Review Articles

Remote and Hybrid Work and Sedentary Behavior Among Working Adults: A Scoping Review of Behavioral Evidence and Cardiometabolic Research Gaps

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ABSTRACT

Background: Remote and hybrid work arrangements may improve autonomy and reduce commuting, but may also reduce routine movement and promote prolonged sitting. Evidence on sedentary behavior in these settings has expanded, whereas direct evidence on cardiometabolic outcomes remains limited. **Objective:** To map behavioral evidence on sedentary exposure in remote and hybrid work, describe its measurement and distribution across work arrangements, and characterize cardiometabolic outcomes as an evidence gap. **Methods:** We conducted a scoping review in accordance with the JBI methodology and reported it following the PRISMA-ScR guideline. PubMed, Embase, Web of Science Core Collection, PsycINFO, CINAHL, and Scopus were searched from database inception to 19 July 2026, supplemented by backward and forward citation searching. Two reviewers independently screened titles and abstracts and assessed potentially eligible full-text reports. Inter-reviewer agreement was high (Cohen's κ=0.82). Data were charted using a standardized form and independently verified by a second reviewer. Methodological appraisal was completed using the latest revised design-specific JBI critical appraisal tools. **Results:** The searches identified 360 records. After removal of 34 duplicates, 326 records underwent title-and-abstract screening, and 161 reports proceeded to full-text assessment. Following exclusion of 127 full-text reports, 34 reports representing 30 unique studies were included. Thirty-three reports representing 29 unique studies contributed quantitative or intervention evidence, and one intervention-development report contributed contextual evidence. Most studies reported greater occupational or total sitting, longer sedentary bouts, or fewer steps on home-working days, although several device-based studies reported null or mixed findings. Direct cardiometabolic evidence remained sparse and consisted mainly of one small cross-sectional study and short-term intervention trials without clear cardiometabolic improvement. **Conclusions:** Remote and hybrid work are often associated with greater sedentary exposure, particularly during working hours, but estimates vary across work arrangements and measurement methods. Direct evidence on long-term cardiometabolic outcomes is insufficient and largely cross-sectional. Movement-break, workstation, and organizational strategies may be considered to reduce occupational sitting, but their longer-term health effects warrant evaluation.

1. Introduction

Remote and hybrid work arrangements have become established components of the contemporary labor market. Advances in digital communication technologies had already enabled telework before the coronavirus disease 2019 pandemic, but public health restrictions greatly accelerated its adoption. Although many employees subsequently returned to conventional workplaces, fully remote and hybrid arrangements have persisted across management, professional, administrative, educational, financial, and technology-related occupations. In the United States, 35.5 million people, representing 22.9% of people at work, teleworked or worked from home for pay during the first quarter of 2024. The increasing proportion of employees completing only part of their working time remotely also reflects the growing importance of hybrid arrangements [1]. European evidence suggests that hybrid work may improve autonomy,

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work-life balance, and productivity while also creating risks related to longer working hours, blurred work-life boundaries, virtual meeting demands, and fewer structured breaks [2].

Remote and hybrid work are related but conceptually distinct. Remote work generally refers to work performed outside the employer's conventional worksite, often without a regular requirement to attend that worksite. Hybrid work involves the planned distribution of working time between the conventional workplace and one or more alternative locations, most commonly the employee's home. However, telework, telecommuting, working from home, home-based work, flexible-location work, and hybrid work are frequently used interchangeably. This definitional inconsistency complicates comparisons and may conceal dose-response relationships between the proportion of working time performed remotely and health-related behaviors.

Sedentary behavior is any waking behavior characterized by an energy expenditure of 1.5 metabolic equivalents or less while in a sitting, reclining, or lying posture [3]. It is distinct from physical inactivity, which refers to insufficient moderate- to vigorous-intensity physical activity. An individual may therefore meet physical activity recommendations while also accumulating substantial sedentary time. Sedentary exposure can be described by its total duration, behavioral domain, prolonged bouts, interruptions, and temporal distribution. These distinctions matter because the physiological consequences of uninterrupted sitting may differ from those associated with the same total sitting time accumulated in shorter bouts [3][4].

High levels of sedentary behavior have been associated with greater waist circumference, impaired insulin sensitivity, unfavorable blood lipid profiles, type 2 diabetes, cardiovascular morbidity, and cardiovascular mortality [4][5][6]. Experimental studies further suggest that interrupting prolonged sitting with brief standing or light-intensity activity can improve acute postprandial glucose and insulin responses. Nevertheless, the long-term clinical significance of sitting interruptions and their feasibility in remote-work settings remain uncertain.

Remote work may increase sedentary exposure through several pathways. Travelling to and moving within a conventional workplace generates incidental activity through commuting, walking between work areas, attending meetings, and using shared facilities. When work is performed at home, these opportunities may be replaced by computer-mediated tasks within a restricted physical space. Remote workers may also experience longer periods of uninterrupted concentration, greater dependence on digital devices, fewer externally structured breaks, and blurred boundaries between work and non-work time.

Evidence from working populations generally supports concern about increased sitting during remote work, although findings are not uniform. Fukushima et al. reported that Japanese employees working from home accumulated more occupational sedentary time and less light- and moderate-to-vigorous-intensity physical activity than workers at conventional worksites [7]. Loef et al. found that both home and hybrid workers were more likely than location-based workers to report high levels of sitting during the pandemic [8]. In the ELSA-Brasil study, working from home was associated with higher odds of accumulating more than 8 hours per day of sitting or screen time [9]. Device-based studies have similarly reported more sitting and fewer steps on home-working days, although some within-person comparisons found small or statistically uncertain differences [10][11].

