

# The impact of utilizing mobile phones to promote physical activity among post-secondary students: a scoping review

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**Abstract:** A commitment to regular physical activity may reduce the risks of chronic diseases for young adults. Internationally, the majority of post-secondary students are insufficiently active for health benefits. Novel health strategies and interventions utilizing mobile phones could increase post-secondary students' physical activity levels. However, there is contradictory evidence to support the use of mobile phones to promote physical activity, and a scoping review could provide further insights into this topic. The purpose of this study was to conduct a scoping review to explore the existing literature and investigate what is currently known about the use of mobile phones to enhance physical activity levels among post-secondary students. A total of 84 articles were identified from the literature search, and six studies were selected for data analysis. Two major themes were supported by the evidence, which included: (I) the relationship between mobile phones and physical activity levels; and (II) students' perceptions of mobile phones. Goal setting principles combined with text message interventions were reported to have significant influences on students' physical activity levels. Students expressed mixed feelings about coaching elements of apps and posting personal results on social networking websites. No studies reported the use of objective physical activity measurements. In conclusion, mobile phone technologies such as text message reminders could be included in health interventions to enhance post-secondary students' physical activity levels. There is limited evidence available on this topic and additional research is warranted to establish a clearer understanding of the relationship between mobile phones and post-secondary students' physical activity.

**Keywords:** Physical activity; mobile health (mHealth); mobile phones; health promotion; post-secondary students

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It is well known that engaging in physical activity and developing active lifestyles are healthy choices for people of all ages (1,2). In particular, there is a reduced risk of chronic diseases such as diabetes mellitus, cardiovascular diseases, and some cancers among adults who regularly participate in physical activity (1,2). In general, the majority of post-secondary students are young adults (e.g., individuals aged 18–24 years) (3), and researchers have found them to be insufficiently active (4,5). Notably, approximately 50% of post-secondary students do not accumulate enough physical activity to experience health gains (4). Individuals transitioning into early adulthood may face

numerous lifestyle changes (e.g., increased independence and responsibilities) that contribute to decreased physical activity levels, especially among post-secondary students (6,7). However, post-secondary students are often eager to participate in physical activity programs (8). Therefore, it is critical to develop and implement novel strategies and programs to promote physical activity among university and college students.

Mobile phones and smart phones are typically capable of text messaging functions and the use of mobile applications (apps), plus these devices could be utilized to store individuals' personal health information. There are almost seven billion

mobile phone subscriptions worldwide (9), and up to 79% of young adults (18–24 years) own a smart phone (10). Additionally, young adults are more likely to utilize their mobile phones to search for health information that is available online (11). Researchers illustrated that the use of mobile phone technologies (e.g., text messages and apps) are associated with enhancing health promoting behaviours such as improving sleep patterns, weight management, and physical activity among young adults (12,13). In a systematic review regarding mobile phone interventions to increase physical activity levels and decrease weight, Stephen *et al.* (14) illustrated that mobile phone interventions that included the use of text messaging and apps could increase physical activity levels and improve individuals' weight management behaviours. Moreover, Fanning *et al.* (15) conducted a meta-analysis on physical activity and mobile devices, and concluded that interventions utilizing mobile devices could be used to increase activity levels. These studies highlight some positive results of mobile health (mHealth) strategies and programs that targeted individuals' physical activity levels. Thus, mobile phones and apps are potentially promising tools to incorporate within an intervention for improving physical activity levels among inactive post-secondary students.

There is contradictory evidence regarding the benefit of using mobile technologies for enhancing health behavioural changes. Although some researchers have indicated possible physical activity-related benefits of utilizing mHealth technologies (12–15), others have found little evidence to support these findings (16,17). For instance, Bort-Roig *et al.* (16) reviewed 26 studies and concluded that there are only weak results to suggest that mHealth technologies could influence individuals' physical activity levels, and it was reported that current studies are of poor quality. Similarly, Free *et al.* (17) completed a comprehensive systematic review that included 75 trials regarding the effectiveness of utilizing mobile technologies for health behaviour change or disease management and reported that there is only weak evidence of any physical activity-related benefits. Because researchers have reported mixed findings regarding the efficacy of mHealth technologies for increasing physical activity levels, it is potentially beneficial to further explore this topic in a scoping review to update what is known within the literature about the use of mHealth to enhance physical activity levels among post-secondary students.

