REVIEW ARTICLE

Effectiveness of M-Health in Improving Physical Activity: An Indian Perspective

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ABSTRACT

Aims: The aim of the study was to provide an articulated body of literature on assessment and consultative exercises of m-health advances in physical activity from an Indian perspective.

Settings and Design: Scoping review was conducted using the Arksey and O'Malley framework (2005) and thereafter consultative exercises were performed.

Subjects and methods: We searched the electronic databases and available grey literature from last 10 years. PRISMA flowchart for the study selection process was used to guide reporting. Data extraction included information on study design, authors, year of study, location and key findings on assessment of m-health advances in physical activity from an Indian context. Data were compiled and summarized narratively.

Results: Total 9 studies were selected for the final review out of 24 review articles searched. Scoping review revealed that six studies measuring physical activity with an accelerometer or pedometer and three studies used Smartphone applications for physical activity promotion. Actigraph Accelerometer, was the most popular tool and pedometer was considered as feasible and effective tool for monitoring physical activity. Stakeholder consultation exercises have indicated that mobile health apps play a valuable role in enhancing accessibility to physical activity resources, promoting behavior modification, and fostering continued user engagement. However, there is a consensus among stakeholders that these apps would be even more beneficial if they provided users with constructive feedback and personalized recommendations.

Conclusion: This review highlights how mobile health interventions promote physical activity. However, limited evidence calls for further research in the Indian context.

Keywords: m-health; accelerometer; physical activity; Smartphone, NCDs

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Introduction

In the last couple of decades, we have witnessed a lot of increase in awareness about the benefits of physical activity amongst the common masses. However, despite being aware of the benefits of physical activities, there is an increase in lifestyle-related diseases over the last decade which can be directly attributed to a sedentary lifestyle.[1,2,3] This is simply because people don't know how they can monitor their physical activity on a daily basis. In other words, awareness about means that are available to quantify physical activity or no physical activity is very low.[4] Additionally, they also lack the motivation and knowledge about the methods that can help them monitor their physical activity which in return can help them in improving it.[5]

India in the last decade has also witnessed a significant surge in mobile use. As per the report of Business Standards, India is going to have approximately 1 billion (10 crores) mobile users by the end of 2026.[6] If these mobile phones can be used for monitoring their physical activities and simultaneously motivating them to increase their physical activity, it can bring revolutionary positive changes in indicators related to a sedentary lifestyle.[7] However, despite being the front-runner in accepting the Smartphone for daily use, it is still not being used widely for health-related interventions.[8] It seems that there isn't much enthusiasm among researchers, clinicians, and common masses to adopt the Smartphone as a tool to monitor health.[8]

This scoping review paper will try to explore the status and numbers of various types of m-health interventions that have happened around the country, where mobile phones have been used for monitoring the health, to understand the acceptance level of the use of mobile phones for improving physical activity.

Methodology

A multi-method study involving scoping review and consultative exercises was conducted for assessing the effectiveness of m-health on physical activity in Indian perspective. The framework proposed by Arksey and O'Malley (2005) and the approach by Peter et al (2015) were used to build a methodology of scoping review.[9,10] The study was conducted using a PRISMA flowchart for selecting relevant studies.[11] This review was followed in five steps: Step 1- Developing the research questions; Step 2- Identifying relevant studies; Step 3- Selecting studies; Step 4- Charting data; and Step 5- Collating, summarizing, and reporting results.

Search strategy: Literature searches were conducted from October 2022 to January 2023. In this review, the studies published within 10 years were included. The following terms assessing the effect of using m-health advances on physical activity in the Indian context were used in the literature search: "Mobile devices on physical activity in India", "mobile technology", "Sensor", "m-health", "Internet of Things (IoT)", "remote devices", "Sedentary Lifestyle". The literature search was limited to the English language using Google Scholar, PubMed/Medline, and Scopus. We also included studies referencing selected articles to further avoid missing literature.