Recent systematic reviews have concentrated on sedentary behavior and physical activity rather than clinical cardiometabolic outcomes. Polspoel et al. synthesized observational comparisons of telework and office work, while Schöne et al. estimated that working from home was associated with approximately 31 additional minutes of sitting during work hours; both reviews reported substantial heterogeneity and a predominance of pandemic-era evidence [12][13]. Consequently, it remains unclear whether behavioral differences persist under routine post-pandemic hybrid work and whether they translate into measurable cardiovascular or metabolic harm.

Several gaps justify a scoping review. First, fully remote and hybrid workers are often combined despite potentially different exposure doses. Second, pandemic-era home working occurred alongside mobility restrictions, childcare disruption, and closure of recreational facilities. Third, many studies rely on a single self-reported estimate of sitting or screen time rather than measuring occupational sitting, prolonged bouts, and interruptions. Fourth, direct evidence linking remote-work-related sedentary behavior with blood pressure, glucose, lipids, adiposity, and clinical cardiovascular outcomes is sparse. Finally, the available intervention evidence has not been integrated with the observational evidence.

Therefore, this review aimed to map evidence concerning sedentary behavior across remote and hybrid work arrangements among working adults, while explicitly characterizing the scarcity and limitations of evidence on cardiovascular and metabolic outcomes. The review also sought to compare work arrangements, describe measurement approaches, identify contextual determinants, summarize intervention strategies, and define priorities for future occupational-health research.

The specific objectives were to:

- describe how remote and hybrid work arrangements were defined and measured;
- characterize the level, domain, accumulation pattern, and measurement of sedentary behavior;
- compare sedentary behavior across fully remote, hybrid, and on-site work arrangements;
- summarize cardiovascular, metabolic, and adiposity-related outcomes measured alongside sedentary behavior;
- identify individual, household, environmental, and organizational determinants;
- map interventions designed to reduce sedentary behavior; and
- identify methodological limitations and evidence gaps.

2. Methods

2.1. Study Design and Reporting

This scoping review was conducted in accordance with the JBI methodology for scoping reviews and reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) [14][15]. The Population-Concept-Context framework was used to define the eligibility criteria.

2.2. Eligibility Criteria

Studies were eligible when they met the following criteria.

2.2.1 Population. Eligible studies involved adults aged 18 years or older engaged in paid employment. Full-time, part-time, contract, and self-employed workers were eligible when the work arrangement was comparable with remote or hybrid employment. Studies focused exclusively on students, retired adults, unemployed populations, unpaid caregivers, or occupational groups whose sedentary exposure was determined by the essential physical requirements of the job were excluded.

2.2.2 Concept. The principal concept was sedentary behavior in relation to remote or hybrid work. Eligible measures included total sedentary time, occupational sitting, non-work sitting, screen-based sedentary time, prolonged bouts, interruptions to sitting, sit-to-stand transitions, or the proportion of working time spent sitting. Studies reporting only physical activity without an identifiable sedentary or sitting measure were excluded. Cardiometabolic outcomes included systolic and diastolic blood pressure, heart rate and heart-rate variability, body weight, body mass index, waist circumference, body fat, glucose, glycated hemoglobin, insulin resistance, blood lipids, metabolic syndrome, type 2 diabetes, cardiovascular risk scores, and cardiovascular events. Studies were eligible through at least one of four pathways: (1) remote or hybrid work as an exposure and sedentary behavior as an outcome; (2) sedentary behavior as an exposure and cardiometabolic health as an outcome in remote or hybrid workers; (3) sedentary behavior as a mediator or explanatory pathway; or (4) an intervention targeting sedentary behavior.

2.2.3 Context and Evidence Sources. Eligible contexts included fully remote work, working from home, telework, telecommuting, hybrid work, and flexible-location work. Conventional on-site workers were eligible only as a comparison group. Pandemic-era studies were retained but were classified separately from routine post-pandemic arrangements. Observational, longitudinal, repeated-measures, experimental, mixed-methods, and relevant intervention-development studies were eligible. Reviews were used for citation searching but were not included in the primary evidence synthesis.

2.3. Information Sources and Search Strategy

A comprehensive literature search was conducted in PubMed, Embase, Web of Science Core Collection, PsycINFO, CINAHL, and Scopus from database inception to 19 July 2026. The searches were supplemented by backward and forward citation searching of included studies and relevant systematic reviews. The search strategy combined controlled vocabulary and free-text terms related to remote and hybrid work with terms related to sedentary behavior and sitting. Database-specific syntax and controlled vocabulary were used where appropriate.

The PubMed strategy was developed first and adapted to the syntax and controlled vocabulary of the other databases. A complementary cardiometabolic block was used to identify reports measuring blood pressure, glucose metabolism, blood lipids, adiposity, metabolic syndrome, diabetes, or cardiovascular outcomes. The complete database-specific strategies, search dates, and applied limits are reported in Supplementary Appendix 1.

("Teleworking"[MeSH] OR telework* OR telecommute* OR "remote work" OR "work from home" OR "working from home" OR "hybrid work") AND ("Sedentary Behavior"[MeSH] OR sedentary* OR sitting OR "occupational sitting" OR "screen time" OR accelerometer* OR activable)

2.4. Source Selection

All retrieved records were entered into a structured screening registry. Duplicates were identified using automated duplicate detection followed by manual verification. Two reviewers independently screened the titles and abstracts of all deduplicated records against the prespecified eligibility criteria. Reports considered potentially eligible by either reviewer proceeded to full-text assessment. The same reviewers independently assessed the full-text reports and assigned one principal reason for each exclusion. Disagreements at both stages were resolved through discussion and consensus. Inter-reviewer agreement was high (Cohen's κ=0.82). Reports from the same cohort were linked to avoid double counting.

