

# Digital Health Support for Rehabilitation after Lower Limb Orthopedic and Trauma Surgery in Older Patients: A Systematic Review and Meta-Analysis

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## Background

Physical rehabilitation following orthopedic and trauma surgery is a critical part of treatment aimed at improving functional outcomes and promoting the return of patients to their daily activities. Demographic changes associated with a growing and ageing population pose new social and economic challenges to the healthcare system. It is crucial to explore innovative approaches that focus on the needs of patients to support the rehabilitation phase, while keeping pace with advancing digitalisation.

## Purpose

This review aims to assess the currently available evidence on the use of digital health interventions to guide rehabilitation of older patients following lower limb orthopedic surgery compared to conventional rehabilitation, and to evaluate their impact on different outcomes.

## Methods

A systematic review and meta-analysis of articles from PubMed, EMBASE and Cochrane Library databases from 2000 to 2022 were conducted according to the PRISMA guidelines to compare different modalities of digital health support with traditional physiotherapy after orthopedic and trauma surgery of the lower limbs in patients with a mean age of  $\geq 65$  years. Outcome measures focused on physical, mobility-related and psychosocial outcomes, intervention satisfaction, safety and medical costs.

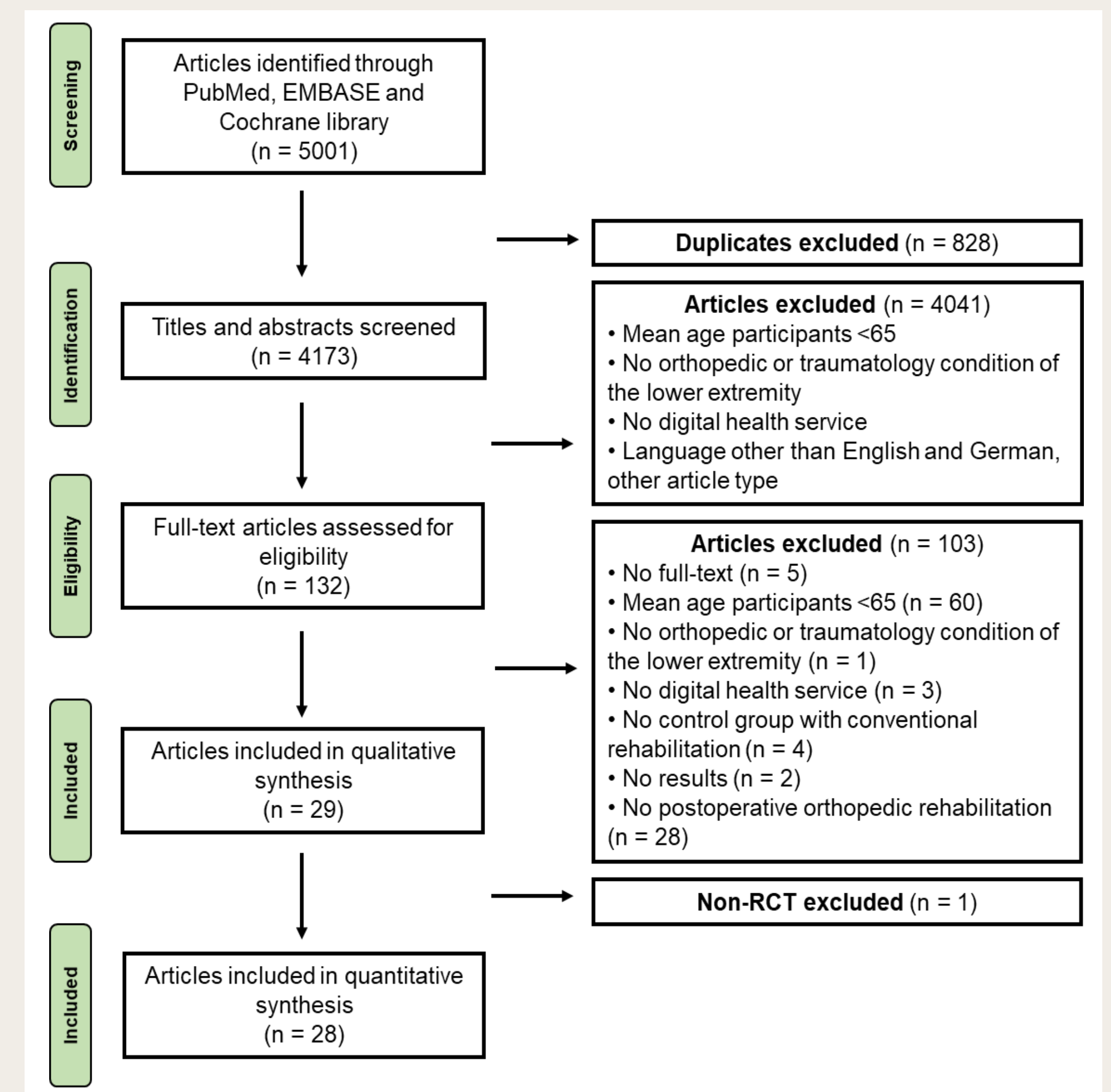


Figure 1: PRISMA flowchart showing the search process.

