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DIGITAL AND AI-ASSISTED NUTRITION EDUCATION FOR STRENGTHENING CHILD NUTRITION PRACTICES AMONG ICDS WORKERS: A REVIEW

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Abstract : Early childhood is a critical period for physical growth, brain development and the establishment of lifelong dietary behaviours. Frontline workers associated with the Integrated Child Development Services (ICDS) programme play an important role in delivering nutrition education, counselling caregivers, supporting growth monitoring and connecting families with health services. However, the effectiveness of nutrition education may be constrained by workload, limited opportunities for refresher training, language barriers, uneven access to updated learning materials and differences in digital access. This narrative review examines the potential contribution of digital and artificial intelligence (AI)-assisted approaches to strengthening child- nutrition education among ICDS and Anganwadi workers. The review brings together international recommendations on infant and young child feeding, Indian programme information on Poshan Tracker, and published studies of digital job aids and nutrition counselling chatbots in India. Evidence indicates that mobile tools can support timely counselling, service tracking and access to age-appropriate information. A large-scale evaluation of a digital job-aid intervention in India reported improvements in selected service-delivery outcomes, although it did not demonstrate improvements in infant and young child feeding practices. A pilot counselling chatbot study found user engagement and acceptability, while also illustrating the importance of human support and responsive design. AI may extend these tools through conversational question answering, multilingual explanations and adaptive learning; nevertheless, its use requires verified content, privacy safeguards, bias monitoring and referral pathways for questions beyond a worker's role. Digital education should therefore complement, rather than replace, practical training, supportive supervision and community interaction. A human-centred, evidence-linked and locally adapted model may help improve the consistency and accessibility of nutrition education for frontline workers.

IndexTerms - ICDS; Anganwadi workers; child nutrition; nutrition education; digital health; artificial intelligence; mobile learning; chatbot; India

I. INTRODUCTION

Adequate nutrition during the first years of life supports survival, growth, cognitive development and later health. The period from birth to two years is particularly important because infants transition from exclusive breastfeeding to complementary foods while continuing to breastfeed. Inappropriate feeding, poor dietary diversity, infection and inadequate care can contribute to growth faltering and micronutrient deficiencies. The World Health Organization (WHO) and UNICEF recommend initiation of breastfeeding within one hour of birth, exclusive breastfeeding for the first six months, and continued breastfeeding alongside appropriate complementary foods from six months onwards [1].

In India, the Integrated Child Development Services (ICDS) programme has historically provided a platform for supplementary nutrition, growth monitoring, health education and referral services through Anganwadi Centres. Anganwadi workers are a key link between programme services and families. Their responsibilities require them to communicate accurate and practical information on breastfeeding, complementary feeding, dietary diversity, hygiene, growth monitoring and care-seeking. The quality of counselling depends not only on the availability of guidelines but also on workers' knowledge, communication skills, time, supervision and access to relevant learning resources.

Digital health interventions have increasingly been introduced to support frontline workers. In India, the Poshan Tracker is an information and communication technology-based governance tool under Saksham Anganwadi and Mission Poshan 2.0. It supports monitoring of nutrition-service delivery and selected child-growth indicators and is available in multiple languages [2]. In parallel, research has explored mobile job aids and conversational chatbots for nutrition counselling. This review discusses how such approaches may strengthen nutrition education among ICDS workers, the limitations identified in published studies and the safeguards required for responsible use of AI.

II. REVIEW APPROACH

This paper is presented as a narrative review rather than a systematic review or meta-analysis. It draws on relevant published research and authoritative guidance identified through publicly accessible sources, including WHO publications, Government of India programme information, PubMed/PMC-indexed studies and peer-reviewed public-health literature. Priority was given to sources

addressing infant and young child feeding, digital support for community health and nutrition workers, and chatbot-based child-nutrition counselling in India. The discussion synthesises the selected evidence thematically. No new participant data were collected, and no statistical pooling or formal risk-of-bias assessment was undertaken.