Reports classified as having no eligible sedentary-behavior measure mentioned sedentary behavior or a related construct but did not provide an extractable measure meeting the eligibility criteria. Reports classified as physical-activity-only presented outcomes such as steps, light-intensity activity, or moderate-to-vigorous physical activity without reporting a sitting or sedentary-behavior outcome. Each excluded full-text report was assigned only one principal exclusion reason.

2.5. Data Charting

A standardized data-charting form was developed and piloted before formal data extraction. One reviewer charted publication year, country, study design, data-collection period, pandemic context, sample characteristics, work arrangement, sedentary-behavior measurement, cardiometabolic outcomes, effect estimates, principal findings, and methodological concerns. A second reviewer independently verified all charted data against the full-text reports. Discrepancies were resolved through discussion and consensus, with reference to the original reports where necessary. Quantitative and intervention reports were charted in the main extraction table; qualitative and intervention-development evidence was retained separately for interpretation and implementation planning.

2.6. Data Synthesis

Study characteristics were summarized descriptively. Reports from the same cohort were grouped under a common study identifier. Findings were synthesized narratively by work arrangement, sedentary-behavior measurement, pandemic context, cardiometabolic outcome, and intervention type. A formal meta-analysis was not undertaken because exposure definitions, study designs, behavioral measures, and outcomes were heterogeneous. Directional findings were described as indicating higher sedentary exposure, no clear difference, mixed findings, or intervention-related reduction.

2.7. Critical Appraisal

Methodological appraisal was completed for all 30 unique studies using the latest revised design-specific JBI critical appraisal tools [16]. After design-based mapping, the analytical cross-sectional tool was applied to 21 studies, the cohort tool to five studies, the randomized controlled trial tool to two studies, and the quasi-experimental tool to two studies. The within-person or repeated-measures observational studies and the repeated cross-sectional study were appraised using the analytical cross-sectional tool. The non-randomized intervention was appraised using the quasi-experimental tool. For the intervention-development study, the quasi-experimental tool was applied only to the uncontrolled empirical testing conducted in Step 5 because the broader intervention-development process was not fully captured by an existing JBI effectiveness appraisal tool. One reviewer completed the item-level appraisal, and a second reviewer verified all judgements against the full-text reports. Discrepancies were resolved through discussion and consensus. Items were judged as Yes, No, Unclear, or Not applicable. No numerical cut-offs or overall high-, moderate-, or low-quality classifications were applied. Appraisal judgements were used to contextualize the narrative synthesis rather than determine study eligibility; study-level item judgements are not reported.

3. Results

3.1. Study Selection

The database searches identified 360 records: PubMed (n=48), Embase (n=65), Web of Science Core Collection (n=145), PsycINFO (n=32), CINAHL (n=14), and Scopus (n=56). After removal of 34 duplicate records, 326 records underwent title-and-abstract screening. Of these, 165 records were excluded, and 161 reports proceeded to full-text eligibility assessment. All full texts were retrieved. Following full-text assessment, 127 reports were excluded because they did not contain an eligible sedentary-behavior measure (n=34), did not involve a remote or hybrid work context (n=23), involved an ineligible population (n=14), reported physical activity without an identifiable sedentary-behavior outcome (n=24), were ineligible publication types (n=14), did not examine an identifiable remote-work-to-sedentary-behavior pathway (n=13), or met other exclusion criteria (n=5). Ultimately, 34 reports representing 30 unique studies were included in the review (Figure 1). Of these, 33 reports representing 29 unique studies contributed quantitative, physiological, or intervention evidence, and one report contributed contextual intervention-development evidence.

Table 1. Study-selection summary

Selection category	Number of reports
Records identified from databases	360
PubMed	48
Embase	65
Web of Science Core Collection	145
PsycINFO	32
CINAHL	14
Scopus	56
Duplicate records removed	34
Records screened by title and abstract	326
Records excluded at title-and-abstract screening	165
Full-text reports assessed	161
Full-text reports excluded	127
Reports included in the review	34
Unique studies represented	30

3.2. Characteristics of the Evidence Base

The 29 quantitative or intervention studies were published from 2018 to 2026, and all but one were published from 2021 onward. Eight studies were conducted in Japan, five in Germany, four in the United States, two in Sweden, and one each in Qatar, Brazil, Finland, the Netherlands, Australia, Canada, Italy, the United Kingdom, and India; one preprint had not yet been fully verified for country. Fourteen studies were classified as pandemic-era, 10 as post-pandemic, and five as pre-pandemic or mixed-context studies. Seventeen studies were cross-sectional or observational, five were longitudinal or cohort studies, three used within-person or repeated-measures comparisons, one used a repeated cross-sectional design, one was a non-randomized intervention, and two were randomized trials. Sample sizes ranged from 23 to 152,421 participants. The evidence was dominated by desk-based, professional, administrative, university, and white-collar workers. Large population studies provided statistical precision but often relied on self-reported work arrangement and sitting, whereas device-based studies generally included smaller and more selected samples.