## Results

Figure 2

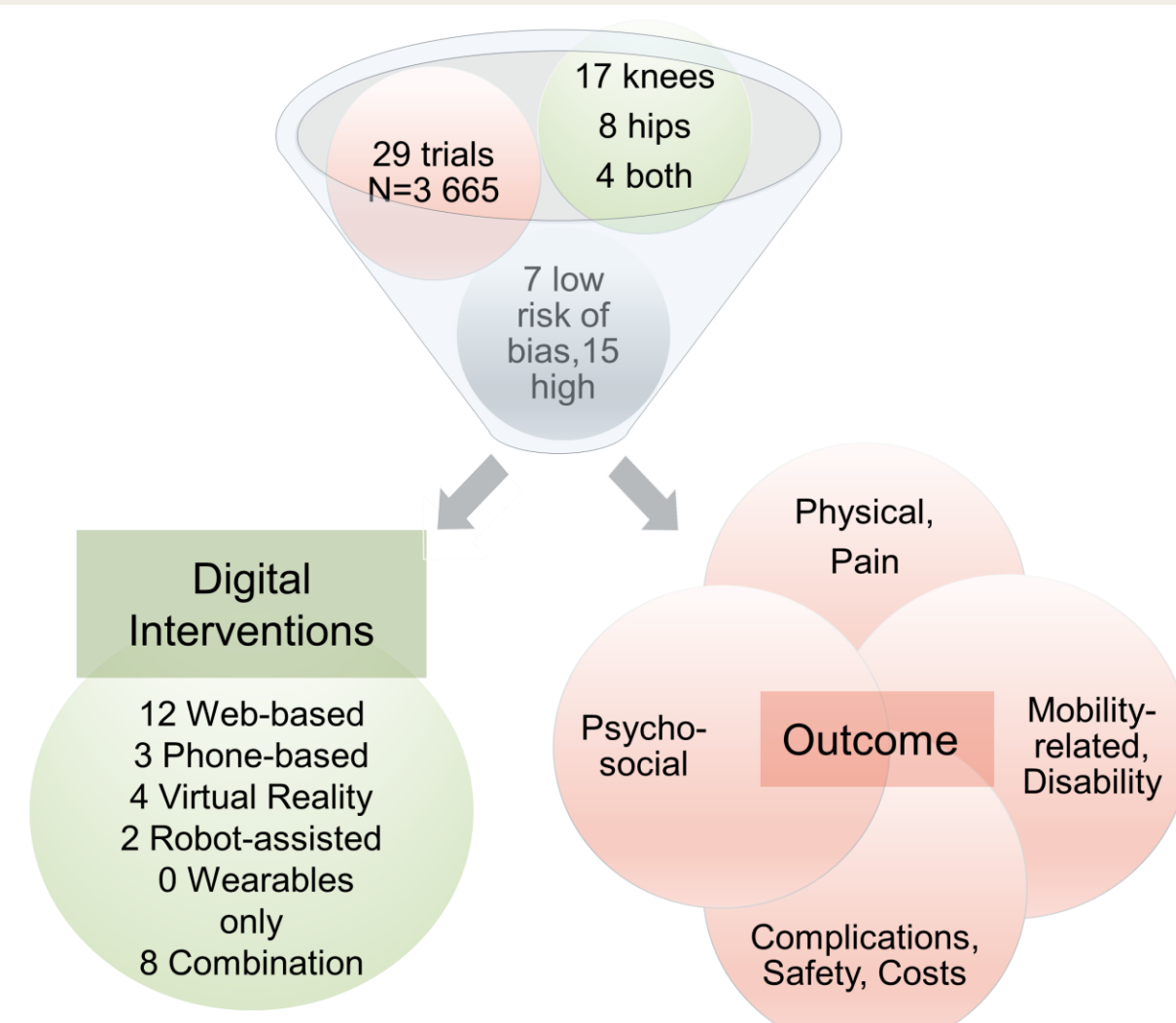


Figure 2: Twenty-nine trials evaluated different digital health interventions and outcome measures compared to traditional physiotherapy.

