Acceptability of mobile health interventions to reduce inactivity-related health risk in central Pennsylvania adults

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Abstract:

Insufficient physical activity and excessive sedentary behavior elevate health risk. Mobile applications (apps) provide one mode for delivering interventions to modify these behaviors and reduce health risk. The purpose of this study was to characterize the need for and acceptability of health behavior interventions among rural adults and evaluate the interest in and the value of app-based interventions in this population. Central Pennsylvania adults with smartphones (N = 258) completed a brief web survey in October–November 2012. Most adults report one or both inactivity-related behavioral risk factors, would use a free app to modify those risk behaviors, and would pay a small amount for that app. Low-cost, efficacious apps to increase physical activity or reduce sedentary behavior should be promoted in public health practice. User experience should be at the forefront of this process to increase value and minimize burden in the service of long-term engagement, behavior change, and health risk reduction.

Keywords: Physical inactivity | Exercise | Sedentary behavior | Smartphone | mHealth | Rural health

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Acceptability of mobile health interventions to reduce inactivity-related health risk in central Pennsylvania adults

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ABSTRACT

Insufficient physical activity and excessive sedentary behavior elevate health risk. Mobile applications (apps) provide one mode for delivering interventions to modify these behaviors and reduce health risk. The purpose of this study was to characterize the need for and acceptability of health behavior interventions among rural adults and evaluate the interest in and the value of app-based interventions in this population. Central Pennsylvania adults with smartphones (N = 258) completed a brief web survey in October–November 2012. Most adults report one or both inactivity-related behavioral risk factors, would use a free app to modify those risk behaviors, and would pay a small amount for that app. Low-cost, efficacious apps to increase physical activity or reduce sedentary behavior should be promoted in public health practice. User experience should be at the forefront of this process to increase value and minimize burden in the service of long-term engagement, behavior change, and health risk reduction.

Introduction

Insufficient physical activity (PA) and excessive sedentary behavior (SB) increase risk for premature mortality, cardiovascular disease, diabetes, and some forms of cancer (Biswas et al., 2015; Physical Activity Guidelines Advisory Committee, 2008; Shen et al., 2014). Less than half of American adults report that they meet national guidelines recommending some combination of 150 min of moderate- or 75 min of vigorous-intensity PA each week (Carlson et al., 2010). Appalachia has some of the greatest levels of inactivity in the United States (Centers for Disease Control and Prevention, 2011). National guidelines for SB (i.e., sitting) have not been developed; however, epidemiological studies consistently report that more than 8 h/day of SB is associated with elevated health risks and American adults spend an average of 7.7 h/day in sedentary activities (Matthews et al., 2008).

Interventions that can be implemented remotely to reduce physical inactivity and SB levels are particularly appealing for rural populations who experience disparities in health care access (National Healthcare Disparities Report, 2013, 2014). One mode for reaching these populations involves smartphone applications (apps) because this technology has been widely adopted by American adults, including over half of the rural adult population (Pew Research Center, 2015). It is presently unclear whether app-based interventions to modify PA and SB would interest rural adults.

Users must adhere to engaging with an app for an extended period of time before it can improve health outcomes (Laing et al., 2014). Sustained engagement is likely influenced by a combination of factors including persuasiveness, user-friendliness, implemented features, perceived costs (i.e., temporal burden) and benefits (i.e., perceived monetary value) of using the app. The level of burden that rural adults would tolerate and the perceived value of apps to modify PA or SB are currently unknown. Moreover, it is not clear whether these engagement-related parameters vary for different segments of the population.

This study sought to characterize intervention needs in seven rural central Pennsylvania counties based on the profile of two inactivity-related health risk behaviors. The seven counties spanned the range of statewide inactivity levels (University of Wisconsin Population Health Institute, 2012). Second, it evaluated rural adults' interest in smartphone apps that could be used to improve PA and SB, along with the perceived value of and anticipated time burden tolerance for those apps. Finally, the study examined whether interest or the antecedents of engagement with app-based interventions varied based on demographic characteristics, health history, or health risk behavior profiles.

