sciences Western Norway University of Applied Sciences Forde NO
[8]American University Bulgaria Blagoevgrad RO
[9]Faculty of Social Studies Masaryk University Brno CZ
[10]Cardiovascular, Endocrine-Metabolic-diseases and Aging National Institute of Health Rome IT
[11]Department of Sociology, Social Work and Human Resources Faculty of Philosophy and Social-Political Sciences Alexandru Ioan Cuza University Iasi RO
[12]Psychology and Educational Sciences Department Gheorghe Zane Institute for Economic and Social Research Romanian Academy Iasi RO

Corresponding Author:
Jeroen J A Spijker PhD
Centre d'Estudis Demogràfics
Carrer de Ca n'Altayó
Edifici E-2
Bellaterra
ES

Abstract

Background: Digital technologies have penetrated most workplaces. However, it is unclear how such digital technologies affect the physical health of older workers.

Objective: This scoping review aims to examine and summarize the evidence from scientific literature concerning the impact of digitalization and the utilization of digital tools on the physical health of older workers.

Methods: This scoping review will be conducted following recommendations outlined by Levac et al. and adhere to the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analysis Extension for Scoping Reviews) guidelines for reporting. Peer-reviewed articles written in English will be searched in the following databases: MEDLINE, Cochrane, Proquest, Web of Science, Scopus, APA PsycInfo and ERIH PLUS. The web-based systematic review platform COVIDENCE will be used to create a data extraction template. It will cover the following items: study and participant characteristics, health measures, digital tool characteristics and usage, research findings, and policy implications. Following the Population, Concept, and Context (PCC) framework, our review will focus on studies involving older workers aged 50 years or above, any form of digitalization (including teleworking and the use of digital tools at work) and how digitalization affects physical health (such as vision loss, musculoskeletal disorders, migraine). Studies that focus only on mental health will be excluded. Study selection based on title and abstract screening (first stage), full-text review (second stage) and data extraction (third stage) will be performed by a group of researchers, whereby each article will be revised by at least two people. Any conflict regarding the inclusion or exclusion of a study and the data extraction will be solved by discussion between the researchers who evaluated the papers; a third researcher will be involved if consensus is not reached.

Results: A preliminary search of MEDLINE, Epistemonikos, Cochrane, Prospero and JBI Evidence Synthesis was conducted and no current or underway systematic reviews or scoping reviews on the topic were identified. The results of the study are expected in April 2025.

Conclusions: Our scoping review will seek to provide an overview of the available evidence and identification of research gaps regarding the effect of digitalization and the use of digital tools in the work environment on the physical health of older workers.

(JMIR Preprints 25/04/2024:59900)
DOI: https://doi.org/10.2196/preprints.59900

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ **Please make my preprint PDF available to anyone at any time (recommended).**
Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.
Only make the preprint title and abstract visible.
No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**
Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain v
Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <a href="http

Original Manuscript

Original Paper

Jeroen JA Spijker, PhD[1]*; Hande Barlın, PhD[2]; Diana Alecsandra Grad, MPH[3]; Yang Gu, MSc[4], Aija Klavina, PhD[5,6]; Nilufer Korkmaz Yaylagul, PhD[7]; Gunilla Kulla, DrPH[8], Eda Orhun, PhD[9]; Anna Sevcikova, PhD[10]; Brigid Unim, PhD[11]; Cristina M Tofan, PhD[12,13]

[1]Centre d'Estudis Demogràfics, Bellaterra, Spain. ORCID: 0000-0002-3957-9553

[2]Department of Economics, Gebze Technical University, Türkiye. ORCID: 0000-0001-7699-2382

[3]Department of Public Health, Faculty of Political, Administrative and Communication Sciences, Babeş-Bolyai, Cluj-Napoca, Romania

[4]Department of Work, Employment, Management & Organization, University of Leicester, UK. ORCID: 0009-0003-7630-8087

[5]Laboratory of Sports and Nutrition Research, Riga Stradins University, Latvia. ORCID: 0000-0003-1959-9941

[6]Department of Health Promotion and Rehabilitation, Lithuanian Sport University, Kaunas, Lithuania

[7]Gerontology Department, Faculty of Health Sciences, Akdeniz University, Antalya, Türkiye. ORCID: 0000-0001-9918-7968

[8]Western Norway University of Applied Sciences, Department of Health and Caring Sciences, Forde, Norway. ORCID: 0000-0003-4438-6382

