Novitasari et al. Scr Med. 2026 Sep-Oct;57(5):1103-14. DOI:10.5937/scriptamed57-64216

META-ANALYSIS

Effectiveness of Digital Health Interventions in Enhancing Self-Efficacy in Adults With Type 2 Diabetes Mellitus: A Systematic Review and Meta-Analysis of Randomised Controlled Trials

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Abstract

Background/Aim: Self-efficacy is a key psychosocial determinant influencing individuals' ability to perform effective self-management behaviours in type 2 diabetes mellitus (T2DM). The rapid expansion of digital health interventions has introduced new approaches to support diabetes self-care; however, the magnitude of its impact on self-efficacy has not been clearly established. This systematic review and meta-analysis were conducted to examine the effectiveness of digital health interventions in improving self-efficacy among adults with T2DM.

Methods: A systematic search was undertaken across *Scopus, PubMed/MEDLINE* and *EBSCO* to identify randomised controlled trials published between 2017 and 2024. Eligible studies included adults with T2DM who received digital health interventions and reported self-efficacy outcomes. Quantitative data were pooled using a random-effects meta-analytic approach, with standardised mean differences (SMDs) and 95 % confidence intervals (CIs) calculated. Methodological quality was assessed using the Cochrane Risk of Bias 2 tool.

Results: Eight randomised controlled trials involving 817 participants were included in the meta-analysis. Digital health interventions demonstrated a statistically significant improvement in self-efficacy compared with control conditions (SMD = 1.38; 95 % CI: 0.77–2.00; $p < 0.00001$). Considerable heterogeneity was observed ($I^2 = 93$ %). The high heterogeneity observed may be attributed to variations in intervention design, duration and outcome measurement across studies. Leave-one-out sensitivity analysis confirmed that the pooled effect was robust and not driven by any single study.

Conclusion: Digital health interventions were effective in enhancing self-efficacy among adults with T2DM. Despite substantial heterogeneity, these findings support digital strategies as complementary components of diabetes self-management. Further research employing standardised self-efficacy measures and follow-up periods is warranted to strengthen the evidence base.

Key words: Diabetes mellitus, type 2; Digital health; Self efficacy; Meta-analysis.

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Citation:
Novitasari RK, Makajil JD, Sugiharto S. Effectiveness of digital health interventions in enhancing self-efficacy in adults with type 2 diabetes mellitus: a systematic review and meta-analysis of randomised controlled trials. Scr Med. 2026 Sep-Oct;57(5):1103-14.

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Received: 20 January 2026
Revision received: 18 April 2026
Accepted: 18 April 2026

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Introduction

Type 2 diabetes mellitus (T2DM) is a global public health concern, characterised by a progressive metabolic disorder that requires long-term self-management to prevent complications and reduce disease burden.[1–3] Effective management of T2DM extends beyond pharmacological treatment. It depends largely on individuals' capacity to engage consistently in core self-management behaviours including healthy eating, regular physical activity, blood glucose monitoring, appropriate medication use, problem-solving skills, risk reduction practices and psychosocial coping.[4, 5] Effective self-management is essential in diabetes care, as patients must actively monitor blood glucose levels, adhere to dietary recommendations and maintain lifestyle modifications to prevent complications.[6] As a result, greater emphasis has been placed on psychosocial factors that shape long-term self-management in diabetes research and clinical practice.

Among these determinants, self-efficacy is widely recognised as a central construct influencing health-related behaviour change. Self-efficacy has been identified as an important psychological factor influencing diabetes self-care behaviours and long-term disease management.[7] Self-efficacy is defined as an individual's belief in their capacity to carry out actions necessary to achieve specific goals.[8] In the context of T2DM, higher self-efficacy has been associated with improved glycaemic control, better adherence to self-care regimens and enhanced quality of life.[9] Conversely, individuals with lower self-efficacy often experience greater difficulty in maintaining consistent self-management practices, leading to suboptimal clinical outcomes. Accordingly, strengthening self-efficacy is widely regarded as a core component of comprehensive diabetes care.[10]

The rapid advancement of digital health technologies has created new opportunities to support diabetes self-management.[11] Digital health interventions, including mobile applications, web-based education platforms, telehealth consultations and remote monitoring systems, are increasingly being incorporated into chronic disease management.[11–13] These approaches provide scalable and accessible support that may address common barriers to care, such as limited access to healthcare professionals, time constraints and geographic disparities.[14–16] By providing continuous feedback, tailored education and interactive support, digital interventions may support patients' ability to engage in effective self-management.[9, 11]

Although digital health interventions are increasingly applied in diabetes care, their impact on self-efficacy has been reported inconsistently across studies.[11, 16] Individual studies reported varying effect sizes, influenced by differences in intervention design, duration, delivery modality, outcome measurement instruments and participant characteristics.[11, 12] While previous systematic reviews have focused mainly on clinical indicators such as glycaemic control, self-efficacy has received comparatively less attention as a primary psychosocial outcome and quantitative synthesis remains limited in this area.[13, 17] Moreover, the absence of quantitative synthesis in some reviews reduces the clarity of effect size estimates and weakens their practical interpretability,[16, 18] particularly given the considerable variation in digital intervention modalities and outcome measurement tools across studies.

