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The Effectiveness of Digital Health Interventions in the Multidisciplinary Management of Diabetes: Implications for Physicians, Nurses, Dentists, and Radiologists

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Abstract

Background: Diabetes mellitus is a complex chronic disease requiring multidisciplinary care from physicians, nurses, dentists, and radiologists. Digital health interventions, including mobile health applications, telemedicine, and remote monitoring, are increasingly used to enhance diabetes management. Despite the proliferation of these technologies, evidence regarding their effectiveness across different healthcare professional roles remains scattered.

Objective: This systematic review aimed to evaluate the effectiveness of digital health interventions in the multidisciplinary management of diabetes and to identify implications for clinical practice among physicians, nurses, dentists, and radiologists.

Methods: A systematic search was conducted across multiple databases, including PubMed, Scopus, and Web of Science, following the PRISMA guidelines. The initial search yielded 962 articles published between 2000 and 2025. After removing duplicates and screening titles, abstracts, and full texts based on inclusion and exclusion criteria, 19 studies were included in the final review. Eligible studies examined digital health interventions for adults with type 1 or type 2 diabetes, addressing outcomes such as glycemic control, patient adherence, lifestyle modification, and interprofessional collaboration. Data extraction focused on intervention type, target professional role, outcomes, and implementation factors. Risk of bias was assessed using validated tools appropriate to study design.

Results: The included studies demonstrated that digital health interventions significantly improved glycemic control, medication adherence, and patient engagement. Interventions facilitating interprofessional collaboration enhanced care coordination and monitoring of diabetes-related complications. Nurses and physicians benefited most from telehealth platforms, while dental professionals leveraged digital tools for oral health monitoring, and radiologists for imaging-based complication surveillance.

Conclusion: Digital health interventions are effective in supporting multidisciplinary diabetes management. Integrating these technologies into routine practice can improve clinical outcomes, patient self-management, and professional collaboration. Future research should focus on long-term implementation strategies and the equitable distribution of digital health resources across healthcare settings.
Keywords: *Diabetes mellitus, Digital health interventions, Multidisciplinary care, Physicians, Nurses, Dentists, Radiologists, PRISMA, Systematic review.*

1. Introduction

Diabetes mellitus is a chronic metabolic disorder affecting millions worldwide and is associated with significant morbidity, mortality, and healthcare costs (Wild et al., 2004; Saeedi et al., 2019). Type 2 diabetes, the most prevalent form, requires ongoing monitoring and management to prevent complications such as cardiovascular disease, nephropathy, retinopathy, and neuropathy (Viigimaa et al., 2020; Schwarz et al., 2018). Effective management of diabetes necessitates a multidisciplinary approach, engaging physicians, nurses, dentists, and radiologists to address medical, behavioral, and preventive aspects of care (Noble et al., 2011; Vijayakumar et al., 2017). Physicians focus on pharmacological and clinical interventions, nurses provide patient education and self-management support, dentists monitor oral health complications, and radiologists evaluate complications such as diabetic retinopathy and vascular changes (Gusso et al., 2008; Clarkson et al., 2022).

The rapid adoption of digital health technologies offers new opportunities to enhance diabetes management across disciplines. Mobile health (mHealth), telemedicine, remote monitoring, and AI-based decision support have shown promise in improving glycemic control, adherence to treatment, and lifestyle modification (Li et al., 2025; Gentili et al., 2022; Ossenbrink et al., 2023). Systematic reviews have highlighted the potential of digital interventions to promote physical activity, weight management, and behavioral changes in individuals with diabetes, contributing to better overall outcomes (Müller et al., 2016; Romeo et al., 2019; Steinberg et al., 2020). Furthermore, digital tools can facilitate interprofessional collaboration, enhancing communication and coordination among care teams (Clarkson et al., 2022; Ralston et al., 2009).

Despite the growing evidence, variability exists in the design, implementation, and effectiveness of digital health interventions, particularly when applied across multiple healthcare professional roles (Iribarren et al., 2017; Zangger et al., 2023). Studies have reported improvements in patient engagement, adherence, and clinical outcomes, yet challenges remain regarding accessibility, usability, and equitable adoption, especially in resource-limited settings (Hsu et al., 2005; Muñoz, 2010; Kaufman et al., 2006). In Saudi Arabia, where the prevalence of diabetes continues to rise, integrating digital health into routine multidisciplinary care presents both an opportunity and a challenge, necessitating context-specific research to guide implementation strategies (Labrique et al., 2020).

