Current Patterns of Use and Acceptability of Consumer Wearable Activity Trackers in Emergency Department Patients

Direct Original Research

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Abstract

Introduction: Obesity and the metabolic syndrome are leading causes of increased healthcare utilization, preventable illness, and premature death. Future emergency department (ED) based strategies may include the use of consumer wearable activity trackers (WATs). Our objective was to characterize patterns of use and acceptability of WATs in ED patients and examine differences based on demographic and socioeconomic factors.

Methods: This was a survey-based study addressing: 1) current or prior use of WATs, and 2) future interest in WAT use and willingness to share associated data with researchers. Any adult patient presenting to the ED was included, with enrollment at two large, urban academic medical centers.

Results: A total of 169 participants were included, with 27% reporting current WAT use. WAT users were significantly younger ($p<0.01$) with higher rates of employment ($p=0.01$), income ($p=0.03$), and education ($p=0.02$) compared to non-WAT users. WAT users were less likely to report comorbidities including hypertension, hyperlipidemia, and diabetes mellitus (all $p<0.01$). Cost was the most prohibitive barrier among non-WAT users. Importantly, >90% were open to wearing WATs and sharing activity data with researchers.

Conclusions: Results indicate that although current WAT use is limited, most ED patients express interest in future use and willingness to share activity data with researchers.

Key Words: device, exercise, emergency care

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Introduction

Obesity and the related metabolic syndrome (MetS) are among the leading causes of increased healthcare utilization, preventable illness, and premature death worldwide.[1-3] While exercise has the potential to positively modulate all components of MetS, multiple biopsychosocial factors have contributed to the widespread failure of adoption and sustainability of targeted exercise interventions.[4-9] Emergency physicians provide care to patients during or shortly after lifechanging events when motivation is high, often within safety net facilities, serving patients with otherwise limited access to care. [10-12] Emergency physicians therefore hold a unique and under-explored position to engage patients in exercise-based interventions targeting sustained behavior change.

However, despite the frequency with which emergency physicians encounter at-risk patients, there is a paucity of data in current literature on how to construct and deploy an ED-based approach aimed at addressing physical inactivity. While such an approach will likely include focusing more directly on factors affecting patient adherence, with the

increasing availability of mobile health technologies and consumer wearable activity trackers (WATs) that offer self-monitoring and an array of motivational features, there remains a lack of data from patients regarding their acceptability of WATs and the sharing of its data in medical research.[13-14] Our objective was to characterize current patterns of use and overall acceptability of consumer wearable activity trackers in patients presenting to the ED and to compare results based on demographic and socioeconomic factors.

Methods

This was a survey-based study of adult patients presenting the ED of two large, urban academic medical centers. Data collection occurred between May-August of 2022. Eligible patients were identified through real-time surveillance of the electronic health record using the ED tracking board, which lists patient name, age, chief complaint, and vitals. Exclusion criteria consisted of any condition limiting the patient's ability to participate including critical illness, acute intoxication, or psychotic state. These exclusion criteria were primarily identified through the chief complaint listed on the tracking board (i.e. complaints related to psychiatric evaluation, psychosis, hallucinations, alcohol or drug use) and patient location (i.e. monitored psychiatric beds or "shock" rooms reserved for critical illness). Children were also excluded.

Eligible patients were approached and asked to complete a short survey with questions related to: 1) current or prior use of WATs, and 2) future interest in WAT use and willingness to share associated data with researchers. The first portion of this survey included whether the patient was a "current", "prior", or "never" WAT user, with subsequent questions related to primary reasons for or barriers to use of these devices and its perceived impact on overall physical activity, health, and wellness. The second portion included the following two questions: "*Would you be open to wearing one of these devices in the future to track physical activity, if given to you as part of a research study?*" and "*Would you be willing to share the activity data collected by this device with medical researchers aiming to better understand the link between exercise and disease?*". The full survey is available in the supplemental materials.

Pertinent demographic and comorbidity data were also obtained through direct patient query. The study protocol was reviewed by the Institutional Review Board and determined to be exempt. Those administering the survey (CR and BM) were individually trained by the PI and personally observed during initial encounters to ensure consistency across associates. Data were collected in REDCap®.

Statistical analysis

Statistical analyses were conducted using SAS software (Version 9.4, SAS Institute, Cary, NC). Descriptive statistics were calculated to summarize data as frequencies and proportions for categorical variables and means with standard deviations for continuous variables. Independent samples t-tests were used to compare the means of continuous variables between two groups (current vs. never users), assuming an approximate normal distribution. Associations between categorical variables were assessed using Pearson's Chi-square test. Statistical significance was defined as $P \leq 0.05$.