Given the central role of self-efficacy in sustaining long-term diabetes self-management and the expanding use of digital health solutions, a comprehensive synthesis of current evidence is required. Therefore, this systematic review and meta-analysis aimed to quantitatively evaluate the effectiveness of digital health interventions in improving self-efficacy among adults with T2DM.[9, 11] By restricting inclusion to randomised controlled trials, the study sought to provide robust evidence to inform clinical practice, policy development and the design of future digital diabetes self-management interventions.

Methods

Study design and reporting framework

Evidence from randomised controlled trials was analysed to assess how digital health interventions influence self-efficacy in adults with T2DM. Reporting followed the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, ensuring transparency and methodological rigour throughout the review process.[19]

Table 1: PICOS eligibility criteria

Component	Description
Population	Adults with type 2 diabetes mellitus
Intervention	Digital health interventions (mobile applications, SMS-based interventions, web-based platforms and telehealth/telenursing)
Comparison	Usual care, standard diabetes education or non-digital interventions
Outcome	Self-efficacy measured using validated instruments
Study design	Randomised controlled trials (RCTs)

PICOS: population, intervention, comparison, outcome and study design; SMS: short message service.

Eligibility criteria

The eligibility criteria for study inclusion were defined using the Population, Intervention, Comparison, Outcome and Study design (PICOS) framework, as summarised in Table 1. Self-efficacy outcomes were eligible for inclusion regardless of whether they were reported as primary or secondary outcomes in the original randomised controlled trials, provided that quantitative data were available for effect size calculation. Studies were excluded if the study population included participants with type 1 diabetes mellitus or gestational diabetes, did not report self-efficacy outcomes, were non-randomised or lacked sufficient quantitative data for effect-size estimation.

Information sources and search strategy

Study identification was undertaken through searches of three electronic databases: *Scopus, PubMed/MEDLINE* and *EBSCO*. Eligible studies published from January 2017 to December 2024 were identified. Keywords and controlled vocabulary terms related to "type 2 diabetes mellitus," "digital health," "mHealth," "telehealth" and "self-efficacy" were combined using Boolean operators.

Database-specific search details are available in the supplementary materials. Reference lists of eligible studies were examined to identify further relevant publications. Records identified through supplementary sources underwent screening based on the predefined eligibility criteria.

Study selection

All identified records were imported into reference management software and duplicate records were removed. Titles and abstracts were screened independently by two reviewers according to predefined eligibility criteria. Potentially relevant articles underwent full-text assessment for inclusion. Discrepancies between reviewers were resolved through discussion and a third reviewer was consulted when required. The study selection process is illustrated in the PRISMA 2020 flow diagram.

Data extraction

Data were extracted independently by two reviewers using a predefined extraction template. Information collected included study characteristics (author, year and country), participant demographics, intervention characteristics (type, duration and delivery modality), comparison conditions, outcome measurement instruments and quantitative data required for meta-analysis (means, standard deviations and sample sizes). When multiple follow-up points were reported, post-intervention outcome data were extracted for consistency. Corresponding authors were contacted when necessary to obtain missing or unclear data.

Risk of bias assessment

The risk of bias of included RCTs was assessed using the Cochrane Risk of Bias tool version 2 (RoB 2).[20] Risk of bias assessment was conducted independently by two reviewers, with disagreements resolved through discussion. Bias was evaluated across five domains: (1) randomisation process, (2) deviations from intended interventions, (3) missing outcome data, (4) measurement of the outcome and (5) selection of the reported result. Each study was classified as having low risk of bias, some concerns or high risk of bias.

Data synthesis and statistical analysis

A meta-analysis was performed using a random-effects approach to accommodate anticipated clinical and methodological variability between studies. A random-effects model was chosen *a priori* because clinical and methodological diversity across studies was expected, including variations in intervention modality, study population, duration and measurement instruments. Meta-analytic procedures followed stan-

dard guidance from the "Cochrane Handbook for Systematic Reviews of Interventions"[21] and the statistical methods were reviewed for accuracy and consistency.