Study selection and Inclusion criteria: The studies assessing the effect of m-health on physical activity from an Indian perspective were included in this scoping review. All selected studies were written in the English language. The reviewers independently searched titles or abstracts to identify studies that met inclusion criteria. The authors independently reviewed and retrieved the full-text articles that met the inclusion criteria. All articles included in this scoping review were chosen by consensus of all reviewers.

Data extraction: The reviewers independently evaluated each article and extracted relevant data. All of the articles chosen for the final review were analysed and discussed by all of the reviewers.

Stakeholder consultative interviews were conducted with developers, implementers, and end-users of the m-health application specifically designed for improving physical activity.

Results

The studies were searched from October 2022 to January 2023. A total of 24 studies were reviewed and analysed. After the removal of duplicate articles, 21 potentially relevant studies were screened for their titles and abstracts, resulting in 16 full-text articles. After careful evaluation, 7 full-text studies were excluded due to the following reasons including perception-based surveys, interventions focused on text messages or phone calls, and descriptor-based approach for activity classification. After reviewing all studies, 9 articles were included in the final review. Figure 1 shows the PRISMA framework used for the literature search process[11].

While analysing the selected articles, we observed that six studies measured physical activity with an accelerometer or pedometer and the remaining other three studies are using Smartphone applications as interventions for physical activity promotion. Heterogeneity in the study methods of selected studies was observed as follows: cross-sectional study (n=3), experimental study (n=2), quasi-experimental study (n=1), cohort study (n=1), Observational study (n=1), and randomized controlled trial (n=1). Similarly, heterogeneity was observed in a study population of selected studies like adults, sedentary people, company employees, medical students, children, Type 2 Diabetic, Chronic Stroke, and coronary artery disease subjects.

Most of the selected studies are using Actigraph Accelerometer as an intervention for measuring physical activity levels. J. Josh Snodgrass (2016) conducted the study among older adults of age groups 49-90 years to measure and document the physical activity levels of the urban population[12]. In this study, low physical activity levels were reported among the population while women had lower levels of physical activity than men. It was also documented that women who are socially integrated have been shown to engage in higher levels of physical activity[12]. Pradeepa Nayak (2019) has conducted a study on Chronic Stroke adults and found that 77 % of the participants are engaged in sedentary activities and 22% in light activities[13]. According to Alisha Britto (2018), an accelerometer is an effective tool for measuring the duration and intensity of physical activity in T2DM (Type 2 diabetes mellitus) patients[14]. A low level of physical activity and a greater amount of time spent on lighter activities were recorded in this study[14]. Similarly, GV Krishnaveni (2009) measured the total activity counts and time spent in children using MTI Accelerometer[15].

Among the selected articles, there is a study conducted by Varna Mathew (2019) using Pedometer to promote physical activity in Software company employees[16]. In this study, the step count difference at baseline (6963) and during the week (9834) was observed as significant. 94% of the participants considered that Pedometer is a feasible and useful tool for improving their physical activity[16].

Some of the researchers have used Smartphone applications as an intervention for improving physical activity. Dr. Mahesh Deshpande (2019) conducted a physical activity program using the Google Fit app among sedentary people. The study has shown a positive effect on daily activity performance and cardiovascular endurance of study participants[17]. Naveen Pentakota in 2019 conducted a study using Smartphone “Runtastic” app among medical students in the purpose to improve physical activity. A significant improvement in physical activity, a decrease in weight, and an improvement in BMI (Body Mass Index) were observed in study subjects[18]. There is a study by Shruti Muralidharan using (mDiab) mobile health app for diabetes prevention. This app is designed to facilitate individuals to track weight, physical activity, and diet as well as provide video sessions on Diabetes prevention[19]. Table 1 presents the characteristics and key findings of included studies for review.