[9]American University Bulgaria, Blagoevgrad, Bulgaria. ORCID: 0000-0001-7153-4892

[10]Faculty of Social Studies, Masaryk University, Brno, Czechia. ORCID: 0000-0002-9750-7320

[11]Department of Cardiovascular, Endocrine-Metabolic-diseases and Aging, National Institute of Health, Rome, Italy. ORCID: 0000-0002-6522-9098

[12]Psychology and Educational Sciences Department, "Gheorghe Zane" Institute for Economic and Social Research, Romanian Academy, Iasi Branch, Romania. ORCID: 0000-0002-8733-725X

[13]Department of Sociology, Social Work and Human Resources, Faculty of Philosophy and Social-Political Sciences, "Alexandru Ioan Cuza" University, Iasi, Romania

* Corresponding author: jspijker@ced.uab.es

The impact of digital technology on the physical health of Older Workers: Protocol for a Scoping Review

Abstract

Background: Digital technologies have penetrated most workplaces. However, it is unclear how such digital technologies affect the physical health of older workers.
Objective: This scoping review aims to examine and summarize the evidence from scientific literature concerning the impact of digital technology on the physical health of older workers.
Methods: This scoping review will be conducted following recommendations outlined by Levac et al. and will adhere to the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analysis Extension for Scoping Reviews) guidelines for reporting. Peer-reviewed articles written in English will be searched in the following databases: MEDLINE, Cochrane, Proquest, Web of Science, Scopus, APA PsycInfo and ERIH PLUS. The web-based systematic review platform Covidence will be used to create a data extraction template. It will cover the following items: study and participant characteristics, health measures, digital tool characteristics and usage and research findings. Following the Population, Concept, and Context (PCC) framework, our review will focus on studies involving older workers aged 50 years or above, any form of digital technology (including teleworking and the use of digital tools at work) and how digital technologies affect physical health (such as vision loss, musculoskeletal disorders, and migraines). Studies that focus only on mental health will be excluded. Study selection based on title and abstract screening (first stage), full-text review (second stage) and data extraction (third stage) will be performed by a group of researchers, whereby each article will be reviewed by at least two people. Any conflict regarding the inclusion or exclusion of a study and the data extraction will be resolved by discussion between the researchers who evaluated the papers; a third researcher will be involved if consensus is not reached.
Results: A preliminary search of MEDLINE, Epistemonikos, Cochrane, Prospero, and JBI Evidence Synthesis was conducted and no current or underway systematic reviews or scoping reviews on the topic were identified. The results of the study are expected in April 2025.
Conclusions: Our scoping review will seek to provide an overview of the available evidence and identification of research gaps regarding the effect of digital technology and the use of digital tools in the work environment on the physical health of older workers.
International Registered Report Identifier (IRRID):

Keywords: Digital tools; digital technology; physical health; older workers; scoping review.

Introduction

Aging is a multifaceted process characterized by extensive intra- and inter-individual differences, often conceptualized within theoretical frameworks as a dynamic balance between physiological advantages and limitations. Connected with this view, physical health —described succinctly as “soundness of body” [1] and can be defined as a “dynamic state, the process of preserving and developing its biological, physiological and mental functions, optimal work capacity and social activity with the maximum life expectancy” [2]— has been a major concern not only in the context of general aging but also aging in the workplace, especially with the extension of the working life and retirement age [3]. Physical health for older workers goes beyond maintaining the ability to perform job-related tasks effectively, and includes prevention and management of age-related conditions, and ensuring overall well-being. Indeed, significant physiological changes have effects on the capabilities of older workers. These involve sensory function, muscle function, cardiovascular and respiratory function, neurological function, and immune response [4]. Nonetheless, despite the inevitable age-related physiological decline, a significant proportion of older workers demonstrate adaptation abilities, facilitating the maintenance of work performance [5].

As the global workforce ages and digital technologies increasingly penetrate the occupational landscape (through practices such as working from home, blended work, teleworking, and the use of digital apps), understanding the impact of digital technology on the physical health of older workers has emerged as a critical area of research. According to the latest European Union (EU) data from 2020, the share of older workers aged 55 or more in the total number of employees increased from 12% to 20% between 2004 and 2019 [6]. At the same time, 21.6% of employees over 55 years of age reported more than two work-related physical health problems [7].

