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Review Article

Telemedicine and mobile health interventions for nutrition management in India: a scoping review

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ABSTRACT

Metabolic health is basis for all health, influencing energy regulation to disease prevention to hormonal balance. The rapid development of digital health technologies has transformed the approach to nutrition and diet management, providing better access to personalized counselling, diet plans, and real-time health monitoring. Nutrition consultations via telemedicine are conducted remotely via video call and chat platforms. Mobile health (mHealth) employs apps, wearable devices and SMS reminders to monitor physical activity and food consumption. This study provides an overview of the impact of telemedicine and mHealth interventions on eating behaviours, nutritional outcomes and overall health in various populations in India regarding dietary adherence, glycaemic control, weight management and implementation challenges. A review was following the guidelines for meta-analysis using PubMed, Scopus, Google Scholar and relevant official reports to select peer-reviewed studies published in the last decade. Studies assessing digital nutrition counselling, mHealth applications, remote dietary monitoring and behavioural interventions among Indian populations were included. Results suggest that mHealth and telemedicine can improve adherence to diet, glycaemic control and weight management. Real-time feedback, AI-powered meal suggestions and virtual coaching improve self-management, especially among people living with diabetes, obesity and cardiovascular diseases. But the digital divide, the limitations of technology and lack of access in resource poor settings remain huge barriers. Capacity building, enabling policies, technological advancement and improved user engagement are needed to optimize these technologies. Improvements in data security and availability can also increase the effectiveness and reach of digital nutrition interventions, especially for remote and underserved populations in India.

Keywords: Telemedicine, mHealth, Nutrition management, Digital health, Remote diet counselling, India

INTRODUCTION

Background of the study

Our health and well-being rely on metabolic health—how we manage our energy, balance our hormones, and fight off disease. The sedentary lifestyle, poor diet, and genetic predispositions have caused the global increase of diseases such as type 2 diabetes, obesity, and metabolic syndrome.[1] Telemedicine and mobile health (mHealth) have found exponential growth in use and have transformed health care delivery across the globe. In India, malnutrition and diet-related diseases are the leading public health concerns, and health professionals are increasingly leveraging digital health interventions for better nutrition and diet management. This scoping analysis evaluates the use of telemedicine and mHealth in tackling nutrition issues in India during the past 10 years.

Definition and concept of telemedicine and mHealth

Definition of telemedicine

The use of telemedicine is widespread to improve access to basic health care, especially in low- and middle-income countries where there are constraints on manpower and infrastructure. Launched in 2019, India's eSanjeevani platform is the world's largest government-run telemedicine initiative.[2]

Telemedicine is defined as the use of telecommunications technology to provide health care services such as diagnosis, treatment, consultation, and monitoring at a distance.[3,4] The World Health Organization (WHO) defines telemedicine as "The use of information and communication technologies (ICTs) for the provision of health care services, where distance is a key actor, by all health professionals, for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and for continuing education of health care providers, all in the interest of advancing the health of individuals and their communities".[3]

Different types of communications can be used to classify

Telemedicine: real-time (synchronous): live video: Consultations (e.g., doctor-patient video calls); Store-and-forward (asynchronous): Transmission of medical records, images, or test results for later review; Remote patient monitoring (RPM): Ongoing surveillance of patient health data through connected devices.5 Telemedicine has been recognised as a legal and regulated method of healthcare delivery in India under the telemedicine practice guidelines.[6]

Concept of mobile health (mHealth)

Mobile health (mHealth) refers to the use of mobile technologies such as mobile phones, tablets, and wearable sensors to improve public health, patient care, and disease management.[7] WHO defines mHealth as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices".[7]

mHealth apps are health apps (e.g., food tracking, fitness tracking, mental health support) SMS-based health initiatives (e.g., reminders for medicine) Wearable gadgets (e.g., smartwatches for heart rate and activity tracking) and mobile-based teleconsultations (e.g., Practo, 1mg, and eSanjeevani in India).[8-11] mHealth has been identified as an important tool for nutrition and diet control, treatment of chronic illness, maternity and child health, and infectious disease surveillance, particularly in resource-limited settings.[12]

