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MOBILE PHONE APPLICATION IN THE MANAGEMENT OF MATERNAL AND YOUNG CHILD MALNUTRITION: A REVIEW

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ABSTRACT

Background: Malnutrition is one of the leading causes of maternal and young child mortality in underdeveloped countries, particularly during pregnancy and delivery. The effects of malnutrition in pregnant women include low birth weight, preterm birth, intrauterine growth restriction, nutrient deficiencies and reduced breast milk production. Mobile phone applications are widely used with features such as portability, ease of communication, storage at relatively low cost that makes such technology attractive to nutritionists.

Objective: To assess if mobile phone applications can be beneficial in maternal and young child malnutrition intervention.

Methods: Zotero reference management software was used to ensure the rigor and reproducibility of the review process. Based on defined key words, a search was conducted on Google Scholar, ScienceDirect, PubMed and Springer databases to retrieve all publications on mobile phone applications in maternal and young child malnutrition interventions. The study used ten articles from unique studies that met the study criteria and are reported in terms of authors, year, sample size, study design and outcome measure.

Results: The articles revealed that mobile phone applications were highly useful in maternal and young child malnutrition intervention, prompting nutrition information seeking and facilitating communication with healthcare providers.

Conclusion: Mobile phone applications are widely acknowledged, and beneficial in maternal and neonatal malnutrition management, they have the potential to improve maternal and young child nutritional status through self-monitoring. Given the low uptake of current mobile phone application, it should be given a

significant consideration as a potential strategy for managing maternal and young child malnutrition.

INTRODUCTION

More than half of all maternal and young child deaths globally are attributed to malnutrition¹, and the bulk of these deaths occur in low-income and middle-income countries². However, the prevalence of maternal and young child malnutrition is rising especially in Asia and Africa. To maintain appropriate maternal and young child nutritional status the problem of malnutrition for the group must be addressed. The short- and long-term nutritional status of maternal and their unborn children are significantly influenced by their dietary intake throughout pregnancy³. In low and lower middle-income countries, a bigger percentage of women suffer from maternal undernutrition. High maternal, newborn, and child mortality in these nations is correlated with poor nutrition⁴.

Utilizing mobile technologies, cost-effective evidence-based interventions are being scaled up to improve maternal outcomes during pregnancy, delivery, and postpartum period. A potentially significant strategy to increase effectiveness and reach within health care systems in poor nations is to use mobile phone applications to enhance nutritional status of maternal and young child. Mobile phone application use and accessibility are growing in low and lower middle-income countries⁵. In developing countries, the number of mobile phone customers is increasing steadily according to the International Telecommunication Union⁶.

Additionally, such mobile phone application technology opens up new possibilities for coordinated, safe, and efficient maternal and young child nutritional status. The

effectiveness of mobile phone application interventions for enhancing maternal and young child care has been examined in a number of reviews, including those on increasing maternal satisfaction with antenatal care and postnatal care seeking behavior and the number of antenatal and postnatal visits improved their nutritional status, knowledge, attitude and practices towards nutrition information seeking⁷. However, the effectiveness of mobile phone application interventions to enhance maternal and young child nutritional status and behaviour change has not been assessed adequately in reviews.

MATERIALS AND METHODS

Published materials which covered mobile phone applications and maternal and young child malnutrition were searched on Google scholar, PubMed, Science Direct and Springer databases and gathered. Articles were reviewed to assess whether there is any significant association between mobile health application and maternal and young child nutrition intervention. Literature search was done using the following keywords; maternal, young child, malnutrition and mobile phone applications (app).

Literature Search Procedure

The PRISMA statement as seen in figure 1, was followed⁸, with searches targeting the following keywords in the title or abstract: (maternal, prenatal, postnatal, young child, malnutrition or health) and (technology, mobile phone application, or mobile app) and behavior. These provided 270 studies, which were submitted to Zotero reference management tool and reduced to 205 articles

after duplicates were removed based on the inclusion and exclusion criteria. Ten eligible papers were obtained after articles acquired met the inclusion criteria. After that, critical appraisal was conducted using the Critical Appraisal Skills Program. This study made use of systematic reviews and 2018 version of the Mixed Methods Appraisal Tool. Subsequent screening for additional records identified through references that included 8 articles allowing the selection of 18 articles meeting eligibility criteria. However, eight articles records were excluded with reason upon full-text screening retaining 10 relevant articles for this review in the final selection as shown in Figure 1.

