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EDITORIAL COMMENT

What Are the Features Promoting and Deterring Engagement in Mobile Health Intervention Use*

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Mobile health (mHealth) interventions are increasingly implemented in multiple aspects of healthcare, including primary cardiovascular prevention through fitness and physical activity promotion.[1] Some interventions rely on patient self-management (eg, fitness promotion application, diet tracking application), while others are prescribed or recommended by clinicians (developed for specific health condition prevention or management), both with the common goal of patient empowerment, self-management, and improving access to equitable healthcare. mHealth intervention deployment at scale is challenged in part by individual engagement and retention.[2] This highlights the need for further research to identify factors promoting uptake or deterring engagement in mHealth interventions to guide the development of effective mHealth interventions. Previous research has suggested that performance expectancy, effort expectancy, and social influence are influencing factors in determining the likelihood of using a mobile application.[3] In the meta-regression analysis of 101 studies, Michie et al[4] found that self-monitoring was the most important behavior change component for increasing physical activity especially when combined with: 1) individualized goal setting; 2) feedback on performance; and 3) review of the goals. In addition, the meta-analysis of 28 randomized controlled trials evaluating mobile application or activity tracker use for physical activity identified that text messaging and flexibility for personalization lead to more effective physical activity promotion.[5] Similarly, automated tracking-texting intervention has been shown to increase step count in a randomized controlled trial.[6] Other aspects to facilitate successful mHealth intervention development include co-development of interventions with end users (human-centered or participatory design)[7] and increasing technology literacy and access. The latter topics are beyond the scope of the current editorial. Despite behavior change concepts influencing health intervention engagement identified by previous studies, there is a gap in the literature regarding user perceptions on mHealth application use and identifying specific features of the mHealth fitness application facilitating or deterring its continued use.

In this issue of *JACC: Advances*, Razaghizad et al[8] evaluate current use, motivators, and barriers associated with engagement in mHealth fitness applications as well as attitudes toward data privacy in a cross-sectional survey study. A total of 694 adults (median age 28 years, IQR: 23-39 years) were recruited via single-stage random sampling over 6 days in September 2022 from a database of 130,000 people registered to participate in crowdsourced behavioral research in Canada. The survey consisted of 57 questions, and it was developed and validated via mixed methods of individual interviews and expert input. 62% of participants were women, 26% were Asian, ~4% were non-Hispanic Black, 2.2% were Hispanic, and 0.7% were indigenous. Majority of patients were from urban and suburban areas. Notably, only participants who owned an Android or iOS

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smartphone and had regular access to the internet were included in this study.

What were the findings of the study? 1) Nearly one-half (48%) of study participants were using an mHealth fitness application with the overwhelming majority (96%) finding the application convenient to use. Application use was uniform among different sex and race groups. 2) Ninety-two percent of participants considered personal health and well-being important for them. The majority of participants were motivated to become more active, improve eating habits, and improve mental well-being. 3) As expected, participants who perceived the importance of physical fitness, personal health, and well-being and those interested in losing weight were more likely to be current users of mHealth applications. Among Asian or Pacific Islander population, perceived importance of mental health and well-being had stronger association with mHealth application use. 4) In subgroup of 333 participants who were using mHealth applications, features associated with routine use and engagement included those that facilitated: a) goal-setting with visualization and tracking of progress; b) motivation; and c) accountability. Tracking health data such as steps, heart rate, calories, or sleep also led to higher user engagement. There was no difference among different sex or racial subgroups in facilitators for mHealth fitness application use. 5) Among 333 participants who were using mHealth fitness applications, individuals who reported a lack of motivation to be physically active or who perceived a lack of control to stay physically active were less likely to stay engaged in app use. Applications that did not allow goal tracking or provided negative feedback when goals were not met were less likely to have continued user engagement. 6) Among all study participants, more than one-half (56%) of the individuals reported that they were comfortable sharing anonymized health and fitness data for research purposes. However, factors such as type of data shared, data use transparency, option to opt out of data sharing, and privacy policy specifics were important factors in acceptability of data sharing.

The results of this study must be considered in the context of several limitations. First, as noted by Razaghizad et al,[8] a major limitation of the study is its limited generalizability. Although the intention was to distribute it to a "pan-Canadian" group, the majority of survey responders were young (median age 28 years), healthy (9% rated their health as poor), and technology proficient (smartphone owners and/or access to high-speed broadband internet). The homogenous participant sample is likely attributable to the recruitment methodology of utilizing the *Prolific platform* database, where the participants registered online and were paid to participate in crowdsourced behavioral research. The approach offers the advantage of a virtual and decentralized study methodology but introduces biases as the survey responders are overall healthy, young, and "tech savvy" compared to the average cardiovascular patient population. Furthermore, the crowdsourced-based approach to participant recruitment may present a barrier to participation of communities that are traditionally underrepresented in research including non-Hispanic Black and Hispanic individuals. Future studies may consider a hybrid approach with active engagement of community stakeholders and community-based participatory research approaches to enhance diversity of participants and ultimately the generalizability of study findings. The second limitation is that this study defined factors that enhance or limit application engagement in mHealth fitness applications based on a healthy and young population; however, for the purposes of physical activity promotion in an older population with or without established atherosclerotic vascular disease, the motivators and barriers may be different. Future studies would benefit from engaging with this population to better understand factors that promote mHealth fitness intervention usage in older adults in primary and/or secondary prevention. For example, cardiac rehabilitation programs, which are now offered with a smartphone application and personalized coaching linked to connected devices are under study (NCT05238103). The third major limitation is the discordant results from this study compared to a prior randomized controlled trial[5] and meta-analysis[6] suggesting a benefit of mHealth application text messages and their overall effectiveness in promoting physical activity. Of note, both the meta-analysis and randomized controlled trial evaluated older patients on average than the present study, suggesting a younger technology proficient population may have a different perceived utility of push notifications with routine use of mHealth fitness applications. Future studies are warranted to evaluate push notifications and texting across age ranges to elucidate their overall effectiveness.

To conclude, we congratulate the authors for advancing the field's knowledge on key factors promoting mHealth fitness intervention usage among a young, healthy, and technology-proficient population, which include the customization of goals, goal tracking, and emphasis on personal health importance. Digital health technologies have advanced over the years to provide a scalable, patient-tailored, and engaging experience for

promoting physical activity at a population health level. A wider and equitable dissemination of these technologies with a focus on user engagement is needed to promote durable adherence to guideline-directed management and sustainable lifestyle modifications. Opportunities remain in research and clinical practice to bridge the digital divide and improve inclusion of a diverse patient population to help inform future digital health interventions and access the promise of health technology.

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