### **Physical activity guidelines and recommendations**

Physical activity refers to any bodily movements that will

increase an individual's energy expenditure such as walking or running (18). The current physical activity guidelines recommend that adults (18–64 years) should accumulate 150 min of moderate- to vigorous-intensity aerobic physical activity (MVPA) throughout the week in bouts of 10 min or more (1). Alternatively, researchers suggested that young adults should achieve 10,000 steps daily to be classified as “active” and to gain health-related benefits (19–21). Adherence to the physical activity guidelines and recommendations are associated with numerous physiological (e.g., decreased blood pressure levels and management of healthy body weight) and psychological (e.g., decreased levels of stress, depression, and anxiety) health benefits among adults of all ages (1,2). As such, it is important to develop physical activity strategies and interventions that will successfully impact and foster change among individuals who are largely inactive such as college and university students. The integration of mobile technologies into health-related programs may contribute to improving young adults' physical activity levels.

### **The impact of utilizing technologies to enhance physical activity levels**

In recent years, electronic health (eHealth) technologies have been incorporated into health interventions as a way to promote and increase physical activity among post-secondary students. For instance, Kwan *et al.* (22) utilized a website to deliver an online intervention to a group of Canadian university students, which resulted in improved physical activity levels among the intervention group. The researchers found that 52% of the participants who engaged with the website maintained adequate MVPA levels in comparison to the 22% who did not use the website. Additionally, 214 young adults significantly increased their physical activity levels in a 12-week randomized controlled trial (RCT) that included an mHealth intervention, which incorporated the use of text messages, apps, blogs, and websites (the TXT2BFiT study) (13). On the contrary, a group of Australian researchers utilizing an RCT design reported that there was no significant relationship between mHealth technologies and young adults' physical activity levels (23). However, these researchers reported that their findings may have been influenced by the low engagement levels with the intervention among the participants. There is limited amount of research in this area and it is important to comprehend the potential barriers for utilizing mHealth technologies for behavioural changes.

## Concerns of mHealth for behavioural changes

A common barrier for adopting mHealth initiatives is the concern about the security of users' data and personal information that are uploaded to corporate networks through the internet on mobile devices via apps (24,25). For instance, Gleason (24) and Lupton (25) expressed that there is a need for policies to ensure that users' privacy are safeguarded because it is often unclear how corporations utilize and protect users' personal data (e.g., data could be sold to other corporations or accidentally breached from their networks). Additionally, social networking websites (e.g., Facebook and Twitter) are often linked with mobile devices and apps, which may contribute to further privacy concerns such as the ubiquity of third party advertisements (25). As such, the issue of privacy raises ethical concerns for those utilizing mHealth technologies in their daily lives or within research projects. Moreover, mHealth technologies have been described as "nag technology" because of the guilty feelings associated with not performing desired health behaviours (26). Lastly, mHealth technologies may further contribute to the "digital divide" and health inequalities in modern societies due to the cost of the software and devices (27). Therefore, it is important to further examine the complex relationship between mobile technologies and health among those who often employ mobile devices such as college and university students.

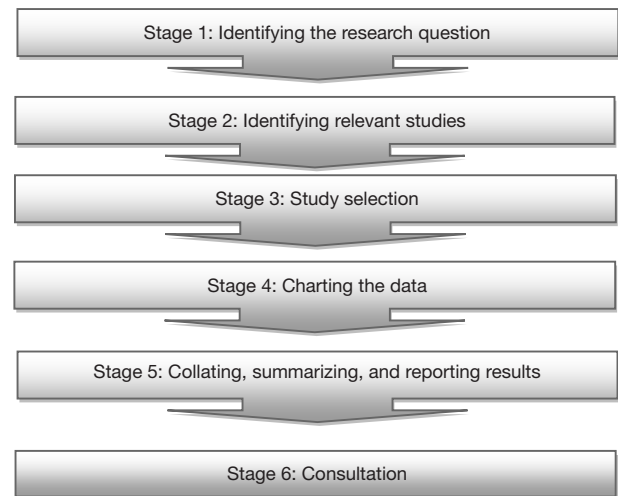
## Purpose

To date, no known scoping review has been conducted to explore the relationships between mobile technologies utilization and post-secondary students' physical activity behaviours. A scoping review may provide further insights into this topic and describe the breadth of evidence currently available. As such, the purpose of this study was to conduct a scoping review to explore the existing literature and investigate what is currently known about the use of mobile phones to enhance physical activity levels among post-secondary students.