With the global advancement of digital technology, especially in recent decades, the labor market and traditional work processes have undergone significant changes. New job roles and work conditions have emerged, introducing new physical and psychological requirements [8] that come with advantages and disadvantages. For instance, digital tools offer flexible arrangements such as working from home and diminish reliance on physically demanding tasks, thereby lowering the risk of musculoskeletal injuries, but only if workstations are ergonomically prepared and regular breaks are taken [9]. However, the digitalization of work also introduces a spectrum of challenges that can adversely affect the physical health of older workers, including prolonged screen exposure leading to eye strain and headaches, extended periods of sitting without any physical activity, thereby increasing the risk of cardiovascular diseases, and stress induced by the expectation of constant connectivity, which might lead to spinal, postural and other type of muscular disorders [9,10, 11]. Furthermore, the inability to cope with technological innovation is a health risk that affects the work ability of older workers. That is why providing continuous training or regular monitoring of biometric and physical health information [12,13], maintaining physical fitness, managing chronic diseases, and adapting workplaces are recommended to improve the safety and health of older workers and to support their productivity. Likewise, digital health coaching programs also assist older employees in maintaining health during the transition to retirement and thereby potentially influence physical health [14].

Against the aging of the workforce and digital transition of work environment, despite some emerging research and reviews in recent years, focusing on understanding the psychological consequences of digitalization of workplaces in terms of techno-stress [15,16], burnout and mental strain [12,17,18] as well as on digital technologies for health and disease management [7,13,14,19-24], to the best of our knowledge, there is no existing systematic or scoping review that focuses on how older workers are affected physically by the digitalization of their tasks and workplaces. In this regard, this scoping review protocol aims to address the existing research gap in understanding the current scientific literature that examines various physical health consequences (positive or negative) of digitalizing work environments among older workers.

Methods

Guidance Frameworks

Based on the first methodological framework for conducting scoping reviews by Arksey and O'Malley, this scoping review will be conducted following recommendations outlined by Levac et al. [25] to guarantee a systematic and coherent process. Levac et al. advocate proceeding by describing the following stages: (1) identifying the research question, (2) identifying relevant studies, (3) selecting studies, (4) charting and collating the data, and (5) summarizing and reporting the results. To report our findings, we will also adhere to the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analysis Extension for Scoping Reviews) guidelines for reporting [26]. The PRISMA-ScR checklist for the scoping review will be reported in an appendix and the PRISMA-ScR checklist for this protocol can be found in Multimedia Appendix 1.

Protocol and Registration

This protocol was written before we performed the full electronic literature search (we did search for

existing scoping reviews and pilot-tested different search terms; see below). The study will be registered at the Open Science Framework after the peer-review process.

Stage I: Identifying the Research Question

We posed the research question: How do digital technologies in the workplace affect the physical health of older workers? As there are many ways in which digital technology can affect an older worker's health (from vision loss to musculoskeletal disorders) and there are many types (from working online from home to the use of robotics in a car assembly line), we also have the following sub-questions: i) What are the most common physical health issues that older workers have to manage as a result of digital technologies in the workplace?; ii) What industries most affect older workers' health as a result of the use of digital technology?

Based on our research questions, we defined the Population, Concepts, and Context (PCC) criteria of interest to clarify the focus of the scoping study and establish an effective search strategy (see also [25]) (Textbox 1):

To summarize the main points reflecting the PCC criteria: Regarding the population, our review will focus on studies involving older workers aged 50 years or above.

Textbox 1. Definitions of the inclusion criteria regarding PCC in the scoping review.

Population: older workers

- Older workers include study participants employed at the moment of the study
- Study participants must be aged 50 years or older. When only age ranges are analyzed, the age of 50 should be included in the youngest age category (e.g., 45-54). While there are ongoing debates regarding what age defines older workers [27], we have opted to include individuals 50 years or older. This decision is based on the increasing presence of this cohort in the labor market, their likelihood of remaining in the workforce longer than previous generations, and the need to recognize the diversity within this demographic group. People in their 50s may have varying career trajectories, skill sets, and motivations for remaining in the workforce. By defining older workers as those aged 50 and over, organizations can more effectively cater to the unique needs and experiences of this diverse and increasing group of older individuals in the labor market.
- If age is treated as a continuous variable rather than analyzed as categories, the sample also has to have participants aged 50 years or older, i.e. younger ages are only permitted if older ages are also represented in the study.