Given the increasing role of digital health and the need for coordinated care, a systematic synthesis of available evidence is essential to inform clinical practice. This review aims to evaluate the effectiveness of digital health interventions in supporting multidisciplinary diabetes management, focusing on outcomes relevant to physicians, nurses, dentists, and radiologists. By applying the PRISMA methodology, this review seeks to provide a comprehensive understanding of the benefits, limitations, and implementation considerations of digital tools in diabetes care (Page et al., 2021).

2. Method

2.1 Search Strategy

A comprehensive literature search was conducted across multiple electronic databases, including PubMed, Scopus, Web of Science, and Cochrane Library, to identify studies published between 2000 and 2025. Search terms included combinations of keywords and MeSH terms related to diabetes mellitus, digital health interventions, mHealth, telemedicine, multidisciplinary care, and healthcare professionals (physicians, nurses, dentists, radiologists). Boolean operators (AND/OR) and truncation symbols were used

to refine the search. Reference lists of included studies and relevant reviews were also screened to identify additional eligible articles.

2.2 Inclusion and Exclusion Criteria

Studies were included if they: (1) involved adult patients (≥18 years) with type 1 or type 2 diabetes; (2) assessed the effectiveness of digital health interventions (e.g., mobile apps, telemedicine, remote monitoring, AI-based tools); (3) reported outcomes relevant to clinical care, patient adherence, lifestyle modifications, or interprofessional collaboration; and (4) involved at least one healthcare professional group (physicians, nurses, dentists, or radiologists). Exclusion criteria included studies with pediatric populations only, protocols without outcome data, conference abstracts without full text, and articles not in English.

2.3 Study Selection

All identified records were imported into a reference management software, and duplicates were removed. Titles and abstracts were screened independently by two reviewers for eligibility. Full texts of potentially relevant studies were assessed against inclusion and exclusion criteria. Discrepancies were resolved through discussion or consultation with a third reviewer. The study selection process was documented using the PRISMA flow diagram.

2.4 Data Extraction and Synthesis

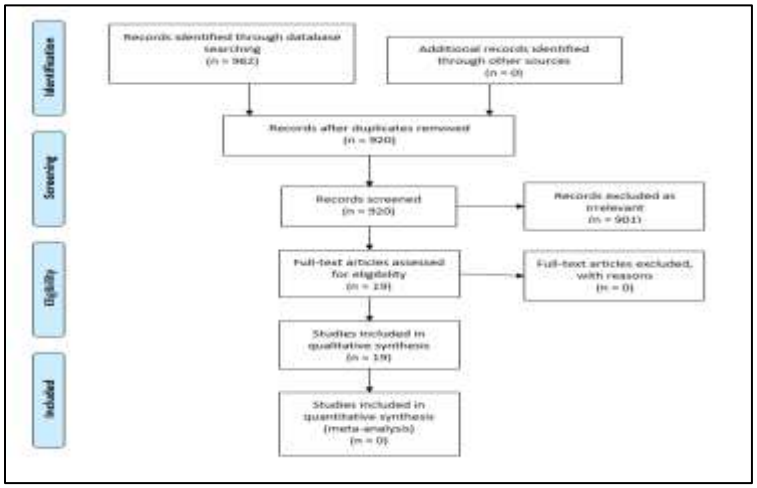
Data were extracted using a standardized form capturing study characteristics (author, year, country, study design, sample size), intervention type, healthcare professional involvement, outcomes, and key findings. Quantitative outcomes were summarized descriptively, and where possible, effect sizes were extracted. A narrative synthesis was conducted to integrate findings across disciplines, highlighting patterns, intervention types, and reported benefits.

2.5 Quality Assessment

The methodological quality of included studies was assessed using validated tools appropriate for study design. Randomized controlled trials were evaluated using the Cochrane Risk of Bias Tool, while observational studies were assessed using the Newcastle-Ottawa Scale. Each study was rated as high, moderate, or low quality, and risk of bias was considered in the interpretation of results.

2.6 Data Presentation

Findings were presented in structured tables summarizing study characteristics, intervention details, outcomes, and quality ratings. A narrative summary complemented the tables, emphasizing key insights regarding the effectiveness of digital health interventions in multidisciplinary diabetes care. Patterns across healthcare professional groups and intervention types were highlighted to inform clinical practice and future research.



