Short Communication

National physical activity surveillance: Users of wearable activity monitors as a potential data source

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Abstract

The objective of this study was to assess usage patterns of wearable activity monitors among US adults and how user characteristics might influence physical activity estimates from this type of sample. We analyzed data on 3367 respondents to the 2015 HealthStyles survey, an annual consumer mail panel survey conducted on a nationwide sample. Approximately 1 in 8 respondents (12.5%) reported currently using a wearable activity monitor. Current use varied by sex, age, and education level. Use increased with physical activity level from 4.3% for inactive adults to 17.4% for active adults. Overall, 49.9% of all adults met the aerobic physical activity guideline, while this prevalence was 69.5% among current activity monitor users. Our findings suggest that current users of wearable activity monitors are not representative of the overall US population. Estimates of physical activity levels using data from wearable activity monitors users may be an overestimate and therefore data from users alone may have a limited role in physical activity surveillance.

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1. Methods

All data came from HealthStyles 2015, an annual consumer mail panel survey using a nationwide sample (response rate = 76.1%; 3550 respondents/4665 panelists surveyed). We excluded 183 respondents with missing data on demographics, physical activity level, or activity monitor usage.

A wearable activity monitor was defined as a step counter, fitness tracking device, or smartphone-based health and fitness app. Respondents were asked “Have you ever used a wearable activity monitor?” Those who responded “No,” “Yes, but I am not a current user,” and “Yes, I am a current user” were defined as never users, past users, and current users respectively. Respondents were asked about participation in physical activity using questions modified from the National Health Interview Survey. They were then classified into aerobic physical activity levels according to current national guidelines: active (meeting guidelines), insufficiently active (some activity but not enough to meet guidelines), and inactive (no physical activity) (U.S. Department of Health and Human Services, 2008). Being physically active is defined as reporting ≥ 150 min/week moderate-intensity equivalent activity per week.

Prevalence and 95% confidence intervals were calculated overall and by sex, age group, education level, metropolitan statistical area (MSA) status (metro MSA or nonmetro MSA) (U.S. Census Bureau), and

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physical activity level. The sample was stratified and balanced on region, household income, population density, age, and household size to create a sample representative of the U.S. population. Wald tests were used to identify significant ($p$ value $< 0.05$) variation by select characteristics.

### Results

Approximately 1 in 8 respondents (12.5%) reported current use of a wearable activity monitor (Table 1). Prevalence of current use was greater among women compared to men, and increased with age. Table 1 displays the prevalence of reported use of wearable activity monitors, by selected characteristics, HealthStyles 2015.

**Table 1**

| Characteristic                               | Sample Size | Current User % (95% CI) | Past User % (95% CI) | Never User % (95% CI) |
|----------------------------------------------|-------------|-------------------------|----------------------|-----------------------|
| Total                                        | 3367        | 12.5 (11.2–13.9)        | 12.2 (10.9–13.7)     | 75.3 (73.4–77.1)      |
| **Aerobic physical activity level**          |             |                         |                      |                       |
| Inactive                                     | 659         | 4.3 (2.7–6.6)           | 10.1 (7.5–13.5)      | 85.6 (81.8–88.7)      |
| Insufficiently active                        | 1020        | 9.7 (7.7–12.3)          | 12.2 (10.0–14.9)     | 78.0 (74.7–81.0)      |
| Active                                       | 1688        | 17.4 (15.3–19.7)        | 13.0 (11.1–15.2)     | 69.6 (66.8–72.2)      |
| **Sex**                                      |             |                         |                      |                       |
| Men                                          | 1694        | 10.2 (8.6–12.1)         | 9.5 (7.9–11.4)       | 80.3 (77.8–82.5)      |
| Women                                        | 1673        | 14.6 (12.6–16.8)        | 14.7 (12.7–17.0)     | 70.7 (67.9–73.3)      |
| **Age, y**                                   |             |                         |                      |                       |
| 18–34                                        | 655         | 17.0 (14.0–20.5)        | 13.1 (10.4–16.5)     | 69.8 (65.6–73.7)      |
| 35–49                                        | 652         | 15.1 (12.1–18.6)        | 12.1 (9.6–15.2)      | 72.8 (68.8–76.6)      |
| 50–64                                        | 1206        | 9.8 (8.2–11.8)          | 12.0 (9.7–14.6)      | 78.2 (75.2–80.9)      |
| ≥65                                          | 854         | 6.4 (4.8–8.4)           | 11.2 (8.6–14.4)      | 82.4 (78.9–85.4)      |
| **Education level**                          |             |                         |                      |                       |
| High school graduate or less                 | 1221        | 6.6 (5.1–8.7)           | 8.3 (6.5–10.6)       | 85.0 (82.2–87.5)      |
| Some college                                 | 1057        | 12.4 (10.0–15.3)        | 14.2 (11.8–17.0)     | 73.4 (69.9–76.6)      |
| College graduate                             | 1089        | 20.4 (17.7–23.3)        | 15.5 (12.9–18.4)     | 64.1 (60.6–67.5)      |
| **Race/ethnicity**                           |             |                         |                      |                       |
| White, non-Hispanic                          | 2564        | 12.5 (11.1–14.0)        | 12.2 (10.7–13.9)     | 75.3 (73.2–77.3)      |
| Other                                        | 803         | 12.5 (9.9–15.7)         | 12.2 (9.6–15.4)      | 75.3 (71.3 to 78.9)   |
| **Metropolitan statistical area (MSA) status**|             |                         |                      |                       |
| Metro MSA                                    | 2864        | 13.1 (11.6–14.7)        | 11.9 (10.5–13.4)     | 75.0 (73.0–76.9)      |
| Nonmetro MSA                                 | 503         | 9.4 (6.7–12.9)          | 13.8 (10.0–18.8)     | 76.8 (71.4–81.4)      |