Effect sizes were summarised as standardised mean differences (SMDs) with corresponding 95 % confidence intervals (CIs). Statistical heterogeneity was evaluated and quantified using the I^2 statistic, which represents the proportion of total variability across studies that is attributable to heterogeneity rather than chance; values above 75 % indicate substantial heterogeneity. In addition, τ^2 was used to estimate the between-study variance in true effect sizes. The use of standardised mean differences allowed outcomes measured using different self-efficacy instruments (such as DMSES, DES-SF and DSES) to be combined in a single meta-analysis. By standardizing the mean difference relative to the pooled standard deviation, SMD enabled comparison across studies that employed different measurement scales while assessing the same underlying construct.

A leave-one-out sensitivity analysis was applied to evaluate the robustness of the pooled effect size. Potential publication bias was assessed by funnel plot inspection and Egger's regression, and results were interpreted cautiously owing to the limited number of included studies. All analyses were conducted using Review Manager software.

Results

Study selection

The systematic database search identified 224 records, comprising 134 from Scopus, 72 from *PubMed/MEDLINE* and 18 from *EBSCO*. An additional 49 records were identified through supplementary manual searching. After removal of 25 duplicate records, 248 records were included for title and abstract screening.

Following title and abstract screening, 202 records were excluded for not meeting the inclusion criteria, primarily due to inappropriate study design, population or outcomes. As a result, 46 full-text articles were identified for retrieval; however, 22 reports could not be retrieved. The remaining 24 full-text articles underwent eligibility assessment.

Of the 24 full-text articles assessed for eligibility, 16 were excluded due to insufficient outcome data or failure to report self-efficacy measures in a format suitable for quantitative synthesis. Ultimately, eight randomised controlled trials fulfilled the inclusion criteria and were included in the meta-analysis. The study selection process is illustrated in Figure 1.

Characteristics of included studies

The characteristics of the included studies are summarised in Table 2. The eight randomised controlled trials were conducted across diverse geographical settings and involved adult participants diagnosed with T2DM. Sample sizes ranged from small to moderate, totalling 817 participants in the meta-analysis.

The digital health interventions evaluated included nurse coaching supported by mobile health,[22] SMS-based education,[23] mobile app programmes,[24, 25] multimedia education compared with SMS,[26] *WhatsApp*-delivered education,[27] tele-nursing [28] and digital health coaching.[29] Intervention durations varied across studies, ranging from short-term interventions to programmes extending several months. Self-efficacy was measured using validated instruments, although the specific tools and scoring methods varied across studies. The key study characteristics, including study design, sample size, intervention, duration and self-efficacy instrument, are summarised in Table 2.

Risk of bias assessment

Risk of bias assessment using the Cochrane Risk of Bias tool version 2 (RoB 2) indicated some variability across domains among the included studies. All studies demonstrated a low risk of bias in the randomisation process and outcome measurement domains. Some concerns were identified in the domain of deviations from intended interventions, reflecting the inherent challenges of blinding in digital health interventions and, to a lesser extent, in missing outcome data.

Overall, all studies were judged to have some concerns, primarily identified in the domain of deviations from intended interventions, largely due to the lack of blinding and challenges in maintaining intervention fidelity, which are common limitations in digital health interventions. The overall risk of bias assessment is presented in Figure 2 while domain-specific judgements for each study are shown in Figure 3.

