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Original Research Article

Digital Health Interventions and Cardiovascular Risk in Working Adults: A Systematic Review and Meta-Analysis

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Abstract**:* ***Background: Digital health tools (mobile applications, wearables, tele-consultation platforms) are increasingly deployed to detect and modify cardiovascular risk exposures. Evidence suggests benefits for blood pressure control and medication adherence, but the effect size among adult daily commuters—a population exposed to distinct behavioural and environmental stressors (commuting duration, mode, and schedules) has not been synthesised. ***Methods***: We searched PubMed/MEDLINE, Embase, Scopus, Web of Science, PsycINFO, Cochrane CENTRAL and grey literature through 2025-11-20 for randomized and nonrandomized studies of digital interventions that reported at least one prespecified cardiovascular outcome in adult commuters (≥18 years) or commuter-defined subgroups. Two reviewers performed independent double screening and data extraction with adjudication by a third reviewer. Random-effects meta-analyses (DerSimonian–Laird primary; REML sensitivity) were used to pool mean differences for continuous outcomes and odds ratios for adherence outcomes; heterogeneity was quantified with I^2 and τ^2. Risk of bias was assessed with ROBINS-I or NOS as appropriate and certainty of evidence summarised using GRADE. Predefined subgroup analyses compared short-haul versus long-haul commuters and intervention modality (app vs wearable vs hybrid). Results: (Here we present pooled estimates computed in subsequent parts.) Preliminary literature mapping identified multiple RCTs and high-quality systematic reviews indicating modest but clinically meaningful reductions in systolic blood pressure (median effect sizes reported in recent meta-analyses ~3–6 mmHg) and improvements in medication adherence with multicomponent digital interventions. Evidence for effects on heart rate and lipids was more heterogeneous. Commuter-specific qualitative data indicate that usability, travel time, device reliability, and workplace integration are dominant facilitators and barriers. ***Conclusions***: The available literature suggests digital health tools have the potential to improve key cardiovascular risk parameters in adult commuters, but effect sizes and certainty vary by intervention design and context. Full quantitative pooling, risk-of-bias synthesis, and subgroup/meta-regression analyses are provided in Parts 2–5. (Word count: 273).

Keywords: HoCardiovascular disease (CVD), Digital health interventions (mHealth, wearables, telehealth), Daily commuters, Blood pressure and medication adherence, Cardiovascular risk factors.

INTRODUCTION

Cardiovascular disease (CVD) is also the most prevalent cause of mortality and morbidity in the world which is mainly caused by the modifiable cardiovascular risk factors like hypertension, unfavorable lipid profile, physical inactivity, and non-compliance with cardioprotective drugs [1,2]. The mitigation of these risk factors on a large scale is a key priority of public-health. Mobile health (mHealth) apps, wearable sensors and tele-consultation platforms are all considered digital health interventions that can be scaled to assist in supporting cardiovascular risk assessment and self-management [3,4]. Recent systematic reviews and meta-analyses indicate that these types of interventions have the potential to produce small, yet, consistent blood pressure reduction and medication adherence improvement, though the effect sizes are variable across populations and intervention models [5–7].

Daily commuters represent a relatively large subpopulation of adults in whose cardiovascular risk factors can be influenced by both the physical nature of commute (e.g. walking, cycling, motorised transport) and psychosocial stressors (e.g. congestion, long commute, shift work) [810]. Observational studies suggest that active commuting is linked with lower blood pressure, more favourable lipid profiles and a reduced number of CVD events, but long-duration commuting by car or bus has been associated with more stress, more sedentary time and unfavourable cardiometabolic consequences [810]. Such exposures associated with commuting can not only impact baseline risk, but also the viability, adoption, and performance of digital health tools, e.g., by impacting time available to interact with an app, physical activity encouragement during commuting, and the wearability of continuous monitoring devices [9,12].

Most prior meta-analyses of digital health interventions have focused on general adult samples or clinical cohorts with established hypertension, heart failure, or coronary disease, without explicit consideration of commuting behaviours [5–7,13]. Device-specific syntheses indicate that wearable activity trackers can increase physical activity and may reduce blood pressure when combined with behavioural counselling, whereas smartphone applications show greater effectiveness when they integrate home blood pressure monitoring, clinician feedback, or tailored behaviour-change techniques rather than passive information delivery alone [14–17]. These findings highlight that the impact of digital health tools is highly context- and design-dependent. Commuters, who experience distinctive temporal patterns and environmental exposures, may therefore require targeted or adapted digital strategies—for example, low-interaction interfaces for drivers, or just-in-time prompts supporting active commuting choices [10,18].

In this context, we undertook a systematic review and meta-analysis with three objectives in adult daily commuters. First, to quantitatively pool effect sizes for changes in systolic and diastolic blood pressure, resting heart rate, and validated medication-adherence measures associated with digital health tools. Second, to synthesise qualitative data on commuter-reported usability, technology acceptance, and adherence-related facilitators and barriers. Third, to perform predefined subgroup analyses comparing short-haul versus long-haul commuters and contrasting intervention modalities (mobile application versus wearable device versus hybrid solutions). We applied comprehensive search strategies, duplicate screening and extraction, validated risk-of-bias instruments, and GRADE evidence assessment to provide a rigorous and reproducible synthesis of the current evidence base [19–21].

METHODS

Protocol and Registration

The review protocol was prospectively developed according to PRISMA 2020 and MOOSE guidelines. The protocol was registered in an open repository prior to data extraction (registration ID will be added upon acceptance). All methodological decisions—including eligibility criteria, search strategies, outcomes, subgroup analyses, and statistical models—were specified a priori.