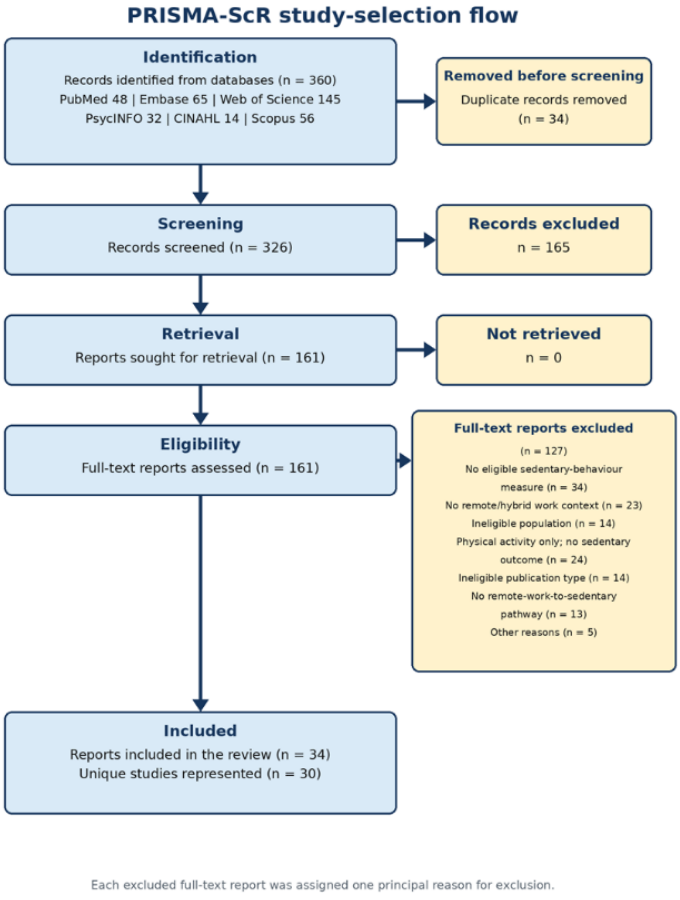

Fig. 1 PRISMA-SCRA flow diagram for study identification and selection

Table 2. Summary profile of the 29 quantitative and intervention studies

Characteristic	Category	Number of studies
Publication period	2018-2020 / 2021-2026	1 / 28
Pandemic context	Pandemic-era / post-pandemic / pre-pandemic or mixed	14 / 10 / 5
Study design	Cross-sectional or observational	17
Study design	Longitudinal or cohort	5
Study design	Within-person or repeated measures	3
Study design	Repeated cross-sectional	1
Study design	Non-randomised intervention	1
Study design	Randomised trial	2
Sedentary measurement	Self-report only	13
Sedentary measurement	Device-based only	10
Sedentary measurement	Mixed device, self-report, or clinical assessment	6
Overall total	Unique studies	29

Note: Design categories and measurement categories are mutually exclusive within their respective blocks; each block sums to 29 unique quantitative or intervention studies.

3.3. Definitions of Remote and Hybrid Work

Terminology and exposure measurement varied considerably. Working from home, remote work, telework, and hybrid work were frequently treated as interchangeable labels. Many studies used a binary comparison between home-working and on-site workers or between home and office days. A smaller but important group quantified exposure using the number of remote-working days, the proportion of work completed at home, or categories of low, middle, and high work-from-home frequency. These frequency-based studies generally provided clearer evidence of a graded relationship between remote work and sedentary exposure.

Fully remote and hybrid workers were not always separated. This was particularly important in large cohort studies, where home and hybrid workers often both showed higher odds of prolonged sitting than location-based workers, but the magnitude of association tended to be greater among fully home-based workers. Voluntary and mandatory remote work, the duration of the work arrangement, and the proportion of work completed remotely were inconsistently reported.

3.4. Measurement of Sedentary Behavior

Thirteen of the 29 studies relied on self-reported sedentary behavior, 10 used device-based measures, and six combined devices with self-report, survey, physiological, or clinical assessment. Self-report instruments included the Occupational Sitting and Physical Activity Questionnaire, the International Physical Activity Questionnaire, study-specific estimates of sitting or screen time, and categorical thresholds such as 8 or 9 hours of daily sitting.

Device-based approaches included activable or thigh-worn inclinometers, accelerometers, and commercial activity monitors. These studies provided more detailed information on total sitting, occupational sitting, prolonged bouts, steps, standing time, and sit-to-stand transitions. However, device placement, valid-wear criteria, work-time definitions, and bout thresholds varied. Screen time was sometimes used as a sedentary indicator, although it did not necessarily correspond to sitting posture.

3.5. Sedentary Behavior Across Work Arrangements

3.5.1 Overall direction of evidence. Most studies indicated that working from home was associated with greater sedentary exposure. This was expressed as more occupational or total sitting, a higher proportion of the workday spent sedentary, longer prolonged bouts, or fewer steps. Fukushima et al. reported a mean occupational sedentary time of 335.7 minutes among home workers compared with 224.7 minutes among workers at conventional worksites. In the Lifelines cohort, the odds of sitting for at least 8 hours on a workday were higher among home workers (odds ratio 1.94, 95% confidence interval 1.83-2.06) and hybrid workers (odds ratio 1.73, 95% confidence interval 1.59-1.88) than among location-based workers.

Large self-report studies consistently identified prolonged sitting. Beginning to work from home during the Japanese state of emergency was associated with an odds ratio of 2.14 (95% confidence interval 1.78-2.57) for an increase of at least 2 hours in prolonged sedentary time. In ELSA-Brasil, home workers had approximately threefold higher adjusted odds of accumulating more than 8 hours per day of sitting or screen time.

3.5.2 Device-measured findings. Device-based studies generally supported the same direction but showed more variation in magnitude. In the German SITFLEX study, workers accumulated an estimated 378 sedentary minutes on home-working days compared with 351 minutes in traditional open-plan offices and 333 minutes in activity-based offices; home-working days also included markedly fewer steps but more sit-to-stand transitions. Kikuchi et al. reported 59.2% fewer steps and a 6.6-percentage-point increase in sedentary time on work-from-home days. Tomonaga et al. found approximately 20 additional sedentary minutes after excluding commuting time, together with lower daily energy expenditure. A recent within-person preprint similarly estimated 31 additional sedentary minutes during remote work time, 24 fewer minutes of light activity, and 7 fewer minutes of moderate-to-vigorous activity.