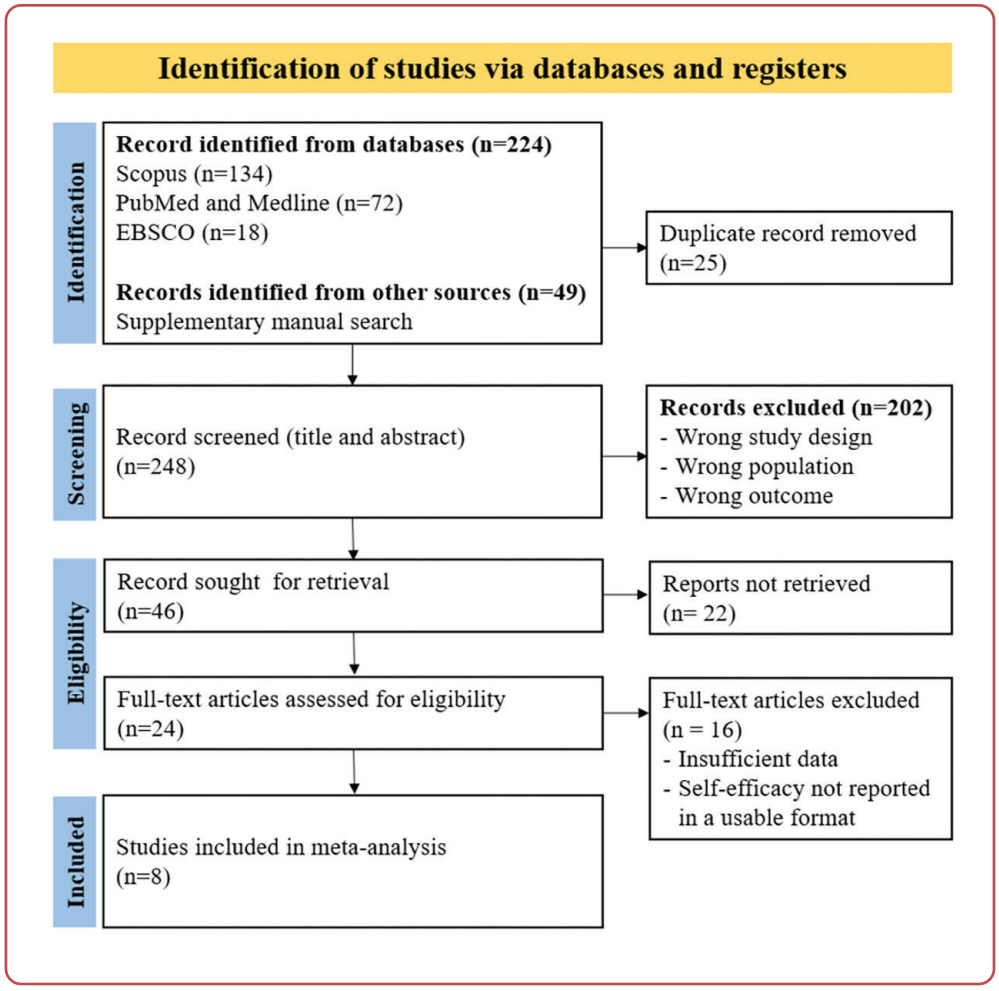


Figure 1: PRISMA 2020 flow diagram

Table 2: Characteristics of the included studies

Study	Country	N (intervention / comparator); duration	Participants	Digital intervention	Comparator	Self-efficacy instrument; time point	Mean (SD): intervention / comparator
Young et al (2020)[22]	USA	I: 158 / C: 161; 3 months	Adults with T2DM; mean age ± 56 years; men and women; diabetes duration ± 9 years	Mobile health app + nurse coaching (goal-setting, feedback, monitoring)	Usual care	DES-SF; post-intervention at 3 months	4.05 (0.69) / 3.71 (0.86)
Abaza and Marschollek (2017)[23]	Egypt	I: 45 / C: 45; 6 months	Adults with T2DM; mean age ± 50 years; men and women; variable diabetes duration	SMS-based education (motivational and reminder messages)	Standard education	DMSES; post-intervention at 6 months	3.51 (0.39) / 2.68 (0.33)
Zhai and Yu (2020)[24]	China	I: 60 / C: 60; 6 months	Adults with T2DM; mean age ± 55 years; men and women	Mobile app–based self-man-agement (monitoring, education, reminders)	Usual care	Diabetes Self-Efficacy Scale (DSES); post-intervention at 6 months	119.2 (9.88) / 102.09 (10.06)

Kusnanto et al (2019)[25]	Indonesia	I: 40 / C: 40; 3 months	Adults with T2DM; mean age ± 54 years; predominantly female	Digital diabetes education (multimedia + digital follow-up)	Conventional education	Indonesian version of DMSES; post-intervention at 3 months	49.2 (2.54) / 41.07 (1.94)
İşleyen et al (2025)[28]	Turkey	I: 36 / C: 34; 3 months	Adults with T2DM; mean age ± 57 years; men and women	Telephone-based telenursing with motivational interviewing	Routine care	Diabetes Self-Efficacy Scale (DSES); post-intervention at 3 months	84.41 (12.74) / 70.11 (10.83)
Neko et al (2023)[27]	Iran	I: 50 / C: 50; 3 months	Adults with T2DM; mean age ± 52 years; men and women	Theory-based digital intervention (HAPA) via online platform and *WhatsApp*	Usual care	Action self-efficacy (HAPA subscale); post-intervention at 3 months	20.32 (5.3) / 15.67 (3.3)
Lee and Iskandar (2025)[29]	Malaysia	I: 15 / C: 15; 12 weeks	Adults with T2DM; mean age 30–65 years; men and women; diabetes duration ≥ 1 year	Digital health coaching program (12 structured online coaching sessions; behaviour change and self-management support; delivered by trained health coaches)	Usual care	DMSES; post-intervention (12 weeks)	65.20 (5.38) / 54.00 (6.25)
Lari et al (2018)[26]	Iran	I: 50 / C: 50; 3 months	Adults with T2DM; mean age ± 53 years; men and women	Digital multimedia education compared with SMS	SMS-based education	Diabetes Self-Efficacy Scale; post-intervention at 3 months	64.86 (16.88) / 67.25 (13.57)