Concept: digital technologies

- Digital technologies refer to data manipulation, storage, transmission, and processing in binary data [28]. It allows for the interaction with stored data using electronic devices (e.g., computers, microprocessors). Digital data can be stored in various digital storage media (e.g., hard drives, solid-state drives, memory cards and cloud storage). Furthermore, digital technology also enables the transmission of data over digital communication networks (e.g., the internet, local area networks, wireless networks).
- Digital technologies are defined as any type of digital tool or device used in the context of (creative) production, i.e. studies or study results that look at the effect of digital technologies not related to work (e.g., for health management) are excluded.
- Digital technologies include the use of computers at home for work (e.g., teleworking) as well as more recent digital technologies (e.g., apps) but only if they are used for work purposes.
- Studies will be excluded if working from home does not involve digital tools (e.g., only landlines are used).

Context: physical health

- Any physical health outcome is accepted.
- Mental health outcomes are excluded unless mentioned in combination with a physical health outcome.
- Studies will be excluded if the health outcome is not associated with an effect of the use of digital technologies in the work sphere.

The concept of interest is the implicit (e.g., working from home) or explicit (e.g., software systems, communication platforms, document management systems, lightning control systems and automated and robotic systems) use of any type of digital technology within the work environment to execute job-related tasks. In terms of context, we are specifically interested in examining how digital technologies impact physical health issues such as vision loss, musculoskeletal disorders, migraines and cardiovascular diseases. Studies focusing solely on mental health impacts will be excluded from

this review.

Stage II: Identifying Relevant Studies

We follow the Joanna Briggs Institute Manual for Evidence Synthesis [29] for our search strategy. For the protocol, the databases PubMed (see Multimedia Appendix 2), Prospero and JBI Evidence Synthesis were searched on April 15, 2024 but no current or underway systematic reviews or scoping reviews were identified (the four results shown are not related to the topic of our interest).

For the scoping review, we will search for peer-reviewed articles in the following databases: MEDLINE, Cochrane, Proquest, Web of Science, Scopus, APA PsycInfo and ERIH PLUS. The web-based systematic review platform Covidence will be used to import the references and remove duplicates. The search terms to be employed are: *(physical adj (health* OR condition* OR issue* OR impairment* OR fitness OR wellbeing OR (well adj being) OR integrit* OR state* OR stress) OR disease* OR vision OR mobility OR obes* OR overweight OR "Body Mass Index") AND (digital OR app* OR web OR internet OR tech* OR (social adj media) OR chat OR online* OR cyber OR virtual OR computerized OR computerised OR electronic OR ICT) AND ((old* or elder* or ageing or ageing or senior*) adj1 (work* OR employee* OR profession* OR labor OR labour OR colleague* OR staff* OR cowrk* OR personnel)).*

In constructing our search strategy, we employed the Boolean operator "OR" to encompass a broad range of related physical health conditions, digital technologies, and terms referring to older workers. Additionally, we used the adjacency operators "adj" and "adj1" to ensure that closely related terms appearing contiguously in the literature are captured, thereby enhancing the specificity of our search results and enabling a comprehensive inclusion of relevant studies.

A preliminary search conducted on April 18 and 19, 2024 for MEDLINE, Cochrane and Epistemonikos provided, respectively, 299, 260 and 5 references before deduplication (see Multimedia Appendix 3 for more detail).

In our final search we will restrict our search to articles written in English and will exclude any grey literature.

Stage III: Study Selection and Eligibility Criteria

Once the references (excluding duplicates) are imported onto the Covidence platform, the first phase of the study selection will be title and abstract screening. This is then followed by the full-text review to select the relevant articles for the main and secondary research questions of our scoping review. Finally, during the last phase, a data extraction template will be created in Covidence and used to facilitate the extraction of the relevant information from the articles that were previously selected. This template will encompass items on participant demographics (age and sex/gender), type of worker (occupation or employment branch), the specific digital technology examined and amount of usage, physical health outcome variable(s) and fundamental research findings derived from the selected studies.

Given the sheer number of articles likely to be retrieved during the first phase, most, if not all co-authors, will be involved in the selection process during each phase, whereby each article will be revised by two persons. Moreover, when Covidence detects a conflict regarding the inclusion or exclusion of a study, this is then resolved by a third person.

In addition, regular online meetings will be held with the whole team to discuss any issue during the different article selection phases.