Several device-based studies found no clear difference or mixed findings. Hallman et al. estimated a home-versus-office difference of approximately -12 minutes of work sitting, with a confidence interval spanning substantial benefit and harm. Kim et al. reported a similarly uncertain within-person difference. Sers et al. found no clear association between work-from-home status and sedentary time, breaks, or bout patterns. Scutari et al. observed no significant difference in accelerometer-measured sedentary time between hybrid and on-site workers, although hybrid workers reported more sitting by questionnaire. Widar et al. found no workplace-by-time interaction for total sedentary time but observed more sit-to-stand transitions during telework [17].

3.5.3 Remote-work frequency and prolonged sitting. Studies that quantified remote-work frequency generally suggested a dose-response pattern. More work-from-home days were associated with greater work-related and total sitting, more prolonged sedentary bouts, and fewer active minutes or steps. In a 2026 longitudinal study of Japanese desk workers, middle-frequency work from home was associated with 1.69 times the odds of sitting for at least 8 hours per day, and high-frequency work from home with 1.88 times the odds, compared with low-frequency work from home [18]. Associations were stronger among men, non-managerial full-time employees, and employees working at least 40 hours per week.

3.5.4 Determinants of sitting and sitting breaks

Among 267 university staff predominantly working from home, 89.5% of working time was spent sitting, and employees took an average of 1.36 sitting breaks per hour. Taking at least two breaks per hour was associated with a 53% reduction in the odds of belonging to the highest sitting category. Physical opportunity, automatic motivation, age, and sitting-break habits explained part of the variation in sitting. Qualitative evidence further identified blurred work-life boundaries, expectations of constant online availability, workload, limited physical space, and line-manager norms as barriers to movement [19].

3.6. Cardiovascular and Metabolic Outcomes

Direct cardiometabolic evidence was limited and substantially weaker than the behavioral evidence. Most included studies measured sedentary behavior without objective cardiovascular or metabolic outcomes. Several reports arose from cohorts with blood-pressure or health measurements, but the extracted analyses focused mainly on sitting, screen time, or physical activity rather than on clinical associations.

The most direct study was an analytical cross-sectional investigation of 142 adults who had worked remotely full-time for at least one year [20]. Sixty-eight percent reported sitting for more than 8 hours per day. Longer sedentary time was associated with higher systolic blood pressure, resting heart rate, low-density lipoprotein cholesterol, body mass index, and waist circumference. Sedentary time and perceived stress remained independent predictors of adverse cardiovascular risk markers in regression analyses. However, sitting was self-reported, recruitment occurred through wellness

programs and online platforms, and the cross-sectional design prevented causal inference.

Other evidence was less conclusive. Abed Alah et al. collected self-reported weight change and found greater increases in sitting among home workers, but weight was a secondary outcome, and the temporal relationship was uncertain. Scutari et al. collected blood samples and clinical parameters in a small hybrid-versus-on-site comparison, but the extracted report did not provide sufficiently detailed biomarker estimates for a robust synthesis. Widar et al. assessed heart rate, heart-rate variability, and cortisol in a small pre-pandemic telework study and found no clear adverse effect of telework. In the Mailey trial, cardiometabolic outcomes were assessed over 12 weeks, but no significant changes were observed despite large reductions in occupational sitting [21]. No included study established an association with incident cardiovascular disease, type 2 diabetes, metabolic syndrome, or cardiovascular mortality.

Table 3. Direct or supportive cardiometabolic and physiological evidence

Study	Design/sample	Sedentary exposure	Health outcomes	Main finding
Chatterjee et al., 2025	Cross-sectional; n=142 long-term remote workers	>8 h/day versus lower sitting categories	Blood pressure, resting heart rate, BMI, waist, fasting glucose and lipids	Higher sitting was associated with less favourable systolic BP, resting heart rate, LDL, BMI and waist circumference.
Mailey et al., 2022	Four-arm RCT; n=95 home-working university employees	Intervention-related reductions in workday sitting	Cardiometabolic health outcomes	Large sitting reductions occurred, but no significant short-term health changes were detected.
Scurati et al., 2024	Cross-sectional; n=56 hybrid/on-site workers	Accelerometer and self-reported sedentary time	Blood samples, clinical and fitness parameters	No objective sitting difference; detailed biomarker estimates require primary-report verification.
Widar et al., 2021	Small telework study; n=23	Device-measured sedentary time and transitions	Heart rate, HRV and cortisol	No clear adverse telework effect; sit-to-stand transitions increased.
Abed Alah et al., 2022	Cross-sectional; n=1,061	Self-reported increase in sitting/reclining	Weight change	Greater sitting increase in home workers; weight evidence was secondary and self-reported.

3.7. Interventions to Reduce Sedentary Behavior

Three studies evaluated the effect of a policy or intervention on sedentary behavior, and one additional study systematically developed a home-working intervention toolkit. Olsen et al. examined a flexible-work policy in a small pre-post study and found high sitting on home-working days, with mixed or non-significant behavioral changes.

In a four-arm randomized trial of 95 university employees working from home, Mailey et al. compared a height-adjustable desk, a 12-week online behavior-change program, their combination, and a control condition. Reductions in workday sitting were largest in the combined group (-206 minutes per workday), followed by the desk-only group (-122 minutes) and programmed-only group (-96 minutes). No significant cardiometabolic changes were detected over the study period.

Enger et al. randomized 121 university employees to individualized workplace counselling, a standardized factsheet, or control [22]. Individual counselling reduced occupational sedentary time by approximately 30.7 minutes over four weeks, compared with no change in the factsheet group and an increase of approximately 6 minutes in controls. Overall sedentary time, well-being, and pain did not improve. The results suggest that personalized behavioral support may outperform information alone, but a single counselling session has limited effects.