Materials and methods

Advertisements for adult smartphone users were placed in central Pennsylvania newspapers and an online listing of community research studies for six weeks in October–November 2012. Interested adults were able to access the online survey via a URL in the advertisement. After opening the online survey, prospective participants (N = 285)

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provided informed consent and entered their zip code and home county to verify eligibility. Eligible participants (n = 259) then completed a survey that included questions about demographic characteristics, the short-form of the International Physical Activity Questionnaire with a past-week response frame (separate questions were written for weekday and weekend sitting time; Sjöström et al., 2005), and perceptions about apps to modify health risk behaviors or improve health outcomes.[1] The latter section included questions about participants' current smartphone operating system, history of using health apps, interest in new health apps, willingness to use a free app to modify their PA or SB, the value they attributed to such an app (i.e., price they would pay), and the time they would tolerate engaging with the app each time. On average, the survey was completed in 16 min. Participants who completed the online survey were entered into a drawing to receive a gift card. All procedures were approved by the local Institutional Review Board.

Results and discussion

Demographic and health characteristics

One participant was excluded because self-reported height and weight were not credible. Participants (187 female, 71 male) ranged in age from 18–78 years (M = 39.4, SD = 14.9) and 51% were parents (median = 2 children; range = 1–5). The average body mass index (BMI; based on self-reported height and weight) of participants was 26.5 kg/m^2; the sample included participants who were underweight (2%), normal weight (46%), overweight (29%), and obese (23%). Comparing the demographic characteristics summarized in Table 1 to regional Census data, the following groups were somewhat over-represented in the sample: young/midlife adults, women, separated partners, and unemployed individuals (U.S. Census Bureau, 2014).

Health risk behavior profiles

In the previous week, only 35% of participants reported sufficient moderate-vigorous PA to satisfy national PA guidelines and 76% of the sample reported having at least one day in the past week when they lacked sufficient motivation for PA (M = 2.54, SD = 2.23). They also reported sitting for an average of 7.12 h/day during the previous week (SD = 3.12; weekday: M = 7.66, SD = 3.70; weekend: M = 5.77, SD = 3.09) and an average of 2.93 days with 8+ hours of sitting time (SD = 2.62). This health risk profile was similar to normative national data (Carlson et al., 2010; Matthews et al., 2008).

Four behavior profiles were created based on whether participants failed to meet national PA guidelines and whether participants reported 8+ hours of SB daily. Overall, only 24% of participants were classified as low-risk based on their behavioral profiles (i.e., sufficient PA and limited SB). The remaining 76% of participants' profiles involved elevations in one or both health risk behaviors (40% with insufficient PA but limited SB, 11% with sufficient PA but excessive SB, 25% with insufficient PA and excessive SB). This finding indicates a clear need for interventions to reduce inactivity-related risk behaviors.

Interest and antecedents of engagement

Most participants indicated that they would use a free app to increase their PA motivation (81%) and many had previously downloaded at least one mobile app to support their PA (49%). Despite the dearth of SB reduction apps, most participants indicated that they would use a free app to reduce their SB (72%).[2] Interest in these apps was equal to or greater than interest in other health-related apps targeting diet (49%), emotional control (48%), cognitive health (42%), sleep (19%), dental hygiene (19%), social engagement (11%), decision making

Table 1
Demographic characteristics of respondents (N = 258).

		n (%)
Race		
	White	227 (88)
	Asian-American	16 (6)
	African-American or Black	4 (2)
	Other	10 (4)
	Missing	1 (<1)
Ethnicity		
	Not Hispanic or Latino/a	247 (96)
	Hispanic or Latino/a	8 (3)
	Missing	3 (1)
Employment status		
	Full-time	151 (59)
	Part-time	51 (20)
	Unemployed	54 (21)
	Missing	2 (<1)
Marital status		
	Married	136 (53)
	Single	100 (39)
	Separated/divorced	20 (8)
	Missing	2 (<1)
Mobile operating system		
	iOS	152 (59)
	Android	86 (33)
	RIM/Blackberry	7 (3)
	Others	9 (4)
	Missing	4 (1)
Health history: cancer		
	Never diagnosed	244 (95)
	Previously diagnosed but not currently in treatment	12 (5)
	Currently under treatment	0 (0)
	Missing	2 (<1)
Health history: cardiovascular disease		
	Never diagnosed	247 (96)
	Previously diagnosed but not currently in treatment	4 (2)
	Currently under treatment	5 (2)
	Missing	2 (<1)
Health history: depression		
	Never diagnosed	209 (81)
	Previously diagnosed but not currently in treatment	27 (10)
	Currently under treatment	20 (8)
	Missing	2 (<1)
Health history: diabetes		
	Never diagnosed	244 (95)
	Previously diagnosed but not currently in treatment	5 (2)
	Currently under treatment	7 (3)
	Missing	2 (<1)
Health history: obesity		
	Never diagnosed	219 (85)
	Previously diagnosed but not currently in treatment	32 (12)
	Currently under treatment	5 (2)
	Missing	2 (<1)