## Methods

### Study design

In accordance with Arksey *et al.* (28) guidelines for conducting a scoping review, this study adheres to the six stages methodological framework as outlined in *Figure 1*. Specifically, stages 1 (identifying the research question), 2



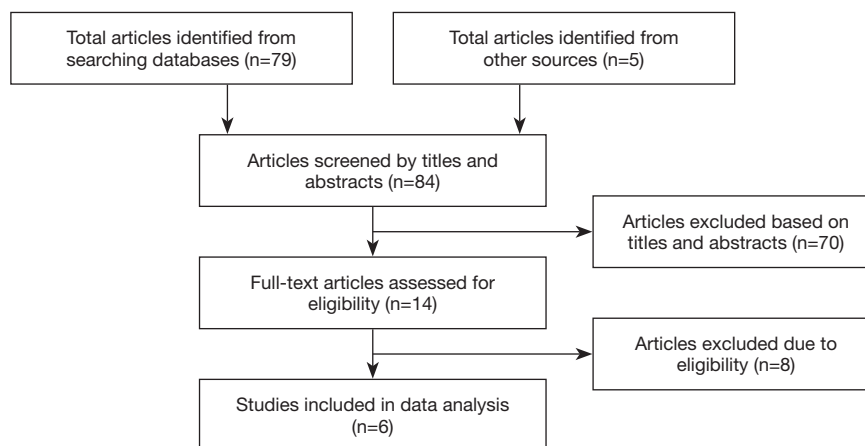
**Figure 1** The six stages methodological framework for conducting a scoping review, as described by Arksey *et al.* (28) and Levac *et al.* (29).

(identifying relevant studies), and 3 (study selection) will be presented in the methods section, stages 4 (charting the data) and 5 (collating, summarizing, and reporting the results) will be illustrated in the results section, and an optional stage 6 (consultation) will be incorporated into the discussion section to articulate the importance and value of disseminating the results of this review (29). A scoping review was considered to be appropriate for this study to explore the depth and breadth of the current literature and determine whether or not a systematic review on this topic is warranted. Moreover, researchers have demonstrated the value of undertaking scoping reviews for different topics in health-related fields such as eHealth and Health Promotion (29-31). Particularly, scoping reviews are potentially important to undertake in order to facilitate knowledge translation to inform policies and practices (28,29).

### Research questions

In accordance with the purpose of this study, the main research question that guided this scoping review was, "What is currently known about the use of mobile phones to enhance physical activity levels among post-secondary students?" In order to provide a comprehensive understanding on this topic, further supporting questions were included to provide an in-depth analysis of the current literature. The three supporting questions for this scoping review included:

- (I) What were the studies' characteristics and research



**Figure 2** The results of searching the databases and the total number of articles included in the data analysis.

designs?

- (II) Where were the studies conducted?
- (III) What are the gaps in the literature?

### *Identifying relevant studies (search strategy)*

The following databases were searched (from 1990 to December 2015): (I) Ovid; (II) ProQuest; (III) PubMed; (IV) Scopus; and (V) Web of Science. The following terms were used to search the databases: (“university student\*” OR “college student\*” OR “post-secondary student\*” OR “postsecondary student\*” OR “young-adult\*” OR “young adult\*”) AND (“physical activit\*” OR “exercise\*” OR “motor activit\*” OR “locomotor activit\*”) AND (“mhealth” OR “m-health” OR “mobile health” OR “telemedicine” OR “telehealth” OR “ehealth” OR “e-health”) AND (“mobile phone\*” OR “mobile telephone\*” OR “smartphone\*” OR “smart phone\*” OR “smart-phone\*” OR “cell phone\*” OR “cellular phone\*” OR “cellular telephone\*”). Further, the references from relevant articles were checked for additional studies related to the purpose and questions of this scoping review. Lastly, the search engine Google Scholar was used to find additional studies or grey literature related to the topic.

### *Study selection (inclusion and exclusion criteria)*

The following inclusion and exclusion criteria were developed prior to searching the databases in order for the investigator to properly appraise and select appropriate studies to include within the data analysis. Primary research articles that investigated the relationships between post-secondary students’ physical activity behaviours and usage

of mobile phone technologies (e.g., text messages, phone calls, and apps) were included in this scoping review. Additionally, only articles written and published in English were assessed. Furthermore, studies were excluded if a mixed population was included within the sample (e.g., undergraduate students and staff). Lastly, studies that fit poorly with the purpose and research questions were eliminated from the data analysis.