I: intervention; C: comparator; DES-SF: Diabetes Empowerment Scale–Short Form; DMSES: Diabetes Management Self-Efficacy Scale; DSES: Diabetes Self-Efficacy Scale; HAPA: Health Action Process Approach; SMS: short message service; SD: standard deviation; T2DM: type 2 diabetes mellitus;

Meta-analysis of self-efficacy outcomes

The pooled effect of digital health interventions on self-efficacy, expressed as standardised mean differences (SMDs) with 95 % confidence intervals, is illustrated in Figure 4. Eight randomised controlled trials involving 817 participants were included in the meta-analysis. The pooled analysis demonstrated a statistically significant improvement in self-efficacy among participants receiving digital health interventions compared with control conditions. The overall standardised mean difference was 1.38 (95 % CI: 0.77–2.00; $p < 0.00001$), indicating a significant effect in favour of digital health interventions.

Substantial heterogeneity was observed across studies ($I^2 = 93$ %), which suggests considerable variability in intervention characteristics, outcome measurement instruments and study populations. The pooled effect of digital health interventions on self-efficacy is presented in Figure 4.

Sensitivity analysis

Sensitivity analysis using a leave-one-out approach indicated that the pooled effect size remained stable after removing individual studies. No single study disproportionately influenced the magnitude or direction of the overall effect, supporting the robustness of the meta-analytic findings despite the observed heterogeneity.

Publication bias

A funnel plot was generated to explore potential publication bias among the included studies (Figure 5). Visual inspection suggested potential asymmetry. Egger's regression test indicated statistical significance. However, these findings should be interpreted with caution given the lim-

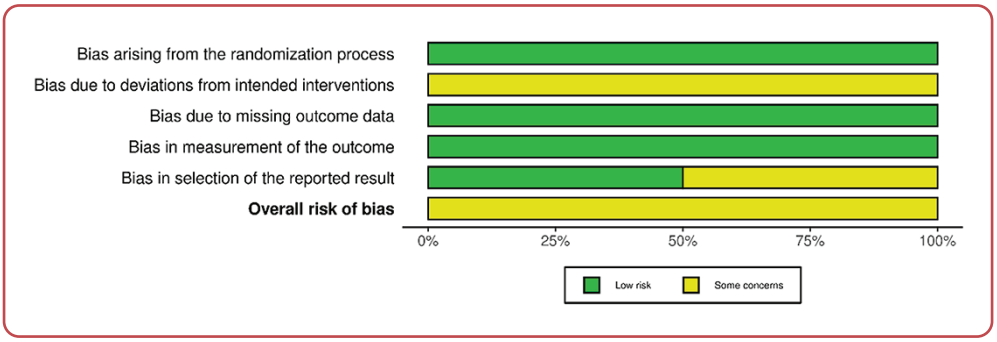


Figure 2: Risk of bias summary across the included studies assessed using the Cochrane Risk of Bias tool version 2 (RoB 2)