[1] A complete copy of the survey is available upon request from the senior author.

[2] We were not aware of many commercially-available apps for SB reduction with which participants might have experience so the survey did not include a question about whether participants had ever downloaded one of these apps or their tolerance for time burden with those apps.

Table 2
Logistic and linear regression coefficients for interest in (logistic) and value (linear) of free apps to increase physical activity and reduce sedentary behavior (N = 235).

	App to Increase physical activity		App to reduce sedentary behavior	
	Interest	Value	Interest	Value
Intercept	0.00 (1.84)	0.22 (1.06)	−2.18 (1.71)	−0.47 (0.85)
Age	0.03 (0.02)	0.01 (0.01)	0.02 (0.02)	0.01 (0.01)
Sex	−0.05 (0.46)	−0.17 (0.27)	−0.27 (0.44)	−0.05 (0.22)
Body mass index	0.00 (0.04)	0.01 (0.02)	0.01 (0.03)	0.03 (0.02)
Parenthood	0.62 (0.57)	−0.31 (0.33)	0.88 (0.54)	−0.23 (0.27)
Lifetime history with activity-related disease or disorder (cancer, cardiovascular disease, depression, or diabetes)	0.19 (0.39)	0.30 (0.21)	0.28 (0.38)	0.23 (0.17)
1 risk factor: insufficient physical activity	−1.84 (0.67)**	0.15 (0.32)	−1.04 (0.53)*	−0.18 (0.25)
1 risk factor: excessive sedentary behavior	−0.87 (0.87)	0.25 (0.43)	−0.13 (0.67)	0.03 (0.35)
2 behavior risk factors: insufficient physical activity & excessive sedentary behavior	−1.05 (0.73)	−0.21 (0.34)	−0.16 (0.59)	−0.49 (0.27)
Perceived value of an app to increase physical activity	0.76 (0.25)**	–	–	–
Perceived value of an app to reduce sedentary behavior	–	–	2.55 (0.44)**	–
Interested in an app to increase physical activity	–	1.05 (0.36)**	–	–
Interested in an app to reduce sedentary behavior	–	–	–	1.26 (0.24)**

* $p < .05$.
** $p < .01$.

under risk (7%), alcohol consumption (5%), smoking (2%), or substance abuse (<1%). These findings match reports that PA-related apps are among the most popular apps available (Citrix, 2014).

If a fee was to be charged for a PA motivation app, 72% of participants reported a willingness to pay and the median value was $1.00 (M = $2.15, SD = 1.97, range = $0.25–$10.00). Similarly, 59% of participants reported a willingness to pay for a SB reduction app and the median value was $1.00 (M = $1.93, SD = 1.70, range = $0.25–$10.00). The average cost of paid apps in a recent review of top-ranked PA apps was $1.97 and only 31% were below $1.00 (Conroy et al., 2014); developers appear to overvalue these apps relative to consumers. Nevertheless, given that most commercial apps are free (Gordon, 2013), most people ascribe some value to apps that reduce health behavior risks.

With respect to the level of temporal burden they would tolerate each time they interacted with PA motivation app, only 7% of the sample reported being unwilling to spend even less than 1 min, 52% of the participants would not spend more than 5 min, and 73% would not spend more than 10 min. These estimates correspond with industry time-use reports (Localytics, 2015). They also provide some of the first evidence of the amount of time burden that users will tolerate in these apps and can inform app design to increase adherence to app-based interventions.