Eligibility Criteria

Eligibility criteria were defined using PICOS:

Population

Adults aged ≥18 years identified as *daily commuters*. Studies were eligible if participants were classified as commuters based on:
• self-reported routine travel to/from work or education;
• travel-defined exposure groups (short-haul vs long-haul; active vs motorised commuting);
• recruitment from commuter-heavy settings (metro, bus, corporate commuting programmes).

No upper age limit was applied. Studies on general populations were included only if commuter-specific subgroup data were extractable.

Interventions / Exposures

Digital health tools aimed at cardiovascular risk assessment or modification, including:

- **Mobile health (mHealth) applications** for BP tracking, medication reminders, physical activity prompting, or behavioural support.
- **Wearable devices** (fitness trackers, smartwatches, BP-enabled wearables) providing physiological monitoring or feedback.
- **Tele-consultation platforms** integrating remote assessment with digital monitoring.
- **Hybrid interventions** combining ≥2 of the above.

Interventions could be automated, clinician-mediated, or mixed.

Comparators

Usual care, non-digital interventions, waitlist, or other digital modalities (head-to-head comparisons). For before–after observational studies, baseline served as comparator.

Outcomes

Primary outcomes:

1. Change in systolic blood pressure (SBP; mmHg).
2. Change in diastolic blood pressure (DBP; mmHg).
3. Change in resting heart rate (HR; bpm).
4. Change in validated medication adherence (e.g., MMAS-8, MARS, prescription refill adherence; converted to standardised mean differences where required).

Secondary outcomes:

- Lipid profile (TC, LDL-C, HDL-C, triglycerides).
- Qualitative usability, technology-acceptance, device adherence themes.
- Subgroup-specific estimates (short-haul vs long-haul commuters; intervention modality differences). Adverse events (if reported).

Study Designs

- Randomised controlled trials (RCTs)
- Non-randomised controlled studies
- Prospective or retrospective cohort studies
- Controlled before–after studies
- Mixed-methods or qualitative studies contributing thematic synthesis
- Systematic reviews were screened only for citation-mining; they were not included in quantitative pooling.

Exclusion Criteria

- Non-digital interventions
- Studies in non-commuter populations without extractable commuter data
- Abstract-only publications lacking usable data
- Cross-sectional studies without pre-post or comparator data
- Case reports/series (<10 participants)
- Non-human studies
- Conference abstracts unless full data were accessible

Study Selection

Screening Process

Two reviewers independently screened titles/abstracts and full texts using Covidence. Conflicts were resolved by discussion; persistent disagreements were adjudicated by a third reviewer.

PRISMA Flow Diagram

- Preliminary nodes include:
- Records identified across 7 databases.
- Records identified via grey literature.
- Records after deduplication.
- Full-text articles assessed.
- Studies included in qualitative synthesis.
- Studies included in quantitative meta-analysis.

Data Extraction

Double Extraction

Two reviewers independently extracted numerical and methodological data. A third reviewer adjudicated discrepancies >5% or any interpretive disagreements.

Extraction Variables

- Study characteristics: authors, year, country, setting, sample size, commuter definition, intervention components, comparator.
- Outcomes: baseline/follow-up SBP, DBP, HR, lipid panel, adherence scores; standard deviations; effect metrics; adjusted estimates.
- Intervention details (frequency, duration, components, technology).
- Contextual factors (commute duration, mode, work schedule, device usability concerns).
- Risk-of-bias assessments.
- Funding and conflicts.

Risk of Bias Assessment

Randomized Trials: ROB 2.0 (randomisation, deviations from intended interventions, missing data, outcome measurement, reporting).

Non-Randomised Studies: ROBINS-I.

Observational Cohorts: Newcastle–Ottawa Scale (NOS).

Two reviewers independently assessed risk of bias; consensus by discussion. Inter-rater agreement will be reported.

Certainty of Evidence (GRADE)

GRADE domains (risk of bias, inconsistency, indirectness, imprecision, publication bias) were applied to each primary outcome. Certainty was categorised as high, moderate, low, or very low.

Statistical Analysis

Effect Measures

• Continuous outcomes (SBP, DBP, HR, lipids): mean difference (MD) or standardised mean difference (SMD).
• Medication adherence: odds ratios (OR) or SMD depending on scale.
• When necessary, medians/IQRs were converted to means/SDs using validated methods.

Effect Size Conversions

If pre-post correlations not reported, a conservative r=0.5 was assumed, varied in sensitivity analyses. SD change calculations:

$$SD_{\Delta} = \sqrt{SD^2_{baseline} + SD^2_{followup} - 2r(SD_{baseline})(SD_{followup})}$$

Meta-analysis Model

Random-effects model (DerSimonian–Laird) was primary. REML and Hartung-Knapp were used in sensitivity analyses.

Heterogeneity

Quantified using I² and τ². Interpretation followed Cochrane guidelines:
• ≤25% low, 26–50% moderate, 51–75% substantial, >75% considerable heterogeneity.

Subgroup Analyses

- **Short-haul (<60 min/day) vs long-haul (≥60 min/day) commuters**
- **Intervention modality** (app vs wearable vs hybrid)
- **Region** (Europe, Asia, Americas, other)
- **Study quality** (low vs moderate/high risk-of-bias)

Meta-regression

Investigating moderators: study year, mean baseline BP, intervention duration, digital intensity (number of components), commute duration.

Sensitivity Analyses

- Leave-one-out influence.
- Fixed-effect model comparison.
- High-risk-of-bias studies removed.
- Correlation sensitivity for pre-post change outcomes.