The intervention-development study by Sivaramakrishnan et al. used the Six Steps in Quality Intervention Development and Behavior Change Wheel frameworks to design a toolkit for home workers [23]. The toolkit combined education, intention formation, action planning, movement strategies, social support, and organizational guidance. Acceptability testing supported a multi-component approach, but effectiveness has not yet been established.

Table 4. Intervention evidence

Study	Design	Intervention	Comparator	Sedentary outcome	Health/implementation outcome
Olsen et al., 2018	Single-group pre-post	Flexible-work policy	Pre-intervention	Mixed or non-significant change	Limited power and short follow-up.
Mailey et al., 2022	Four-arm RCT; n=95	Height-adjustable desk, online programme, or both	Control	-122, -96, and -206 min/workday, respectively	No significant short-term cardiometabolic change.
Engeroff et al., 2026	Three-arm RCT; n=121	20-min individualised counselling	Factsheet and control	-30.7 min occupational sitting	No improvement in overall sitting, well-being, or pain.
Sivaramakrishnan et al., 2025	Intervention development	Multi-component home-working toolkit	Not applicable	Effectiveness not yet tested	Acceptable employee, manager, and organisational strategies.

3.8. Methodological Characteristics and Limitations

Formal JBI critical appraisal was completed and considered alongside the design and reporting characteristics of the evidence base. Common methodological strengths included large cohort datasets, within-person comparisons, posture-sensitive devices, and adjustment for demographic or occupational covariates. Common limitations included cross-sectional designs, convenience sampling, self-reported work arrangements, inconsistent hybrid-work definitions, incomplete control of confounding, and inadequate separation of work and non-work sitting. Because no overall

quality categories were assigned, the appraisal informed the cautious narrative interpretation of these recurring strengths and limitations.

Only a minority of studies combined objective sedentary measurement with objective cardiometabolic assessment. Device studies were often small and occupationally homogeneous, while large studies relied on self-report. Several linked reports came from the same cohorts, particularly RESET-BP, Lifelines, and FLOC, requiring study-level grouping to avoid double counting. One recent device-based study remained a preprint, and several primary reports required further verification of exact effect estimates and methods.

4. Discussion

4.1. Principal Findings

This scoping review identified four principal findings. First, most studies reported greater occupational or total sedentary exposure when working from home, although several device-based comparisons were null or mixed. Second, studies that quantified remote-work frequency generally reported longer sitting or prolonged bouts at higher frequencies. Third, the evidence base was weighted towards behavioral outcomes; direct cardiometabolic evidence was sparse, predominantly cross-sectional, and not sufficient for causal inference. Fourth, small short-term interventions reduced occupational sitting, but evidence was insufficient to determine longer-term health effects or the effectiveness of organization-wide strategies.

4.2. Sedentary Behavior Across Remote and Hybrid Work Arrangements

The general direction of evidence is consistent with a loss of incidental movement. Commuting, walking between meeting rooms, and moving to shared facilities are reduced when work is performed at home. Virtual meetings and digital communication can also compress work into long uninterrupted periods. The 2025 systematic review used for citation chasing reached a similar conclusion, estimating 31 additional minutes of sitting during work hours when employees worked from home.

However, remote work should not be conceptualized as a binary exposure. An employee working from home once per week retains most commuting and office-related movement, whereas an employee working remotely every day may experience a substantial reduction in incidental activity. The longitudinal findings by Miura et al. and the frequency gradients observed in Japanese and German studies reinforce the need to report remote-working days, weekly hours, proportion of work completed remotely, and duration of exposure.

4.3. Fully Remote Versus Hybrid Work

Hybrid work may preserve some commuting and workplace movement, but it does not necessarily prevent high sedentary exposure. Large cohort data suggested that both fully home-based and hybrid workers were more likely than location-based workers to report prolonged sitting, with somewhat stronger associations among fully home-based workers. Within-person studies are especially informative because they compare the same employees on home and office days, thereby reducing confounding by stable occupational and individual characteristics.

Nevertheless, hybrid schedules remain heterogeneous. A schedule involving four home days and one office day is not equivalent to one home day and four office days. Future studies should avoid using 'hybrid' without quantifying the schedule and should distinguish planned hybrid work from occasional or emergency home working.

4.4. Cardiometabolic Implications

The revised title frames cardiometabolic health as a research gap because this part of the literature is underdeveloped. General-population research provides strong biological plausibility: prolonged sitting reduces skeletal-muscle activity and energy expenditure and may impair glucose regulation, lipid metabolism, and vascular function. However, it is not valid to infer that all health changes observed among remote workers are caused by sitting.

Remote work may influence health through diet, sleep, psychosocial stress, alcohol use, work duration, social isolation, and leisure-time physical activity. The Chatterjee study is important because it measured multiple objective risk markers, but its cross-sectional design and self-reported sitting preclude causal inference. The absence of significant health changes in the Mailey trial may reflect the short intervention period, small sample, and relatively healthy working population rather than the absence of a long-term benefit. Longitudinal studies with repeated device-based sitting and clinical assessments are needed before the cardiometabolic consequences of remote work can be quantified.

4.5. Pandemic-Era Versus Post-Pandemic Evidence

Nearly half of the quantitative studies were conducted during the COVID-19 pandemic. Mandatory home working occurred alongside restrictions on travel, exercise facilities, social contact, and childcare arrangements. Increased sitting during this period may therefore reflect both work location and wider reductions in mobility. Post-pandemic studies nevertheless continued to show more sitting, fewer steps, or prolonged sedentary exposure on home-working days, suggesting that the issue is not entirely explained by lockdown conditions.