Factors associated with acceptability and values

Table 2 presents coefficients from the logistic regression models of interest and the multiple regression models of value ratings for PA- and SB-related apps. Adults not meeting the PA guidelines were less likely to report interest in apps to increase PA or reduce SB; this finding warrants further research. Interest and the perceived value of these apps were positively associated. Neither outcome was associated with age, sex, BMI, parenthood, lifetime history with activity-related diseases/disorders, excessive SB, or the combination of insufficient PA and excessive SB. It will be important to identify other reasons why PA and SB apps appeal to users and additional features that can be implemented in apps to increase their appeal, particularly among adults who fail to engage in sufficient PA.

Conclusions

Adults in central Pennsylvania report high health risk behavior profiles that indicate a need for interventions to reduce inactivity-related health risks. Apps are an acceptable mode for delivering these interventions so health promotion efforts may benefit from integrating existing apps to increase PA or reduce SB. Both interest in and the perceived value of apps appear to be consistent across demographic groups, health risk profiles, and health histories. Unfortunately, these apps have limited intrinsic value and will only be tolerated for a limited amount of time during each engagement. Moreover, a high-need population, insufficiently active adults, appears to be the least interested in using them as currently designed. Thus, future app development efforts should place the user experience at the forefront and identifying app features that could increase value and minimize time burden in the service of long-term engagement.

Conflict of interest statement

The authors declare that there is no conflict of interest.

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References

Biswas, A., Oh, P.I., Faulkner, G.E., et al., 2015. Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: a systematic review and meta-analysis. Ann. Intern. Med. 162, 123–132. http://dx.doi.org/10.7326/M14-1651.

Carlson, S.A., Fulton, J.E., Schoenborn, C.A., Loustalot, F., 2010. Trend and prevalence estimates based on the 2008 Physical Activity Guidelines for Americans. Am. J. Prev. Med. 39, 305–313. http://dx.doi.org/10.1016/j.amepre.2010.06.006.

Centers for Disease Control and Prevention, 2011. Highest Rates of Leisure-Time Physical Inactivity in Appalachia and South.

Citrix, 2014. Mobile Analytics Report. Author, Santa Clara, CA.

Conroy, D.E., Yang, C.-H., Maher, J.P., 2014. Behavior change techniques in top-ranked physical activity apps. Am. J. Prev. Med. 46, 649–652. http://dx.doi.org/10.1016/j.amepre.2014.01.010.

Gordon, M.E., 2013. The History of App Pricing, and Why Most Apps Are Free.

Laing, B.Y., Mangione, C.M., Tseng, C.-H., et al., 2014. Effectiveness of a smartphone application for weight loss compared with usual care in overweight primary care patients: a randomized, controlled trial. Ann. Intern. Med. 161, S5–S12. http://dx.doi.org/10.7326/M13-3005.

Localytics, 2015. Average Mobile App Session Length 2014, by Category. Stat. - Stat. Portal.

Matthews, C.E., Chen, K.Y., Freedson, P.S., et al., 2008. Amount of time spent in sedentary behaviors in the United States, 2003–2004. Am. J. Epidemiol. 167, 875–881. http://dx.doi.org/10.1093/aje/kwm390.

National Healthcare Disparities Report, 2013, 2014. Agency for Healthcare Research and Quality, Rockville, MD.

Pew Research Center, 2015. The Smartphone Difference.

Physical Activity Guidelines Advisory Committee, 2008. Physical Activity Guidelines Advisory Committee Report, 2008. U.S. Department of Health and Human Services, Washington, DC.

Shen, D., Mao, W., Liu, T., et al., 2014. Sedentary behavior and incident cancer: a meta-analysis of prospective studies. PLoS One 9, e105709. http://dx.doi.org/10.1371/journal.pone.0105709.

Sjöström, M., Ainsworth, B., Bauman, A., Bull, F., Craig, C., Sallis, J., 2005. Guidelines for Data Processing and Analysis of the Intentional Physical Activity Questionnaire (IPAQ) — Short and Long Forms.

U.S. Census Bureau, 2014. State and County Quickfacts (Data derived from Population Estimates, American Community Survey, Census of Population and Housing, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits). Author, Washington, DC.

University of Wisconsin Population Health Institute, 2012. County Health Rankings 2012.