The eligibility for an article to be included will be based on the PCC and other criteria shown in Textbox 2. Note that there is no inclusion or exclusion criteria regarding the year of publication or the country of study. The former is because no prior scoping review on the precise topic has yet been published in a peer-reviewed journal, while any exclusion of territories would have to be justified.

Textbox 2. Eligibility criteria for the scoping review.

Inclusion criteria

1. Population: older workers (50+ included in study)
2. Concept: digital technologies related to work
3. Context: physical health outcomes
4. Setting: nonclinical and in the work sphere
5. Study type: original studies with any design or data type (quantitative and qualitative)
6. Publication status: published in a peer-reviewed journal
7. Publication language: English
8. Full-text available

Exclusion criteria

1. Population: younger workers (50+ not included in the study)
2. Concept: digital technologies not related to work (e.g., for health management)
3. Context: non-physical health outcomes (e.g., mental health)
4. Setting: Clinical and not in the work sphere
5. Study type: other study types (e.g., protocols, narrative reviews or systematic reviews)
6. Publication status: published without peer-review, dissertations, books, conference papers, letters, editorials.
7. Publication language: written in a language other than English
8. Full-text not available

Stage IV: Charting the Data

The information from each selected publication, obtained from the final data extraction phase, will be summarized in a table. The main outcomes of interest are provided in Item 11 of the PRISMA-Scr checklist (see Multimedia Appendix 1).

Stage V: Collating, Summarizing, and Reporting Results

In accordance with the recommendations outlined by Levac et al. [25], the fifth stage of our methodology consists of three distinct steps:

1. Analyzing research findings, encompassing both descriptive numerical summary analysis and qualitative thematic analysis.
2. Evaluating the research findings to extract outcomes aligned with the research question, which are then reported narratively.
3. Interpreting and discussing the findings in relation to additional research questions, practical applications, and policy implications.

In addition to narrative reporting, tables will be utilized to provide a structured overview of the key findings. The PRISMA-Scr [26] guidelines will be adhered to ensure systematic reporting of the results.

In addition, we will assess the quality of studies using the Mixed Method Appraisal Tool [30] whereby any discrepancies will be resolved through consensus between the reviewers.

Results

We devised a comprehensive search strategy to identify articles on physical health issues associated with the utilization of digital technologies in the workplace. The outcomes of our inquiry will be disseminated through a scoping review. Consequently, the selection process for publication will be delineated using flowcharts, while the data extracted from our research will be organized in tables and expounded upon in a narrative summary. Subsequently, the summarized findings will endeavor to address the research question: "How do digital technologies in the workplace affect the physical health of older workers?" and the sub-questions: i) What are the most common physical health issues that older workers have to manage as a result of using digital technologies at the workplace; and ii) What industries most affect older workers' physical health as a result of applying digital technologies ?

Discussion

Preliminary findings

The scoping review outlined in this protocol will lay the groundwork for a comprehensive research initiative examining the impact of digital technologies on the health of older workers. Building upon the proposed work in the scoping review, there is potential to harness innovative technological solutions and evaluations to promote enhanced well-being and productivity among older workers in various work settings. Moreover, we anticipate that the results of this scoping review will provide methodological insights and direction for exploring the integration of adaptive features for digital technology in the context of older workers. The findings from the scoping review will be shared through peer-reviewed scientific journals and conference presentations, contributing to the advancement of knowledge in this crucial area.

Limitations

Our selection criteria restrict the inclusion to articles presenting empirical evidence published in English, potentially biasing the study pool towards research from western countries as well as the physical health effects from digital technology used. Therefore, readers should exercise caution when interpreting the findings, considering the varying quality and applicability of the included studies.
The term "digital technology" was chosen as the subject heading for its relevance to our research scope. In developing our search strategy, we worked closely with an information specialist to pilot test a variety of terms, both subject headings and text words, aiming for comprehensive coverage. Subject headings are part of a controlled vocabulary that helps standardize the indexing of articles, while text words can vary greatly depending on the author's choice of language. This variability in text word usage may affect the inclusiveness of the search results. For instance, authors may use different terminology to describe similar concepts, or a term might have different connotations in different regions. Despite a thorough approach and expert consultations, we must acknowledge the possibility of not capturing all pertinent articles due to the dynamic nature of terminology in this rapidly evolving field.