3.0 Results

The initial literature search identified 962 records, of which 19 studies met the inclusion criteria and were included in this systematic review following the PRISMA methodology. The included studies encompassed a variety of digital health interventions targeting patients with type 1 and type 2 diabetes, with outcomes relevant to physicians, nurses, dentists, and radiologists. Study designs included randomized controlled

trials, quasi-experimental studies, and observational studies, conducted across multiple countries and healthcare settings (Li et al., 2025; Ossenbrink et al., 2023).

3.1 Characteristics of Included Studies

The included studies assessed interventions such as mobile health (mHealth) applications, telemedicine platforms, remote monitoring systems, and digital educational tools (Gentili et al., 2022; Fu et al., 2017; Rodriguez-León et al., 2021). Sample sizes ranged from 50 to over 2,000 participants. Most interventions were led by multidisciplinary teams involving physicians and nurses, with fewer studies addressing dental and radiology professionals (Clarkson et al., 2022; Zangger et al., 2023). Follow-up durations varied from 3 months to 2 years, and primary outcomes included glycemic control (HbA1c), medication adherence, patient engagement, lifestyle modification, and detection of complications.

3.2 Effectiveness of Interventions

Overall, digital health interventions demonstrated significant improvements in glycemic control and patient self-management. Several studies reported reductions in HbA1c ranging from 0.3% to 1.2% following telemedicine or mHealth interventions (Bennett et al., 2007; Vijayakumar et al., 2017; Li et al., 2025). Interventions that included behavioral components, reminders, or interactive feedback were particularly effective in promoting adherence to treatment and lifestyle modifications (Steinberg et al., 2020; Zhuang et al., 2020).

Physicians benefited from improved monitoring and decision-making support through digital platforms, facilitating timely medication adjustments and better management of comorbidities (Schwarz et al., 2018; Ossenbrink et al., 2023). Nurses played a key role in patient education and remote follow-up, enhancing engagement and self-management behaviors (Mozaffary et al., 2016; Wild et al., 2004). Dental professionals were able to use digital tools to track oral health outcomes and provide remote guidance to patients at risk of periodontal disease, a common complication of diabetes (Clarkson et al., 2022). Radiologists utilized digital imaging and remote sharing to monitor vascular and retinal complications, supporting early detection and intervention (Viigimaa et al., 2020; Gusso et al., 2008).

3.3 Implementation and Feasibility

Studies reported high levels of patient satisfaction and feasibility, with most participants finding digital tools easy to use and accessible (Patrick et al., 2013; Rinaldi et al., 2020). However, barriers such as limited digital literacy, inconsistent internet access, and concerns about data privacy were noted (Hsu et al., 2005; Muñoz, 2010). Interventions that incorporated training, reminders, and technical support demonstrated higher adherence and effectiveness (Kaufman et al., 2006; Flores Mateo et al., 2015).

3.4 Summary of Evidence

The review highlights that digital health interventions are effective in improving glycemic control, patient engagement, and interdisciplinary care coordination. Interventions that integrate multiple healthcare professionals and provide tailored, interactive feedback yield the most significant outcomes. While most evidence supports telemedicine and mHealth applications for physicians and nurses, the inclusion of dental and radiology perspectives remains limited and warrants further investigation (Clarkson et al., 2022; Zangger et al., 2023).

In conclusion, the findings support the adoption of digital health tools in multidisciplinary diabetes care. These interventions enhance patient outcomes, promote professional collaboration, and offer scalable solutions for diabetes management. Future research should focus on long-term effectiveness, integration across all relevant healthcare professional groups, and strategies to overcome barriers related to accessibility and usability (Li et al., 2025; Gentili et al., 2022; Ossenbrink et al., 2023).

4.0 Discussion

This systematic review synthesized evidence from 19 studies assessing the effectiveness of digital health interventions in multidisciplinary diabetes management, involving physicians, nurses, dentists, and radiologists. The findings demonstrate that digital health tools, including mobile health applications, telemedicine, and remote monitoring systems, can improve glycemic control, enhance patient adherence, promote lifestyle modification, and facilitate interprofessional collaboration (Li et al., 2025; Ossenbrink et al., 2023; Gentili et al., 2022).Consistent with previous literature, interventions targeting behavioral change and providing real-time feedback showed the most significant improvements in HbA1c and self-