### *Data analysis*

The full-text of each article included in this scoping review was analyzed and the findings are reported below. First, the data was charted in a Microsoft Excel [2013] spreadsheet and Microsoft Word [2013] document then presented as a table and figure. Second, the data was summarized and common themes were developed according to the reported findings within each study. The quantitative data was summarized using a descriptive numerical summary analysis and the qualitative data were incorporated within the thematic analysis of the findings.

## **Results**

As illustrated in *Figure 2*, a total of 84 articles were identified from searching the databases. These articles were screened and assessed for eligibility according to the inclusion and exclusion criteria. Based on the relevance of the articles’ titles and abstracts, 70 articles were eliminated from further analysis. Subsequently, eight articles were also excluded after analyzing the full-text of each report. As a result, six articles were included in the data analysis for this scoping

**Table 1** The studies selected for data analysis

Study (country)	Study design (technology)	Population	Aims	Findings
Prestwich <i>et al.</i> , 2009 (UK)	Randomized controlled trials using surveys (text messages)	University students (n=155)	The relationship between implementation intentions on physical activity and text message reminders was investigated	Implementation intentions combined with text message reminders significantly influenced physical activity
Prestwich <i>et al.</i> , 2010 (UK)	Randomized controlled trials using surveys (text messages)	University students (n=149)	The authors examined whether implementation intentions with text message reminders of students' plans or goals can influence their physical activity levels	The intervention group had a significant increase in physical activity levels compared to the control group
Lepp <i>et al.</i> , 2013 (USA)	Interviews, surveys, and objective measures of physical fitness (text messages, phone calls, and apps)	College students (n=49)	The researchers assessed the relationships between cell phone use, physical and sedentary activity, and objective measures of physical fitness among students	There was an inverse relationship between cell phone use and physical fitness. Cell phone use can disrupt leisure time physical activity and increase sedentary behaviours
Gowin <i>et al.</i> , 2015 (USA)	Qualitative study utilizing semi-structured interviews (apps)	College students (n=27)	The authors investigated how students utilized health and fitness apps and the effects on their behaviours	The two main findings included: (I) students who used apps to support an established behaviour; and (II) students who used apps to adopt a new behaviour
Middelweerd <i>et al.</i> , 2015 (Netherlands)	Qualitative study utilizing focus groups (apps)	University students (n=30)	The researchers explored students' preferences for physical activity apps	Five main themes were developed: (I) app usage; (II) technical aspects; (III) physical activity assessment; (IV) coaching aspects; and (V) sharing through social media
Yan <i>et al.</i> , 2015 (USA)	Qualitative study utilizing focus groups (text messages)	College students (n=33)	The aim of the study was to develop physical activity promotion text messages in accordance with students' preferences	Students expressed a preference for tailored messages to support physical activity related goals

review. From the six articles included for the analysis, there were three qualitative studies, two RCTs, and one mixed methods study. In total, there were 443 participants from the six studies and the majority of participants included within this study were female undergraduate students from high-income countries. Furthermore, only one article included objective assessments to measure physical fitness (i.e., anthropometric measurements and an endurance running test on a treadmill) but no study objectively measured participants' physical activity levels. All studies included surveys or questionnaires to measure descriptive factors. Two out of the three qualitative studies used focus groups, and in total there were 10 different groups. Lastly, the following sections will describe two major themes that emerged from the data analysis, which included: (I) the relationship between mobile phones and physical activity levels; and (II) students' perceptions of mobile phones.

### *The relationship between mobile phones and physical activity levels*

As illustrated by *Table 1*, two out of the three studies with quantitative measures reported some positive relationships between physical activity and mobile phone technologies (32,33). The results from these studies illustrated that theoretically based text messaging interventions significantly influenced students' physical activity levels ( $P < 0.05$ ). Moreover, Lepp *et al.* (34) reported that some participants in their study did perceive that there was a partially negative relationship between the use of their mobile phones and their physical activity and sedentary behaviours ( $P = 0.014$ ), and this is further illustrated by an inverse relationship found between mobile phone use and students' physical fitness ( $P = 0.047$ ). Furthermore, cell phone use was also found to disrupt planned leisure time physical activity (e.g., exercising at the gym) and increased sedentary behaviours

(e.g., by browsing various websites and using gaming apps on mobile devices) among post-secondary students (34). Overall, the three quantitative studies reported mixed findings, which indicated that the efficacy of mHealth technologies to increase physical activity levels within this population is still unclear.

