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Use of Smart Devices to Track Cardiovascular Health Goals in the United States

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Abstract

BACKGROUND—Smartphone-based health applications are increasingly popular, but their real-world use for cardiovascular risk management remains poorly understood.

OBJECTIVES—The purpose of this study was to investigate the patterns of tracking health goals using smart devices, including smartphones and/or tablets, in the United States.

METHODS—Using the nationally representative Health Information National Trends Survey for 2017 to 2020, we examined self-reported tracking of health-related goals (optimizing body weight, increasing physical activity, and/or quitting smoking) using smart devices among those with cardiovascular disease (CVD) or cardiovascular risk factors of hypertension, diabetes, obesity, and/or smoking. Survey analyses were used to obtain national estimates of use patterns and identify features associated with the use of these devices for tracking health goals.

RESULTS—Of 16,092 Health Information National Trends Survey participants, 10,660 had CVD or cardiovascular risk factors, representing 154.2 million (95% CI: 149.2-159.3 million) U.S.

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APPENDIX For supplemental figures and tables, please see the online version of this paper.

The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

adults. Among the general U.S. adult population, 46% (95% CI: 44%-47%) tracked their health goals using their smart devices, compared with 42% (95% CI: 40%-43%) of those with or at risk of CVD. Younger age, female, Black race, higher educational attainment, and greater income were independently associated with tracking of health goals using smart devices.

CONCLUSIONS—Two in 5 U.S. adults with or at risk of CVD use their smart devices to track health goals. While representing a potential avenue to improve care, the lower use of smart devices among older and low-income individuals, who are at higher risk of adverse cardiovascular outcomes, requires that digital health interventions are designed so as not to exacerbate existing disparities.

Keywords

cardiovascular diseases; heart disease risk factors; health disparity; healthy lifestyle; smartphone; telemedicine

The widespread availability of smartphones and their potential role in the management of cardiovascular risk factors highlight their utility in improving cardiovascular health.[1-12] In the United States, 12.4 million and 8.8 million disability-adjusted life years of cardiovascular disease (CVD) were attributable to metabolic and behavioral risk factors, respectively, in 2019[13,14]; however, these modifiable cardiovascular risk factors may be managed through smartphone-based cardiovascular health applications.[4-11] Therefore, 220 million U.S. adults who own a smartphone may benefit from its various features, including health or wellness applications that could potentially help them to control these risk factors and boost the adoption of a healthier lifestyle with the ultimate hope of preventing CVD.[1,2,12]

The health applications of smart devices, including smartphones and/or tablets, provide opportunities to mitigate multiple modifiable cardiovascular risk factors simultaneously, including hypertension, diabetes mellitus (DM), obesity, and cigarette smoking.[4-11] This integrated approach, targeted at improving multiple sources of cardiovascular risk by encouraging and promoting lifestyle modifications is a potentially useful tool against CVD[3]; nevertheless, data on the real-world utilization of smart devices for improving cardiovascular health remains scarce. It is imperative to understand the uptake patterns of smart devices for improving health to enable the implementation of novel mobile health technologies in routine health care because the current use patterns indicate the gaps and the readiness of the population to adopt these technologies. Additionally, their equitable uptake in the community may serve as an avenue to overcome the inequities in cardiovascular risk factor management.[15,16] On the other hand, the knowledge of the uptake patterns of smart devices may help to prevent the digital divide that exacerbates health disparities.[17]

In this nationally representative study of U.S. adults, we investigated the patterns of ownership of a smart device, having health applications on smart devices, and using smart devices for tracking key health goals, such as optimizing body weight, increasing physical activity, and quitting smoking. We also explored sociodemographic features associated with the use of smart devices to track health goals among U.S. adults with or at risk of CVD.

METHODS

DATA SOURCE.

In this cross-sectional study, we used data from the Health Information National Trends Survey (HINTS), the largest nationally representative survey of health technology utilization among the noninstitutionalized U.S. adult population, to examine the knowledge, attitude, and practice of seeking and employing health information. HINTS captures data on the use of technologies for improving health, which distinguishes it from other national surveys in the United States. The National Cancer Institute conducted HINTS-5 through 4 nationally representative cross-sectional surveys, from cycle 1 to cycle 4, from 2017 to 2020.[18]

Briefly, each cycle of HINTS-5 utilized a 2-stage stratified probability sampling strategy. In the first stage, an equal-probability sample of addresses was selected from 2 sampling strata of all nonvacant residential addresses in the United States in the Marketing Systems Group database. The 2 sampling strata were based on the concentration of minority populations, high-minority areas (≥34% of the population are Hispanics or African Americans) and low-minority areas (the rest of the addresses). The high-minority area addresses were oversampled in all 4 cycles to enhance the representativeness of the minority population in the survey (Supplemental Table 1). In the second stage, one adult from the sampled household was selected to participate in the survey. To ensure accurate estimates and adjust for nonresponse and noncoverage biases, the full-sample weights were computed in 4 steps, including calculating household-level base weights, adjusting for household nonresponse, calculating person-level initial weights, and calibrating the person-level weights to population counts (Supplemental Methods). We combined 4 cycles of HINTS-5 from 2017 through 2020 to obtain a nationally representative sample of U.S. adults in this period.

STUDY POPULATION.

We included all adults (≥18 years of age) with a self-reported history of CVD or at least one cardiovascular risk factor. CVD was defined as a positive response to the question, “Has a doctor or other health professional ever told you that you had a heart condition such as heart attack, angina, or congestive heart failure?” Self-reported cardiovascular risk factors that have been recorded in all 4 cycles of HINTS-5 were metabolic, including hypertension, DM, and obesity, and behavioral, including cigarette smoking. Hypertension and DM were defined as ever being told by a doctor or other health professional that they had high blood pressure or hypertension, and diabetes or high blood sugar, respectively. We defined obesity as a body mass index ≥30 kg/m^2. Current cigarette smoking every day, or some days, was considered a behavioral risk factor.[19]

STUDY OUTCOMES.