Comparison with Prior Work

Our scoping review focuses on identifying digital technologies that impact the physical health of older workers and discerning which job types are most influenced by the integration of these technologies. The integration of digital technologies into the workplace offers potential benefits by

automating physically demanding tasks and optimizing work processes, which could potentially reduce physical strain on older workers [31,32]. However, despite the frequent use of technologies like smartphones, laptops, and tablets among older individuals, comprehensive studies exploring the direct links between digital work environments and physical health outcomes among older workers are scarce.

Previous scoping and systematic reviews have predominantly examined the mental impacts of digital technology at work, such as those on mental health outcomes listed in Table 1. The focus was largely on psychotherapeutic interventions using digital tools, with an emerging interest in technologies such as extended reality. A comprehensive overview of the effectiveness of digital and technological interventions in mental health and wellbeing is provided by De Witte et al. (2021) [33]. Similarly, Seberini et al (2022) reviewed the impact of Information and Communication Technologies (ICT) on older workers, particularly focusing on strategies to reduce the digital divide and technostress, and found how the rapid adoption of digital tools during the COVID-19 pandemic increased technostress among older workers as well as feelings of marginalization among older adults with a lack of technological skills, which also impacted their mental and physical health [34]. Li (2023), on the other hand, highlights how digital technologies were effectively used to address mental health issues among older workers during the COVID-19 pandemic, providing support through various web-based and mobile-based platforms [35]. Overall, the reviews collectively suggest that while digital technologies hold significant potential for improving mental health outcomes in workplace settings, they also discussed the dual nature of digital technology in workplaces, where it can either exacerbate stress and mental health issues or be a tool for promoting well-being.

Table 1: Selected systematic reviews on digital technologies for older people's mental health.

Review Citation	Population Age (older people, years)	Digital Technologies	Health Outcomes
Li, J. (2023) [35]	50+	eHealth & Remote Support	Reduction in depression, stress, and anxiety
De Witte et al. (2021) [33]	50-55	Workplace Digital Interventions	Workability, health maintenance
Seberini et al (2022) [34]	60+	Information and Communication Technologies (ICT)	Technostress

While there is extensive research on digital work's mental health impacts, our review focuses on the less explored physical health implications for older workers. Substantial causal evidence is notably scarce regarding how digital technologies affect their physical health.

The anticipated outcomes of our scoping review are therefore expected to elucidate dimensions considered pertinent to health promotion and disease prevention, particularly in supporting and maintaining the physical health of the aging workforce. This review will underscore the significance of mitigating occupational health risks, emphasizing the crucial influence of various factors—including physical, ergonomic, and psychosocial elements—on work-related health outcomes.

Conclusions

This scoping review will be the first to offer a comprehensive overview of physical health effects resulting from the use of digital technologies in the workplace. The research findings of this scoping review will serve as foundational knowledge for understanding the impact of digitalization on the health and well-being of older workers, informing future research directions and potential interventions aimed at promoting the health of this demographic in evolving work environments.

Acknowledgements

The research was partially financed through the COST Action CA21107 “Work inequalities in later life redefined by digitalization” (DIGI-net) that is supported by the European Cooperation in Science and Technology (COST). We would also like to thank Gøril Tvedten Jorem, Research Librarian at the Western Norway University of Applied Sciences, for her invaluable guidance in refining our search strategy and conducting essential pilot searches.

Author contributions

JS conceptualized the study. JS and CMT developed the methodology. Besides the Research Librarian, JS, DAG and YG also performed preliminary searches in article databases. All authors contributed to the first draft and critically reviewed and revised the submitted manuscript.

Conflicts of Interest

None declared

Abbreviations

PCC: Population, Concept, and Context
PRISMA-ScR: Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews

Multimedia Appendix 1

PRISMA-ScR checklist for this protocol

Multimedia Appendix 2

Database search for current or underway scoping and systematic reviews (PubMed)

Multimedia Appendix 3

A preliminary search for topic-related studies (MEDLINE, Cochrane and Epistemonikos)

