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## Mobile Health (mHealth) Use or Non-Use by Residents of West Virginia

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### Abstract

**Objective:** To compare mobile health (mHealth) usage by residents of West Virginia with national estimates.

**Methods:** Pew Research Center data from its Internet and American Life Project were accessed for secondary data analysis. These data, available to the public, are a probability sample of Internet use in the United States, differences in use based on selected variables (eg, education, household income), and how usage affects the lives of Americans. Using SAS software, diagnostics were performed on the data, revealing that the variables of interest were prepared and represented without any need for information. Data were used as is, with categorical and continuous characteristics and stipulations being provided in accompanying documents from the Pew Research Center.

**Results:** The national sample consisted of 509 men and 557 women with an average age of 51.02 years (standard deviation 17.04). The 30 West Virginia residents included 19 women and 11 men (mean for age 48.10, standard deviation 15.30). When controlling for socioeconomic and demographics factors, the odds of a West Virginia resident using an mHealth device were 82% less than the rest of the country, a statistically significant association. Women in West Virginia were 52% more likely to access mHealth information than men, and an increase in age corresponded with increased mHealth usage.

**Conclusions:** The lack of mHealth use by residents in West Virginia represents an opportunity for clinicians and scientists. The high rates of preventable diseases in the region could be more effectively managed with greater use of these technologies.

### Keywords

mobile health use; West Virginia compared with national usage rates

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Electronic health applications involve the use of a broad range of communication and information technologies, particularly the Internet, to improve health care and monitor patient status.<sup>1</sup> Mobile health (mHealth) involves the use of mobile computing and

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communication devices that include smartphones and wearable devices (eg, Fitbit) that can be used to provide real-time data collection on individuals' behaviors (eg, diet, exercise, sleep) and health status.<sup>1,2</sup> mHealth devices have become increasingly accepted and used by the public across demographic, racial, and ethnic groups.<sup>3</sup> A report by the Pew Research Center showed that 93% of households with an annual income >\$75,000/year own a smartphone while 67% with an income <\$30,000 own a smartphone.<sup>3</sup> More important, 62% of Americans with smartphones used their devices to search for health information, and 58% of smartphone users have downloaded an mHealth application.<sup>3,4</sup> Because of the pervasive nature of smartphones, these devices have become the focus of empirical scrutiny by public health and medical professionals because they have the potential to reach large numbers of people and these devices may play a role in patient education; disease management; collection of data related to diet, exercise, and other behavioral risk factors; and disease self-management.<sup>5-8</sup>

Although mHealth usage is increasing, some have questioned their efficacy and effectiveness to change behavior.<sup>2,9</sup> One systematic review included a meta-analysis from 14 randomized controlled trials included 1337 adult participants.<sup>9</sup> The focus of this review was to analyze the effects of interventions using mHealth technologies with overweight and obese adults. Compared with control groups, mHealth interventions were associated with significant changes in body weight ( $-1.44$  kg) and body mass index ( $-0.24$  U). Subgroup analyses showed that findings were consistently significant across trials of varying length, with body weight changes of  $-0.92$  kg ( $<6$  months) and  $-1.85$  kg ( $>6$  months), respectively.

Another systematic review and consensus statement documented the availability of 7954 and 25,491 mHealth applications on Google Play Store and iTunes, respectively.<sup>2</sup> The purpose of this review was to evaluate evidence from randomized controlled trials about the effects of mHealth application use on cardiovascular disease risk prevention, including weight management, improving physical activity, controlling or decreasing hypertension, quitting smoking, blood glucose management, and managing dyslipidemia. Results suggested that there was strong evidence for short-term weight loss in adults with studies that used text messaging in conjunction with other technological methods such as Web-based resources. Likewise, smoking cessation studies demonstrated that text messaging-based programs may be as effective as nicotine replacement therapy. Burke and colleagues concluded that mobile technologies have the potential to "transform the delivery of health-related messages and ongoing interventions targeting behavior change."<sup>2</sup>

The findings reviewed above notwithstanding, we raised questions about the degree to which individuals living in rural areas were represented in the studies in both reviews.<sup>2,9</sup> After closely examining these studies, we concluded that only one study recruited participants from a rural community. To be considered rural, all housing, population, and territory should encompass fewer than 2500 people.<sup>10</sup> The state of West Virginia is ranked as the third most rural state, with 950,184 individuals living in defined rural areas, and it is the only state that is completely immersed in the Appalachian region.<sup>11</sup> West Virginia also has several dubious distinctions related to high rates of obesity, physical inactivity, smoking, and several chronic diseases.<sup>12,13</sup> Given these observations, there is a need to develop a better understanding of mHealth usage by residents living in West Virginia; therefore, the purpose of our study was

to compare mHealth usage in the predominantly rural state of West Virginia with national estimates. Secondary purposes were to examine potential differences in mHealth use based on sex and age while controlling for educational achievement and income.