The primary outcome was the proportion of U.S. adults with or at risk of CVD who reported tracking of their progress to achieve a health goal using their smart devices, including smartphones and/or tablets, according to the following question: "Has your tablet or smartphone helped you track progress on a health-related goal, such as quitting smoking, losing weight, or increasing physical activity?" The study outcome was assessed among

those participants who owned a smart device. We also evaluated if being affected by CVD or cardiovascular risk factors is associated with the use of smart devices for improving health.

STUDY COVARIATES.

We included self-reported demographics and socioeconomic characteristics to assess the patterns of tracking health goals using smart devices, and to identify the characteristics associated with the use of smart devices for tracking health goals. These included age, sex, race, ethnicity, educational attainment, household income, and residence area. Age was recorded as a continuous measure and was categorized into 18 to 49, 50 to 64, and ≥65 years of age. Race and ethnicity consisted of 4 groups of non-Hispanic White, non-Hispanic Black, Hispanic, and other, including non-Hispanic American Indian or Alaska Native, non-Hispanic Asian, non-Hispanic Native Hawaiian or other Pacific Islander, or multiple races. Residence area was defined as metropolitan and nonmetropolitan (micropolitan, small town, and rural) based on the size and direction of primary commuting flows using the rural-urban commuting area codes.

STATISTICAL ANALYSIS.

All analyses accounted for the complex survey design. We used full-sample weights to calculate point estimates and employed the sampling clusters, stratification by minority density, and person-level full-sample weights to calculate standard errors of estimates. We evaluated weighted annual trends of owning a smart device, having health applications on smart devices, and tracking health goals using smart devices from 2017 through 2020. The slope of each time trend was computed by separate survey logistic regression models fitted for calculating odds of the dependent variable, including owning a smart device, having health applications, or tracking of health goals, using calendar year as the independent variable.

To compare the use of smart devices for monitoring health behaviors between individuals with or at risk of CVD and those without CVD or cardiovascular risk factors, we used survey logistic regression models that were sequentially adjusted for demographics (age, sex, and race and ethnicity) and socioeconomic characteristics (educational attainment, household income, and residence area). We next evaluated independent factors associated with tracking of health goals using smart devices through survey logistic regression models that were sequentially adjusted for demographics (age, sex, and race and ethnicity), cardiovascular risk factors (hypertension, DM, obesity, and cigarette smoking), and socioeconomic characteristics (educational attainment, household income, and residence area). The first model focused on demographics. The second model accounted for demographics but also included cardiovascular risk factors. The third model included socioeconomic characteristics in addition to demographics and cardiovascular risk factors.

Analyses were conducted using R version 4.0.3 (2020-10-10). All statistical tests were 2-sided, with an alpha of 0.05 as the level of statistical significance. The protocol of HINTS has been reviewed by the Westat Institutional Review Board and was exempted from review by the U.S. National Institutes of Health Office of Human Subjects Research Protections.[18]

This study complies with the Strengthening the Reporting of Observational Studies in Epidemiology reporting guidelines.[20]

RESULTS

STUDY POPULATION CHARACTERISTICS.

We identified 16,092 participants with a mean age of 56.9 ± 16.7 years between 2017 and 2020, representing 251 million U.S. adults with a mean age of 49.0 (17.6) years, including 51% (95% CI: 50%-53%) women. This included 10,660 (68.3%) participants with or at risk of CVD with a mean age of 60.4 ± 15.5 years, representing 154.2 million (95% CI: 149.2-159.3 million) U.S. adults with or at risk of CVD with a mean age of 53.0 ± 16.9 years. In the study population, 49% (95% CI: 47%-51%) were women, 13% (95% CI: 12%-14%) were of non-Hispanic Black race/ethnicity, and 16% (95% CI: 15%-17%) were of Hispanic race/ethnicity (Table 1). From 2017 to 2020, 19.2 million (95% CI 17.6-20.8 million) U.S. adults had CVD, and 134.4 million (95% CI: 129.5-139.4 million) U.S. adults were at risk of CVD (Supplemental Table 2).

USE OF SMART DEVICES.

Compared with an estimated 87% (95% CI: 86%-88%) of the total U.S. adult population who had a smart device, 84% (95% CI: 83%-85%) of individuals with or at risk of CVD owned a smart device (Table 2, Central Illustration). From 2017 to 2020, the odds of owning a smart device significantly increased among both the general population and those with or at risk of CVD every year (OR for calendar-year change: 1.16 and 1.17, respectively) (Figure 1). Individuals with or at risk of CVD were less likely to own a smart device compared with individuals without CVD or cardiovascular risk factors (OR: 0.37, 95% CI: 0.30-0.45). This association remained significant after accounting for demographic differences of age, sex, and race and ethnicity (OR: 0.66, 95% CI: 0.53-0.82). However, there were no significant differences after accounting for socioeconomic differences of educational attainment, household income, and residence area (OR: 0.90, 95% CI: 0.69-1.17).

HAVING HEALTH APPLICATIONS ON SMART DEVICES.

Among U.S. adults who had a smart device, 51% (95% CI: 50%-53%) had health and wellness applications on their smart device, compared with 48% (95% CI: 46%-50%) for those with or at risk of CVD (Table 2, Central Illustration). There was a year-to-year increase in the use of health applications on smart devices between 2017 and 2020 (OR for calendar-year change: 1.18 overall and 1.21 for those with or at risk of CVD, respectively) (Figure 1). Compared with U.S. adults without CVD or cardiovascular risk factors, those with or at risk of CVD had significantly lower use of health applications on their smart devices (OR: 0.69, 95% CI: 0.61-0.78). This pattern was consistent after accounting for demographic differences between groups (OR: 0.82, 95% CI: 0.72-0.94), but not after additional adjustment for socioeconomic characteristics (OR: 0.97, 95% CI: 0.85-1.11).

USE OF SMART DEVICES TO TRACK HEALTH GOALS.