Global historical background of telemedicine and mHealth

The global development of telemedicine and mobile health (mHealth) has been influenced by the evolution of communication technology, satellite systems, and digital health developments over time. Telemedicine has its origins in early radio communications and military applications. Telemedicine started in the 1920s to offer medical assistance to ships at sea with radio transmission.[13] The future of telemedicine was envisaged in a cover of Radio News Magazine in 1924, when a doctor was diagnosing the patient remotely using a video and audio system.[4]

Big with NASA and the military as contributors was the emergence of telemedicine (1960s-70s). In the 1960s, telemedicine started to take an organised shape when NASA launched the Integrated Medical and Behavioural Laboratory Measurement System (IMBLMS) to monitor the health of astronauts in space.[14] At the same time, the Nebraska Psychiatric Institute (USA) conducted one of the first two-way video consultations for psychiatric patients, thus pioneering the use of telemedicine for mental health.[15] The World Health Organization (WHO) and the Pan American Health Organization (PAHO) also experimented with satellite-based healthcare consultations in remote locations in the 1970s.[16]

Digital growth and Internet-enabled telemedicine (1980s-1990s) The 1980s saw the advent of electronic health records (EHRs) and video conferencing, which heralded the advent of telemedicine applications.[17] The U.S. Department of Defence started telemedicine initiatives in wartime to deliver military healthcare.[18] During the 1990s, internet-based healthcare services evolved fast, leading to the first web-based medical consultations and telemedicine programs for chronic disease management.[19]

Mobile health & AI telemedicine (2000s–now) With the rapid growth of smartphones and mobile applications in the 2000s, mobile health (mHealth) becomes an essential part of telemedicine.[20] The mHealth Global Observatory was created by WHO to track mobile technology in health.[7] The COVID-19 pandemic has led to an accelerated, unprecedented expansion in the use of telemedicine worldwide, with platforms like Teladoc Health, Amwell, and Babylon Health showing significant increases.[21] Since then, advances in artificial intelligence, cloud computing, and wearable health devices have revolutionised telehealth services.[22]

Development of telemedicine and mobile health in India

Early Indian telemedicine projects started in the 1990s-2000s. The telemedicine adventure began in the late 1990s when the Indian Space Research Organization (ISRO) initiated the first satellite-based telemedicine project in 2001.[23] The ISRO GRIDS (Grameen Rural Telemedicine Network) program connected rural

hospitals with urban specialists and greatly enhanced the availability of healthcare in remote places.[24]

The Apollo Telemedicine Networking Foundation (ATNF) was launched in 2000 and is one of the earliest private telemedicine ventures in India.[25]

With the surge of smartphone usage in India, mobile health (mHealth) underwent tremendous development in the 2010s. The Government of India has started several mobile health programs, including mSwasthya for disease and maternal health surveillance.[26,27] Kilkari, an mHealth platform developed for awareness on maternal and child health.[28] and the Ayushman Bharat Digital Mission (ABDM), a digital health record initiative.[27,29] Teleconsultation, e-pharmacy, and digital health services developed by commercial firms such as Practo, 1mg, and NetMeds are major participants.[30]

COVID-19 and the epidemic have led to a lot of use of telemedicine in India (2020-present). The Indian government officially recognized telemedicine as a healthcare service and released the Telemedicine Practice Guidelines in March 2020.[6] The Ministry of Health and Family Welfare (MoHFW) has launched the eSanjeevani platform, which has provided over 100 million free teleconsultations.[31] There were apps for tracking Covid-19 and vaccination, such as Aarogya Setu and CoWIN. In addition, remote patient monitoring for chronic disease management is increasing.[32] Wearable health devices and AI-enabled telehealth solutions are also becoming popular.

Mobility and telemedicine have transformed the approach India takes at nutrition and diet management. This has led to better adherence to diet, weight control, diabetes treatment, and awareness about maternal nutrition. But issues such as computer literacy, data privacy, and the need for culturally adapted dietary guidelines need to be addressed. Digital health implementation in India is challenged by ongoing social health inequalities, which are more pronounced by poor availability, accessibility, and digital literacy among the unserved and the underserved (especially in rural areas).[33]