Future reviews should stratify pandemic and post-pandemic evidence. Contemporary remote workers may have greater autonomy to walk outdoors, use coworking spaces, or organize exercise, but they may also experience more intensive digital monitoring and meeting schedules. The determinants of sedentary behavior may therefore change even when the total sitting difference remains similar.

4.6. Measurement Considerations

Measurement heterogeneity limits comparison. Self-reported sitting is feasible in large samples but is vulnerable to recall bias and may not capture short breaks. Screen time is an imperfect proxy because screen use can occur while standing, whereas non-screen work can occur while sitting. Hip- and wrist-worn accelerometers estimate movement intensity but may misclassify stationary standing as sedentary behavior. Thigh-worn inclinometers are more suitable for distinguishing posture and transitions, but they are more costly and burdensome.

Future studies should combine posture-sensitive devices with work diaries or ecological momentary assessment to distinguish work and non-work time. Device placement, valid-wear criteria, sedentary thresholds, bout definitions, and working-hour classification should be fully reported. A 24-hour movement-behavior approach would also help determine whether reduced occupational movement is compensated by more leisure-time physical activity or sleep.

4.7. Implications for Occupational Health Practice

Given the consistency of the behavioral signal but limited intervention evidence, sedentary behavior may be considered within remote-work health and safety planning. Sitting is shaped by workload, meeting schedules, managerial expectations, communication practices, and workstation design; however, the effects of organization-level changes have not been adequately tested in remote and hybrid settings.

Low-risk strategies that warrant evaluation include short movement breaks, avoiding unnecessarily consecutive virtual meetings, optional walking or standing during suitable tasks, and access to sit-stand equipment where feasible. Small trials indicate that a height-adjustable desk combined with an online programmed and individualized counselling can reduce occupational sitting, whereas a factsheet alone showed little change in one trial. Whether protected breaks, meeting redesign, or broader organizational culture changes improve cardiometabolic outcomes remains untested.

4.8. Research Priorities

- Conduct longitudinal studies with repeated measures of remote-work exposure, posture-sensitive sedentary behavior, and objective cardiometabolic outcomes.
- Quantify fully remote, hybrid, and occasional remote work using days, hours, and proportion of total working time.
- Separate occupational sitting, leisure sitting, screen time, prolonged bouts, and sitting interruptions.
- Recruit more diverse occupational and socioeconomic groups, including workers with chronic conditions, caregiving responsibilities, disabilities, and limited home-workspace resources.
- Evaluate multi-component organizational and environmental interventions over longer follow-up periods.
- Assess implementation outcomes, including feasibility, acceptability, equity, cost, organizational support, and unintended consequences.

4.9. Strengths and Limitations

This review has several strengths. A comprehensive search was conducted across six biomedical, nursing, psychological, occupational-health, and multidisciplinary databases and was supplemented by citation searching. Study selection was conducted independently by two reviewers, with high inter-reviewer agreement (Cohen's κ=0.82), and all charted data were independently verified by a second reviewer. Methodological appraisal was completed for all 30 unique studies using design-specific JBI tools, and all appraisal judgements were verified by a second reviewer. The review also distinguished sedentary behavior from physical inactivity, separated fully remote and hybrid arrangements where possible, incorporated device-based and self-reported evidence, and grouped multiple reports from the same study to minimize double counting.

This review also has important limitations. Terminology and measurement of remote and hybrid work varied substantially across studies, and the evidence base was dominated by cross-sectional and pandemic-era research. Large studies frequently relied on self-reported sitting and work arrangements, whereas device-based studies generally involved smaller and occupationally selected samples. Although design-specific JBI appraisal was completed and verified, study-level item judgements were not reported in the main text or supplementary materials, which limits independent verification of the appraisal. Several primary reports require direct citation verification, and one recent study was a non-peer-reviewed preprint. Direct cardiometabolic evidence remained sparse, limiting causal interpretation and generalizability to routine post-pandemic hybrid work.

5. Conclusions

Remote and hybrid work are often associated with greater occupational sedentary exposure, including more sitting, longer sedentary bouts, or fewer steps on home-working days. However, estimates vary, and several device-based studies found null or mixed differences. Higher remote-work frequency may be associated with greater odds of prolonged sitting, but causal effects have not been established.

Evidence linking these behavioral changes with long-term cardiovascular and metabolic outcomes is currently insufficient. Only a small number of studies measured objective health markers, and the clearest direct evidence was cross-sectional. Future research should use quantitative definitions of remote and hybrid work, posture-sensitive measurement, repeated clinical assessments, and longer intervention follow-up.

Movement breaks, workstation, counselling, and organizational strategies may be considered to reduce occupational sitting, but recommendations should remain proportionate to the evidence. The short-term behavioral effects of sit-stand desks and individualized counselling are more directly supported than the health effects of meeting redesign, protected breaks, or organization-wide culture change. These broader strategies warrant prospective evaluation with objective cardiometabolic outcomes.

CRediT authorship contribution statement

XXXX: Writing – original draft, Methodology, Formal analysis, Conceptualization. **XXXX:** Writing – review & editing, Methodology. **XXXX:** Writing – review & editing, Methodology, Conceptualization.

Declaration of generative AI and AI-assisted technologies in the writing process

The free versions of Grammarly were used for spell-checking and grammar corrections. After using these tools, the author(s) reviewed and edited the content as needed and take full responsibility for the content of the publication.

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REFERENCES

[1] U.S. Bureau of Labor Statistics. Telework trends. Beyond the Numbers. March 2025.

[2] Eurofound. The Hybrid Workplace: Ensuring Benefits for Workers and Organisations. Publications Office of the European Union; 2025.