Overall, an estimated 46% (95% CI: 44%-47%) of the U.S. adults reported tracking of their progress to achieve a health goal using their smart devices. Among those with or at risk of CVD, 42% (95% CI: 40%-43%) tracked their health goals with smart devices (Table 2, Figure 2, Central Illustration). Between 2017 and 2020, the odds of tracking of health goals using smart devices significantly increased among both the general population and those with or at risk of CVD across calendar years (OR for calendar-year change: 1.11 and 1.10, respectively) (Figure 1). U.S. adults with or at risk of CVD less frequently used their smart devices to track their progress to achieve a health goal compared with those without CVD or cardiovascular risk factors (OR: 0.67, 95% CI: 0.59-0.77); nevertheless, this difference was no longer significant after accounting for differences in demographics (OR: 0.89, 95% CI: 0.78-1.02), or both demographics and socioeconomic characteristics (OR: 1.02, 95 CI: 0.88-1.17).

CHARACTERISTICS ASSOCIATED WITH TRACKING OF HEALTH GOALS USING SMART DEVICES.

Among individuals with or at risk of CVD, younger individuals (<65 years of age), women, those of non-Hispanic Black race/ethnicity (vs White race/ethnicity), and those with higher educational attainment (college education or higher vs high school or lower) and greater household income (>$50,000 vs <$20,000) were more likely to track their health goals using smart devices. In contrast to individuals with obesity, those with hypertension and cigarette smoking reported lower use of smart devices to track health goals (Table 3).

In multivariable models, younger individuals (<65 years of age) compared with older individuals and women compared with men were more likely to track their health goals using smart devices after accounting for differences in demographic characteristics, cardiovascular risk factor profile, and socioeconomic features. While there were no differences between Black and White individuals in health tracking using smart devices after accounting for either demographic differences or differences in demographics and cardiovascular risk factors, Black individuals were more likely to report higher use when also accounting for socioeconomic differences. Higher educational attainment (college education or higher vs high school or lower) and greater household income (>$50,000 vs <$20,000) were independently associated with tracking health goals using smart devices among U.S. adults with or at risk of CVD (Table 3, Figure 3). Similar results were observed among U.S. adults with CVD and at-risk populations (Supplemental Table 3, Supplemental Figure 1).

DISCUSSION

In this nationally representative study of U.S. adults between 2017 and 2020, 2 in 5 adults with or at risk of CVD used their smart devices to track their progress toward achieving a health goal, such as optimizing body weight, increasing physical activity, and/or quitting smoking. The odds of owning a smart device, having health applications on smart devices, and using smart devices to track health goals all significantly increased both in the general U.S. adult population and among those with or at risk of CVD across calendar years during

2017-2020. While U.S. adults with or at risk of CVD were less likely to own a smart device, have health applications on smart devices, or use smart devices to track health goals when compared with those without CVD or cardiovascular risk factors, differences in demographics and socioeconomic characteristics may explain these differences. Among U.S. adults with or at risk of CVD, younger age, female sex, non-Hispanic Black race/ethnicity, higher educational attainment, and greater household income were independently associated with tracking of health goals using smart devices.

Previous studies have demonstrated the effectiveness of smart device-based interventions for both primary and secondary prevention of CVD among those at-risk and those with established CVD, respectively.[8-10,21] According to the Pew Research Center survey for 2021, 85% of U.S. adults have a smartphone, which is in agreement with our estimates.[1] Our work builds on the literature and identifies a lower access to smart devices and health applications and a lower use of smart devices to track health goals among individuals with or at risk of CVD compared with individuals without CVD or cardiovascular risk factors. This suggests that the use of novel technologies remains suboptimal in the populations that are at the highest risk of major adverse cardiovascular events and may derive the greatest absolute health benefit from smart devices.[8,21]

To leverage the potential cardiovascular health benefits of smart devices, it is imperative to ensure their equitable and effective utilization across clinical and sociodemographic subgroups.[22] Our observation that younger individuals, women, and those with higher educational attainment and greater household income had higher use of smart devices to improve cardiovascular health is in agreement with previous studies,[23,24] though our study establishes the nationally representativeness of such patterns. A key consideration is that groups with a lower use of smart devices for health management, including older individuals, men, and those with a lower socioeconomic status also have worse cardiovascular outcomes.[25,26] This represents a key consideration for technology-driven implementation studies that would need to explicitly factor such differences in current use patterns to ensure smart health interventions ameliorate rather than exacerbate disparities in health outcomes.

It is worth noting that among those who already possessed smart devices, an estimated 58% did not use their devices to track their cardiovascular health goals, despite substantial evidence on the efficacy of these interventions.[3,4,8-11] This may be due to a lack of recognition of these opportunities by clinicians. To maximize the available technology, clinicians and healthcare providers should consider including an evaluation of access to smart devices as a consideration in patient evaluation. When smart device access is confirmed, identifying potential tools that patients can use to better manage their cardiovascular health may be an important proximate step, especially in sociodemographic groups with lower use of smart devices.[27,28]

STUDY LIMITATIONS.

Our findings should be interpreted in light of the following limitations. First, our study is based on self-report. However, the use of a standardized survey by trained interviewers likely improves the quality of the observations. Second, the survey-based assessments

are prone to recall bias, and there was no verification of how participants used their smart devices to track health goals, whether they successfully achieved a health goal, or how they defined tracking of health goals using smart devices. However, this is the first report that will allow the design of large studies that objectively measure specific cardiometabolic benefits of smart devices. Third, the definition of CVD was based on a question that combined atherosclerotic CVD and heart failure, though a history of stroke or peripheral arterial disease was not explicitly recorded. Fourth, although we included all metabolic and behavioral cardiovascular risk factors recorded in HINTS, dyslipidemia was not reported and was not considered for this study. Given the high correlation between different atherosclerotic diseases and cardiovascular risk factors with each other, we likely captured most of the individuals with conditions not explicitly evaluated in the survey.