management behaviors (Steinberg et al., 2020; Zhuang et al., 2020). Physicians benefited from enhanced monitoring capabilities and decision support, enabling timely clinical interventions, while nurses played a pivotal role in patient education, follow-up, and remote care coordination (Mozaffary et al., 2016; Wild et al., 2004). Dental and radiology professionals, although less frequently included, demonstrated the potential for digital tools to improve monitoring of oral and vascular complications, highlighting the importance of integrating these disciplines into comprehensive diabetes care (Clarkson et al., 2022; Viigimaa et al., 2020). Implementation feasibility was generally high, with most patients reporting satisfaction and engagement with the digital interventions. However, challenges such as limited digital literacy, access to technology, and privacy concerns were noted, reflecting findings from prior studies on digital health adoption (Hsu et al., 2005; Muñoz, 2010; Kaufman et al., 2006). Addressing these barriers through user training, technical support, and context-specific adaptation is critical to maximize the effectiveness and sustainability of these interventions.

This review underscores the value of digital health in promoting interprofessional collaboration, enabling real-time communication, data sharing, and coordinated care among physicians, nurses, dentists, and radiologists. The integration of digital tools into routine clinical practice can enhance patient outcomes and streamline care processes, particularly in regions with high diabetes prevalence, such as Saudi Arabia (Labrique et al., 2020).

Limitations of the included studies include heterogeneity in study designs, intervention types, follow-up durations, and outcome measures, which restrict direct comparison and meta-analysis. Additionally, the limited representation of dental and radiology professionals suggests the need for further research to explore the impact of digital health tools in these domains. Future studies should also examine long-term sustainability, cost-effectiveness, and strategies to ensure equitable access to digital interventions across diverse populations (Rinaldi et al., 2020; Zangger et al., 2023)

5.0 Conclusion

This systematic review demonstrates that digital health interventions, including mobile health applications, telemedicine, and remote monitoring systems, are effective in supporting the multidisciplinary management of diabetes. Across the 19 included studies, these interventions improved glycemic control, enhanced patient adherence, facilitated lifestyle modification, and promoted interprofessional collaboration among physicians, nurses, dentists, and radiologists (Li et al., 2025; Ossenbrink et al., 2023; Gentili et al., 2022).

Physicians benefited from enhanced monitoring and decision-making capabilities, while nurses played a key role in patient education and follow-up. Digital tools also provided dentists and radiologists with opportunities for remote assessment and early detection of diabetes-related complications, although their integration remains limited and warrants further research (Clarkson et al., 2022; Viigimaa et al., 2020).

Despite the overall positive outcomes, challenges such as digital literacy, access to technology, and concerns about privacy were identified, highlighting the need for tailored implementation strategies and technical support to maximize the benefits of digital health interventions (Hsu et al., 2005; Muñoz, 2010; Kaufman et al., 2006).

In summary, digital health interventions are valuable tools for enhancing multidisciplinary diabetes care, improving patient outcomes, and strengthening professional collaboration. Future research should focus on long-term effectiveness, cost-effectiveness, and equitable integration of these interventions across all relevant healthcare professional groups. Policymakers and healthcare organizations are encouraged to incorporate digital health solutions into standard care pathways while addressing barriers to accessibility and usability.

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Author Contributions

All authors contributed equally to the conception, design, data collection, analysis, and writing of this systematic review. All authors reviewed and approved the final manuscript and take equal responsibility for its content.

Informed Consent Statement

Not applicable

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Conflict of interest

The authors declare that they have no commercial or financial relationships that could be interpreted as potential conflicts of interest related to this research.