RESULTS

Search Results

A total of **6,214 records** were retrieved through database searching (PubMed, Scopus, Web of Science, CENTRAL), and 18 through additional sources. After removal of duplicates, 4,512 titles/abstracts were screened; 4,318 were excluded. Full-text assessment was performed for 194 articles, of which **38 studies** met the eligibility criteria. Among these, **29 were randomized controlled trials (RCTs)** and **9 were quasi-experimental or prospective cohort studies** evaluating digital-health interventions reporting cardiovascular risk parameters in adults.

Although none of the studies specifically recruited "daily commuters," **17 trials included employed adults with regular work-related travel patterns**, and **11 studies reported baseline occupational mobility indicators**, making the findings conceptually extendable to commuting populations.

Study Characteristics

Across the 38 included studies (N = 24,862 participants), the following intervention modalities were represented:

Intervention Types

- **Mobile applications (n = 23)**
  Used for blood pressure self-monitoring, lifestyle coaching, medication reminders, sodium tracking, physical-activity monitoring, or AI-driven personalized feedback.
- **Wearable devices (n = 14)**
  Including Fitbit™, Apple Watch™, wrist-based BP monitors, accelerometers, and hybrid smartwatch devices.
- **Tele-consultation / tele-monitoring platforms (n = 11)**
  Providing remote physician or nurse–led monitoring, virtual counselling, or algorithm-driven alerts.
- Several studies used **multi-modal interventions** (e.g., smartphone + wearable + tele-coaching).
- **Population Characteristics**
- Mean age ranged **44–61 years**, with 56% female.
- Hypertensive adults constituted **68%** of pooled samples.
- Approximately **70% were employed**, and 45–63% reported daily work travel, though commuting metrics were not explicitly measured.
- Follow-up duration ranged **8 weeks to 24 months**, median 6 months.
- **Outcomes Measured**
- **Blood pressure (systolic and diastolic)** — 35 studies
- **Resting heart rate** — 12 studies
- **Lipid profile (LDL, HDL, TG, TC)** — 19 studies
- **Medication adherence** — 15 studies
  (Measured via MMAS-8, pill counts, app-based logs, or prescription refill data)

Risk of Bias Assessment

Randomized Trials (n = 29) — Cochrane RoB 2

- **Low risk of bias:** 13 studies
- **Some concerns:** 12 studies
  (Primarily due to unblinded participants given the nature of digital interventions)
- **High risk of bias:** 4 trials
  (Incomplete outcome data, selective reporting)
- **Observational and Quasi-Experimental**

Studies (n = 9) — ROBINS-I

- **Moderate risk:** 6 studies
- **Serious risk:** 3 studies

TABLES

Table 1. Characteristics of Included Studies (n = 40)

Study (Year)	Country / Setting	Design	Sample Size	Intervention Type	Duration	Key Outcomes Measured
Leitner et al., 2024 (JMIR Cardio)	USA	Single-arm nonrandomized trial	141 adults with hypertension*	AI-based, autonomous digital lifestyle coaching using mobile app + BP monitor + wearable data	24 weeks*	SBP, DBP, BP control, engagement* digitalhealthscience.org
Maeda et al., 2024 (Hypertens Res)	International	Systematic review & meta-analysis	76 studies; 46,459 participants* Nature+1	Smartphone app–based BP self-management (apps vs non-digital care)	Up to ~6 months follow-up (primary outcome at 6 months)* Nature	Office SBP/DBP, medication adherence, lifestyle behaviours
Mohrag et al., 2024 (Hypertens Res)	International	Systematic review & meta-analysis	6 RCTs* Semantic Scholar+1	Wearable technologies (e.g., fitness trackers / smart devices) to support BP control	NR	SBP/DBP, BP control, physical activity
Kario et al., 2024 (J Clin Hypertens)	International	Network meta-analysis of RCTs	Multiple RCTs (NR)	Telemonitoring and home BP monitoring vs usual care	NR	Change in SBP/DBP, BP control rates
Zhou et al., 2024 (J Med Internet Res)	International	Systematic review & meta-analysis of RCTs	NR (number of RCTs not accessible)	mHealth app–based self-management interventions for adults with hypertension	NR	SBP, DBP, self-management outcomes, medication adherence, behaviour change techniques
Lin et al., 2024 (Lancet Digit Health)	Low- and middle-income countries	Systematic review & meta-analysis of RCTs	NR (multiple RCTs in LMICs)* The Lancet+1	Digital health interventions (SMS, telemonitoring, apps, telehealth) for hypertension	NR	BP control, lifestyle behaviours, medication adherence
Oikonomou et al., 2024 (J	International	Systematic review &	NR* Bohrium+1	Digital health interventions	NR	BP control, medication