CONCLUSIONS

Two in 5 U.S. adults with or at risk of CVD use their smart devices to track health goals. The lower use of smart devices among older individuals, men, and those with a lower socioeconomic status, who are also at higher risk of adverse cardiovascular outcomes, requires that digital health interventions are designed so as not to exacerbate existing health disparities.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

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ABBREVIATIONS AND ACRONYMS

CVD	cardiovascular disease
DM	diabetes mellitus
HINTS	Health Information National Trends Survey

REFERENCES

1. Pew Research Center. Mobile fact sheet. 2021. Accessed November 11, 2022. https://www.pewresearch.org/internet/fact-sheet/mobile/

2. United States Census Bureau. U.S. adult population grew faster than nation's total population from 2010 to 2020. 2022. Accessed November 11, 2022. https://www.census.gov/library/stories/2021/08/united-states-adult-population-grew-faster-than-nations-total-population-from-2010-to-2020.html

3. Shariful Islam SM, Farmer AJ, Bobrow K, et al. Mobile phone text-messaging interventions aimed to prevent cardiovascular diseases (Text2PreventCVD): systematic review and individual patient data meta-analysis. Open Heart. 2019;6:e001017. [PubMed: 31673381]

4. Kitsiou S, Paré G, Jaana M, Gerber B. Effectiveness of mHealth interventions for patients with diabetes: an overview of systematic reviews. PLoS One. 2017;12:e0173160. [PubMed: 28249025]

5. Bricker JB, Watson NL, Mull KE, Sullivan BM, Heffner JL. Efficacy of smartphone applications for smoking cessation: a randomized clinical trial. JAMA Intern Med. 2020;180:1472–1480. [PubMed: 32955554]

6. Chow CK, Redfern J, Hillis GS, et al. Effect of lifestyle-focused text messaging on risk factor modification in patients with coronary heart disease: a randomized clinical trial. JAMA. 2015;314:1255–1263. [PubMed: 26393848]

7. Martin SS, Feldman DI, Blumenthal RS, et al. mActive: a randomized clinical trial of an automated mHealth intervention for physical activity promotion. J Am Heart Assoc. 2015;4:e002239. [PubMed: 26553211]

8. Hamilton SJ, Mills B, Birch EM, Thompson SC. Smartphones in the secondary prevention of cardiovascular disease: a systematic review. BMC Cardiovasc Disord. 2018;18:25. [PubMed: 29415680]

9. Widmer RJ, Collins NM, Collins CS, West CP, Lerman LO, Lerman A. Digital health interventions for the prevention of cardiovascular disease: a systematic review and meta-analysis. Mayo Clin Proc. 2015;90:469–480. [PubMed: 25841251]

10. Davis AJ, Parker HM, Gallagher R. Gamified applications for secondary prevention in patients with high cardiovascular disease risk: a systematic review of effectiveness and acceptability. J Clin Nurs. 2021;30:3001–3010. [PubMed: 33872436]

11. Piette JD, List J, Rana GK, Townsend W, Striplin D, Heisler M. Mobile health devices as tools for Worldwide cardiovascular risk Reduction and disease management. Circulation. 2015;132:2012–2027. [PubMed: 26596977]

12. Manuel DG, Lim J, Tanuseputro P, et al. Revisiting rose: strategies for reducing coronary heart disease. BMJ. 2006;332:659–662. [PubMed: 16543339]

13. Roth GA, Mensah GA, Johnson CO, et al. Global Burden of cardiovascular diseases and risk factors, 1990-2019: update from the GBD 2019 study. J Am Coll Cardiol. 2020;76:2982–3021. [PubMed: 33309175]

14. Yusuf S, Joseph P, Rangarajan S, et al. Modifiable risk factors, cardiovascular disease, and mortality in 155 722 individuals from 21 high-income, middle-income, and low-income countries (PURE): a prospective cohort study. Lancet. 2020;395:795–808. [PubMed: 31492503]

15. Wali S, Hussain-Shamsy N, Ross H, Cafazzo J. Investigating the Use of mobile health interventions in Vulnerable populations for cardiovascular disease management: scoping review. JMIR Mhealth Uhealth. 2019;7:e14275. [PubMed: 31593547]

16. Valero-Elizondo J, Hong JC, Spatz ES, Salami JA. Persistent socioeconomic disparities in cardiovascular risk factors and health in the United States: Medical Expenditure Panel Survey 2002-2013. Atherosclerosis. 2018;269:301–305. [PubMed: 29254694]

17. Mahajan S, Lu Y, Spatz ES, Nasir K, Krumholz HM. Trends and predictors of use of digital health technology in the United States. Am J Med. 2021;134:129–134. [PubMed: 32717188]

18. Finney Rutten LJ, Blake KD, Skolnick VG, Davis T, Moser RP, Hesse BW. Data resource profile: the national Cancer Institute's health information national trends survey (HINTS). Int J Epidemiol. 2019;49:17.

19. Arnett DK, Blumenthal RS, Albert MA, et al. 2019 ACC/AHA guideline on the primary prevention of cardiovascular disease: a report of the American college of Cardiology/American heart association Task Force on clinical practice guidelines. J Am Coll Cardiol. 2019;74(10):e177–e232. [PubMed: 30894318]

20. von Elm E, Altman DG, Egger M, et al. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. Ann Intern Med. 2007;147:573–577. [PubMed: 17938396]
21. Feigin VL, Owolabi M, Hankey GJ, Pandian J, Martins SC. Digital health in primordial and primary stroke prevention: a systematic review. Stroke. 2022;53:1008–1019. [PubMed: 35109683]
22. Shan R, Ding J, Plante TB, Martin SS. Mobile health access and Use among individuals with or at risk for cardiovascular disease: 2018 health information national trends survey (HINTS). J Am Heart Assoc. 2019;8:e014390. [PubMed: 31818220]
23. Bhuyan SS, Lu N, Chandak A, et al. Use of mobile health applications for health-seeking behavior among US adults. J Med Syst. 2016;40:153. [PubMed: 27147516]
24. Krebs P, Duncan DT. Health App Use among US mobile phone Owners: a national survey. JMIR Mhealth Uhealth. 2015;3:e101. [PubMed: 26537656]
25. Anon. Heart disease and stroke statistics—2022 update: a report from the American Heart Association. Circulation. 2022;145(8):e153–e639. [PubMed: 35078371]
26. Schultz WM, Kelli HM, Lisko JC, et al. Socioeconomic status and cardiovascular outcomes. Circulation. 2018;137:2166–2178. [PubMed: 29760227]
27. Kauw D, Huisma PR, Medlock SK, et al. Mobile health in cardiac patients: an overview on experiences and challenges of stakeholders involved in daily use and development. BMJ Innov. 2020;6:184–191.
28. Smith R, Menon J, Rajeev JG, Feinberg L, Kumar RK, Banerjee A. Potential for the use of mHealth in the management of cardiovascular disease in Kerala: a qualitative study. BMJ Open. 2015;5:e009367.