Results

A total of 188 eligible patients through real-time ED surveillance during the study period. Of these patients, 169 (90%) enrolled in the study and completed the survey. The remaining eligible patients were either missed (n=4) or declined enrollment (n=15). The most common reason for declining to participate was not feeling well (60%). Pertinent demographic and comorbidity data for all survey participants are included in Table 1, representing a diverse cohort. Across all participants, 27% (n=45) identified as current users of a wearable activity tracker, while an additional 12% (n=21) reported prior use. The majority (61%, n=103) had never used a WAT.

Current WAT users reported a mean duration of use of 2 years, with Apple watch being the most common brand used by our ED cohort (64%), followed by Samsung (16%), and Fitbit (14%). The most commonly reported benefits or reasons for use were: "monitoring or improving my overall health" (48%) and "monitoring my fitness goals" (32%). The majority of current WAT users responded positively regarding their experiences with the device, selecting either strongly agree or agree to the following prompts, also displayed graphically in Figure 1: (1) "Wearing an activity tracker has been a positive experience": 93%, (2) "Wearing an activity tracker has had a positive impact on my physical activity": 82%, (3) "Wearing an activity tracker has had a positive impact on my wellness": 75%, (4) "Since starting to wear an activity tracker, I feel healthier": 73%.

Table 1. Demographics and baseline comorbidities, including total cohort and comparison of current WAT users vs. never WAT users

	Total cohort (n=169)	Current WAT users (n=45)	Never WAT users (n=103)	p	95% CI*
Mean age in years	37	31	41	<0.01	-14.8 to -4.8
Female	54%	44%	58%	0.12	-31% to 4%
Hispanic or Latino	21%	27%	18%	0.22	-6% to 22%
African American or Black	39%	40%	38%	0.82	-15% to 19%
Caucasian or White	41%	33%	44%	0.21	-28% to 7%
Asian or Asian American	1%	4%	0%	0.04	0.4% to 8%
Other race	17%	22%	16%	0.40	-7% to 20%
Education: high school or less	57%	40%	63%	0.01	-40% to -6%
Education: undergraduate degree	18%	31%	14%	0.02	4% to 31%
Currently employed	75%	87%	66%	0.01	5% to 36%
Annual income: less than $25,000	66%	51%	70%	0.03	-36% to -2%
Insurance: private or commercial	10%	18%	7%	0.06	-0.4% to 21%
Average BMI in kg/m²	26.7	25.7	27.7	0.02	-3.5 to -0.4
Hypertension	51%	33%	62%	<0.01	-46% to -11%
Hyperlipidemia	24%	9%	35%	<0.01	-42% to -11%
Diabetes mellitus	29%	13%	40%	<0.01	-43% to -10%
Composite "metabolic syndrome"	38%	16%	51%	<0.01	-53% to -19%
Anxiety	37%	11%	45%	<0.01	-50% to -17%
Depression	26%	18%	30%	0.13	-28% to 3%
Prior venous thromboembolism	6%	2%	10%	0.09	-17% to 2%
Cancer	5%	0%	9%	0.04	-17% to -0.4%
Disabled	4%	2%	5%	0.43	-10% to 4%
Home oxygen use	3%	0%	5%	0.12	-11% to 1%
Current smoker	20%	7%	22%	0.03	-29% to -2%
Prior smoking history	24%	11%	31%	0.01	-35% to -5%
"I consider myself physically active"	80%	91%	72%	0.01	5% to 34%
Average days per week of exercise	4.3	5.1	3.7	<0.01	0.7 to 2.1

*95% CI for the difference in means/proportions between current WAT users and never WAT users