AI-powered telemedicine is revolutionizing the treatment of metabolic health with continuous, predictive and personalized therapy. Gut microbiome analysis and AI enabled platforms for a new approach to diabetes, obesity and cardiovascular disease. Real-time physiological and microbiological data are converted into meaningful information thru wearable sensors, mobile health apps and cloud analytics. Machine learning, deep learning and natural language processing can support risk assessment, dietary customization, early intervention, and microbiome analysis can provide biomarkers of disease progression and medication response. These advances together make it possible to take a more proactive, personalized approach to nutrition and metabolic care.[1] Telemedicine and mHealth are two main pillars of digital health. They lower the cost and improve the accessibility of healthcare and improve patient engagement. Telemedicine is mainly about remote consultation and delivery of health services, but mHealth includes this with self-care, monitoring and health education thru mobile devices.[5,7] Their integration is transforming the face of healthcare in India, especially in rural India, chronic illness management and preventive nutrition programs.[31]

As said, it is needed to establish state of knowledge on present interventions of technology and thereby identify knowledge gaps for future direction of research on intervention of digital technology in nutrition and diet management. Hence, the present study aims to evaluate the influence of telemedicine and mobile health (mHealth) interventions on eating behaviours, nutritional outcomes, and overall health of the rural and urban population of India. It also seeks to analyse the efficacy of these digital solutions on dietary adherence, glycaemic control, and weight management. The study also intends to describe the challenges and enablers for the adoption of these treatments to inform efforts to strengthen the health system. The findings also include evidence-based recommendations for policymakers, physicians, and researchers.

Questions for a scoping review

What are the different types of digital technologies (e.g., mobile health apps, telemedicine platforms, SMS/voice interventions, and wearable devices) that have been used for nutrition management in India, and what is their reach among different groups?

What nutrition-related outcomes (e.g., dietary adherence, micronutrient intake, weight management, glycemic control, and maternal and child nutrition indicators) have been reported in the studies that have used digital technology therapies in India?

What are the barriers (e.g., digital divide, low literacy levels, regulatory issues) and enablers (e.g., government initiatives, smartphone penetration, cost-effectiveness) to the use and usefulness of digital technologies for nutrition management in India?

How do national policies, guidelines, and regulatory structures (e.g., Telemedicine Practice Guidelines, National Digital Health Mission, and Digital Personal Data Protection Act) influence the implementation and impact of digital technologies for nutrition management in India?

Primary outcomes

The primary outcomes of this scoping study are to identify and describe the impact of telemedicine and mobile health interventions on nutrition management in India. The review specifically aims to determine how effective these digital resources have been in improving

eating habits, nutritional outcomes, and glycaemic management across diverse population groups. It also plans to look at changes in dietary adherence, nutrition knowledge, and the availability of nutritional counselling on digital platforms. The review would also investigate how these techniques have enhanced delivery within the health system and communication between service users and health providers to improve nutrition and health outcomes.

METHODS

The review used Arksey and O'Malley's scoping review framework to map the evidence (Daudt et al, 2013). Search keywords were telemedicine, mHealth, digital health, nutrition, diet management, remote diet counselling, and India. We searched for papers published between 2013 and 2026 in PubMed, Scopus, Google Scholar, and associated official publications. We reviewed papers on digital health interventions for nutrition in India, with a focus on systematic reviews, randomised controlled trials, and observational studies in English. We also explored grey literature from government and health care institutions to uncover content of practical and policy importance.

Selection and screening

The records were merged and duplicates removed by Endnote software. The data would be processed using the Microsoft Excel program. Papers selected following the approach described in the scoping review framework developed by Arksey and O'Malley (2005).[34]

A stepwise flow diagram

The stepwise process involved formulating the research question, identifying relevant studies, selecting eligible studies, followed by charting the data, collating and reporting the findings, and conducting consultation where appropriate.

Data extraction

For this scoping review, we used a structured yet practical approach to extract information from the included studies. Each study would be carefully examined, and details such as the author, year, aim, methodology, participants, type of review, barriers identified, facilitators identified, digital tools used, interventions, outcomes, limitations, and database of sources were recorded (Table 1). To keep the findings transparent and easy to follow, the extracted data were organized into the table. This review process would help us maintain consistency, strengthen reliability, and provide a clear foundation for analysing how digital technologies are shaping nutrition management in India.