Through stakeholder consultative interviews, we identified the stakeholder perspectives of developing, implementing, and usage of m-health applications for improving physical activity. In the context of developing m-health apps, the stakeholders recognized the challenges regarding user adoption and long-term engagement. They mentioned that m-health applications can be effective in improving physical activity if apps are able to track physical activity levels accurately, provides reliable feedback to users, accommodate individual differences and offer personalized recommendations. Developers considered the integration of apps with wearable devices, fitness trackers, or other monitoring technologies to be an effective way for enhancing data accuracy and promoting seamless user experience. The advantages of m-health apps identified by developers such as easy access to physical activity resources, behaviour modification support, and motivational features for continued user engagement.

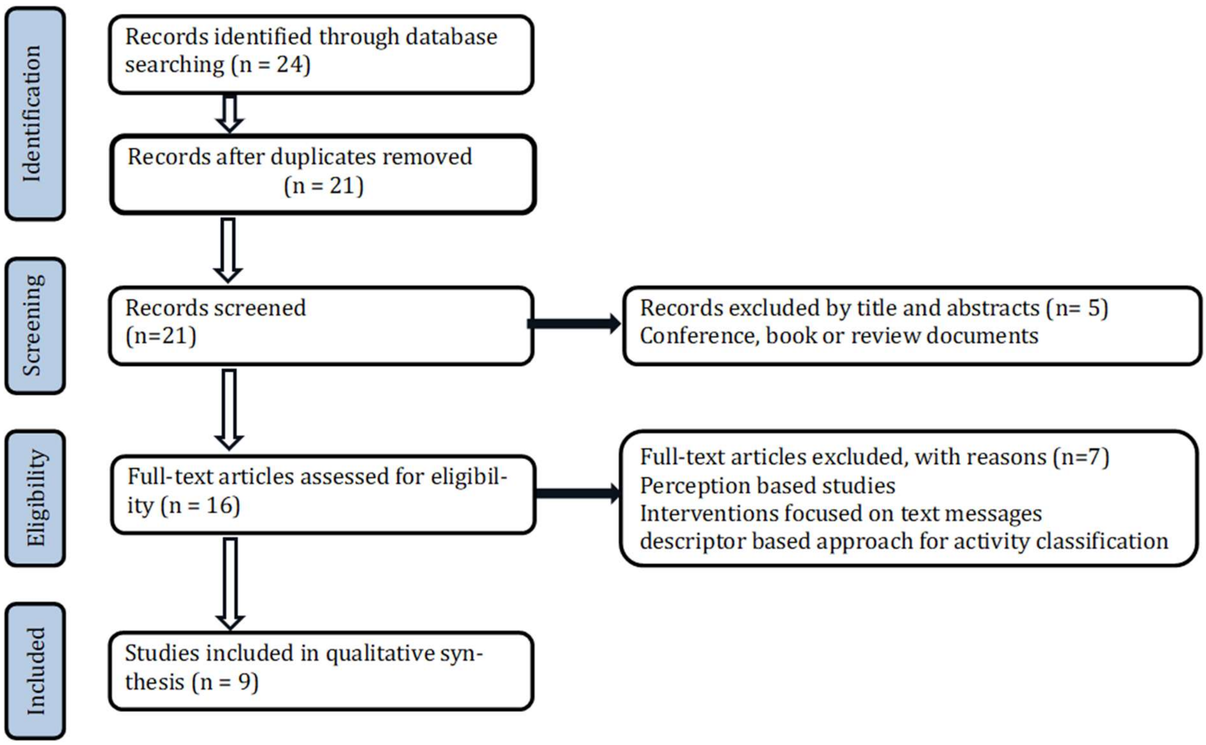

Figure 1: PRISMA Framework for Literature Search Process

Table 1: Characteristics and Key Findings of included studies

Study	Type of Intervention	Population	Key Findings	location	Method of Study
J Josh Snodgrass (2015)[12]	Actigraph GT3X accelerometry with anthropometric and sociodemograhic data	200 Adults (Age 49-90 years)	• Extremely low activity levels in males and females (PAL averages of 1.14–1.17). • Total Energy Expenditure (TEE) and Activity Energy Expenditure (AEE) are significantly higher in younger age groups. TEE and AEE are higher levels in males. • AEE was positively correlated with BMI in men (P < 0.01) and women (P < 0.05). • Socially integrated women had greater AEE (P < 0.01).	Urban India	Cross-sectional study
Mahesh Deshpande (2019)[17]	Google Fitness app	20 sedentary people (Age: 30-45 years)	• Positive effect on daily activity performance, cardiovascular endurance of the sedentary peoples and beep test levels, distance, time, VO2Max, speed, score, calories and rating of the subjects were observed.	West Bengal	Experimental study
Varna Mathew (2019)[16]	Health education program on physical activity, goal setting, and instructions regarding the use of pedometers.	46 Software company employees (Age >=30 years)	• Significant increase in physical activity levels and step counts during the intervention. • Higher adherence (77%–91%). • 94% found pedometer useful in improving their physical activity.	Puducherry	Experimental study
Naveen Pentakota (2019)[18]	Smartphone app (Runtastic)	350 Medical under- graduates (mean age of 18.9 years)	• Significant improvement in total and leisure time Physical Activity. • Significant decline in weight and BMI of the study participants.	Puducherry	Quasi-experimental study