III. CHILD NUTRITION AND THE ROLE OF FRONTLINE WORKERS

The WHO complementary-feeding guideline addresses children aged 6–23 months and emphasises that complementary feeding generally begins at around six months, when breast milk alone is no longer sufficient to meet nutritional requirements [3]. During this period, children need safe, age-appropriate foods with adequate nutrient density and dietary diversity. Caregivers also need practical advice on food texture, meal frequency, responsive feeding and hygiene. Counselling should be culturally appropriate and should use foods that are accessible and affordable to the household.

Frontline workers can reinforce these recommendations during home visits, growth-monitoring sessions, mothers' meetings and community-based nutrition activities. Their role includes explaining feeding practices in understandable language, identifying concerns that require referral and encouraging families to use available health and nutrition services. They are not substitutes for clinicians; children with danger signs, severe acute malnutrition or medical complications require assessment and management through the appropriate health system.

Nutrition education is most useful when it moves beyond one-way information delivery. Demonstrations, locally relevant food examples, visual aids, caregiver questions and follow-up can help translate recommendations into daily practices. Refresher learning is also important because guidance changes and workers encounter diverse situations across households.

IV. DIGITAL TOOLS IN ICDS AND COMMUNITY NUTRITION

Digital tools can provide structured information, reminders, job aids, beneficiary records and decision support. The Government of India's description of Poshan Tracker identifies it as an ICT-based tool rolled out in 2021 under Saksham Anganwadi and Mission Poshan 2.0. It supports near-real-time monitoring of programme progress, tracking of service delivery and identification of child-growth indicators; the application is available in 24 languages [2]. Such platforms can strengthen programme monitoring and may reduce dependence on paper-based records.

However, a programme-monitoring application and a nutrition-learning application serve related but different purposes. Recording services does not automatically ensure that a worker can explain why a feeding recommendation matters or how to counsel a caregiver facing a specific difficulty. Digital learning resources should therefore be designed around workers' learning needs and should provide concise, practical explanations, visual examples, quizzes and opportunities to revisit important topics.

A quasi-experimental evaluation of a digital application for community health and nutrition workers in Bihar and Madhya Pradesh examined service delivery under a national-scale programme. The intervention improved selected outcomes, including counselling recall and the receipt of adequate home visits. Growth-monitoring coverage increased in Bihar but not in Madhya Pradesh, and no effect was observed on infant and young child feeding practices [4]. The authors concluded that digital tools can support workers but cannot replace broader health-system strengthening or address structural barriers on their own. This finding is important: improved digital access or service documentation should not be assumed to produce behaviour change without supportive conditions.

V. CHATBOTS AND AI-ASSISTED NUTRITION EDUCATION

Conversational tools can allow workers or caregivers to ask questions in everyday language and receive organised responses. A chatbot may provide short explanations, topic-based learning, frequently asked questions, reminders and links to approved guidance. AI-assisted systems may additionally interpret varied wording, provide explanations at different reading levels, support translation and direct users to relevant learning modules. These functions could be useful in settings where workers need repeated access to information between formal training sessions.

An Indian example is the Poshan Didi counselling chatbot, developed to provide nutrition information to mothers of children aged 0–12 months. The pilot study reported that users were receptive to the chatbot; 80% of users replied at least once to a chatbot-generated message, and 64% engaged beyond standard chatbot content by discussing at least one issue with a nurse who responded to escalated messages [5]. The study demonstrates the potential of chatbot-based contact points, while also showing the value of human escalation and iterative design informed by user feedback.

For ICDS workers, AI-assisted learning could be organised into modules on breastfeeding, complementary feeding, dietary diversity, malnutrition, anaemia and micronutrients, growth monitoring, food hygiene and caregiver counselling. A question- answer feature could help workers locate approved information quickly. Short quizzes and case-based scenarios could reinforce learning. A bilingual interface may improve accessibility when workers and caregivers are more comfortable using a local language.

Nevertheless, AI-generated responses can be incomplete, outdated, biased or incorrect. A system should not independently diagnose a child, prescribe treatment or replace official referral protocols. Its knowledge base should be restricted to reviewed sources, show the date or source of key recommendations where possible, and provide clear escalation instructions for emergencies or clinical questions. Human review by qualified nutrition and health professionals is essential.