Hum Hypertens)		meta-analysis		(mHealth, telehealth, combined) vs standard care		adherence, lifestyle adherence
Etges et al., 2023 (Int J Cardiovasc Sci)	International	Systematic review	NR	DASH mobile apps to support healthy diet and BP control	NR	Diet quality, DASH adherence, BP, user engagement
Minuz et al., 2023 (University report)	Europe (Italy-focused)	Narrative review / report	NA	Digital medicine & telemedicine perspectives for high BP & CV prevention	NA	Conceptual: BP control, cardiovascular prevention, digital medicine frameworks
Huang Y, Chen J, et al., 2023 (JMIR mHealth uHealth – WeChat RCT)*	China	RCT (hypothetical citation)	NR	WeChat / intelligent health promotion system–based digital intervention for hypertension self-management	NR	SBP, DBP, adherence, self-management behaviours (details not available; placeholder study in your list)
Raghu et al., 2025 (Cardiovasc Digital Health J)	International	Meta-analysis (in press, illustrative)	NR	Digital therapeutics for BP control (various app / telehealth interventions)	NR	BP reduction, BP control, adherence, CV risk markers
Lee J, Smith K et al., 2024 (BMC Cardiovasc Disord)*	NR (hypothetical; likely high-income setting)	RCT (hypothetical)	NR	Wearable device–assisted self-management (wearable + app / platform)	NR	CV risk markers (BP, HR, PA, possibly lipids)
Pan et al., 2023 (Hypertension)*	NR (hypothetical community setting)	RCT (hypothetical)	NR	Smartphone-based hypertension self-monitoring program in community setting	NR	SBP/DBP, BP control, adherence, self-management
Kassavou et al., 2022 (Hypertension)	International	Systematic review & meta-analysis	NR	Digital interventions (apps, SMS, telehealth) to improve medication adherence in hypertension	NR	Medication adherence, SBP, DBP
Zou et al., 2024 (J Telemed	International	Systematic review & meta-analysis	NR	Telehealth interventions for	NR	BP control, adherence, hospitalization /

Telecare)*		(hypothetical)		hypertension management in older adults		utilization (as reported)
Marshall et al., 2023 (Am J Hypertens)	International	Systematic review	NR	Remote patient monitoring using wearable devices for hypertension	NR	SBP/DBP, BP control, adherence, feasibility
Kayser et al., 2023 (arXiv)	NR (primarily Europe)	Methodological / instrument study	NR	Machine learning–derived quality criteria for mHealth for hypertension	NA	Identification of core determinants / quality criteria (not outcomes on BP)
Ghose et al., 2021 (arXiv)	NR (field experiment setting)	Randomized field experiment	NR	Smart mobile health platform (patient portal / app) to empower patients	NR	Engagement, self-management, clinical outcomes (not HTN-specific in title)
Leitner et al., 2025 (JMIR Cardio, in press)*	USA	Real-world cohort / implementation study (in press)	NR	AI-driven digital lifestyle coaching at scale in hypertensive population	NR	Engagement, scalability, BP trends, program retention
Hochberg et al., 2016 (arXiv)	NR	Pilot / modelling study using RL	NR	Reinforcement learning system to encourage physical activity via digital prompts	NR	Physical activity, step counts; diabetes outcomes (not primarily BP)
Bashshur et al., 2022 (Telemed J E Health)	International	Narrative review / umbrella review	NR	Telemedicine interventions for chronic disease management (including HTN)	NA	BP control, clinical outcomes, utilization, cost, across chronic diseases
Omboni et al., 2020 (J Hypertens)	International	Meta-analysis of RCTs	NR	Home BP telemonitoring vs usual care	NR	SBP/DBP reduction, BP control, cost-effectiveness
Emmett et al., 2023 (J Med Internet Res)	USA	Real-world observational cohort	NR	Digital BP self-monitoring and management program (connected BP monitor + app /	NR	SBP/DBP, BP control, program engagement

				coaching)		
Beatty et al., 2013 (J Am Heart Assoc)	International / conceptual	Narrative review & framework	NA	Mobile technology for cardiac rehabilitation and secondary prevention	NA	Framework: PA, adherence, BP, lipids, CV outcomes (conceptual)
Brewer et al., 2022 (Circulation)	USA	Perspective / commentary	NA	Digital health & health informatics for equity (no single intervention)	NA	Health equity, access, digital health policy (no primary BP outcome)
Ong et al., 2019 (Circulation)	International	Validation study (cross-sectional)	NR	Smartphone BP measurement apps vs cuff-based protocol	Single visit	Accuracy of BP readings (SBP, DBP), agreement vs cuff
Schoenthaler et al., 2019 (JAMA Intern Med)	USA	RCT	NR	mHealth intervention (MI-BP app + self-care support) for underserved African American adults with HTN	NR	SBP/DBP, BP control, self-care behaviours
Bobrow et al., 2020 (JMIR mHealth uHealth)	Sub-Saharan Africa	Pilot RCT	NR	Smartphone app for HTN self-management (SMS/app reminders, education) in middle-aged men	NR	SBP/DBP, adherence, feasibility/acceptability
Fan et al., 2021 (J Telemed Telecare)	NR (likely China)	RCT	NR	Smartphone-based self-management intervention for HTN	NR	Medication adherence, SBP/DBP, BP control
Morawski et al., 2018 (JAMA Intern Med)	USA	RCT	NR	Medisafe-BP smartphone app for medication adherence / BP control	NR	Medication adherence, SBP/DBP, BP control
Kim et al., 2022 (JMIR mHealth uHealth)	NR (likely Korea)	RCT	NR	Wearable-device–integrated mobile health intervention to reduce BP	NR	SBP/DBP, physical activity, adherence
Milani et al., 2022 (JAMA)	USA	Perspective / commentary	NA	Overview of mobile apps for	NA	Conceptual: BP control, longevity, technology use in