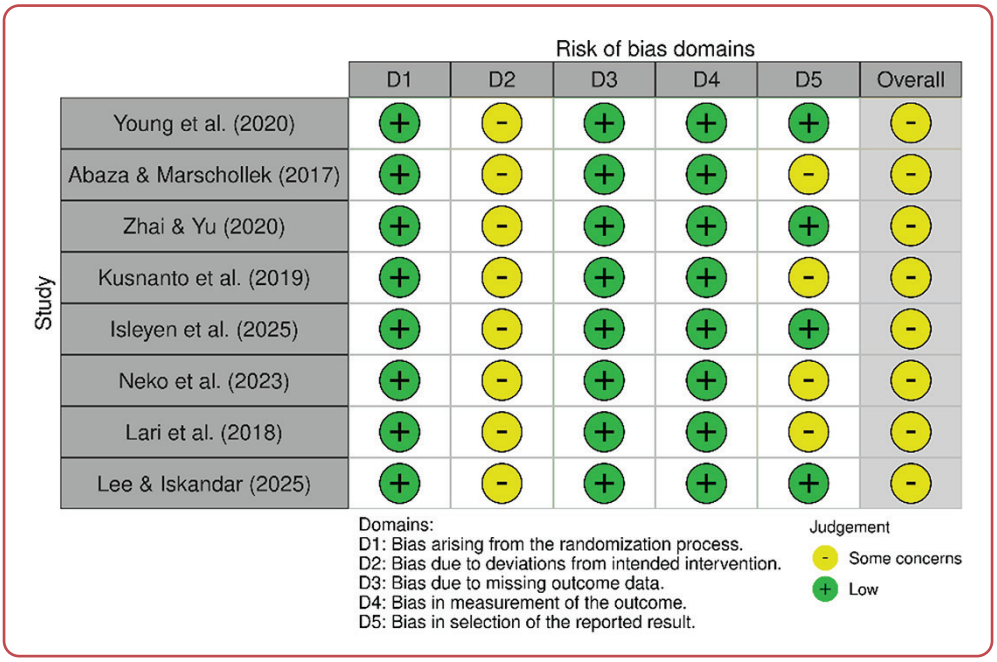
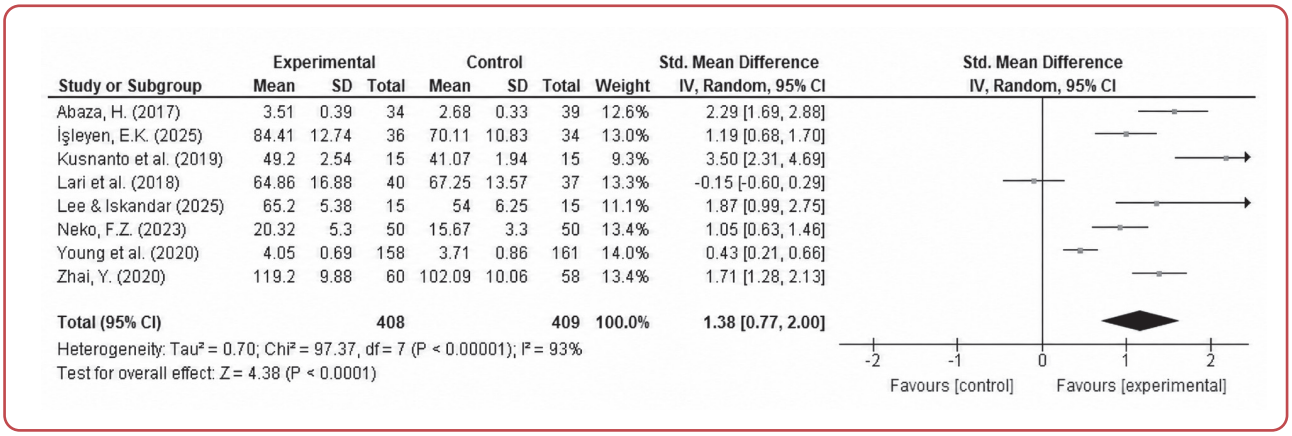


Figure 3: Risk of bias traffic-light plot



Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI
Abaza, H. (2017)	3.51	0.39	34	2.68	0.33	39	12.6%	2.29 [1.69, 2.88]
İşleyen, E.K. (2025)	84.41	12.74	36	70.11	10.83	34	13.0%	1.19 [0.68, 1.70]
Kusnanto et al. (2019)	49.2	2.54	15	41.07	1.94	15	9.3%	3.50 [2.31, 4.69]
Lari et al. (2018)	64.86	16.88	40	67.25	13.57	37	13.3%	-0.15 [-0.60, 0.29]
Lee & Iskandar (2025)	65.2	5.38	15	54	6.25	15	11.1%	1.87 [0.99, 2.75]
Neko, F.Z. (2023)	20.32	5.3	50	15.67	3.3	50	13.4%	1.05 [0.63, 1.46]
Young et al. (2020)	4.05	0.69	158	3.71	0.86	161	14.0%	0.43 [0.21, 0.66]
Zhai, Y. (2020)	119.2	9.88	60	102.09	10.06	58	13.4%	1.71 [1.28, 2.13]
Total (95% CI)			408			409	100.0%	**1.38 [0.77, 2.00]**

Heterogeneity: Tau² = 0.70; Chi² = 97.37, df = 7 (P < 0.00001); I² = 93%
Test for overall effect: Z = 4.38 (P < 0.0001)