Shruti Muralidharan (2017)[19]	Mobile phone app (mDiab)	1500 Android Smartphone users who are at a risk of Type 2 Diabetes	• 15 % Improvement in their dietary and physical activity behaviors in intervention group. • Improvement in cardio-metabolic risk factors (waist circumference, blood pressure, glucose, insulin, and lipids)	Chennai, Bengaluru, and New Delhi	Randomized controlled trial
Pradeepa Nayak (2019)[13]	Physical Activity Scale for Individuals with Physical Disabilities (PASIPD) and an accelerometer (Actigraph GT3X)	33 Adults with chronic stroke	• Energy Expenditure per day and number of steps walked in a day are extremely low recorded. • 77% of participants spent their time in sedentary activities, 22% of in light activities, and 1% of their time in moderate activities.	semi-urban region of India	Cross-sectional study
Shilpa Gupta (2020)[20]	Actigraph accelerometer	16 subjects with Coronary artery Disease (CAD)	• PA energy expenditure averaged 283.71 Kcals/3days, step counts/day 4861.50, METs (Metabolic Equivalents) 5.79. • EE (Energy Expenditure) in light and moderate intensity activities were 1.01 Kcals and 5.72 Kcals.	Medical college in India	Observational study
G.V Krishnaveni (2009)[15]	MTI Actigraph	103 children of mean age of 6.6 years	• Total counts and time spent in various activity levels were similar in both boys and girls (P>0.2). • Time spent< 20 mins in vigorous activities. • Boys spent higher percentage of total counts in vigorous activity, and girls a higher percentage of total counts in light activity • Accelerometers are a well-accepted and objective method of measuring activity behavior in free-living children.	Holdsworth Memorial Hospital, Mysore	Cohort study
Alisha Britto (2018)[14]	GT3X triaxial accelerometer	25 subjects T2DM (Age: 30 -65 years)	• Low PA in most of the participants (mean PA was 1.63 ± 0.28 metabolic equivalents (MET)/min/wk). • Total time spent on lighter activities (135.28 ± 62.39) was greater than time spent on moderate (107.44 ± 99.45) and vigorous (28.07 ± 10.27) activities. • Accelerometer considered as effective tool for measuring duration and level of PA.	India (Exact location not disclosed)	Cross-sectional study

Implementers raised technological issues related to m-health apps such as limited internet connectivity and disparities in digital literacy. Despite of its challenges, the implementation stakeholders expressed the benefits of m-health apps in improving physical activity. They believed that these apps can be effective in delivering affordable and accessible solutions to reducing healthcare costs associated with sedentary lifestyles. According to them, m-health apps empower individuals to take control of their physical activity levels and have the potential to improve health outcomes and lower the risk of chronic diseases. Apps can provide valuable insights into population-level physical activity patterns, behaviour trends, and the effectiveness of interventions.