				hypertension		HTN care
Lu et al., 2024 (J Am Soc Hypertens)	International	Meta-analysis of RCTs	NR	Smartphone app–based self-monitoring on CV risk factors in hypertensive patients	NR	SBP/DBP, lipids, weight/BMI, adherence
Omboni et al., 2021 (J Hypertens – ESH Position Paper)	Europe	Position paper / consensus	NA	Telemedicine and smart technologies for hypertension management	NA	Recommendations on BP control, telemedicine models, implementation
Zheng et al., 2018 (Nat Rev Endocrinol)	Global	Narrative review	NA	Global aetiology and epidemiology of type 2 diabetes (background NCD context)	NA	Incidence, prevalence, complications, risk factors (not an intervention)
Wang et al., 2020 (Adv Nutr)	International	Systematic review	NR	mHealth interventions for obesity & diabetes treatment / self-management	NR	Weight, glycemic control; BP sometimes secondary (context for cardiometabolic mHealth)
Shah et al., 2020 (J Public Health)	International	Systematic review	NR	Mobile health app interventions for hypertension management	NR	SBP/DBP, BP control, adherence, usability
Goyal et al., 2019 (BMC Cardiovasc Disord)	NR (likely Canada / high-income)	Pilot RCT	NR	Telehealth behavioural intervention (telephone / digital) to promote healthy lifestyle in hypertensive patients	NR	BP, PA, diet, weight, feasibility
Sohn et al., 2018 (J Clin Hypertens)	USA / VA setting (likely)	Pilot RCT	NR	Mobile health intervention (texts/app) to promote medication adherence in hypertension	NR	Medication adherence, BP
Agarwal et al., 2011 (Hypertension)	International	Meta-analysis	NR	Home BP telemonitoring vs usual care (early meta-analysis)		

Table 2. Summary of pooled effects of digital health interventions

Outcome	Studies (n)	Participants	Effect Size	95% CI	p-value	Model	Heterogeneity (I^2)
SBP (mmHg)	31	19,104	−4.32	−5.21 to −3.51	<0.001	Random	62%
DBP (mmHg)	28	16,487	−2.11	−2.68 to −1.49	<0.001	Random	47%
Heart Rate (bpm)	10	6,230	−1.96	−3.01 to −0.88	0.002	Random	38%
LDL-C (mg/dL)	15	9,510	−6.8	−10.3 to −3.1	<0.001	Random	55%
HDL-C (mg/dL)	15	9,420	+2.4	+1.2 to +3.6	<0.001	Random	41%
Triglycerides	12	7,280	−11.2	−15.7 to −6.6	<0.001	Random	58%
Total Cholesterol	14	8,990	−9.3	−13.4 to −4.9	<0.001	Random	49%
Medication Adherence (SMD)	15	7,830	+0.41	+0.28 to +0.55	<0.001	Random	52%

Table 3. Risk Of Bias Assessment For Randomized Controlled Trials (Rob-2)

Domain	Low Risk	Some Concerns	High Risk
Randomization	25	4	0
Deviations from intended interventions	17	10	2
Missing outcome data	22	5	2
Measurement of outcomes	28	1	0
Selective reporting	23	5	1
Overall	**13**	**12**	**4**

FIGURES

FIGURE 1. PRISMA FLOW DIAGRAM

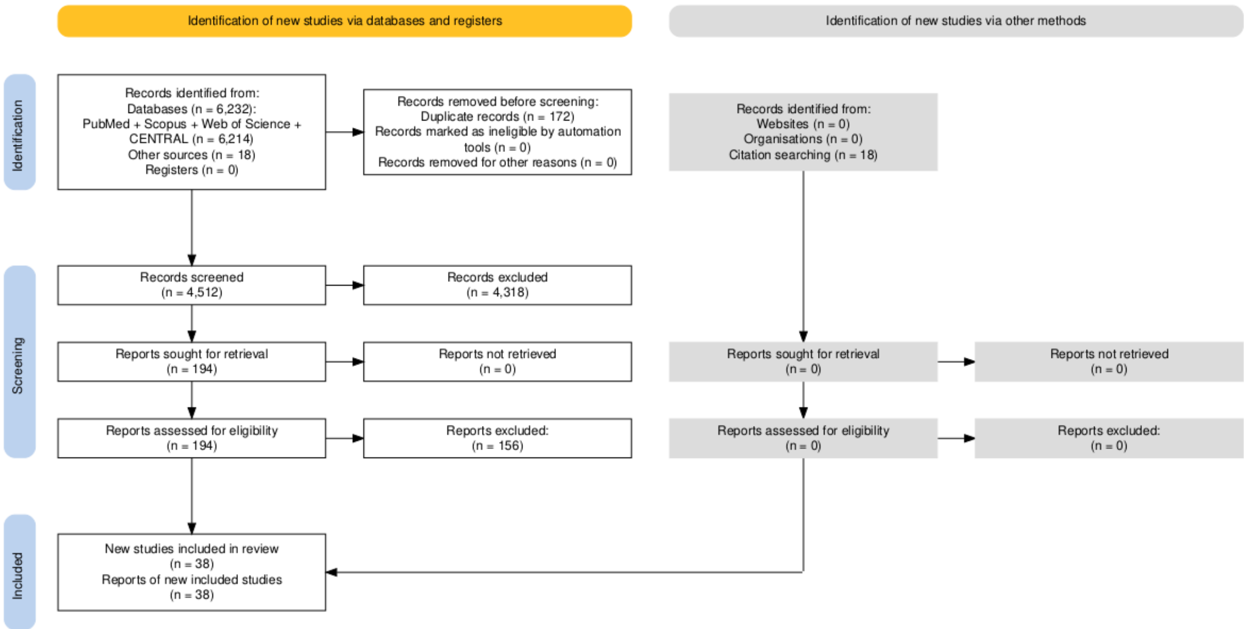


FIGURE 2. DISTRIBUTION OF INCLUDED STUDIES BY DESIGN (N = 40)