PERSPECTIVES

COMPETENCY IN MEDICAL KNOWLEDGE:

Two in 5 U.S. adults with or at risk of CVD use their smart devices to track their progress toward achieving a health goal, such as optimizing body weight, increasing physical activity, and/or quitting smoking. From 2017 to 2020, the use of smart devices for improving cardiovascular health significantly increased among U.S. adults with or at risk of CVD; however, these individuals remain less likely to derive health benefits from smart devices compared with individuals without CVD or cardiovascular risk factors. The lower use of smart devices for improving health is more pronounced among older or male individuals, as well as those with lower educational attainment and income, who are at higher risk of major adverse cardiovascular outcomes.

TRANSLATIONAL OUTLOOK:

Smart devices represent a potentially meaningful advance in cardiovascular risk management, enabling patients to track their cardiovascular health goals. Health care providers may need to participate in the rigorous evaluation of the benefits of these devices for their patients. With interventions that have been recognized to be effective, clinicians will also need to actively engage to improve their use among patients, particularly among sociodemographic subgroups with lower digital literacy and poor cardiovascular outcomes. This study informs the design of future studies that objectively measure specific cardiometabolic benefits of smart devices.

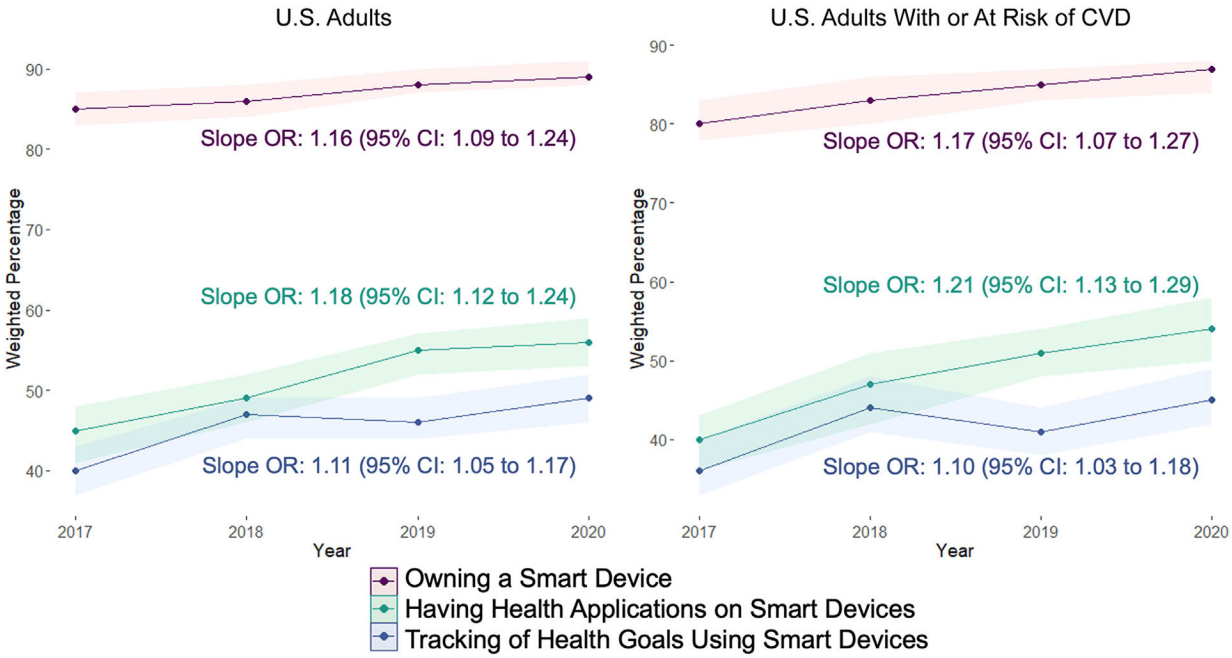


FIGURE 1. Owning a Smart Device, Having Health Applications, and Tracking of Health Goals Using Smart Devices Among U.S. Adults and U.S. Adults With or At Risk of Cardiovascular Disease From HINTS, 2017-2020

CVD = cardiovascular disease; HINTS = Health Information National Trends Survey.