Figure 3

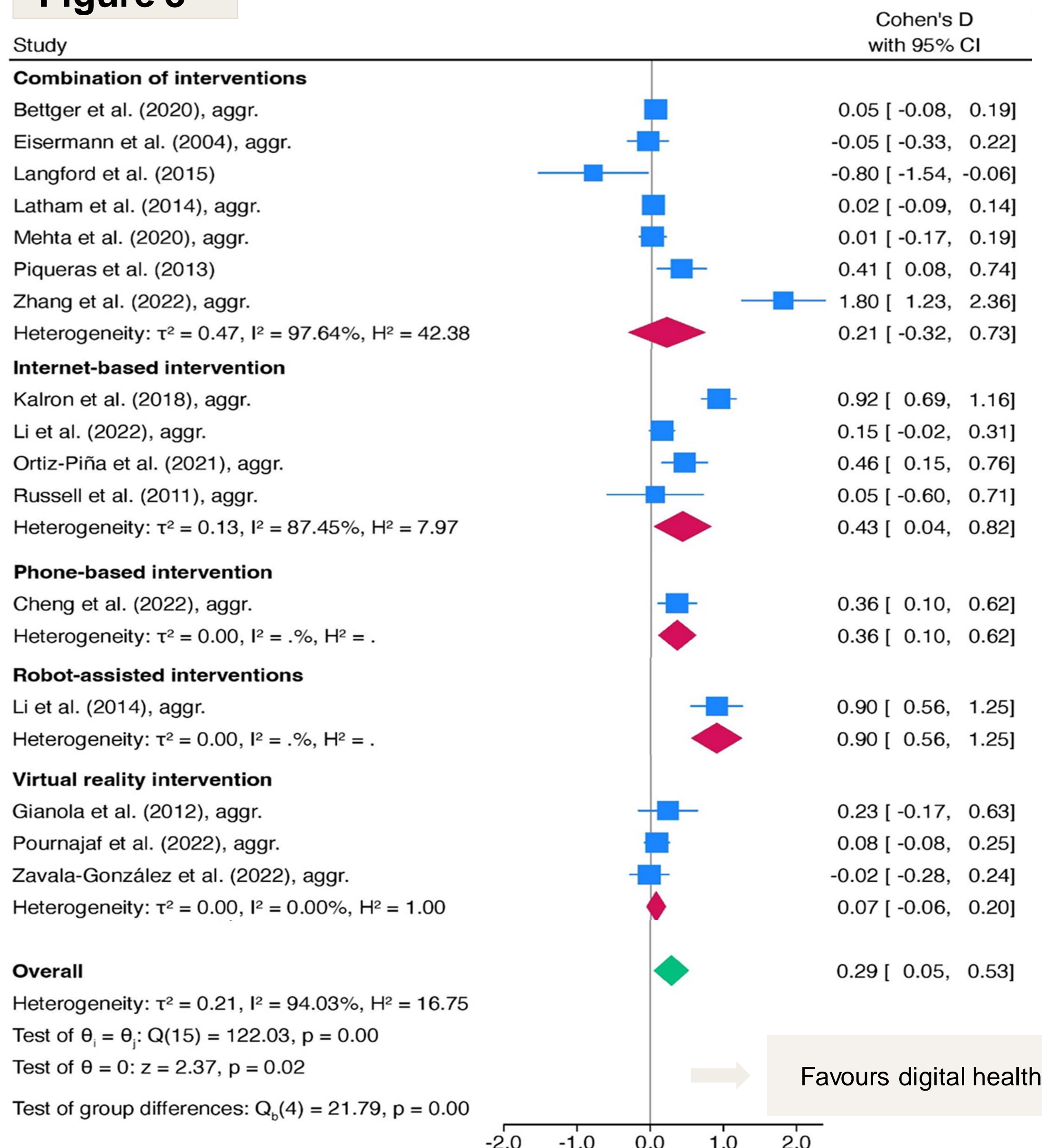


Figure 3: Forest plot for mobility-related outcomes (gait, balance, fall risk and disability) across digital health interventions. Multiple outcomes in one domain were standardised (standardised mean difference) and pooled across the study (aggr).