Inclusion and Exclusion Criteria

The following inclusion criteria were used to screen identified studies for eligibility: Study evaluated on mobile health app intervention targeting increased antenatal care attendance, postnatal care attendance, or childhood immunization rates through behaviour change; Study included low and middle-income countries; Study included measurement of process, behavior change, health, or quality of care outcomes; Study of a peer-reviewed articles; Study that was available in English; Study articles that were published with an independent variable; and use of mobile phone applications including self-monitoring strategies.

Exclusion criteria leading to studies being classified as ineligible were: Maternal age <15 years; Diagnosis of intellectual disability; lack of original data in conceptual study, study examining other health conditions apart from nutritional conditions.

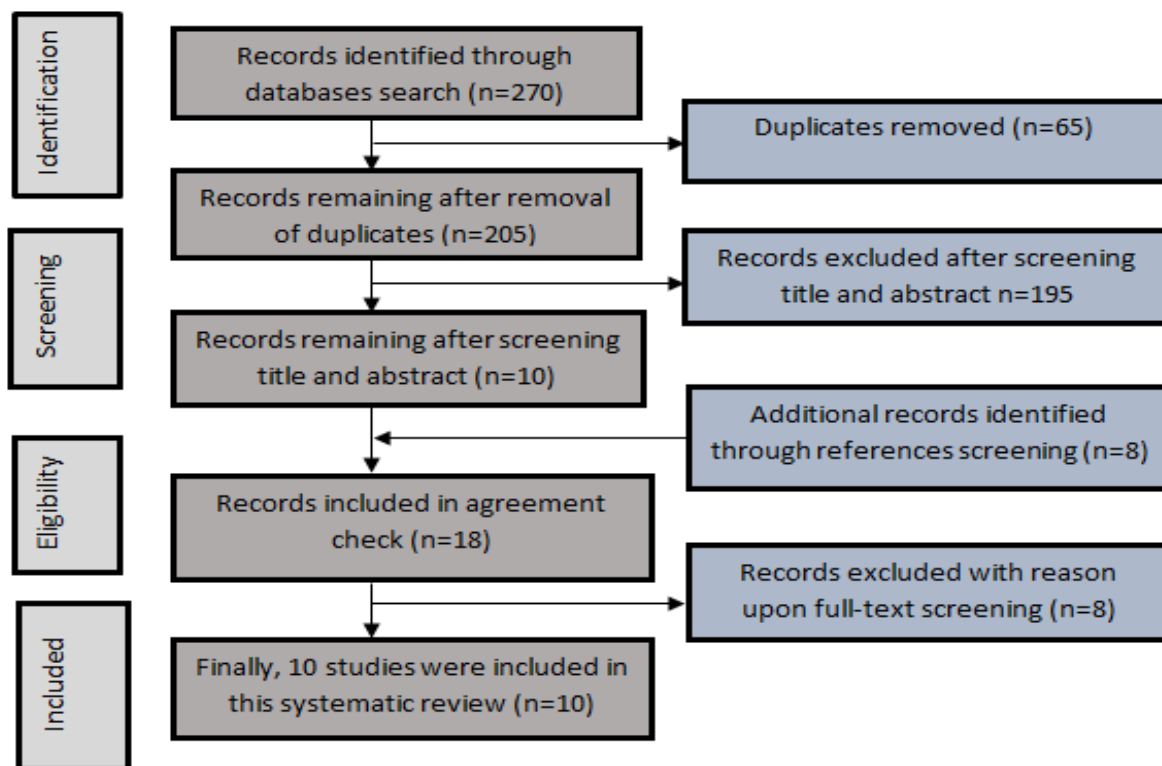


Figure 1: PRISMA 2009 flowchart illustrating inclusion process

RESULTS

Table 1 shows key information obtained from the reviewed studies. This included; the names of authors, the year of publication, sample size, study design and the outcome measure. Eighty percent of the studies reviewed used the

randomized controlled trial (RCT) as the study design; one study used randomized pilot study design to assess breastfeeding status, and the other used comparative study design to compare mobile phone applications and pen-and-paper method on breastfeeding and nutrition.