RESULTS

Initial searches in PubMed, Google Scholar, Scopus, and relevant government reports identified 2320 records. Duplication resulted in 1268 entries that were excluded. Of these 1052 records, 695 were excluded after screening the titles and document types. Out of 357 reports sought, 320 were excluded by publication stage, including final. The remaining 37 reports were assessed for eligibility and relevance, and 21 were removed because they were not compatible with the inclusion criteria. Thus, a total of 16 studies were included in the review.[2,33,36-39] Out of the 16 studies included, 1 is the qualitative study, 2 are mixed-method studies, 1 is the state-level report, 5 are systematic reviews, 4 are narrative reviews, 1 is the case study, 1 is a commentary review, and 1 is the quasi-experimental study. All the studies were conducted in India. A flowchart showing the steps involved in the entire search process is illustrated in the PRISMA-ScR (preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews) 2026 diagram (Figure 1).[35] The characteristics of the 16 studies included are given in Table 1 below.

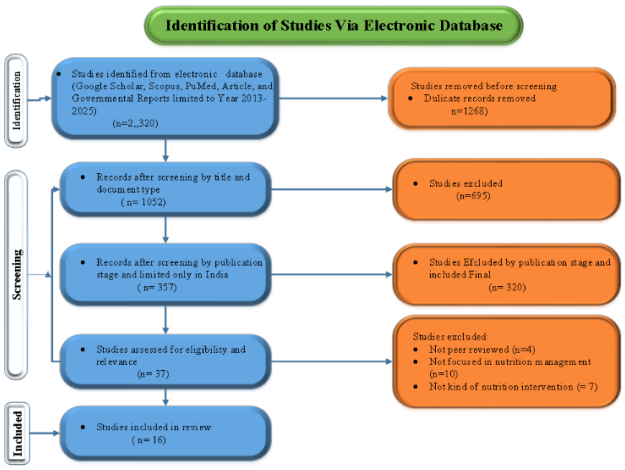


Figure 1: A flowchart showing the steps involved in the entire search process is illustrated in the PRISMA-ScR (preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews) 2026 diagram.

Table 1: Summarizing the 16 articles on the impact of telemedicine and mobile health for nutrition and diet management in India from 2013 to 2026.

Author(s)	Year	State	Participants	Intervention Type	Aim	Methodology	Barriers Identified	Facilitators Identified	Outcome	Limitation	Source of database
ICMR-NIN	2020	India	General population	mHealth	Report on nutrition-related diseases	State-level report	Digital literacy, internet connectivity	Improved nutrition awareness	Positive impact on nutrition awareness	Limited to state-level data	Official Report
Vetrivel et al[37]	2025	India (chapter context)	Adults and elderly	AI tools; digital monitoring; mHealth concepts	Describe technological impact on adult nutrition.	Book chapter; narrative synthesis	Early-stage adoption; personalization gaps	AI potential for tailored nutrition advice	Conceptual benefits for monitoring and personalization in nutrition	Early-stage evidence; limited empirical data	Book chapter: *Artificial Intelligence in Healthcare for the Elderly*
Hossain et al[38]	2019	India	People living with NCDs	Digital interventions; mHealth, and telehealth programs	Systematic review of digital interventions for NCDs in India	Systematic review of intervention studies	Digital divide; low digital literacy; infrastructure gaps	High mobile penetration; integration potential	Mixed effectiveness for NCD management; promising program examples	heterogeneity; limited long-term data.	Digital Health (PubMed)
Banerjee et al[39]	2025	Rural India	Community populations in rural areas	ICT for health and nutrition education: SMS/voice	Overview ICT impact on health and nutrition education in rural areas	Narrative overview / book chapter	Infrastructure and literacy constraints; cultural fit	Community engagement; local adaptation	Improved education and awareness in some rural ICT programs	Limited empirical evaluation and outcome measurement	*Organizational Knowledge Management* (book/chapter)
Huda et al[40]	2025	India	Patients with hypertension and diabetes	mHealth-enabled interventions; remote monitoring	Assess the effectiveness of mHealth for HTN and diabetes in India.	Systematic review	Access inequities, adherence, and heterogeneous studies	Mobile access; task shifting to community workers	Reported improvements in disease management indicators in some studies	Heterogeneous interventions; limited long-term follow-up	Preventive Medicine Reports (PubMed)
Joshi et al[41]	2023	India	General population exposed to mHealth	mHealth interventions; app and SMS programs	Systematic review and meta-analysis of mHealth health impacts in India	Systematic review and meta-analysis	Publication bias; variable study quality	Scalability and wide reach of mobile platforms	Overall positive effects on selected health indicators in pooled analyses	Heterogeneity and risk of bias in primary studies	Online Journal of Public Health Informatics (PubMed)
Majumdar et al[42]	2015	India	Populations at risk for NCDs	mHealth; SMS; prevention and control programs	Discuss mHealth possibilities for NCD prevention and control in India	Commentary/review	Policy gaps; infrastructure; digital literacy	Low-cost SMS; widespread mobile ownership	Highlighted potential for prevention and control of NCDs via mHealth	Early evidence; need for implementation research	Journal of Clinical and Diagnostic Research (JCDR) (PubMed)
Prakash et al[43]	2026	India	Oncology patients	User-centred mHealth design	Develop oncology care apps.	Mixed method design study	Diverse patient needs; usability	Co-design; iterative feedback	Prototype apps aligned with patient needs	Early-stage; limited outcome data	PubMed, scopus