Table 1

ROB	Study	Physical	Pain	Gait, Balance, Risk of Fall	Disability, Activity of Daily Life	Quality of Life	Psychological Outcome	Intervention adherence, Compliance	Costs
SC	Bettger et al. (2020)	0.1 (0.0; 0.3)	-0.1 (-0.3; 0.1)	0.0 (-0.2; 0.2)	0.1 (-0.1; 0.2)	0.1 (-0.2; 0.3)	0.2 (-0.1; 0.4)	0.0 (-0.1; 0.2)	0.8 (0.5; 1.0)
H	Chen et al. (2016)	0.1 (-0.0; 0.2)	0.4 (0.1; 0.6)	-	-	0.4 (-0.2; 0.9)	1.1 (0.8; 1.4)	-	-
SC	Cheng et al. (2022)	-	-	0.6 (0.2; 1.1)	0.2 (-0.1; 0.5)	-	-	0.6 (0.2; 1.1)	-
H	Eisermann et al. (2004)	-0.1 (-0.3; 0.2)	-	-	-0.1 (-0.3; 0.2)	-	-	-	-
H	Gianola et al. (2012)	0.7 (0.5; 0.9)	0.6 (0.3; 0.8)	0.7 (0.3; 1.2)	0.1 (-0.3; 0.4)	1.0 (0.3; 1.7)	-	-	0.3 (-0.2; 0.7)
H	Huang et al. (2020)	-	-	-	-	-	-	-	-
SC	Jin et al. (2016)	1.2 (0.8; 1.6)	0.4 (0.1; 0.8)	-	-	-	-	-	-
SC	Kalron et al. (2018)	1.0 (0.5; 1.5)	-	0.9 (0.7; 1.2)	-	-	-	-	-
H	Koo et al. (2018)	-	-	-	-	-	-	-	-
L	Kramer et al. (2020)	-	-	-	-	-	-	-	-
H	Langford et al. (2015)	0.0 (-0.7; 0.7)	-0.2 (-0.9; 0.6)	0.8 (-1.5; -0.4)	-	0.7 (-0.1; 1.4)	-	-	-
H	Latham et al. (2014)	-0.0 (-0.2; 0.2)	-	0.0 (-0.1; 0.2)	-0.1 (-0.3; 0.2)	-	-	0.0 (-0.3; 0.3)	-
L	Latham et al. (2014)	-0.1 (-0.4; 0.2)	-0.2 (-0.6; 0.2)	0.1 (-0.1; 0.3)	0.2 (-0.1; 0.5)	-	-	-	-
H	Li et al. (2014)	0.5 (0.2; 0.7)	-	0.9 (0.6; 1.5)	-	-	-	-	-
SC	Marsh et al. (2014)	-	-	-	-	-	-	-	-
H	Mehta et al. (2020)	-	-	0.0 (-0.2; 0.2)	-	-	-	-	-
L	Moffet et al. (2015)	-	-	-	-	-	-	-	-
SC	Moffet et al. (2017)	-	-	-	-	-	-	-	-
L	Ortiz-Piña et al. (2021)	-	-	0.5 (0.2; 0.7)	0.4 (-0.6; 1.4)	-	-	-	-
H	Piqueras et al. (2013)	0.1 (-0.1; 0.2)	0.3 (-0.1; 0.6)	0.4 (0.1; 0.7)	-	-	-	-	-
L	Pournajaf et al. (2022)	0.1 (-0.1; 0.3)	0.4 (0.0; 0.8)	0.1 (-0.1; 0.3)	-0.1 (-0.4; 0.3)	-	-	-	-
L	Russell et al. (2011)	-0.2 (-0.4; 0.1)	-0.1 (-0.6; 0.4)	-0.3 (-0.6; 0.1)	0.7 (0.2; 1.2)	-0.0 (-0.5; 0.4)	-	0.7 (0.2; 1.2)	-