Table 1

Studies associating mobile phone applications (apps) on maternal and young child malnutrition interventions

Study ID	Author(s)	Year	Sample Size	Study Design	Outcome Measure
1	Hojati <i>et al.</i> ⁹	2023	n=116	RCT	Growth indicators and Increase in Nutrition Knowledge Attitude and Practices (KAP) score
2	Seyyedi <i>et al.</i> ¹⁰	2021	n=102	RCT	Increase in Nutrition KAP score
3	Archana <i>et al.</i> ¹¹	2019	n=2,480	RCT	Reduction of stunting in young children
4	Demirci <i>et al.</i> ¹²	2016	n=61	RPI	Assess breastfeeding status
5	Areemit <i>et al.</i> ¹³	2023	n=358	RCT	Assessment of child's health and growth
6	Shefaly <i>et al.</i> ¹⁴	2018	n=17	RCT	Postnatal Knowledge
7	Karamolahi <i>et al.</i> ¹⁵	2021	n=140	RCT	Maternal health literacy during pregnancy
8	Zhang <i>et al.</i> ¹⁶	2012	n=120	Comparative	Infant feeding practices
9	Avishek and Murari. ¹⁷	2021	n=1480	RCT	Maternal health awareness
10	Demirci <i>et al.</i> ¹⁸	2019	n=17	RCT	Maternal breastfeeding confidence score

Abbreviations: RCT, randomized controlled trial; KAP, Knowledge, Attitude and Practices; RPI, Randomized Pilot Intervention

Hojati *et al.*⁹ established that using smartphones can help to deliver educational content on a large scale and at a low cost. The review recommends clinical trials of interventions that apply mobile phone application. However, the review noted lack of adequate mobile app effectiveness and usability. Seyyedi *et al.*¹⁰ investigating effectiveness of a smartphone-based educational intervention to improve breastfeeding established that the smartphone-based app for educating new mothers on

breastfeeding had a significantly positive effect on breastfeeding self-efficacy and maternal knowledge, attitude and practices. Aligned to this, the review recommends that the app intervention be tested in both prenatal and postpartum periods.

Archana *et al.*¹¹ conducted a study to investigate mobile phone application solutions to help community providers promote maternal and infant nutrition and health using a community-based cluster randomized controlled trial. The review noted that in the process of study result evaluation, the

technology savviness was not factored in; hence it was recommended that technology savviness should be included. Demirci *et al.*¹², investigated mothers' use and experiences of infant feeding apps with a feeding tracker component. It included establishment of how information within these apps are used, initial reasons for downloading, the role of the apps in infant feeding, perceived benefits and disadvantages of infant feeding apps. The study established that most participants owned smartphones and used technology during pregnancy to track pregnancy data, follow fetal development, address pregnancy concerns, and obtain breastfeeding information. The study established that the mobile app enabled mothers to track their infant's feeding as well as their growth pattern. However, this review noted that the data is qualitative hence cannot be used to represent the wider population.

Aremit *et al.*¹³, their study trial focuses on the effectiveness of using the mobile phone application with the Maternal and Child Health Handbook (MCHH) and standard care (intervention) compared with the conventional MCHH and standard care (control) on parents' health literacy. The study established that the number of parents with high total health literacy significantly increased specifically in the health management and child health management domains in the app group, but not in the control group. It also established that parents in the app group could correctly assess their child's head circumference and development better than those in the control group at both visits. Nonetheless, this review noted that the study was conducted at a single institution and that the sample contained a larger proportion of parents with high health literacy than the general adult population, hence this may influence generalizability to parents with lower health literacy status.