[3] Tremblay MS, Aubert S, Barnes JD, et al. Sedentary Behavior Research Network terminology consensus project process and outcome. Int J Behav Nutr Phys Act. 2017;14:75. doi:10.1186/s12966-017-0525-8.

[4] World Health Organization. WHO Guidelines on Physical Activity and Sedentary Behaviour. World Health Organization; 2020.

[5] Biswas A, Oh PI, Faulkner GE, et al. Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: a systematic review and meta-analysis. Ann Intern Med. 2015;162(2):123-132. doi:10.7326/M14-1651.

[6] Patterson R, McNamara E, Tainio M, et al. Sedentary behaviour and risk of all-cause, cardiovascular and cancer mortality, and incident type 2 diabetes: a systematic review and dose-response meta-analysis. Eur J Epidemiol. 2018;33(9):811-829. doi:10.1007/s10654-018-0380-1.

[7] Fukushima N, Machida M, Kikuchi H, et al. Associations of working from home with occupational physical activity and sedentary behavior under the COVID-19 pandemic. J Occup Health. 2021;63(1):e12212. doi:10.1002/1348-9585.12212.

[8] Loef B, van Oostrom SH, van der Noordt M, Lifelines Corona Research Initiative, Proper KI. Working from home during the COVID-19 pandemic and its longitudinal association with physical activity and sedentary behavior. Scand J Work Environ Health. 2022;48(5):380-390. doi:10.5271/sjweh.4027.

[9] Scaranni PODS, Griep RH, Pitanga FJG, et al. Work from home and the association with sedentary behaviors, leisure-time and domestic physical activity in the ELSA-Brasil study. BMC Public Health. 2023;23:305. doi:10.1186/s12889-023-15167-z.

[10] Wahlström V, Mathiassen SE, Heiden M, Hallman DM. Hybrid office work in women and men: do directly measured physical behaviors differ between days working from home and days working at the office? Ann Work Expo Health. 2023;67(9):1043-1055. doi:10.1093/annweh/wxad057.

[11] Tomonaga R, Watanabe Y, Jiang Y, Nakagawa T, Yamato H. Comparison of physical activity and sedentary behavior between work in office and work from home: a self-controlled study. J Occup Environ Med. 2024;66(4):344-348. doi:10.1097/JOM.0000000000003061.

[12] Polspoel M, Mullie P, Reilly T, Van Tiggelen D, Calders P. Comparison of physical activity and sedentary behavior between telework and office work in a working population during the COVID-19 pandemic: a systematic review and meta-analysis of observational studies. BMC Public Health. 2025;25:1805. doi:10.1186/s12889-025-22948-1.

[13] Schöne C, Sauter M, Backé EM, Prigge M, Brendler C, Hegewald J. The impact of working from home on sedentary behaviour and physical activity compared to onsite work in the working population: a systematic review and meta-analysis. BMC Public Health. 2025;25:3963. doi:10.1186/s12889-025-24960-x.

[14] Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews: checklist and explanation. Ann Intern Med. 2018;169(7):467-473. doi:10.7326/M18-0850.

[15] Peters MDJ, Marnie C, Tricco AC, et al. Updated methodological guidance for the conduct of scoping reviews. JBI Evid Synth. 2020;18(10):2119-2126. doi:10.11124/JBIES-20-00167.

[16] Peters MDJ, Godfrey C, McInerney P, Munn Z, Tricco AC, Khalil H. Scoping reviews. In: Aromataris E, Lockwood C, Porritt K, Pilla B, Jordan Z, eds. JBI Manual for Evidence Synthesis. JBI; updated regularly.

[17] Niven A, Baker G, Almeida EC, et al. 'Are We Working (Too) Comfortably?': Understanding the Nature of and Factors Associated with Sedentary Behaviour When Working in the Home Environment. Occup Health Sci. 2023;7(1):71-88. doi:10.1007/s41542-022-00128-6.

[18] Morton S, Fitzsimons C, Sivaramakrishnan D, Jepson R, Niven A. 'Are we working (too) comfortably?': a focus group study to understand sedentary behaviour when working at home and identify intervention strategies. BMC Public Health. 2024;24:1516. doi:10.1186/s12889-024-18892-1.

[19] Mailey EL, Rosenkranz R, Rosenkranz SK, et al. Reducing Occupational Sitting While Working From Home: Individual and Combined Effects of a Height-Adjustable Desk and an Online Behavioral Intervention. J Occup Environ Med. 2022;64(2):91-98. doi:10.1097/JOM.0000000000002410.

[20] Chatterjee BB, Kuppusamy S, Aung MT, Saoji A, Kumar SIS. Analytical study on cardiovascular implications of remote work, sedentary behavior and stress. Bioinformation. 2025;21(9):3059-3062. doi:10.6026/973206300213059.

[21] Engeroff T, Kraus L, Wilke J, Niederer D, Groneberg D. Reducing sedentary behavior through workplace counseling: effects on activity, sitting breaks, and well-being - a randomized controlled trial. Arch Public Health. 2026;84:67. doi:10.1186/s13690-026-01867-6.

[22] Miura M, Tanimoto T, Tabuchi T. Association between work-from-home frequency and prolonged sedentary behavior: a longitudinal study among Japanese desk workers in the post-COVID-19 pandemic era. Work. 2026;84(2):342-352. doi:10.1177/10519815251413168.

[23] Sivaramakrishnan D, Fitzsimons C, Morton S, Manner J, Jepson RG, Niven A. Are we working (too) comfortably: the systematic development of an intervention to support workers to move more while working at home. Int J Behav Nutr Phys Act. 2025;22:84. doi:10.1186/s12966-025-01762-3.