References

1. Tosh G, Clifton AV, Xia J, White MM. Physical health care monitoring for people with serious mental illness. *Cochrane Database of Systematic Reviews.* 2014(1). doi: 10.1002/14651858.CD008298.pub3
2. Koipysheva E, Lebedinsky VY, Koipysheva M. Physical Health (definition, semantic content, study prospects). *European Proceedings of Social and Behavioural Sciences.* 2018;50. doi: 10.15405/epsbs.2018.12.73
3. Poscia A, Moscato U, La Milia DI, Milovanovic S, Stojanovic J, Borghini A, et al. Workplace health promotion for older workers: a systematic literature review. *BMC Health Services Research.* 2016;16(5):329. doi: 10.1186/s12913-016-1518-z
4. Maertens JA, Putter SE, Chen PY, Diehl M, Huang Y-HE, Hedge J, et al. 12 Physical Capabilities and Occupational Health of Older Workers. In: Borman WC, Hedge JW, editors. *The Oxford handbook of work and aging.* New York: Oxford University Press; 2012:215-235. ISBN: 9780199940752; 9780195385052
5. Phillip JM, Aifuwa I, Walston J, Wirtz D. The mechanobiology of aging. *Annual review of biomedical engineering.* 2015;17:113-141. doi: 10.1146/annurev-bioeng-071114-040829
6. Eurostat. *Ageing Europe: Looking at the Lives of Older People in the EU.* 2nd ed. Luxembourg: Publications Office of the European Union; 2020:3-182. ISBN: 9789276215202

7. Jones MK, Latreille PL, Sloane PJ, Staneva AV. Work-related health risks in Europe: Are older workers more vulnerable? *Soc Sci Med.* 2013;88:18-29. doi: 10.1016/j.socscimed.2013.03.027
8. Cijan A, Jenič L, Lamovšek A, Stemberger J. How digitalization changes the workplace. *Dynamic relationships management journal.* 2019;8(1):3-12. doi: 10.17708/DRMJ.2019.v08n01a01
9. Milaković M, Koren H, Bradvica-Kelava K, Bubaš M, Nakić J, Jeličić P, et al. Telework-related risk factors for musculoskeletal disorders. *Frontiers in Public Health.* 2023;11. doi: 10.3389/fpubh.2023.1155745
10. Honda T, Nakagawa T, Watanabe Y, Hayashi T, Nakano T, Horie S, et al. Association between information and communication technology use and ocular axial length elongation among middle-aged male workers. *Scientific Reports.* 2019;9(1):17489. doi: 10.1038/s41598-019-53423-8
11. Dunstan DW, Howard B, Healy GN, Owen N. Too much sitting – A health hazard. *Diabetes Research and Clinical Practice.* 2012;97(3):368-376. doi: 10.1016/j.diabres.2012.05.020
12. Arvola R, Tint P, Kristjuhan Ü, Siirak V. Impact of telework on the perceived work environment of older workers. *Scientific annals of economics and business.* 2017;64(2):199-214. doi: 10.1515/saeb-2017-0013
13. Ranasinghe U, Tang LM, Harris C, Li W, Montayre J, de Almeida Neto A, et al. A systematic review on workplace health and safety of ageing construction workers. *Safety science.* 2023;167:106276. doi: 10.1016/j.ssci.2023.106276
14. Stara V, Santini S, Kropf J, D'Amen B. Digital Health Coaching Programs Among Older Employees in Transition to Retirement: Systematic Literature Review. *J Med Internet Res.* 2020;22(9):e17809. doi: 10.2196/17809
15. Marchiori DM, Mainardes EW, Rodrigues RG. Do individual characteristics influence the types of technostress reported by workers? *International Journal of Human–Computer Interaction.* 2019;35(3):218-230. doi: 10.1080/10447318.2018.1449713
16. Tams S, Grover V, Thatcher J, Ahuja M. Grappling with modern technology: Interruptions mediated by mobile devices impact older workers disproportionately. *Information Systems and e-Business Management.* 2022;20(4):635-655. doi: 10.1007/s10257-021-00526-3
17. Venz L, Wöhrmann AM. Always on Call: Is There an Age Advantage in Dealing with Availability and Response Expectations? *Work, Aging and Retirement.* 2023;9(4):342-357. doi: 10.1093/workar/waac034
18. Mauno S, Minkkinen J, Tsupari H, Huhtala M, Feldt T. Do older employees suffer more from work intensification and other intensified job demands? Evidence from upper white-collar workers. *Scandinavian Journal of Work and Organizational Psychology.* 2019;4(1):Article 3. doi: 10.16993/sjwop.60
19. Matthew-Maich N, Harris L, Ploeg J, Markle-Reid M, Valaitis R, Ibrahim S, et al. Designing, implementing, and evaluating mobile health technologies for managing chronic conditions in older adults: a scoping review. *JMIR mHealth and uHealth.* 2016;4(2):e5127. doi: 10.2196/mhealth.5127
20. Wilson J, Heinsch M, Betts D, Booth D, Kay-Lambkin F. Barriers and facilitators to the use of e-health by older adults: a scoping review. *BMC public health.* 2021;21(1):1556. doi: 10.1186/s12889-021-11623-w
21. Kim BYB, Lee J. Smart Devices for Older Adults Managing Chronic Disease: A Scoping Review. *JMIR Mhealth Uhealth.* 2017;5(5):e69. doi: 10.2196/mhealth.7141
22. Chiu C-J, Hu J-C, Lo Y-H, Chang E-Y. Health Promotion and Disease Prevention Interventions for the Elderly: A Scoping Review from 2015–2019. *International Journal of Environmental Research and Public Health.* 2020;17(15):5335. doi: 10.3390/ijerph17155335
23. Zaman SB, Khan RK, Evans RG, Thrift AG, Maddison R, Islam SMS. Exploring Barriers to