Shafaly *et al.*¹⁴, their descriptive and qualitative study explored the views of parents of newborn babies on the content and delivery of a mobile health app-based postnatal educational program. The study established the mobile phone - based educational program was helpful in supporting a multi-ethnic sample of parents during the postnatal period. However, this review noted that health professionals were not involved in the development of the mobile app; therefore this review recommended that health care professionals should be included in the developmental stage regarding the feasibility or acceptability of such a program in their professional practice.

Karamolahi *et al.*¹⁵ investigated the efficacy of mobile app-based training on health literacy among pregnant women. The results of the study showed that mobile app-based training is effective in the health literacy of pregnant women especially in situations like the Corona Virus pandemic. This review recommended that a mixed method study should be applied in identification of the educational needs in designing and building need-based application. Zhang *et al.*¹⁶, investigated Smartphone versus Pen-and-Paper Data Collection of Infant Feeding Practices. The study established that smartphones can be successfully used for household data collection on infant feeding. However, the review recommended that to deliver maximum benefits, smartphone data collection should be further evaluated for other surveys and on a larger scale.

Avishek and Murari¹⁷ investigated mobile phone applications for mothers' intervention to augment maternal health awareness and behavior of pregnant women. Their study established that the mobile phone interventions can augment awareness of, and persistence in, recommended maternal health

behaviors. However, this review recommended that research is needed to capture the direct impact of the mobile phone application intervention, on maternal health awareness and behavior in tribal communities when pregnant women are active users without assistance from trained personnel. Demirci *et al.*¹⁸ researched on the impact of telelactation through mobile phone app in rural Pennsylvania. The study established that telelactation was convenient and efficient, provided a needed service in rural areas lacking breastfeeding support services, and increased maternal breastfeeding confidence. However, the review recommends further research to establish the value of direct-to-consumer telelactation across diverse populations.

CONCLUSION

This review established that there is enough agreement across studies to conclude that mobile phone applications are patient-acceptable and helpful in reducing maternal and young child malnutrition through knowledge, attitude and practices. While several review studies have examined the role of mobile phone applications in malnutrition interventions to promote proper diet and nutrition or to lose weight in maternal and young children to the best of our knowledge, there are limited or no studies that have focused on the role of mobile phone applications for addressing anemia prevalence, a common nutritional issue among pregnant women. As in pregnant women, anemia prevalence among young children can be indicative of nutritional issues, particularly iron deficiency. Hence more studies on mobile phone application interventions on anemic prevalence on both maternal and young child should be encouraged. This will help

healthcare providers, policymakers, and researchers identify nutrition-related problems, track progress in nutrition interventions, and develop targeted strategies to improve the health and well-being of both maternal and young children nutritional status.

While mobile apps can be valuable tools for raising awareness, providing education, and tracking personal nutrition and health goals, they should be seen as part of a broader strategy for nutrition management. This study also emphasizes the importance of combining mobile apps with access to healthcare, community-based interventions, and policy changes that can lead to more effective nutrition management and improved health outcomes.

REFERENCES

1. Asmare AA, Agmas YA. Determinants of coexistence of stunting, wasting, and underweight among children under five years in the Gambia; evidence from 2019/20 Gambian demographic health survey: application of multivariate binary logistic regression model. *BMC Public Health*. 2022 Aug 26;22(1):1621.
2. Tesema GA, Yeshaw Y, Worku MG, Tessema ZT, Teshale AB. Pooled prevalence and associated factors of chronic undernutrition among under-five children in East Africa: a multilevel analysis. *PLoS One*. 2021 Mar 25;16(3):e0248637.
3. Marshall NE, Abrams B, Barbour LA, Catalano P, Christian P, Friedman JE, Hay Jr WW, Hernandez TL, Krebs NF, Oken E, Purnell JQ. The importance of nutrition in pregnancy and lactation: lifelong consequences. *American journal of obstetrics and gynecology*. 2022 May 1;226(5):607-32.
4. Zhu PH, Mhango SN, Vinnakota A, Mansour M, Coss-Bu JA. Effects of COVID-19 pandemic on nutritional status, feeding practices, and access to food among infants and children in lower and middle-income countries: a narrative review.