End users conceded these apps are effective in promoting physical activity subjected that they are accessible despite their varying abilities, languages, cultural backgrounds, and health conditions. Issues related to the privacy and security of personal health data was also mentioned. They perceived m-health apps are convenient and flexible as these can be used conveniently for physical activity, eliminating the need for specific locations or schedules. The users mentioned that m-health apps can empower them to take control of their health by providing insights and feedback on their physical activity levels.

Discussion

This scoping review was performed to identify literature on effects of m-health interventions on physical activity from an Indian perspective. We identified 9 studies focused on impacts of mobile health such as smart-phones or wearables in promoting the physical activity. The purpose of this review to provide insights into the various ways in which mobile health interventions are being used to promote physical activity for future directions. Though, there is limited evidence available and more research required in Indian context.

This review revealed the use of Accelerometers in measuring physical activity levels in most of the selected studies.[12,13,14,15,20] It is commonly used in research and clinical settings to objectively measure physical activity. Accelerometers are small and portable, making them easy to use in a variety of settings and with different populations.[21,22,23] There have been studies conducted in India that have used accelerometers as physical activity trackers in older adults, individuals with chronic diseases, and children.[12,13,14,15,20] Accelerometers can help in identify periods of physical inactivity, which can lead to the development of chronic diseases and other health problems.[14,24] Literature has shown that there are gender differences in physical activity levels when comparing accelerometer-based physical activity tracking in males and females.[12] Using accelerometer activity trackers to assess gender differences in physical activity levels can provide valuable insights for researchers and clinicians as well as help in the development of targeted interventions for physical activity promotion based on needs of population.[25,26]

While they have several strengths, but their effectiveness in promoting physical activity may be limited by several factors. Accelerometers are typically worn on the wrist, waist, or ankle to measure movement in the lower part of the body, but they may not detect upper body movements as accurately.[12,27] Accelerometers cannot distinguish between sitting and standing still as they do not provide information about body posture.[27,28,29]

Some researchers considered that using Pedometers at workplace can be feasible and effective approach for increasing physical activity over the short term.[16] Pedometers are simple devices that worn on the hip or waist and count the number of steps taken.[16,29,30] They are relatively easy to use, inexpensive, and can provide immediate feedback to individuals about their physical activity levels.[16] They also encourage individuals to be more active throughout the day.[16] These findings are consistent with studies conducted in other parts of the world, which have also found pedometers to be an effective tool for promoting physical activity in various populations.[31,32,33,34] While pedometers have been found to be effective in the short term, it is important to note that long-term adherence to physical activity programs may be challenging.[16,35] In addition, there is limited evidence on the sustainability of the effects of pedometer-based interventions over the long-term.

There are studies conducted on effectiveness of smart phone applications for improving physical activity in India. These studies suggest that Smartphone apps can be valuable tool for promoting healthy behaviors and improving overall health and well-being in the Indian context.[17,18,19] They are considered as convenient, affordable and customizable way for individuals to engage in physical activity and improve their overall health and wellbeing.[36] While Smartphone apps have the potential to improve physical activity in India, there are a number of challenges and limitations that need to be addressed.[37,38] Cultural context, limited digital literacy, language barriers, disparities in access to Smartphones particularly in rural areas or lower income groups, privacy or security concerns are all issues to address in developing these applications.[38] App developers also consider the personalization needs of Indian users, and ensure that their apps are engaging and effective over the long term.[36]

Conclusion

In conclusion, this review sheds light on the diverse applications of mobile health interventions in fostering physical activity. Despite the prevalence of smartphones, a notable inclination toward wearable devices and other smart gadgets was evident. It is worth noting that there is a scarcity of studies directly addressing the use of mobile devices for physical health monitoring in the Indian context, which limits the available evidence for drawing conclusive remarks on the efficacy of mHealth interventions. This emphasizes the need for further research specific to the Indian context and potential for more extensive investigations into the utility of mobile phones and mHealth interventions in promoting physical well-being.

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