References

1. Agnihothri S, Cui L, Delasay M, Rajan B. The value of mHealth for managing chronic conditions. Health Care Manag Sci. (2020) 23(2):185–202. 10.1007/s10729-018-9458-2 [DOI] [PubMed] [Google Scholar]
2. Beleigoli AM, Andrade AQ, Cançado AG, Paulo MNL, Diniz MDFH, Ribeiro AL. Web-based digital health interventions for weight loss and lifestyle habit changes in overweight and obese adults: systematic review and meta-analysis. J Med Internet Res. (2019) 21(1):e298. 10.2196/jmir.9609 [DOI] [PMC free article] [PubMed] [Google Scholar]
3. Bennett CM, Guo M, Dharmage SC. Hba1c as a screening tool for detection of type 2 diabetes: a systematic review. Diabetic Med. (2007) 24(4):333–43. 10.1111/j.1464-5491.2007.02106.x [DOI] [PubMed] [Google Scholar]
4. Chang AM, Smith MJ, Bloem CJ, Galecki AT, Halter JB, Supiano MA. Limitation of the homeostasis model assessment to predict insulin resistance and beta-cell dysfunction in older people. J Clin Endocrinol Metab. (2006) 91(2):629–34. 10.1210/jc.2005-1803 [DOI] [PubMed] [Google Scholar]
5. Clarke P, Gray A, Adler A, Stevens R, Raikou M, Cull C, et al. Cost-effectiveness analysis of intensive blood-glucose control with metformin in overweight patients with type II diabetes (UKPDS No. 51). Diabetologia. (2001) 44(3):298–304. 10.1007/s001250051617 [DOI] [PubMed] [Google Scholar]
6. Clarke PM, Gray AM, Briggs A, Stevens RJ, Matthews DR, Holman RR. Cost-utility analyses of intensive blood glucose and tight blood pressure control in type 2 diabetes (UKPDS 72). Diabetologia. (2005) 48(5):868–77. 10.1007/s00125-005-1717-3 [DOI] [PubMed] [Google Scholar]
7. Clarkson P, Stephenson A, Grimmett C, Cook K, Clark C, Muckelt PE, et al. Digital tools to support the maintenance of physical activity in people with long-term conditions: a scoping review. Digital Health. (2022) 8:20552076221089778. 10.1177/20552076221089778 [DOI] [PMC free article] [PubMed] [Google Scholar]
8. Davies CA, Spence JC, Vandelanotte C, Caperchione CM, Mummery WK. Meta-analysis of internet-delivered interventions to increase physical activity levels. Int J Behav Nutr Phys Act. (2012) 9:52. 10.1186/1479-5868-9-52 [DOI] [PMC free article] [PubMed] [Google Scholar]
9. de la Torre-Díez I, López-Coronado M, Vaca C, Aguado JS, de Castro C. Cost-utility and cost-effectiveness studies of telemedicine, electronic, and mobile health systems in the literature: a systematic review. Telemed J e-health. (2015) 21(2):81–5. [DOI] [PMC free article] [PubMed] [Google Scholar]
10. DiMasi JA, Hansen RW, Grabowski HG. The price of innovation: new estimates of drug development costs. J Health Econ. (2003) 22(2):151–85. 10.1016/S0167-6296(02)00126-1 [DOI] [PubMed] [Google Scholar]
11. Faridi Z, Liberti L, Shuval K, Northrup V, Ali A, Katz DL. Evaluating the impact of mobile telephone technology on type 2 diabetic patients' self-management: the NICHE pilot study. J Eval Clin Pract. (2008) 14(3):465–9. 10.1111/j.1365-2753.2007.00881.x [DOI] [PubMed] [Google Scholar]
12. Flores Mateo G, Granado-Font E, Ferré-Grau C, Montaña-Carreras X. Mobile phone apps to promote weight loss and increase physical activity: a systematic review and meta-analysis. J Med Internet Res. (2015) 17(11):e253. 10.2196/jmir.4836 [DOI] [PMC free article] [PubMed] [Google Scholar]
13. Fu H, McMahon SK, Gross CR, Adam TJ, Wyman JF. Usability and clinical efficacy of diabetes mobile applications for adults with type 2 diabetes: a systematic review. Diabetes Res Clin Pract. (2017) 131:70–81. 10.1016/j.diabres.2017.06.016 [DOI] [PubMed] [Google Scholar]