- Current Tropical Medicine Reports. 2022 Dec;9(4):197-206.
5. Schneider L, Ollila S, Mutanen M. The usefulness of nutrition and health videos displayed on mobile phones in rural Uganda: Experiences of community health workers and mothers. *Maternal & Child Nutrition*. 2022 Apr;18(2):e13322.
 6. Slalmi A, Chaibi H, Chehri A, Saadane R, Jeon G. Toward 6G: Understanding network requirements and key performance indicators. *Transactions on Emerging Telecommunications Technologies*. 2021 Mar;32(3):e4201.
 7. Carrandi A, Hu Y, Karger S, Eddy KE, Vogel JP, Harrison CL, Callander E. Systematic review on the cost and cost-effectiveness of mHealth interventions supporting women during pregnancy. *Women and Birth*. 2023 Feb 1;36(1):3-10.
 8. Sanjaya AN, Purnomo A, Prasetyo YT, Tho C, Maulana FI, Persada SF. Marketing in Wireless Communication: A Systematic Review. In *International Conference on Wireless and Satellite Systems 2023* (pp. 85-93). Springer, Cham.
 9. Hojati A, Alesaeidi S, Izadi S, Nikniaz A, Farhangi MA. MyKid's Nutrition mobile application trial: a randomized controlled trial to promote mothers' nutritional knowledge and nutritional status of preschool children with undernutrition—a study protocol. *Trials*. 2023 Aug 19;24(1):544.
 10. Seyyedi N, Rahmatnezhad L, Mesgarzadeh M, Khalkhali H, Seyyedi N, Rahimi B. Effectiveness of a smartphone-based educational intervention to improve breastfeeding. *International Breastfeeding Journal*. 2021 Dec;16:1-8.
 11. Patel AB, Kuhite PN, Alam A, Pusdekar Y, Puranik A, Khan SS, Kelly P, Muthayya S, Laba TL, Almeida MD, Dibley MJ. M-SAKHI—Mobile health solutions to help community providers promote maternal and infant nutrition and health using a community-based cluster randomized controlled trial in rural India: A study protocol. *Maternal & Child Nutrition*. 2019 Oct;15(4):e12850.
 12. Demirci JR, Cohen SM, Parker M, Holmes A, Bogen DL. Access, use, and preferences for technology-based perinatal and breastfeeding support among childbearing women. *J Perinat Educ*. 2016 Jan 1;25(1):29-36.
 13. Areemit R, Saengnipanthkul S, Sutra S, Lumbiganon P, Pornprasitsakul P, Paopongsawan P, Sripanidkulchai K. Effectiveness of a Mobile App (KhunLook) Versus the Maternal and Child Health Handbook on Thai Parents' Health Literacy, Accuracy of Health Assessments, and Convenience of Use: Randomized Controlled Trial. *Journal of Medical Internet Research*. 2023 May 9;25:e43196.
 14. Shorey S, Yang YY, Dennis CL. A mobile health app-based postnatal educational program (home-but not alone): descriptive qualitative study. *Journal of medical Internet research*. 2018 Apr 19;20(4):e119.
 15. Karamolahi PF, Khalesi ZB, Niknami M. Efficacy of mobile app-based training on health literacy among pregnant women: A randomized controlled trial study. *European Journal of Obstetrics & Gynecology and Reproductive Biology*: X. 2021 Oct 1;12:100133.
 16. Zhang S, Wu Q, van Velthoven MH, Chen L, Car J, Rudan I, Zhang Y, Li Y, Scherpbier RW. Smartphone versus pen-and-paper data collection of infant feeding practices in rural China. *Journal of medical Internet research*. 2012 Sep 18;14(5):e2183.
 17. Choudhury A, Choudhury M. Mobile for Mothers mHealth Intervention to Augment Maternal Health Awareness and Behavior of Pregnant Women in Tribal Societies: Randomized Quasi-Controlled Study. *JMIR mHealth and uHealth*. 2022 Sep 21;10(9):e38368.
 18. Demirci J, Kotzias V, Bogen DL, Ray KN, Uscher-Pines L. Telelactation via mobile app: Perspectives of rural mothers, their care providers, and lactation consultants. *Telemedicine and e-Health*. 2019 Sep 1;25(9):853-8.