Figure 4: Forest plot of the reported standardised mean differences

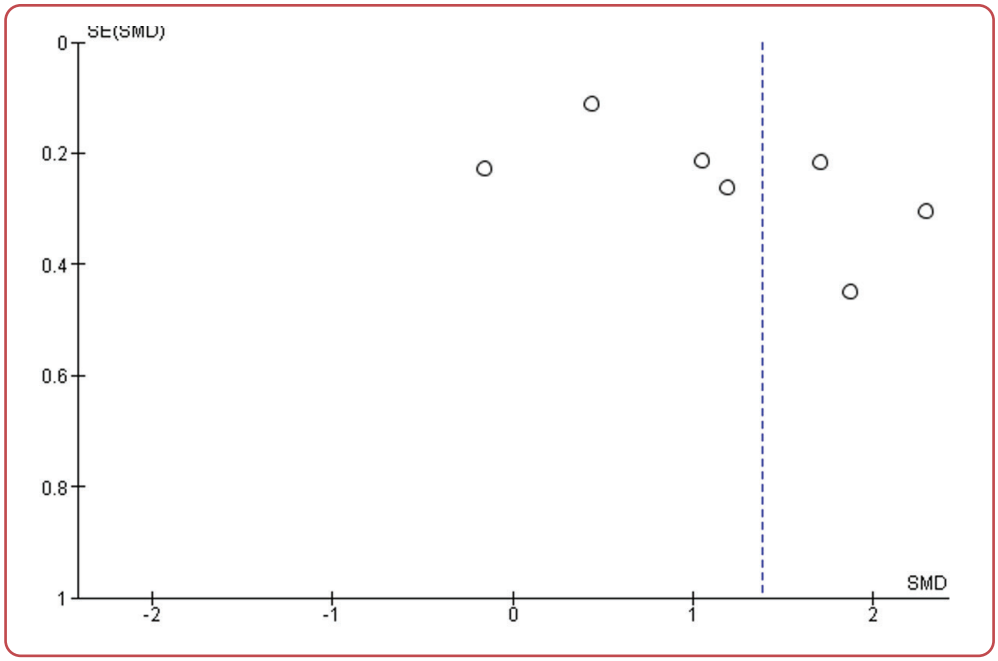


Figure 5: Funnel plot of the reported study effects

ited number of included studies and the presence of substantial heterogeneity.[30] Statistical tests for funnel plot asymmetry are generally underpowered when fewer than ten studies are included. Therefore, conclusions regarding publication bias remain exploratory rather than definitive.

Discussion

This systematic review and meta-analysis evaluated the effectiveness of digital health interventions in improving self-efficacy among adults with T2DM. The pooled findings demonstrated a large, statistically significant effect of digital health interventions on self-efficacy compared with standard care or non-digital interventions. These results highlight the potential of digital health strategies as practical psychosocial support tools within diabetes self-management programmes, consistent with previous evidence in this field.[11, 12]

The observed improvement in self-efficacy is consistent with social cognitive theory, which posits self-efficacy as a key determinant of behaviour change and sustained self-management.[31] Self-efficacy may be enhanced by digital health interventions through several mechanisms, including continuous access to tailored educational content, real-time feedback, goal-setting features and interactive communication with healthcare providers. These features can reinforce mastery experiences and provide social and verbal persuasion, both of which are central pathways for strengthening self-efficacy.[9, 14] Consequently, digital platforms may offer advantages over traditional face-to-face education by providing ongoing support beyond clinical encounters.

Despite the statistically significant pooled effect, substantial heterogeneity was observed across the included studies. This heterogeneity likely reflects variations in intervention design, delivery modality, duration, intensity and level of professional involvement, as well as differences in the measurement instruments used to assess self-efficacy.[11, 12, 16] Geographical diversity across the included studies may also contribute to variability in self-efficacy outcomes. Differences in cultural context, digital literacy, healthcare infrastructure and accessibility of digital technologies may influence how patients engage with digital health interventions and perceive their capacity to manage diabetes. For example, mobile application–based interventions may differ fundamentally from telehealth consultations in terms of user engagement and interactivity. Telehealth interventions often involve direct interaction with healthcare professionals, enabling personalised feedback and guidance. In contrast, mobile health applications typically provide automated reminders, monitoring tools and educa-

tional resources that support more self-directed self-management. These differences in delivery modality may partly explain variations in patient engagement and intervention effectiveness across studies. Differences in intervention duration across studies may also contribute to variability in outcomes. Additionally, short-term interventions may yield larger immediate effects on self-efficacy compared with longer-term programmes, where behavioural fatigue or declining adherence may attenuate outcomes. The diversity of outcome measurement tools further contributes to variability in effect, making comparability challenging.

The magnitude of the pooled effect size should be interpreted with caution. The large pooled effect size observed in this meta-analysis may partly reflect the substantial heterogeneity across studies, which can influence the magnitude and stability of standardised mean difference estimates. While the significant standardised mean difference suggests a meaningful impact of digital health interventions, several factors may have inflated the observed effect. These include the reliance on self-reported outcomes, small sample sizes in some trials and the limited number of studies included in the meta-analysis.[19] In addition, the interpretation of funnel plot asymmetry and Egger's regression should be approached cautiously when the number of included studies is small, as statistical power to detect publication bias is limited under such conditions. Furthermore, substantial heterogeneity underscores the need for careful interpretation and limits the generalisability of the findings across all digital health modalities.