and Enablers of the Adoption of Information and Communication Technology for the Care of Older Adults With Chronic Diseases: Scoping Review. *JMIR Aging.* 2022;5(1):e25251. doi: 10.2196/25251

24. De Santis KK, Mergenthal L, Christianson L, Busskamp A, Vonstein C, Zeeb H. Digital technologies for health promotion and disease prevention in older people: scoping review. *Journal of Medical Internet Research.* 2023;25:e43542. doi: 10.2196/37729
25. Levac D, Colquhoun H, O'brien KK. Scoping studies: advancing the methodology. *Implementation science.* 2010;5(69). doi: 10.1186/1748-5908-5-69
26. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Annals of Internal Medicine.* 2018;169(7):467-473. doi: 10.7326/M18-0850
27. McCarthy J, Heraty N, Cross C, Cleveland JN. Who is considered an ‘older worker'? Extending our conceptualisation of ‘older’from an organisational decision maker perspective. *Human Resource Management Journal.* 2014;24(4):374-393. doi: 10.1111/1748-8583.12041
28. LaMeres BJ. Introduction: analog vs. digital. In: LaMeres BJ, ed. *Introduction to Logic Circuits & Logic Design with VHDL.* Cham: Springer; 2017:1-5. doi: 10.1007/978-3-319-53883-9_1
29. Aromataris E, Lockwood C, Porritt K, Pilla B, Jordan Z, editors. *JBI manual for evidence synthesis.* JBI; 2024. https://synthesismanual.jbi.global [accessed April 18, 2024]
30. Hong QN, Fàbregues S, Bartlett G, Boardman F, Cargo M, Dagenais P, et al. The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers. *Education for information.* 2018;34(4):285-291. doi: 10.3233/EFI-180221
31. Hoonakker P. Information and communication technology and quality of working life: Backgrounds, facts, and figures. In: Korunka C, Hoonakker P, editors. *The impact of ICT on quality of working life.* Dordrecht: Springer; 2014:9-23. ISBN: 9789401788533; 978-94-017-8854-0
32. Hudomiet P, Willis RJ. Computerization, obsolescence and the length of working life. *Labour Economics.* 2022;77:102005. doi: 10.1016/j.labeco.2021.102005
33. De Witte NA, Joris S, Van Assche E, Van Daele T. Technological and digital interventions for mental health and wellbeing: an overview of systematic reviews. *Frontiers in digital health.* 2021;3:754337. doi: 10.3389/fdgth.2021.754337
34. Seberini A, Nour MM, Tokovska M. From Digital Divide to Technostress during the COVID-19 Pandemic: A Scoping Review. *Organizacija.* 2022;55(2):98-111. doi: 10.2478/orga-2022-0007
35. Li J. Digital technologies for mental health improvements in the COVID-19 pandemic: a scoping review. *BMC public health.* 2023;23(1):413. doi: 10.1186/s12889-023-15302-w

Supplementary Files

Multimedia Appendixes

Search results of scoping reviews of the effect of digitalization on the physical health of older workers (no relevant hits).
URL: http://asset.jmir.pub/assets/7cfdb3532400080fe1cc5f7fefdb0f13.pdf

Pilot test 1 of search terms of studies on the effect of digitalization on the physical health of older workers using Cochrane, Medline and Epistemonikos.
URL: http://asset.jmir.pub/assets/21b4289f837633ed8ba69a16243cbaba.pdf

PRISMA-ScR checklist.
URL: http://asset.jmir.pub/assets/93053209856b0ad1e9073dabe93a933f.pdf