## Methods

We accessed data in June 2016 from the Internet and American Life Project conducted by the Pew Research Center. This project used a probability sample of survey data to examine Internet use in the United States, differences in Internet usage based on selected variables (eg, education, household income), and how Internet usage impacts the lives of Americans. Pew Research Center reports and associated data are publicly available with appropriate permission. The data were imported into SAS as a comma-separated value file and imported into SAS using the PROCIMPORT command (SAS software, version 9.3, SAS Institute, Cary, NC). For our investigation, we compared the use of mHealth applications between residents of West Virginia and national estimates, controlling for age, education, and income. This nationally representative data consisted of 1066 adult participants, including 30 residents of West Virginia. Probability sampling procedures, such as the one used by Pew, are likely to produce unbiased estimates of population usage of mHealth applications because each member of the population in the United States has an equal probability of being selected as a participant and therefore eliminate potential selection biases.<sup>14</sup>

## Data Analysis

The data management and analysis for this article were generated using SAS software. No observations were excluded based on the premise that all variables of interest were represented in a reasonable manner. Sampling weights were included with the original data and no other calculations were needed. Three categories of education were used: less than high school, high school and/or some college, and college degree. Annual income was separated into four categories: <\$50,000, \$50,000 to \$100,000, \$100,000 to \$150,000, and > \$150,000. There was a relatively even spread of observations across these categories. A dummy variable was created for West Virginia residential status. Survey-weighted logistic regression models were fitted using the above parameters and the dependent variables of interest using the provided survey weights. All of the analyses were conducted in SAS version 9.3.

## Results

The national sample consisted of 509 men and 557 women with an average age of 51.02 years (standard deviation 17.04). The 30 West Virginia residents included 19 women and 11 men (mean for age 48.10, standard deviation 15.30). After controlling for socioeconomic and demographics factors, West Virginia residents were 82% less likely to use mHealth technology compared with the rest of the US population, which was a statistically significant association (odds ratio [OR] 0.182, confidence interval [CI] 0.036–0.932,  $P=0.0409$ ). Women in West Virginia were 52% more likely to access mHealth information than men (OR 1.452, CI 1.120–1.884,  $P=0.049$ ), and an increase in age corresponded with increased mHealth usage (OR 1.041, CI 1.033–1.049,  $P=0.0001$ ). These results suggested that for

every year in age, there was a 4.1% increase in the probability of residents in West Virginia using an mHealth device.

## Discussion

The findings of the present study suggest that factors beyond socioeconomic and demographic variables may dictate choices surrounding the use of mHealth applications in West Virginia. These factors may include cultural factors not accounted for or other environmental factors influencing the usage of mHealth. One possibility could be related to the overall use of healthcare resources, because researchers have noted that healthcare usage, in general, is lower in Appalachian communities as compared with non-Appalachian communities.<sup>15</sup> Likewise, medical avoidance has been noted in Appalachian populations, particularly with regard to early or preventive care.<sup>16,17</sup> Overall, the lower levels of mHealth technologies may reflect Appalachian residents' concerns about and avoidance of healthcare resources on a larger scale.

Another possible explanation for our findings could be related to the lack of broadband and wireless access in rural parts of West Virginia. Further exploration revealed that Internet access can only partially explain our findings. Specifically, one independent source revealed that in 2017, West Virginia ranked 41st in the United States with 66 Internet providers and has an average download speed of 25.5 megabytes per second, which is the 17th fastest in the United States.<sup>18</sup>

The lack of mHealth use by residents in West Virginia represents an opportunity to prevent or mitigate chronic diseases that plague much of the state's population. These technologies have the potential to reach the entire population of West Virginia and could offer clinicians real-time monitoring of multiple health processes while providing lifestyle management tools for users. Further research should focus on the utilization of mHealth technology during the medical visit and constructing mHealth resources that do not require constant connectivity. The latter issue has been largely addressed with technological advances. For instance, it may be possible for medical professionals to provide tablets or other technologies in the waiting areas for patients to use before visits in primary care or other settings. Additional exposure to mHealth during clinical visits may encourage residents in West Virginia or throughout Appalachia to use these programs, particularly if they are encouraged by physicians or other healthcare professionals. The findings presented here, along with evidence about the efficacy of mHealth applications, could provide a strong rationale for the procurement of public and private support for expanded Internet and wireless access in rural, urban, and community centers throughout West Virginia.

Given these findings and observations, the present study has at least one limitation worth noting. The relatively low sample size of West Virginia residents compared with other states may raise questions about how well these individuals represented West Virginia residents. We contend that the nature of the probability sampling scheme used by the Pew Research Center should significantly mitigate concerns about issues of generalizability and whether the sample is representative of West Virginia as a whole. Another limitation is that the data were self-reported, which is prone to biases related to recall and social desirability.

Finally, future researchers interested in the development and testing of mHealth applications should ensure these technologies be relevant for an Appalachian population by involving end users during the developmental stages. Finally, policies regarding infrastructure and communication improvements within West Virginia may be beneficial for its residents by allowing greater access to mHealth throughout the state.

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**Key Points**

- Use of mobile health or multiplatform applications has proliferated in recent years.
- Secondary analysis of publically available Pew Research Center data showed that residents of West Virginia were 82% less likely than national estimates to use mobile health applications.
- Results are possibly the result of cultural ambivalence toward health-seeking behaviors.
- Health application usage has the potential to improve the health of West Virginia residents.