The findings of this review are consistent with previous literature, indicating that structured education and digital health interventions can positively influence psychosocial outcomes and self-management behaviours in chronic disease management.[32] However, many prior systematic reviews have focused primarily on clinical outcomes such as glycaemic control, with less emphasis on self-efficacy as a primary outcome.[13, 17] By specifically targeting self-efficacy and restricting inclusion to randomised controlled trials, this study contributes novel quantitative evidence to the existing literature. It reinforces the importance of addressing psychosocial determinants alongside clinical indicators in diabetes care. Improvements in self-efficacy may indirectly influence clinical outcomes such as glycaemic control by strengthening patients' confidence and adherence to self-management behaviours.

From a clinical and policy perspective, the results suggest that integrating digital health interventions into routine diabetes management may enhance patients' confidence in managing their condition. Previous studies have also demonstrated that structured diabetes self-management education programmes can significantly improve patients' self-care behaviours.[33] Such integration could be particularly beneficial in settings with limited healthcare resources, where digital platforms may improve access to education and support.[9, 34] However, the variability in intervention effectiveness indicates that digital health solutions should be carefully designed, contextually adapted and supported by appropriate training to maximise patient engagement and sustained benefit.

Limitations

Several limitations of this review should be acknowledged. First, the limited number of studies included in the meta-analysis constrained the ability to conduct subgroup analyses to identify the most effective intervention characteristics. Second, the high level of heterogeneity reduces confidence in the pooled estimate and suggests that intervention effects may differ substantially across contexts. Moreover, the small number of studies included in the meta-analysis should be considered when interpreting heterogeneity statistics and sensitivity analyses. Methodological literature suggests that when fewer than ten studies are available, estimates of heterogeneity such as I^2 may be unstable and sensitivity analyses may have limited power to detect influential studies. Therefore, the interpretation of heterogeneity and robustness analyses should be approached with caution. Third, the assessment of publication bias was exploratory due to the small number of studies, limiting the reliability of statistical tests for funnel plot asymmetry.[19, 30] Fourth, this review was not prospectively registered in PROSPERO, which may increase the risk of reporting bias. However, the eligibility criteria, outcomes and analytic methods were defined *a priori* and applied consistently throughout the review process.

In addition, the certainty of evidence was not formally assessed using the GRADE approach, which limits conclusions regarding the overall strength of evidence. Future reviews should incorporate

formal evidence grading to strengthen interpretability and clinical applicability. Finally, most included studies relied on self-reported measures of self-efficacy, which may be subject to response and social desirability bias.

Future research should prioritise well-designed randomised controlled trials with standardised self-efficacy measurement tools and longer follow-up periods to assess the sustainability of intervention effects. Comparative studies examining different digital health modalities and levels of professional support would further clarify which components are most effective at enhancing self-efficacy. Such evidence would support the development of targeted, scalable and evidence-based digital health interventions for diabetes self-management.

Conclusion

This systematic review and meta-analysis provide quantitative evidence that digital health interventions are effective in improving self-efficacy among adults with T2DM. By synthesising data from randomised controlled trials, the findings demonstrate that digitally delivered self-management support can enhance patients' confidence in managing their condition, a critical psychosocial component of sustained diabetes care.

Despite the significant pooled effect, the findings should be interpreted in light of substantial heterogeneity across studies. Variations in intervention design, delivery modality, duration and outcome measurement instruments highlight the complexity of digital health interventions and underscore the need for standardisation in future research. Nevertheless, the overall evidence supports the potential role of digital health strategies as complementary tools within comprehensive diabetes management programmes.

Future research should focus on rigorously designed trials with standardised self-efficacy measures, longer follow-up periods and comparative evaluations of different digital health modalities. Such efforts will strengthen the evidence base and guide the development of effective, scalable and contextually appropriate digital health interventions to improve psychosocial outcomes and long-term self-management among individuals with T2DM.

Ethics

This study was a secondary analysis based on the currently existing data and did not directly involve with human participants or experimental animals. Therefore, the ethics approval was not required in this paper.

Acknowledgement

The authors thank colleagues who provided technical assistance and constructive feedback during the preparation of this manuscript.

Conflicts of interest

The authors declare that there is no conflict of interest.

Funding

This study was supported by the Program Penelitian Tesis Magister (PTM) Grant from the Ministry of Higher Education, Science, and Technology of Indonesia (Kemdiktisaintek). Grant code: 196/KPA/C3/KPT/2026. Grant holder: Sugiharto.

Data access

The data that support the findings of this study are available from the corresponding author upon reasonable individual request.

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