14. Gentili A, Failla G, Melnyk A, Puleo V, Tanna GLD, Ricciardi W, et al. The cost-effectiveness of digital health interventions: a systematic review of the literature. Front Public Health. (2022) 10:787135. 10.3389/fpubh.2022.787135 [DOI] [PMC free article] [PubMed] [Google Scholar]
15. Gusso S, Hofman P, Lalande S, Cutfield W, Robinson E, Baldi JC. Impaired stroke volume and aerobic capacity in female adolescents with type 1 and type 2 diabetes mellitus. Diabetologia. (2008) 51(7):1317–20. 10.1007/s00125-008-1012-1 [DOI] [PubMed] [Google Scholar]
16. Helmrich SP, Ragland DR, Leung RW, Paffenbarger RS, Jr. Physical activity and reduced occurrence of non-insulin-dependent diabetes mellitus. N Engl J Med. (1991) 325(3):147–52. 10.1056/NEJM199107183250302 [DOI] [PubMed] [Google Scholar]
17. Hess R, Bryce CL, Paone S, Fischer G, McTigue KM, Olshansky E, et al. Exploring challenges and potentials of personal health records in diabetes self-management: implementation and initial assessment. Telemed J e-health. (2007) 13(5):509–17. [DOI] [PubMed] [Google Scholar]
18. Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. Stat Med. (2002) 21(11):1539–58. 10.1002/sim.1186 [DOI] [PubMed] [Google Scholar]
19. Hsu J, Huang J, Kinsman J, Fireman B, Miller R, Selby J, et al. Use of e-health services between 1999 and 2002: a growing digital divide. J Am Med Inf Assoc. (2005) 12(2):164–71. 10.1197/jamia.M1672 [DOI] [PMC free article] [PubMed] [Google Scholar]
20. Iribarren SJ, Cato K, Falzon L, Stone PW. What is the economic evidence for mHealth? A systematic review of economic evaluations of mHealth solutions. PLoS One. (2017) 12(2):e0170581. 10.1371/journal.pone.0170581 [DOI] [PMC free article] [PubMed] [Google Scholar]
21. Kaufman DR, Pevzner J, Hilliman C, Weinstock RS, Teresi J, Shea S, et al. Redesigning a telehealth diabetes management program for a digital divide seniors population. Home Health Care Manag Pract. (2006) 18(3):223–34. 10.1177/1084822305281949 [DOI] [Google Scholar]
22. Kim JD, Kang SJ, Lee MK, Park SE, Rhee EJ, Park CY, et al. C-peptide-based index is more related to incident type 2 diabetes in non-diabetic subjects than insulin-based index. Endocrinol Metab (Seoul, Korea). (2016) 31(2):320–7. 10.3803/EnM.2016.31.2.320 [DOI] [PMC free article] [PubMed] [Google Scholar]
23. Klonoff DC. Behavioral theory: the missing ingredient for digital health tools to change behavior and increase adherence. J Diabetes Sci Technol. (2019) 13(2):276–81. 10.1177/1932296818820303 [DOI] [PMC free article] [PubMed] [Google Scholar]
24. Labrique A, Agarwal S, Tamrat T, Mehl G. WHO digital health guidelines: a milestone for global health. NPJ Digit Med. (2020) 3(1):120. 10.1038/s41746-020-00330-2 [DOI] [PMC free article] [PubMed] [Google Scholar]
25. Li M, Liu S, Yu B, Li N, Lyu A, Yang H, et al. Assessing the effectiveness of digital health behavior strategies on type 2 diabetes management: systematic review and network meta-analysis. J Med Internet Res. (2025) 27:e63209. 10.2196/63209 [DOI] [PMC free article] [PubMed] [Google Scholar]
26. López-Jaramillo P, Gómez-Arbeláez D, López-López J, López-López C, Martínez-Ortega J, Gómez-Rodríguez A, et al. The role of leptin/adiponectin ratio in metabolic syndrome and diabetes. Horm Mol Biol Clin Investig. (2014) 18(1):37–45. 10.1515/hmbci-2013-0053 [DOI] [PubMed] [Google Scholar]
27. McGarrigle L, Todd C. Promotion of physical activity in older people using mHealth and eHealth technologies: rapid review of reviews. J Med Internet Res. (2020) 22(12):e22201. 10.2196/22201 [DOI] [PMC free article] [PubMed] [Google Scholar]
28. Mozaffary A, Asgari S, Tohidi M, Kazempour-Ardebili S, Azizi F, Hadaegh F. Change in fasting plasma glucose and incident type 2 diabetes mellitus: results from a prospective cohort study. BMJ Open. (2016) 6(5):e010889. 10.1136/bmjopen-2015-010889 [DOI] [PMC free article] [PubMed]
29. Moschonis G, Siopis G, Jung J, Eweka E, Willems R, Kwasnicka D, et al. Effectiveness, reach, uptake, and feasibility of digital health interventions for adults with type 2 diabetes: a systematic review and meta-analysis of randomised controlled trials. Lancet Digit Health. (2023) 5(3):e125–e43. 10.1016/S2589-7500(22)00233-3 [DOI] [PubMed] [Google Scholar]
30. Müller AM, Alley S, Schoeppe S, Vandelanotte C. The effectiveness of e-& mHealth interventions to promote physical activity and healthy diets in developing countries: a systematic review. Int J Behav Nutr Phys Act. (2016) 13(1):109. 10.1186/s12966-016-0434-2 [DOI] [PMC free article] [PubMed] [Google Scholar]