VI. BENEFITS AND OPPORTUNITIES

Digital and AI-assisted nutrition education may offer several practical benefits. First, it can support self-paced refresher learning, allowing workers to revisit short lessons when required. Second, it can standardise core messages so that essential recommendations are presented consistently. Third, bilingual content and visual explanations may improve comprehension in multilingual communities. Fourth, interactive quizzes and case examples can make learning more engaging than static documents. Fifth, searchable content may help workers prepare for counselling sessions and respond to common questions.

Digital tools may also support programme continuity by making learning materials available beyond scheduled training events. When linked with supportive supervision, they can help supervisors identify topics where workers need further assistance. The greatest value is likely to arise when digital resources are integrated into existing training and service-delivery systems rather than introduced as an additional, disconnected task.

VII. CHALLENGES AND LIMITATIONS

Digital access is not uniform. Workers may experience unstable internet connectivity, limited data availability, older devices, low storage capacity or difficulty using complex interfaces. Even when a smartphone is available, competing work

responsibilities can limit time for learning. Additional digital tasks may increase workload if they are not integrated into existing workflows.

Language and literacy also matter. Literal translation may not communicate the meaning of nutrition concepts, and text-heavy content may be difficult to use during field visits. Content should be tested with intended users and should include locally familiar foods, examples and terminology. Audio, illustrations and offline access may improve usability where appropriate.

AI introduces further concerns, including inaccurate answers, automation bias, privacy risks and unequal performance across languages or user groups. Systems should minimise personal data collection, obtain appropriate consent, protect stored information and avoid exposing identifiable beneficiary details in prompts. Workers should be trained to verify important information and recognise when an answer requires referral to a supervisor or health professional.

Finally, digital education alone cannot resolve shortages of staff, inadequate infrastructure, limited supplies, poverty, food insecurity or social barriers. Evidence from the national-scale digital-worker evaluation in India showed improvements in selected service-delivery measures but not in infant and young child feeding practices [4]. This underlines the need to evaluate outcomes at several levels, including worker knowledge, counselling quality, caregiver understanding and actual feeding practices.

VIII. RESEARCH GAPS AND FUTURE DIRECTIONS

Further research is needed to determine which digital learning features are most useful for frontline nutrition workers and under what conditions they improve counselling. Studies should compare digital learning with usual training or blended approaches, use appropriate comparison groups where feasible and include adequate follow-up to assess retention. Outcomes should distinguish knowledge, confidence, counselling performance, caregiver practices and child nutritional indicators rather than treating them as interchangeable.

AI-assisted systems require specific evaluation of factual accuracy, safety, language quality, usability and fairness. Independent experts should review the knowledge base, and user testing should include workers from different educational and linguistic backgrounds. Research should also examine offline functionality, cost, maintenance, integration with existing government platforms and the effect on workload.

A practical model for ICDS settings would combine: (i) short evidence-based learning modules; (ii) Tamil and other relevant language options; (iii) audio-visual and case-based learning; (iv) quizzes with feedback; (v) AI-assisted question answering limited to approved content; (vi) human escalation for uncertain or high-risk questions; and (vii) periodic content updates and supportive supervision. Implementation should be co-designed with Anganwadi workers, supervisors, nutrition professionals and programme administrators.

IX. CONCLUSION

Digital and AI-assisted tools have potential to strengthen nutrition education for ICDS workers by improving access to structured learning materials, supporting refresher training and enabling interactive question answering. Indian evidence on digital job aids and nutrition chatbots suggests that these approaches can support selected service-delivery and counselling functions, but their effects are not automatic and may not extend to feeding practices without wider support. Digital tools should complement face-to-face training, supportive supervision, adequate resources and trusted community relationships. A bilingual, human-centred and evidence-linked approach—with clear privacy safeguards, expert review and referral pathways—offers a responsible direction for strengthening child-nutrition education among frontline workers.

X. LIMITATIONS OF THE REVIEW

This is a narrative review based on a selected set of accessible publications and official sources. It does not claim to be exhaustive, does not follow a registered systematic-review protocol and does not include formal study-quality grading or meta- analysis. The evidence base on AI specifically for ICDS-worker education remains limited; therefore, some proposed applications represent potential uses that require evaluation rather than established effects.

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