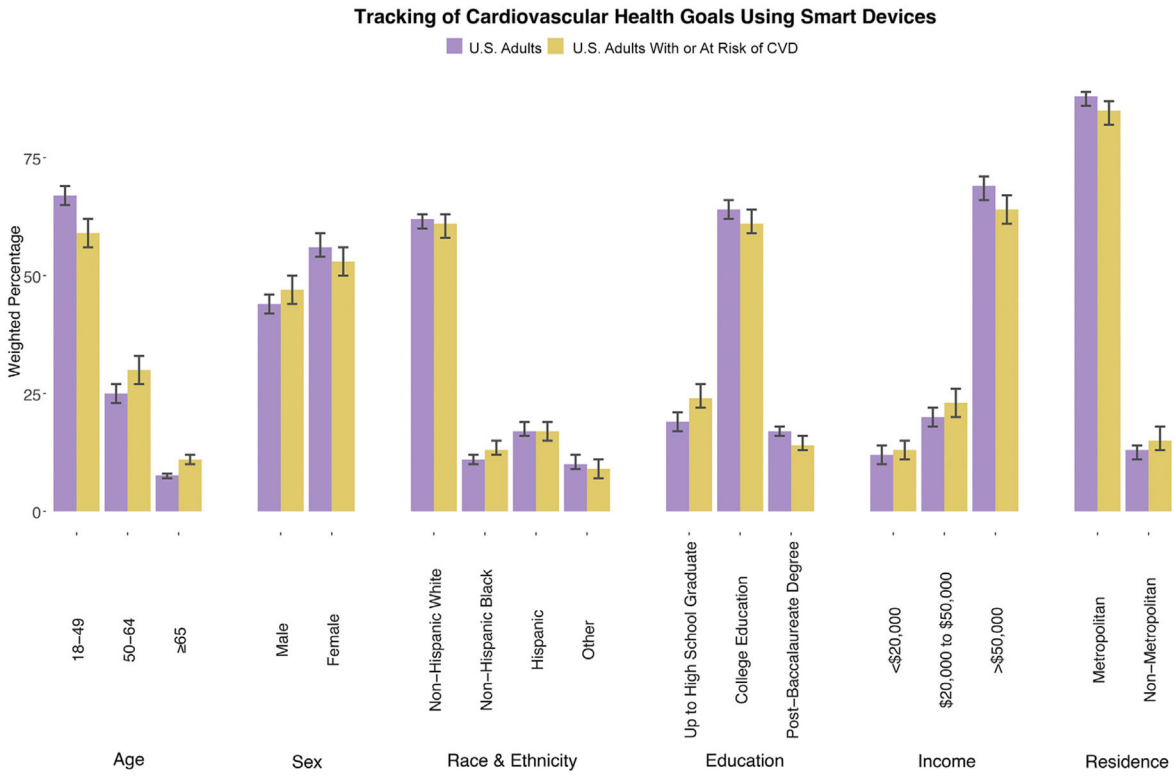


FIGURE 2. Distribution of Demographics and Socioeconomic Characteristics Among U.S. Adults and Those With or at Risk of CVD Who Tracked Their Progress to Achieve a Health Goal Using Their Smart Devices From HINTS, 2017 to 2020

CVD = cardiovascular disease; HINTS = Health Information National Trends Survey.

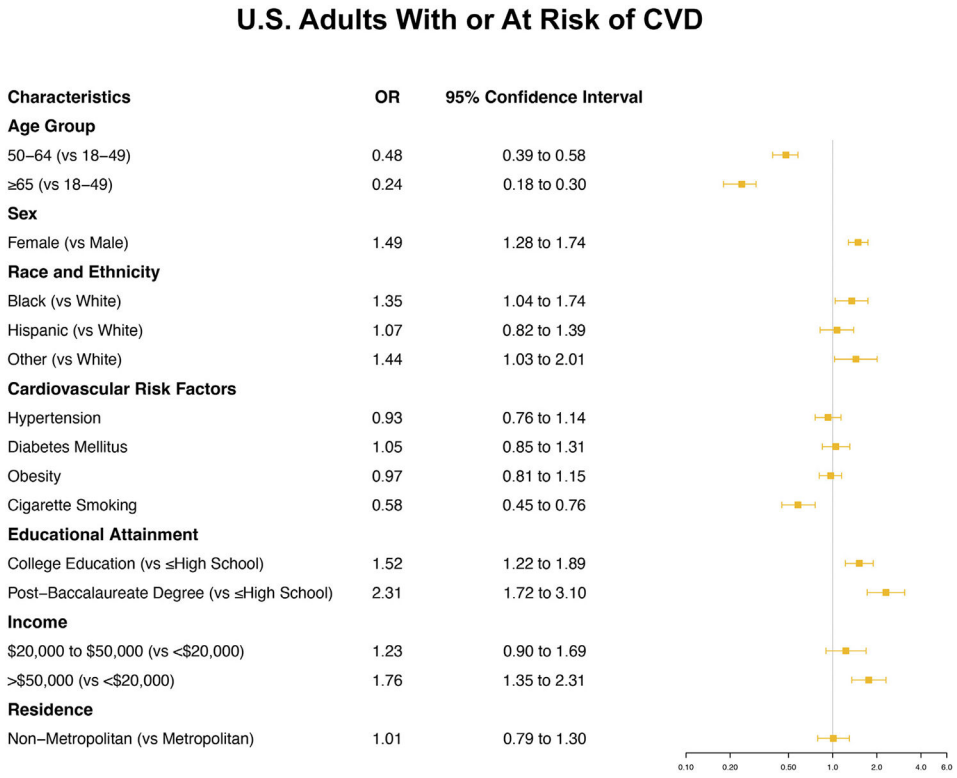
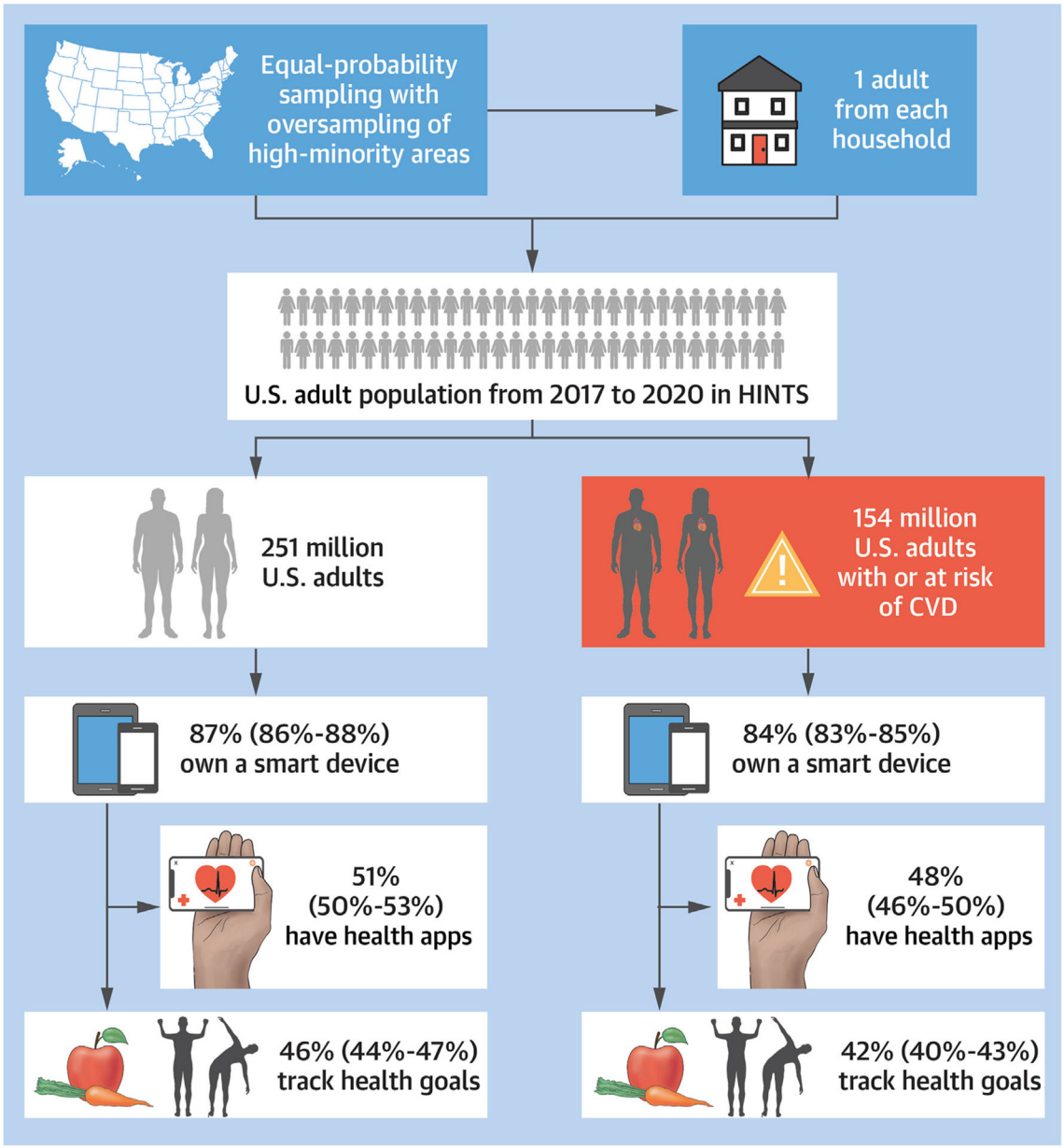