Continued.

Author(s)	Year	State	Participants	Intervention Type	Aim	Methodology	Barriers Identified	Facilitators Identified	Outcome	Limitation	Source of database
Smith et al[44]	2015	India	Cardiovascular disease patients	mHealth apps & tools	Explore the potential of mHealth in CVD management.	Qualitative study (interviews/focus groups)	Digital literacy gaps; infrastructure	Patient willingness; mobile access	Identified feasibility of mHealth in Kerala	Small sample; context-specific	PubMed
Sood et al[2]	2025	India	General population using eSanjeevani	National telemedicine service (eSanjeevani)	Assess adoption & utilization of eSanjeevani	Mixed-methods study	Connectivity issues; awareness gaps	Government support; scalability	High uptake of telemedicine services	Limited long-term outcome data	PubMed, Scopus
Naithani et al[45]	2025	India	General population using eSanjeevaniOPD	National telemedicine service (eSanjeevani OPD)	Describe India's digital health shift via eSanjeevaniOPD.	Case study / descriptive analysis	Infrastructure gaps; training needs	Policy backing; national rollout	Demonstrated potential of telemedicine in India	Case-based; limited empirical evaluation	Google Scholar, Scopus
Prinja et al[46]	2017	Uttar Pradesh, India	Community health volunteers; mothers and children in rural areas	mHealth application for CHVs	Assess impact of mHealth app on utilization of maternal, newborn, and child health services	Quasi-experimental study in rural Uttar Pradesh	Limited digital literacy among CHVs; infrastructure gaps; cultural acceptability	Training of CHVs; mobile penetration; supportive supervision	Improved utilization of antenatal care, institutional deliveries, immunization services	Non-randomized design; limited generalizability; short follow-up	PubMed, Google Scholar.
Bhattacharya et al[47]	2022	India	Policy context (health system stakeholders, not patient level)	National Digital Health Blueprint (NDHB)	Discuss opportunities and challenges in implementing NDHB	Policy analysis / narrative review.	Infrastructure gaps; interoperability challenges; privacy/security concerns; workforce readiness	Government commitment; digital health mission; potential for integration	Identified opportunities for strengthening health systems via NDHB; highlighted roadmap for digital health adoption	Conceptual analysis; limited empirical data; implementation challenges remain PP	PubMed, Scopus, google scholar
Tolley et al[48]	2023	India	Adults with chronic diseases (studies included patients with hypertension, diabetes, and other chronic conditions)	Multi-component adherence interventions: mHealth/SMS reminders, counselling, community health worker support, education, and fixed-dose combinations	Synthesize evidence on interventions to promote medication adherence for chronic diseases in India.	Systematic review of intervention studies (Frontiers in Public Health)	Limited digital literacy; inconsistent access to phones/internet; cost and medication supply issues; health system fragmentation	Use of CHWs, simple SMS reminders, task-shifting, integration with primary care, culturally adapted education	Most interventions reported modest improvements in medication adherence; some showed improvements in intermediate clinical indicators.	Heterogeneity of interventions and outcomes; variable study quality; many small or short-term studies limiting generalizability	PubMed, Google scholar

Continued.