### Goal setting

Prestwich *et al.* (32) emphasized the importance of utilizing theory based methodology to enhance the efficacy of mHealth interventions for increasing physical activity levels among university students. The majority of participants indicated that utilizing goal oriented approaches may help motivate them to engage in physical activity (33,35-37). Specifically, it was important that students set realistic and achievable goals that emphasized positive gains such as focusing on the health benefits associated with performing physical activity (37). In addition, goal setting might be particularly beneficial for inactive students who may need the support and encouragement (35,36), which was also demonstrated in an RCT conducted in the United Kingdom (33). Thus, these findings indicate that combining theory based mHealth interventions with goal setting principles are effective to enhance post-secondary students' physical activity behaviours.

### Students' perceptions of mobile phones

#### Technical features and accessibility

Middelweerd *et al.* (36) described that university students prefer to have physical activity-related apps that are customizable with a simple design. In other words, the apps should include a straightforward layout that could be easily used to record different activities and report results. Also, some participants described that visual representations of their records (e.g., in graphs or diagrams) were important motivational features to include in physical activity and exercise apps (36). Additionally, a sample of college students indicated that they preferred mobile apps that are free to download with a simple sign-up process (35). Lastly, the majority of the participants illustrated that utilizing text message reminders were suitable motivators to promote their engagement in physical activity (37).

#### Tailoring the technologies for post-secondary students

College and university students indicated that they are more likely to keep using physical activity and exercise apps if they met their needs (35,36). For example, some participants

described that exercise apps should include coaching features to motivate and support students' decisions to engage in physical activity (36). However, students have reported that this coaching element of an app may be problematic because of the self-monitoring aspects, which might elicit feelings of shame or guilt triggered by various features of the app such as reminders (35,36). Moreover, some students expressed that they enjoyed the competitive aspects when using the apps, and liked to compete with their friends (35,36). In contrast, Yan *et al.* (37) found that female students preferred to receive text messages without competitive elements, which highlights the importance of personalizing the content of the text messages to support physical activity goals.

### Social networking websites

Lepp *et al.* (34) described that high frequency users of mobile phones often have social networking apps and frequently check social networking websites (e.g., Facebook and Twitter), which could be a barrier to physical activity. In other words, students may choose to utilize their time interacting with the social networking websites and apps rather than participating in physical activity. On the contrary, certain students may also use their phones to visit social networking platforms to connect with other active individuals (34), and share their personal results as well (35,36). Overall, there were mixed feelings about sharing their personal results using social media (35,36). Some students articulated that it is acceptable to post exceptional accomplishments (e.g., completing a marathon) using social media (36), while others were afraid of "over sharing" their personal results online (35). However, participants illustrated that forming private groups on social networking websites could increase feelings of social support, especially among close friends (36). Thus, post-secondary students are more willing to share their notable achievements among groups of close friends through social networking websites.

### Gaps in the literature

Currently, all six studies that investigated the use of mHealth technologies among post-secondary students included small samples of undergraduate students (*Table 1*) between the ages of 18–26 years (32-37). No studies reported the inclusion of graduate or post-doctoral students. Although all six studies included a greater proportion of female participants in their samples,

most researchers reported no discerning sex differences (32-35). However, Yan *et al.* (37) suggested that there are different preferences for text messaging content among male and female college students. As such, the relationship between male and female students' preferences for text messaging content to promote physical activity may need further investigation. Moreover, the studies included in this review were conducted in high-income countries (i.e., Netherlands, United Kingdom, and United States of America) and additional research is needed to explore this topic among post-secondary students in low-income countries. Lastly, two out of three studies that incorporated quantitative methods and analyses employed self-reported measures of physical activity, and only included a 4-week follow-up (32,33). Therefore, additional longitudinal studies using objective measurements are needed to establish a better understanding of this topic.