FIGURE 3. Multivariable-Adjusted Characteristics Associated With Tracking of Health Goals Using Smart Devices Among U.S. Adults With or at Risk of CVD From HINTS, 2017 to 2020

CVD = cardiovascular disease; HINTS = Health Information National Trends Survey.



CENTRAL ILLUSTRATION. Use of Smart Devices to Improve Cardiovascular Health in the United States From HINTS, 2017 to 2020

Values are % (95% CI). CVD = cardiovascular disease; HINTS = Health Information National Trends Survey.

TABLE 1

Distribution of Demographics, CVD and Risk Factors, and Socioeconomic Characteristics Among U.S. Adults and Those With or at Risk of CVD From HINTS, 2017-2020

	U.S. Adults (n = 16,092)		U.S. Adults With or at Risk of CVD (n = 10,660)	
	n (%)	Weighted Percentage (95% CI)	n (%)	Weighted Percentage (95% CI)
Demographics				
Age group, y				
18-49	4,967 (30.9%)	50% (49%-52%)	2,401 (22.5%)	41% (39%-43%)
50-64	5,017 (31.2%)	30% (29%-31%)	3,511 (32.9%)	33% (32%-35%)
≥65	5,756 (35.8%)	20% (19%-21%)	4,557 (42.7%)	26% (25%-27%)
Sex				
Male	6,494 (40.4%)	49% (47%-50%)	4,532 (42.5%)	51% (49%-53%)
Female	9,245 (57.5%)	51% (50%-53%)	5,956 (55.9%)	49% (47%-51%)
Race and ethnicity				
Non-Hispanic White	9,038 (56.2%)	64% (63%-66%)	5,761 (54%)	64% (62%-66%)
Non-Hispanic Black	2,011 (12.5%)	11% (10%-12%)	1,602 (15%)	13% (12%-14%)
Hispanic	2,214 (13.8%)	16% (15.5%-17%)	1,425 (13.4%)	16% (15%-17%)
Other	1,181 (7.3%)	8% (7.7%-9%)	696 (6.5%)	7% (6%-8%)
CVD and cardiovascular risk factors				
CVD	1,606 (10%)	7.8% (7%-8%)	1,606 (15.1%)	13% (12%-14%)
Cardiovascular risk factors	10,478 (65.1%)	62% (61%-64%)	10,478 (98.3%)	-
Hypertension	7,133 (44.3%)	36% (35%-38%)	7,133 (66.9%)	59% (57%-60%)
Diabetes mellitus	3,368 (20.9%)	17% (16%-18%)	3,368 (31.6%)	28% (26%-29%)
Obesity	5,246 (32.6%)	34% (33%-35%)	5,246 (49.2%)	55% (53%-56%)
Cigarette smoking	1,917 (11.9%)	14% (13%-15%)	1,917 (18%)	23% (22%-25%)
Socioeconomic characteristics				
Educational attainment				
Up to high school graduate	3,997 (24.8%)	31% (30%-32%)	3,161 (29.7%)	37% (36%-39%)
College education	8,772 (54.5%)	57% (56%-58%)	5,677 (53.3%)	54% (52%-55%)
Post-baccalaureate degree	2,868 (17.8%)	12% (11.5%-13%)	1,572 (14.7%)	9% (8.6%-10%)
Household income				

	U.S. Adults (n = 16,092)		U.S. Adults With or at Risk of CVD (n = 10,660)	
	n (%)	**Weighted Percentage (95% CI)**	**n (%)**	**Weighted Percentage (95% CI)**
<$20,000	2,666 (16.6%)	17% (16%-18%)	2,117 (19.9%)	20% (19%-22%)
$20,000-$50,000	3,796 (23.6%)	25% (24%-26%)	2,774 (26%)	28% (27%-30%)
>$50,000	7,833 (48.7%)	58% (56%-59%)	4,604 (43.2%)	52% (50%-53%)
Residence				
Metropolitan	13,912 (86.5%)	85% (84%-86%)	9,086 (85.2%)	83% (82%-84%)
Nonmetropolitan	2,179 (13.5%)	15% (14%-16%)	1,574 (14.8%)	17% (16%-18%)

CVD = cardiovascular disease; HINTS = Health Information National Trends Survey.