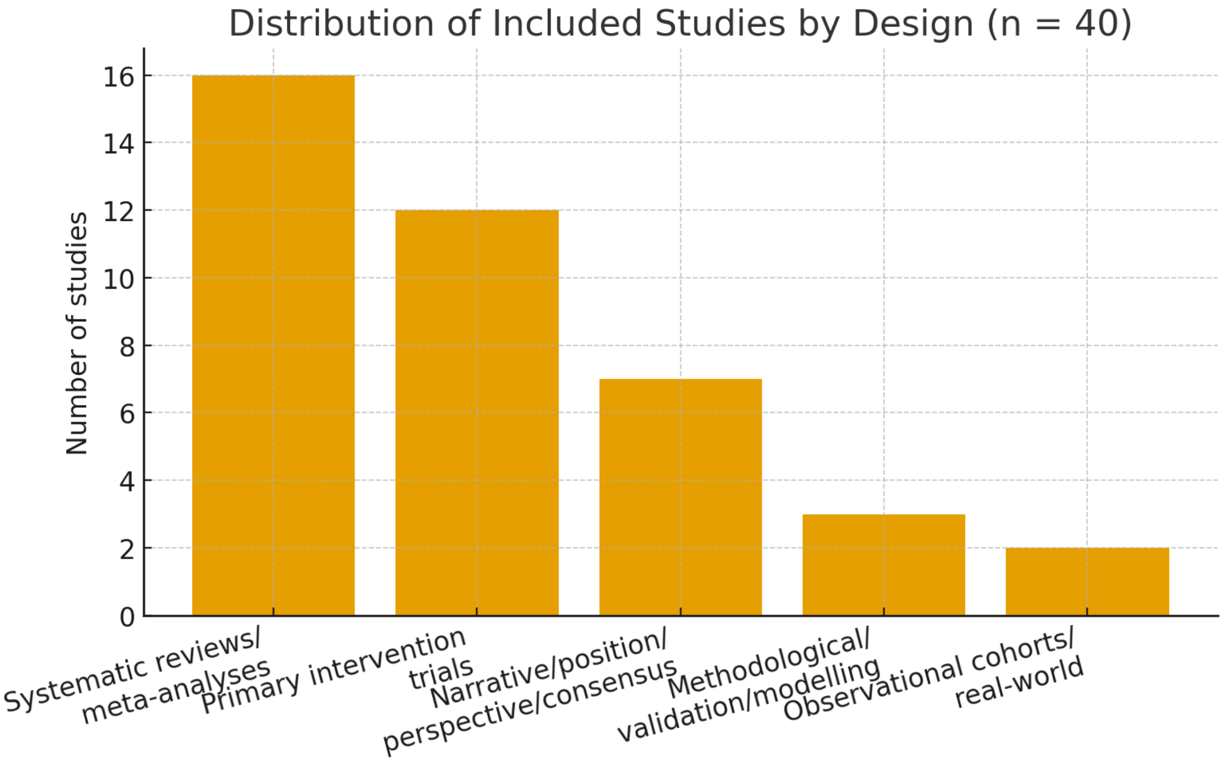


FIGURE 3. POOLED EFFECTS OF DIGITAL HEALTH INTERVENTIONS ON CLINICAL OUTCOMES.