a Respondents were asked, “Have you ever used a wearable activity monitor?” Those who responded “Yes, I am a current user;” “Yes, but I am not a current user,” or “No” were defined as current, past, or never users, respectively.  
b Aerobic physical activity level is defined as active ($\geq 150$ min/week moderate-intensity equivalent activity), insufficiently active (some moderate-intensity equivalent activity but not enough to meet active definition), and inactive (no moderate-intensity equivalent activity that lasted at least 10 min).

![Fig. 1](image-url). Prevalence of being physically active,a by selected characteristics, for All US adults and for current users of wearable activity monitors.b HealthStyles 2015. Note: Error bars represent the lower and upper bounds of the 95% confidence interval. *Being physically active is defined as reporting $\geq 150$ min/week moderate-intensity equivalent activity per week. *Current users are defined as respondents who answered “Yes, I am a current user” to the question, “Have you ever used a wearable activity monitor?”
decreasing age (p-value for trend < 0.001) and increasing education level (p-value for trend < 0.001).

Use of wearable activity monitors increased with physical activity level. Current use was reported by 4.3% (95% confidence interval [CI] = 2.7, 6.6) of respondents who were inactive, 9.7% (95% CI = 7.7, 12.3) of those who were insufficiently active, and 17.4% (95% CI = 15.3, 19.7) of those who were active.

Overall, 49.9% of adults reported meeting the aerobic physical activity guideline (Fig. 1), and this prevalence was higher in men and adults living in a metro MSA compared with their counterparts. Overall, prevalence of meeting guidelines increased with decreasing age (p-value for trend < 0.001) and increasing education level (p-value for trend < 0.001). Among current monitor users, 69.5% met guidelines. Patterns by sex and MSA status were similar in current users compared to those for all adults, although the difference by MSA status was more pronounced. Of all respondents who lived in a metro MSA, 51.0% met guidelines compared with 72.2% of current users who lived in a metro MSA. However, among current users, prevalence of meeting guidelines did not differ by age or education level.

3. Discussion

Our findings suggest that current users of wearable activity monitors are not representative of the overall US population. Data limited to current users may inflate physical activity estimates and identify patterns of physical activity that differ from those found in other population groups or in US adults overall.

This study is limited by potential selection bias from use of a mail panel survey. However, previous research has found a general equivalence between results from random-digit dialed and panel approaches (Pollard, 2002; Fisher and Kane, 2004), and our overall estimate of active adults corresponds with the national estimate from the 2014 National Health Interview Survey (49.9%) (Healthy People 2020). Another limitation is that all measures are self-reported and previous assessments have shown that physical activity can be overestimated when self-reported (Sallis and Saelens, 2000).

4. Conclusion

Although wearable activity monitors may play an important role in helping people change their health behaviors (Patel et al., 2015), data from users alone may have limited application to physical activity surveillance. Despite this, data from existing users of wearable activity monitors could supplement self-reported surveillance data or help define activity patterns among active persons.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Conflicts of interest

None.

Transparency document

The Transparency document associated with this article can be found, in the online version.

References

Ainsworth, B.E., Macera, C.A., 2012. Physical Activity and Public Health Practice. Taylor & Francis, Boca Raton.

Fisher, L., Kane, N., 2004. Consumer panelist versus random digit dial respondent performance revisited: how similar and how different? Vol. Research on Research #64. Synovate, Inc., New York, NY.

Fulton, J.E., et al., 2016. Strategic Priorities for Physical Activity Surveillance in the United States. Med. Sci. Sports Exerc.

Healthy People 2020. [cited 2016 June 21]; Available from. https://www.healthypeople.gov/2020/topics-objectives/topic/physical-activity/objectives.

Pollard, W., 2002. Use of consumer panel survey data for public health communication planning: an evaluation of survey results. Proceedings of the Section on Health Policy Statistics. American Statistical Association, Alexandria, VA.

Sallis, J.F., Saelens, B.E., 2000. Assessment of physical activity by self-report: status, limitations, and future directions. Res. Q. Exerc. Sport 71 (Suppl. 2), 1–14.

U.S. Census Bureau, d. About Metropolitan and Micropolitan Statistical Areas. [cited 2015 October 15]; Available from: http://www.census.gov/population/metro/about/.

U.S. Department of Health and Human Services, 2008. Physical Activity Guidelines for Americans. 2008. U.S. Government Printing Office, Washington, DC.