TABLE 2

Owning a Smart Device, Having Health Applications, and Tracking of Health Goals Using Smart Devices Among U.S. Adults and Those With or at Risk of CVD From HINTS, 2017-2020

		Owning a Smart Device		Having Health Applications on Smart Devices		Tracking of Health Goals Using Smart Devices	
	Total	n (%)	Weighted Percentage (95% CI)	n (%)	Weighted Percentage (95% CI)	n (%)	Weighted Percentage (95% CI)
HINTS-5 cycles							
Cycle 1, 2017	3,285 (20.4%)	2,607 (80.3%)	85% (83%-87%)	1,173 (42.6%)	45% (41%-48%)	992 (36.9%)	40% (37%-43%)
Cycle 2, 2018	3,504 (21.8%)	2,770 (80.9%)	86% (84%-88%)	1,344 (48.5%)	49% (46%-52%)	1,195 (43.3%)	47% (44%-49%)
Cycle 3, 2019	5,438 (33.8%)	4,460 (84.3%)	88% (87%-90%)	2,344 (52.4%)	55% (52%-57%)	1,852 (41.5%)	46% (44%-49%)
Cycle 4, 2020	3,865 (24.0%)	3,239 (85.2%)	89% (88%-91%)	1,739 (53.5%)	56% (53%-59%)	1,434 (44.5%)	49% (46%-52%)
HINTS-5							
U.S. adults	16,092 (100%)	13,076 (82.9%)	87% (86%-88%)	6,600 (49.8%)	51% (50%-53%)	5,473 (41.7%)	46% (44%-47%)
U.S. adults with or at risk of CVD	10,660 (66.2%)	8,318 (79.7%)	84% (83%-85%)	3,917 (46.4%)	48% (46%-50%)	3,175 (38.0%)	42% (40%-43%)

CVD = cardiovascular disease; HINTS-5 = Health Information National Trends Survey 5.

TABLE 3

Demographics, Cardiovascular Risk Factors, and Socioeconomic Characteristics Associated With Tracking of Health Goals Using Smart Devices Among U.S. Adults With or at Risk of CVD From HINTS, 2017-2020

	U.S. Adults With or at Risk of CVD							
			Multivariable Analysis[a]					
	Univariable Analysis		Model 1		Model 2		Model 3	
	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
Demographics								
Age group								
18-49	Reference				Reference			
50-64	0.5 (0.41-0.59)	<0.001	0.51 (0.42-0.62)	<0.001	0.48 (0.40-0.59)	<0.001	0.48 (0.39-0.58)	<0.001
≥65	0.26 (0.22-0.32)	<0.001	0.27 (0.22-0.33)	<0.001	0.23 (0.18-0.30)	<0.001	0.24 (0.18-0.30)	<0.001
Sex								
Male	Reference				Reference			
Female	1.35 (1.18-1.53)	<0.001	1.44 (1.25-1.66)	<0.001	1.4 (1.22-1.61)	<0.001	1.49 (1.28-1.74)	<0.001
Race and ethnicity								
Non-Hispanic White	Reference				Reference			
Non-Hispanic Black	1.26 (1.03-1.56)	0.028	1.13 (0.90-1.42)	0.30	1.15 (0.92-1.45)	0.20	1.35 (1.04-1.74)	0.023
Hispanic	1.19 (0.96-1.46)	0.10	0.98 (0.77-1.25)	0.90	0.91 (0.70-1.17)	0.40	1.07 (0.82-1.39)	0.60
Other	1.57 (1.16-2.11)	0.003	1.4 (1.03-1.92)	0.033	1.41 (1.01-1.96)	0.041	1.44 (1.03-2.01)	0.033
Cardiovascular risk factors								
Hypertension	0.71 (0.61-0.83)	<0.001	-	-	0.93 (0.76-1.14)	0.50	0.93 (0.76-1.14)	0.50
Diabetes mellitus	0.84 (0.71-1.00)	0.054	-	-	0.99 (0.81-1.22)	>0.9	1.05 (0.85-1.31)	0.60
Obesity	1.29 (1.12-1.48)	<0.001	-	-	0.91 (0.77-1.07)	0.20	0.97 (0.81-1.15)	0.70
Cigarette smoking	0.71 (0.58-0.88)	0.002	-	-	0.51 (0.40-0.65)	<0.001	0.58 (0.45-0.76)	<0.001
Socioeconomic characteristics								
Educational attainment								
Up to high school graduate	Reference		-	-	-	-	Reference	
College education	1.74 (1.45-2.09)	<0.001	-	-	-	-	1.52 (1.22-1.89)	<0.001
Post-baccalaureate degree	2.84 (2.27-3.56)	<0.001	-	-	-	-	2.31 (1.72-3.10)	<0.001
Household income								

	U.S. Adults With or at Risk of CVD							
			Multivariable Analysis[a]					
	Univariable Analysis		Model 1		Model 2		Model 3	
	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
<$20,000	Reference		-		-	-	Reference	
$20,000-$50,000	1.25 (0.94-1.67)	0.13	-	-	-	-	1.23 (0.90-1.69)	0.20
>$50,000	1.93 (1.56-2.40)	<0.001	-	-	-	-	1.76 (1.35-2.31)	<0.001
Residence								
Metropolitan	Reference		-	-	-	-	Reference	
Nonmetropolitan	0.92 (0.72-1.16)	0.50	-	-	-	-	1.01 (0.79-1.30)	>0.90

[a]Model 1 is adjusted for demographics. Model 2 further accounts for cardiovascular risk factors. Model 3 is further adjusted for socioeconomic characteristics.

CVD = cardiovascular disease; HINTS = Health Information National Trends Survey.