SC	Russell et al. (2003)	-	-	-	-	-	-	-	-
H	Tousignant et al. (2011a)	-	-	-	-	-	-	-	-
H	Tousignant et al. (2011b)	-	-	-	-	-	-	-	-
H	Tousignant et al. (2015)	-	-	-	-	-	-	-	0.5 (0.3; 0.7)
H	Van der Walt et al. (2018)	-	-	-	-	-	-	-	-
L	Zavala-González et al. (2022)	0.6 (0.1; 1.1)	1.0 (-1.1; 3.1)	-0.0 (-0.3; 0.2)	-	-	-	-	-
H	Zhang et al. (2022)	1.2 (0.7; 1.6)	-	2.2 (0.3; 4.0)	1.6 (1.2; 2.1)	-	-	-	-

H high risk of bias (ROB)  
L low risk of bias  
SC some concerns

Cohen's D, positive effect of digital health  
Cohen's D, negative effect of digital health

>0.0; 0.2 very small effect  
>0.2; 0.5 small effect  
>0.5; 0.8 medium effect  
>0.8 large effect

-0.2; <0.0 very small effect  
-0.5; <-0.2 small effect  
-0.8; <-0.5 medium effect  
<-0.6 large effect

Table 1: Summary of outcome measures. The sign of Cohen's D has been adjusted so that positive values indicate a positive effect of the digital intervention over standard therapy, suggesting superiority of digital health support.

## Conclusion

Digital health interventions for post-operative care and remote monitoring of rehabilitation following orthopedic and trauma surgery of the lower extremity have been widely evaluated in many randomised controlled trials over the past decade. Despite the heterogeneity and poor methodological quality of the included studies, the results of this systematic review suggest that digital health interventions in older people may improve **physical** outcomes (with robotic interventions (RI) and virtual reality (VR)), **mobility** outcomes (with web-based (WI), phone-based (PI) and RI interventions), **quality of life** (with PI and VR), **psychological** outcomes (with PI), **adherence to interventions** (with WI and PI) and reduce postoperative rehabilitation **costs** (with WI and a combination of interventions).