## Discussion

Although it has been well established that regular participation in physical activity is a health promoting behaviour for adults (1,2), there tends to be a decline in physical activity among college and university students during early adulthood (4-7). The purpose of this scoping review was to explore the existing literature and investigate what is known about the use of mobile phones to enhance physical activity levels among post-secondary students. The limited evidence currently available illustrate that there is a need for more research in this area. Similar to the evidence for young adults (13,23), the results of this study indicated that there are contradictory findings regarding the utilization of mobile phones and post-secondary students' physical activity levels. In particular, the current findings suggest that text message interventions supported by behavioural theories and goal setting principles could significantly influence post-secondary students' self-reported physical activity levels (32,33). Interventions utilizing text messages should include positive messages that are tailored based on individuals' sex and physical activity goals (37). However, none of the studies reviewed included an objective measure of physical activity (e.g., accelerometer) to further support this relationship. In contrast, researchers reported that high levels of mobile phone usage were related to low levels of cardiorespiratory fitness and increases in sedentary behaviours (34). Thus, the relationship between mobile phones and physical activity among post-secondary students needs to be further explored

in order to develop a better understanding of this topic.

In regards to mobile apps, students expressed a preference for easy to use and simple apps that are free to download and tailored to their needs such as features to customize the apps (35,36). Although coaching features of an app may motivate some students to engage in physical activity and exercise, others have described feelings of guilt and shame associated with the coaching elements of an app (35,36). In concert with previous findings (26), this demonstrated that certain aspects of mHealth were perceived as "nag technology" among some post-secondary students. Moreover, researchers described the use of data visualization as an approach to provide objective insights for health behaviours measured by mHealth technologies (38). Students reported that the option for visual representations of the data (e.g., graphs) was an essential element to help them understand their health behaviours (36). Furthermore, some participants in the studies had mixed feelings about uploading personal results and information online through social networking websites (35,36). Interestingly, students were concerned about over sharing their results online but did not explicitly express any privacy concerns. Individuals also articulated their willingness to post exceptional achievements to close friends through private groups (36). These examples may characterize potentially unique traits of this particular generation who have grown up with mobile technologies and the internet (commonly referred to as "digital natives"). Post-secondary students' perceptions of the relationship between mobile apps and physical activity varied and additional research in this area is needed to comprehensively understand any possible influences on their physical activity behaviours.

This review contributes to the existing knowledge about the potential benefits and barriers of employing mHealth technologies to promote physical activity, and may help inform key stakeholders, such as staff and students from post-secondary institutions, about innovative health initiatives. There has also been greater public interest with mobile apps that could be used to encourage participation in physical activity (e.g., Pokémon GO and Zombies, Run!). As such, the results of this study might be useful for various professionals such as health educators, health promotion practitioners, and policy makers who may want to provide recommendations to the public, and may use the information to develop mHealth guidelines. Hence, there is a need for researchers to conduct additional high quality studies on this topic, and present their findings via publications (e.g., in scientific journals) and presentations

(e.g., at international conferences) in order to fill in the gaps within the literature.

### *Limitations and future directions*

Although there are numerous benefits of utilizing a scoping review to study this topic, the investigator acknowledges that this review lack a methodological quality assessment for the studies included within the review. However, Arksey *et al.* (28) suggested a quality assessment may not be imperative depending on the purpose and breadth of the review. Because the purpose of this scoping review was to explore the current literature available for this topic, it was deemed unnecessary to include a quality assessment. In addition, the results of this review might not be generalizable and transferrable to other student populations, especially those from low-income countries. Nonetheless, the investigator recognizes that it is important to study different populations within the area of mHealth because of the potential disparities and inequalities that may arise (27). As mentioned, no objective physical activity measurements were used in any of the studies that were included in this scoping review. Researchers should incorporate objective physical activity measurements (e.g., accelerometers) in future studies to strengthen their findings. Further investigations of this topic should include longitudinal designs with adequate sample sizes to examine whether or not mHealth strategies and programs will help sustain improved physical activity levels among post-secondary students. Lastly, the limited evidence that is currently available precludes any recommendations for conducting a systematic review on this topic.

### **Conclusions**

In conclusion, the findings of this scoping review suggest that the use of mobile phone technologies such as text message reminders that are tailored to the target population could be incorporated into innovative interventions to enhance post-secondary students' physical activity levels. Since there is limited evidence available on this topic, additional research is warranted to establish a clearer understanding of the relationship between the use of mobile phones and post-secondary students' physical activity levels. Lastly, longitudinal study designs with the use of objective physical activity measures are needed in future studies to examine this relationship.

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### **Footnote**

*Conflicts of Interest:* The author has no conflicts of interest to declare.

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