Author(s)	Year	State	Participants	Intervention Type	Aim	Methodology	Barriers Identified	Facilitators Identified	Outcome	Limitation	Source of database
Narayan et al[49]	2024	India (national policy context)	Health system stakeholders; policymakers; digital health implementers (not patient-level	National digital health strategy components (health IDs, interoperable registries, telemedicine, digital public goods, AI governance)	Describe evolution, priorities, and implementation challenges of India's digital health strategy.	Policy analysis / perspective drawing on policy documents, implementation examples, and stakeholder insights	Fragmented implementation across states; interoperability gaps; privacy and data governance concerns; workforce capacity and digital literacy; equity and access risks	Strong central policy architecture (NDHB, Ayushman Bharat Digital Mission), public digital infrastructure (health IDs, federated registries), government commitment, public–private partnerships, growing digital ecosystem	India's digital health strategy has rapidly matured with concrete building blocks (digital public goods, health IDs, and registries) enabling scale; early implementations show promise for improved service delivery and data-driven planning but require stronger governance and equity safeguards.	Perspective piece: limited empirical outcome data; relies on policy documents and early implementation reports; may underrepresent subnational variability and on-the-ground challenges	Google Scholar
Indian Journal of Medical Ethics (Editorial)	2017	India	Policymakers; health system stakeholders	National Health Policy 2017 (policy document)	Critically appraise NHP 2017 with emphasis on implementation implications.	Editorial policy analysis drawing on the policy text and contemporary commentary.	infrastructure gaps; limited financing clarity, weak implementation mechanisms; workforce shortages; unclear public–private roles; limited digital governance and interoperability planning.	Clear policy vision for UHC and prevention; emphasis on primary care; political momentum for reform; potential to align digital investments with policy goals.	Cautious endorsement of NHP 2017's potential to catalyse health system modernization including digital health, while warning that without concrete financing, governance, and implementation plans technology gains may be uneven.	Perspective only; not empirical; may reflect editorial stance; limited to policy critique	PubMed

DISCUSSION

This review highlights critical areas that must be addressed in digital health interventions; in particular, mHealth, telemedicine, and emerging AI tools have clear potential to improve nutrition awareness, service uptake, and some NCD management indicators. As per the state-level report of the ICMR National Institute of Nutrition for the year 2020, mHealth activities have enhanced the nutrition awareness in the tested population. Mobile communications and education efforts increase awareness of nutrition-related diseases. But the analysis also revealed that the improvement was hampered by uneven online literacy and lack of internet connection in some locations.[36] The data are from state-level surveillance and not nationally representative outcome statistics.

In this book chapter on AI and digital monitoring for adult and senior nutrition, the authors present evidence at an early stage that shows that AI-enabled tools and mHealth concepts have conceptual potential for better individualised nutrition advice and continuous monitoring. However, they note that acceptability is in its infancy, empirical validation is limited, and there are large gaps in customization, usability, and real-world effectiveness.[37]

Digital interventions for noncommunicable diseases in India show promise but have varying results, according to a comprehensive evaluation. Some mHealth and telehealth programs revealed advantages in intermediate markers of NCD management; however, trials showed very varying overall performance. The study noted that the country's high mobile penetration was a positive aspect but also pointed to the continued issues of the digital divide, low levels of internet literacy, and infrastructural restrictions. As mentioned in the review, the differences in study design and the lack of sufficient long-term follow-up limited the findings to be strong.[38,39] reviewed approaches to using ICTs for health and nutrition education in rural India. They found that SMS, voice messaging, and other low-bandwidth ICT interventions had improved awareness and education in some community programs when adapted to local contexts and used with community engagement. However, there is still little proof of long-term health impacts due to infrastructure, literacy levels, and lack of outcome tracking.

This systematic review of mHealth-enabled interventions for hypertension and diabetes in India identified a number of programs reporting improvements in disease management indicators (e.g., medication adherence, blood pressure, or glycemic control) in selected studies, but results were heterogeneous and tempered by access inequities, variable adherence, and short follow-up periods. Mobile access and contracting work to community workers were key enablers. Further thorough long-term study is recommended.[40]

They have systematically reviewed and meta-analysed the mHealth interventions in India and have concluded that the pooled analyses suggest more or less good impacts on chosen health variables. This illustrates that mobile platforms are scalable and have a huge reach. However, the authors note that publication bias and heterogeneity of interventions as well as disparities in study quality limit confidence in effect estimates and underscore the need for standardised outcome measures.[41]

In one of the first commentaries on mHealth for NCD prevention and control in India, the authors observed that "low-cost SMS and widespread mobile ownership provide a practical channel for large-scale prevention efforts, but policy gaps, infrastructure shortfalls, and technological literacy need to be addressed through implementation research before the full preventive potential of mHealth can be realized".[42]