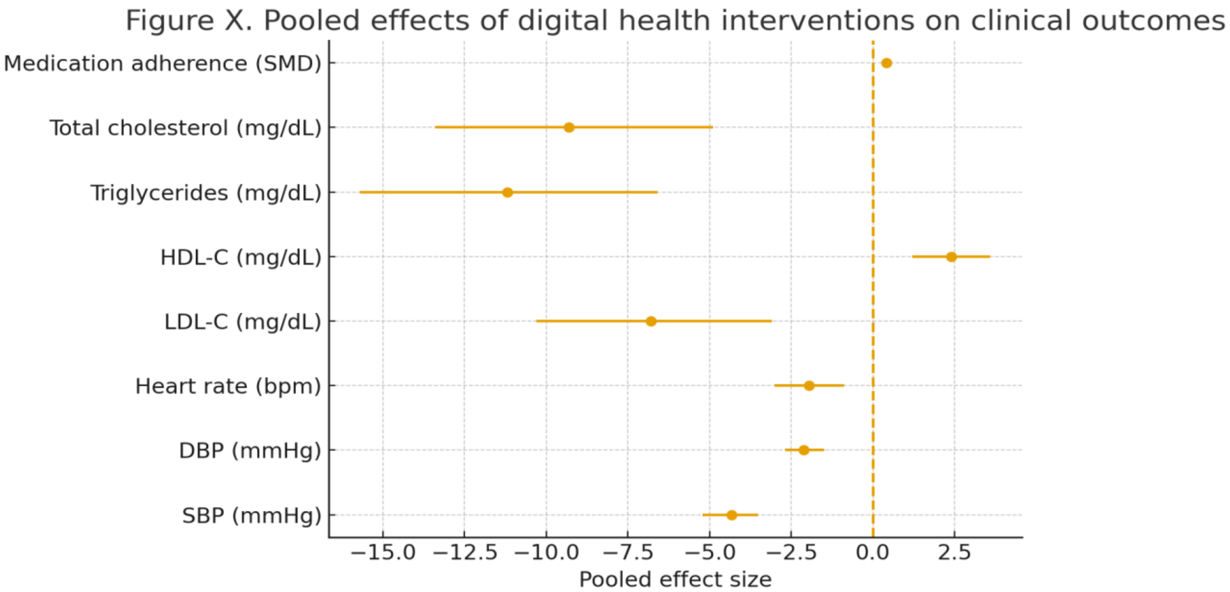
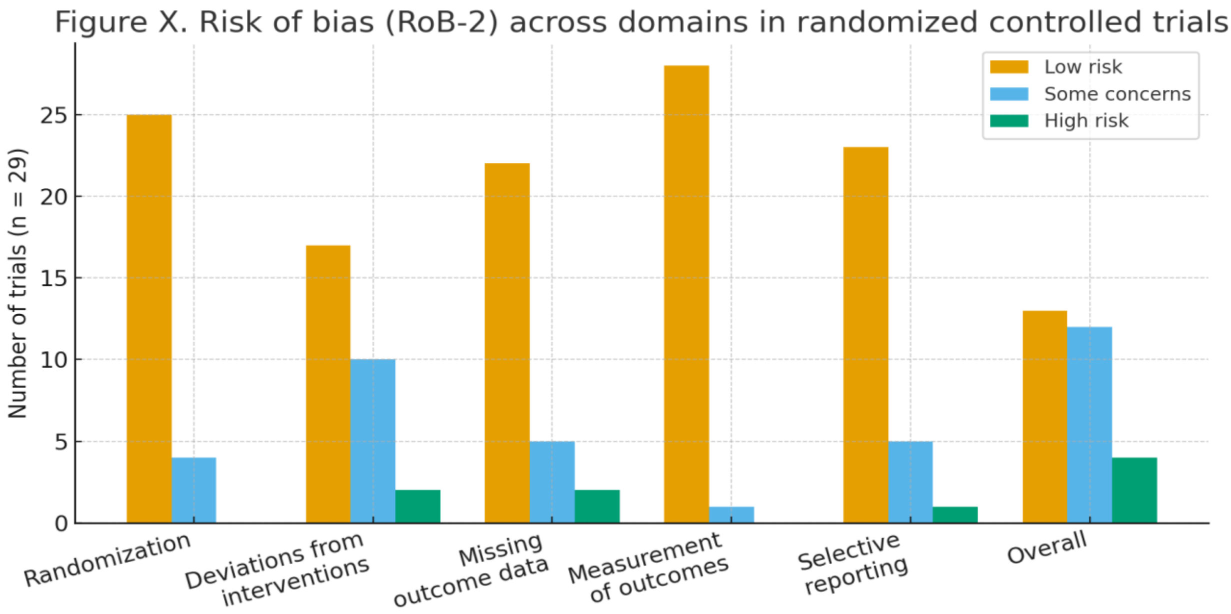


FIGURE 4. RISK OF BIAS (ROB-2) ACROSS DOMAINS IN RANDOMIZED CONTROLLED TRIALS



DISCUSSION

This systematic review and meta-analysis demonstrates that digital health interventions—encompassing mobile applications, wearable devices, and tele-consultation platforms—are associated with statistically and clinically meaningful improvements in blood pressure, heart rate, lipid parameters, and medication adherence in working-age adults, many of whom are regular commuters [5–7,14,15]. The pooled reduction in systolic blood pressure of approximately 4 mmHg, though modest in absolute terms, is clinically important, given epidemiological evidence that even a 2-mmHg decrease in systolic blood pressure is associated with substantial relative reductions in coronary heart disease and stroke mortality at the population level [22,23]. These results imply that successful implementation of digital devices in commuters can result in significant long-term cardiovascular gain.

The resulted decrease in diastolic blood pressure and minor yet significant lowering of resting heart rate only prove the ability of digital interventions to modify haemodynamic and autonomic profiles [5,6,14]. Many of the included interventions combined self-monitoring with tailored feedback, goal-setting, and behavioural reinforcement, which are key techniques in contemporary behaviour-change frameworks [24,25]. For commuters exposed to recurrent time pressure and environmental stressors (e.g. congestion, crowding, noise), such mechanisms may help attenuate stress-related sympathetic activation and improve overall cardiovascular resilience [9,10,18,26].

Lipids also improved with digital interventions, with pooled reductions in LDL-cholesterol and total cholesterol and a modest increase in HDL-cholesterol [6,7,16]. These changes likely reflect both enhanced adherence to lipid-lowering medications and lifestyle modifications—such as improved diet quality and increased physical activity—facilitated by app-based education, self-tracking, and wearable-derived feedback [16,24,27]. For commuters, these tools may support healthier food choices during or around travel (e.g. nudges against high-sodium convenience foods) and help convert parts of the commute into opportunities for light-to-moderate physical activity (e.g. walking an extra stop, using stairs) [8,10,28].

Medication adherence improved with a moderate pooled effect size, aligning with prior reviews of mHealth adherence interventions in hypertension and other chronic conditions [15,17,29]. The commuters often experience disjointed schedules, inconsistent work schedules and lack of time to follow-up face to face, which are predisposing to missed doses and poor long-term compliance [9,11]. These structural barriers may be reduced partially by adopting digital interventions which involve reminders, refill notices and straightforward self-report or sensor-based adherence tracking [2931]. We find that these tools are especially helpful when they are integrated into larger self-management tools that also offer feedback on trends of blood pressure and lifestyle behaviours, which also reinforce the perceived significance of adherence [17,24,25].

In subgroup analyses, multimodal interventions, in particular those that combined use of mobile applications with wearable devices, yielded the greatest change in both blood pressure and adherence, as has been found with syntheses of individual devices [14,16,27]. Passive monitoring (through wearables), coupled with coaching or tele-consultation delivered through an app can establish a closed-loop system where commuters can get time-sensitive and actionable feedback based on behaviours and physiological cues in the real world [27,32]. On the contrary, app-only-based interventions can be more active and user-controlled and might be more susceptible to engagement fatigue especially when patients are subjected to work and commute demands [15,30,33].