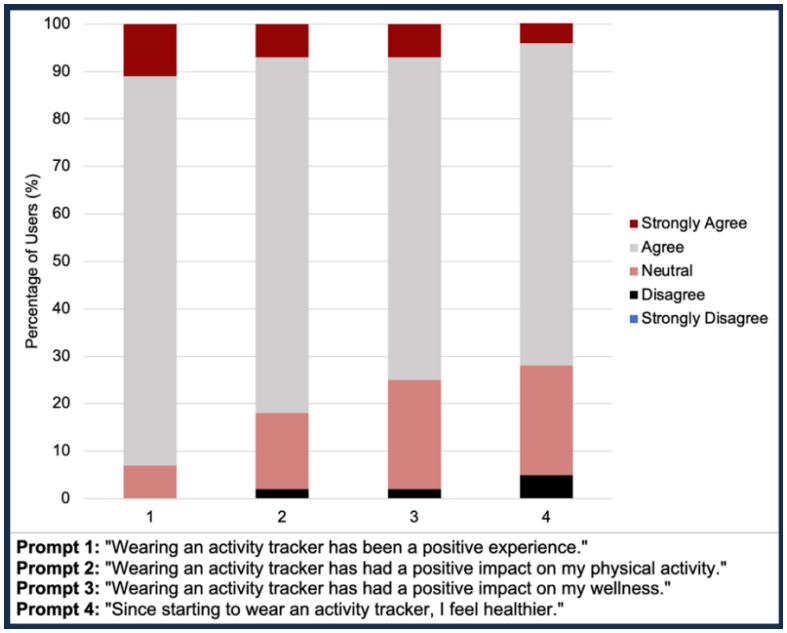

Figure 1. Current WAT users were asked to characterize their experiences with the device by responding to four distinct prompts related to the perceived impact of WAT use on physical activity, overall health, and wellness (all measured via a 5-point Likert scale ranging from strongly disagree to strongly agree).

In the cohort of patients reporting prior WAT use (used for an average of 11 months), the most common reasons for stopping use were: "I forgot to wear it" (55%), "It broke or didn't function correctly" (10%), "It was uncomfortable or bothersome to wear" (5%), and "It ran out of battery and/or I forgot to charge it" (5%). No prior WAT users selected either of the following options when asked about reasons for stopping use: (1) "It didn't help to increase my physical activity" and (2) "I had concerns about data collection or sharing". Amongst participants who had never worn a WAT device, the most commonly identified barrier to use was cost/financial (57%).

Table 1 also includes a direct comparison of demographic and comorbidity data between "current" vs. "never" WAT users. Current WAT users were significantly more likely to report a younger age (31 years vs. 41 years, $p<0.01$), an educational level of an undergraduate degree or higher (31% vs. 14%, $p=0.02$), a household income >$25,000 (49% vs. 30%, $p=0.03$), and current employment (87% vs. 66%, $p=0.01$). Additionally, WAT users reported significantly fewer comorbid conditions including hypertension (33% vs. 62%, $p<0.01$), hyperlipidemia (9% vs. 35%, $p<0.01$), diabetes (13% vs. 40%, $p<0.01$), anxiety (11% vs. 45%, $p<0.01$), and cancer (0% vs. 9%, $p=0.04$), as well as a lower BMI (25.7 kg/m^2 vs. 27.7 kg/m^2, $p=0.02$). WAT users were less likely to meet composite "MetS" criteria (16% vs. 51%, $p<0.01$), which was defined as having ≥2 of 4: hypertension, hyperlipidemia, diabetes mellitus, and BMI ≥30 kg/m^2. WAT users also reported higher rates of weekly exercise (5.1 vs. 3.7 days, $p<0.01$) and lower tobacco use (7% vs. 22%, $p=0.03$). There was also a trend toward higher private/commercial insurance in WAT users (18% vs. 7%, $p=0.06$). There were no significant differences in current vs. never WAT users related to gender, race, or ethnicity. As an additional subgroup analysis, "prior users" were also examined, who tended to report socioeconomic and comorbidity data positioned in between that of "current" and "never" users including the following: current employment (80%), household income >$25,000 (32%), private/commercial insurance (10%), hypertension (35%), hyperlipidemia (10%), diabetes (20%), and average BMI (26.5 kg/m^2).

When asked "*Would you be open to wearing one of these devices in the future to track physical activity, if given to you as part of a research study?*" 91% responded "yes", while 93% responded "yes" when asked "*Would you be willing to share the activity data collected by this device with medical researchers aiming to better understand the link between exercise and disease?*" (Figure 2).