A mixed-methods study on co-design and iterative feedback in the development of user-centered mHealth applications for cancer care. Prototype apps were targeted to heterogeneous patient needs and usability preferences. The work shows that patient-centered design is viable, but it is in its infancy with few outcome data on clinical or quality of life repercussions. [43]

Qualitative interviews and focus groups with cardiovascular patients in Kerala found that patients were open to interacting with mHealth tools and that mobile access provided practicality for digital support, but lack of technical competence and infrastructure limited widespread use. mHealth proved feasible in the local context, but results are limited by small, context-specific samples. [44]

A mixed methods study indicated high use of India's national telemedicine portal, eSanjeevani. Government support and scalability facilitated rapid adoption, but lack of connectivity and knowledge hindered equitable access. The authors emphasize that the assessment of clinical outcomes and sustainability should be a continuous long-term effort.[2,45] conducted a descriptive case study on eSanjeevaniOPD, characterising India's digital health evolution as policy-driven and nationally rolled out and highlighting the platform's potential for improving access while noting infrastructure and training needs and adding to empirical evaluations of health outcomes beyond service utilisation.

A quasi-experimental evaluation in rural Uttar Pradesh found higher utilisation of antenatal care, institutional delivery, and immunisation services when community health volunteers used an mHealth application compared to baseline. Training and supervision facilitated success despite challenges of CHV online literacy and local infrastructure. The nonrandomised design and short follow-up limit the generalisability of the study.[46]

The authors conclude that India's National Digital Health Blueprint (NDHB) provides a strategic opportunity to integrate digital resources across the health system, but implementation would need to solve challenges of interoperability, privacy, infrastructure, and workforce training. The empirical data are now limited to evidence on the outcomes of the rollouts.[47]

Challenges and limitations

Infrastructure and connectivity: Inequity in internet connectivity in remote and rural areas hinders access to mHealth and telemedicine. Unreliable power and network stability are hampering the continuous surveillance and real-time services. Cost is a limiting factor; not all low-income groups have access to equipment.

Online literacy and user readiness: Lack of online literacy of patients, community health volunteers, and few physicians hinders successful utilisation. Language and culture obstacles prevent older people and those who do not understand English from accessing material and interfaces. Lack of user confidence and awareness of online resources hampers uptake and sustained use.

Compatibility, standards, and governance: Different systems and incompatible platforms and infrastructures are interrupting smooth data flow. Poor or imprecise data governance guidelines can lead to misunderstandings about what is permissible, what data can be shared, and what secondary uses are allowed. Digital medicines and AI face regulatory and procurement barriers to reliable validation and safe deployment.

Evidence, evaluation, and scalability: heterogeneity of study design and outcome makes synthesis and meta-analysis difficult; few long-term randomised trials and economic evaluations reduce confidence in sustained clinical impact and cost effectiveness, and publication bias and variable quality of studies reduce confidence in pooled findings for policy decisions.

Equity and inclusion: Mitigation of increased health disparities due to the digital divide (socioeconomic, geographic, and gender) and reduced equitable benefits due to gaps in accessibility for people with low literacy, disabilities, or limited language support; and a one-size-fits-all solution that does not consider local cultural norms and community needs.

Implementation, Personnel, and Sustainability Fidelity and uptake are undermined by lack of training/support for CHVs, clinicians, and program administrators. Short pilot cycles and lack of maintenance funding led to abandoned enterprises and the depreciation of technology. If it is not integrated into healthcare workflows and payment systems, there is little incentive for ongoing use.

Technical, usability, and AI-specific issue risks: Poor usability and lack of co-design lead to poor engagement and significant drop-out. Algorithmic bias, lack of external scrutiny, and the "black box" nature of AI models can jeopardise safety and fairness. Problems of data quality and device accuracy endanger clinical reliability.

Systems for monitoring, evaluation, and accountability: Poor monitoring of routines and equity procedures restricts quick notice of problems and rectification of the path. Digital medicines and artificial intelligence (AI) technologies are subject to limited post-market control and thus risk unrecognised effects or performance drops.