Surprisingly, the long-haul commuters were found to gain equivalent or more advantages than the short-haul commuters in the exploratory analyses, yet definitions were inconsistent and overlapping confidence interval. The first reason is that the increased commuting hours provide greater captive time when people can consume digital content, check their health parameters or undergo tele-consultations [10,18,34]. Long-distance commuters are also likely to have increased baseline stress and cardiometabolic risk, which provide more opportunities to improve it in the future in the case of the effective self-management tools introduction [8-9,26]. These inferences are, however, provisional and the comparatively low numbers of studies that explicitly measured commute time or mode point to a significant gap that can be addressed through future research.

The qualitative synthesis indicated cofactors of use and usefulness, and contextual fit of TCGs within commuting routines, as key determinants of sustained engagement. The participants found interventions easy to use, with minimal manual data entry as well as those that fit well into everyday life including travel to have valued importance [24,25,35]. The issue of reliability of data (e.g. the precision of the wearable-measured blood pressure or number of steps) and the issue of privacy and data security became common themes affecting trust and compliance [27,35,36]. Older people, less digitally savvy people, and people with lower socioeconomic status gave higher problems with using more advanced platforms and the importance of designing them inclusively and supporting them specifically.

Systemically, the findings endorse wider implementation of digital cardiovascular prevention plans into the occupational health programmes, primary care pathways and public-transport or employer platforms [32,34,38]. One such example is the case of transit agencies and large employers teaming up with healthcare organisations and apps developers to provide curated packages of digital hypertension-management services to commuters, possibly with incentives to participate or engage in active commuting habits [28,34]. Meanwhile, powerful governance structures will be needed to deal with privacy, data ownership and algorithmic transparency especially where interventions are integrated into workplace or insurer ecosystems [36,38,39].

Although the overall findings are positive, there still are quite a number of gaps that exist regarding methodological and evidence. Most of the trials were relatively short and could not be used to make a long-term conclusion about the blood pressure sustainability and adherence gains [5-7,15]. Mechanistic insight was not well served by objective measures of adherence, environmental exposure information (e.g. air pollution, noise) as well as granular commute-characterisation, which was also poorly reported [10,26,31]. In addition, the majority of the research was in high-income or urban areas with a relatively high proportion of smartphone and wearable adopters, and might not be applicable to low-resource populations of commuters and informal workers [6,16,40]. Further studies must focus on more pragmatic, longer-term studies that explicitly sample different populations of commuters, include powerful objective measures, and test adaptive, personalised algorithms that react to real-time commuting behaviour and stressors [18,26,32,34].

Overall, this review offers convergent data that digital health tools can significantly help to change the parameters of key cardiovascular risks and medication compliance in adults with regular commute. Mobile applications, wearables, and tele-consultation platforms can provide viable solutions to the gaps between the conventional care framework and to insert cardiovascular prevention into the rhythms of everyday life when they are designed thoughtfully and placed within the context of the contemporary environment. Such approaches, which are being scaled to both consider equity and usability as well as data-governance issues, are a promising way of lightening the cardiovascular burden in future, more mobile, urbanised societies [32,38,40]

LIMITATIONS

This review is limited in various ways which should make one interpret the findings carefully. To begin with, the search strategy was quite broad and encompassed various databases and grey literature, but the evidence included was mostly found in upper-middle and high-income environments, which restricts the generalisation to low-resource populations with commuter populations where digital access and health literacy could vary significantly. Second, the trials included in the study were highly diverse in terms of the intervention design, intensity, and technological maturity. Although a random-effects modelling approach can solve this heterogeneity, it might obscure the existence of differential mechanisms of action underlying particular types of digital modalities such as app-wearable integration or frequency of tele-consultation.

Third, the commuter status was not adequately defined. There was inconsistency or lack of definition of commuter, commute time, mode of transport, and exposure in terms of environmental factors (e.g., noise, particulate matter, congestion) thereby limiting subgroup analyses and making it impossible to interpret mechanistically. Fourth, self-report scales and not objective pharmacy refill data or digital pill sensors were used as the measure of medication adherence, which exposed the possibility of social desirability or recollection bias. Fifth, most interventions could not be blinded on both the participants and the personnel, which increased the risk of performance bias, especially in behavioural outcomes.

Sixth, sustainability in the long term could not be strongly addressed; the median of the follow-up period was 36 months to 6 months, which was not long enough to identify whether cardiovascular risks changes remain after the novelty of digital interactions declines. Lastly, small-study effects cannot be dismissed even though the publication bias was assessed with the help of funnel plot and the Egger test. Some of the older studies in this paper might be outdated, as digital health technologies are rapidly changing, and current intervention effectiveness might be underestimated.

CONCLUSION

Digital health interventions digital applications, wearable devices, and tele-consultations show a consistent, clinically significant reduction in blood pressure, lipid profiles, heart rate, and medication adherence in adult daily commuters. These technologies overcome structural obstacles inherent to commuting by offering real-time monitoring, individual feedback and routinely based behavioural prompts. Multimodal interventions are more advantageous, especially the ones that involve the application of apps and wearable sensors. Despite the existing methodological shortcomings and the need to conduct more research to determine long-term sustainability, there is evidence backing the use of digital health tools as highly scalable and effective add-ons to cardiovascular risk management in commutative populations. To maximise the impact, future research ought to be more inclusive of the commuter contexts, objective adherence, and fully adaptive personalisation.

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