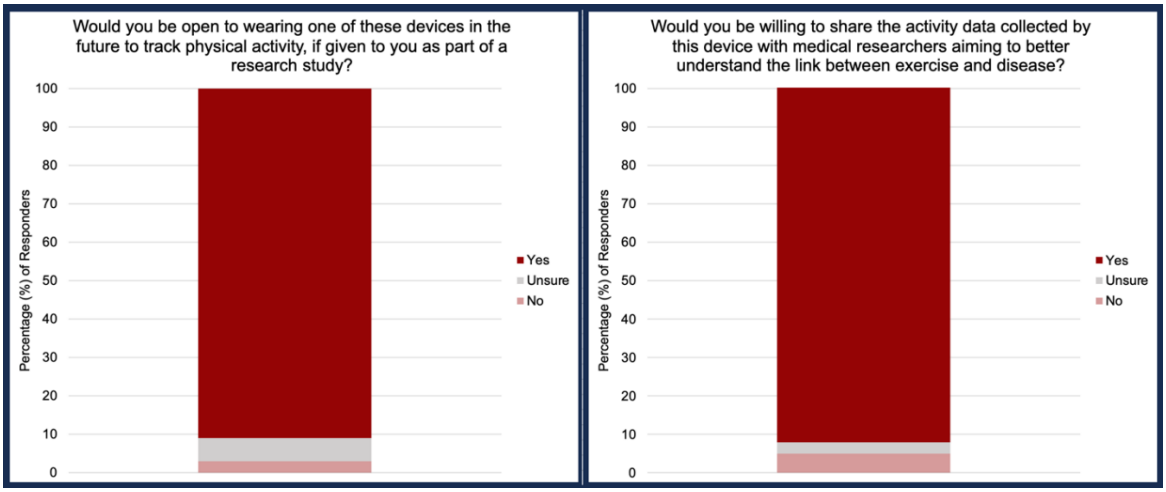

Figure 2. All ED survey participants were asked to characterize their future willingness to use WATs to track physical activity and to share activity data with research team.

Discussion

In this survey of ED patients, results demonstrated that although current WAT use is limited, >90% of all patients would be willing to wear an activity tracker for future exercise-based research study and share collected activity data. Our results add several novel findings to existing literature. This was the first study to our knowledge to survey a heterogenous urban ED population. Our patient sample represents a more racially and ethnically diverse group with a lower proportion of private/commercial insurance compared to national estimates of ED visit characteristics across the U.S. healthcare system.[15] Additionally, it was the first to demonstrate an overwhelmingly positive attitude toward wearing WATs for research in this population, which will be useful to the feasibility and human subjects' considerations

of future investigators. Although not particularly surprising, the significant variability in WAT use based on socioeconomic factors, with higher rates among higher income households, college graduates, suburban residents, and younger populations, was an additional novel finding in this population that aligns with prior studies.[16-17] WAT users were also significantly less likely to report comorbidities, including obesity and the related metabolic conditions of hypertension, hyperlipidemia, and diabetes, which is supported by results of a recent population-based cross-sectional study including a nationally representative sample of U.S. adults that showed decreased WAT use in individuals with cardiovascular disease compared to the overall population.[18] However, it is important to consider the influence of confounding variables when examining these results, specifically socioeconomic factors likely affecting both WAT use and overall health outcomes. Physical inactivity has been previously well-established to lead to numerous unfavorable health outcomes, with higher prevalence of inactivity amongst low-income and less educated subgroups.[19]

With rising numbers of patients using the ED for primary care, particularly socioeconomically disadvantaged populations, emergency physicians serve an increasingly vital role in providing health promotion and disease prevention services.[20-21] Additionally, emergency physicians are often in the unique position of encountering patients after a potentially life-threatening or lifechanging event, with prior studies demonstrating how experiencing a negative consequence related to one's risky health behavior can promote behavior change, i.e. the "sentinel event effect".[10-11] Although valid concerns exist over limitations in time and resources, particularly in the setting of increasing patient volumes and length-of-stay, ED-based health promotion interventions have been successfully implemented across several other areas, including alcohol and smoking cessation, opioid use disorder, vaccination programs, and HIV and STI screening.[22-23] Related to our study, future directions might include an ED-based intervention consisting of initial in-person exercise counseling and prescription, utilizing WAT technology to both measure and encourage physical activity upon ED discharge. Importantly, our results also suggest future study should include specific efforts to address disparities and reduce barriers currently existing amongst disadvantaged groups in this population, potentially through cost-reduction programs and increased educational initiatives.

The study has several limitations including its relatively small sample size and methodological design, with self-reported data. Thus, it could introduce recall or social desirability bias with participants over-reporting favorable responses such as those related to their daily exercise or willingness of future WAT use. Additionally, temporal bias may exist given the relatively short study period (May-August), which could limit our ability to capture seasonable variability in results. The survey utilized was created by our research team and not a validated instrument. Although WAT users were found to report more frequent exercise and fewer comorbidities, this association does not imply causality, and the inherent limitations of our survey-based study design precludes measuring the actual impact of the WAT itself on activity levels, health outcomes, or its ability to lead to behavior change.

Conclusions

Results indicate that although current WAT use is limited, most ED patients express interest in future use and willingness to share activity data with researchers. These data support the need and feasibility of an ED-based interventional study aimed at promoting activity-based behavior change, which could include the use of an exercise counseling and prescription program aided through WAT technology. Importantly, such interventions should include specific efforts to address disparities and reduce existing barriers in this population.

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