Future research directions and recommendations

Reviewed findings of this study integrated into actionable priority instructions and recommendations. Each section offers specific recommendations for researchers, policymakers, implementers, and funders to improve digital health and nutrition interventions in India:

Research Priorities: 1. Make complete trials, 2. Undertake and conduct randomised controlled studies and pragmatic trials with clinical and patient-level outcomes (e.g., glycemic control, blood pressure, nutritional status) with a minimum 12 to 24 month follow-up to assess durability, Standardise metrics and outcome measures: Develop and agree on a baseline set of outcomes for digital health research in nutrition and NCDs to reduce heterogeneity and enable meta-analysis, 4. Evaluate cost-effectiveness: Conduct economic evaluation alongside effectiveness studies to inform decisions on scale-up and budget implications, 4. Bring AI and personalisation into the real world, and 5. From conceptual pilot projects in AI to real testing on accuracy, fairness, and therapeutic effectiveness across diverse Indian cultures. Implementation Science: Employ effectiveness-implementation approaches to identify contextual barriers and facilitators and test solutions for acceptance, fidelity, and sustainability;

Governance & policy: 1. Improved Standards and Interoperability, 2. Speed up the adoption of national standards (e.g., NDHB) for data formats, APIs, and clinical terminologies to allow smooth integration across platforms and services. Data Governance and Privacy: Establish standards for data privacy, consent, and de-identification and mandate transparency in the documentation and validation of algorithms for AI products, 3. Encourage evidence-based buying. Link public procurement and reimbursement to proven effectiveness and safety and 4. National evaluation framework: Develop a national framework for the evaluation and accreditation of digital health solutions, including criteria for safety, equity, and performance.

Implementation and scale-up: 1. User-centered design at scale: Co-design with end users (patients, CHVs, and physicians) must be necessary before deployment, as must iterative usability testing; low-bandwidth, multilingual interfaces should be prioritised, 2. Workforce integration and job shifting: Train and formalise the integration of community health volunteers and allied health workers in delivering and supporting digital interventions with clear protocols and supervision, 3. Staged scale-up through pilots: Roll out in stages—pilot, review, adjust, and then scale up—so that local adaptations and technology solutions are obtained prior to national roll-out, and 4. Public-private partnerships: Use partnerships to accelerate access to technology with public oversight, affordability, and alignment with public health goals;

Equality & Inclusion: 1. Closing the digital divide Invest in basic infrastructure (connectivity, electricity) in underserved sites. Subsidize services for low-income people, 2. Campaigns to increase internet literacy, 3. Offer customized, online literacy training to patients, CHVs, and physicians, using resources tailored by language, age, and education level, 4. Universal Design Solutions that are accessible to those with low literacy (voice/SMS choices), older folks, people with impairments, and people speaking regional languages and 5. Quantify equity outcomes. Regularly disaggregate program data by socioeconomic level, gender, age, and geography to identify and remedy inequitable uptake

Follow-up, assessment, and ongoing improvement: 1. Real-time monitoring dashboards. Use dashboards to monitor utilization, clinical indicators, engagement, and equity metrics to quickly identify and address issues, 2. Post-deployment surveillance. Mandate continued post-deployment surveillance of the safety and efficacy of digital therapeutics and traditional artificial intelligence (AI) systems, including systems that include user feedback and incident reporting, 3. Open evaluation data Encourage sharing of data on implementation and outcomes (including negative results) to reduce publication bias and speed up learning, and 4. Iterative Updates and Maintenance: Provide assets for ongoing technical maintenance, content updates, and retraining of AI models to prevent performance degradation.

CONCLUSION

The evidence reviewed indicates that digital health interventions, in particular mHealth, telemedicine, and emerging AI tools, have clear potential to improve nutrition awareness, service uptake, and some NCD management indicators in India, if they are user-cantered, integrated into existing health systems, and backed by training and supervision. Barriers to efficacy remain, such as the digital divide, limited digital proficiency, patchy connectivity, restrictions around interoperability and data governance, and the abundance of short and varied studies with few long-term randomised trials. To fulfil the promise of pilots and achieve fair and sustainable gains in population health, stakeholders ought to give priority to support for robust effectiveness and cost-effectiveness research, standardised outcomes metrics, strong data privacy and interoperability standards, targeted investments in connectivity and digital proficiency, and phased, co-designed scale-up strategies that monitor equity and clinical outcomes.

The review emphasizes the need to overcome these barriers with concerted action across policy, research, technology development, and community engagement—through targeted investments in connectivity and literacy; binding standards on interoperability and privacy; robust long-term assessments and inclusive, user-centred implementation strategies—to ensure that digital health delivers equitable, sustainable benefits

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