HHS Public Access
Author manuscript
J Assoc Nurses AIDS Care. Author manuscript; available in PMC 2024 September 25.

Published in final edited form as:
J Assoc Nurses AIDS Care. 2023 ; 34(6): 527–537. doi:10.1097/JNC.0000000000000427.

Do Walk Step Reminders Improve Physical Activity in Persons Living with HIV in New York City?: Results from a Randomized Clinical Trial

Gabriella Alvarez, MPH [Research Assistant],
Columbia University School of Nursing, New York, New York, USA.

Gabriella Sanabria, MEd [Doctoral Student],
Community and Family Health, College of Public Health University of South Florida, Tampa, Florida, USA.

Haomiao Jia, PhD, MS [Professor of Biostatistics (in Nursing)],
Columbia University School of Nursing, New York, New York, USA.

Hwayoung Cho, PhD, RN [Assistant Professor],
Department of Family, Community, and Health System Science, College of Nursing, University of Florida, Gainesville, Florida, USA.

Nancy R. Reynolds, PhD, MS, RN [Professor],
Johns Hopkins University School of Nursing, Baltimore, Maryland, USA.

Melissa Gradilla, MPH [Director of Grantmaking],
Every Mother Counts, New York, New York, USA.

Susan Olender, MD [Assistant Professor of Medicine],
Division of Infectious Disease, Department of Medicine, Columbia University Irving Medical Center, New York, New York, USA.

David C. Mohr, PhD [Director, Chief of Behavioral Medicine, Professor of Preventive Medicine (Behavioral Medicine)],
Center for Behavioral Intervention Technologies (CBITs), Department of Preventive Medicine, Medical Social Sciences and Psychiatry and Behavioral Sciences, Northwestern University, Chicago, Illinois, USA.

*Corresponding Author: Rebecca Schnall: rb897@columbia.edu.

Author Contributions
All authors on this article meet the four criteria for authorship as identified by the International Committee of Medical Journal Editors (ICMJE); all authors have contributed to the conception and design of the study, drafted or have been involved in revising this manuscript, reviewed the final version of this manuscript before submission, and agreed to be accountable for all aspects of the work.

Disclosures
The authors report no real or perceived vested interests related to this article that could be construed as a conflict of interest.

Clinical Trials.Gov Registration number: NCT03205982

Specifically, using the CRediT taxonomy, the contributions of each author is as follows:
Conceptualization: R. Schnall, H. Cho; Writing-Original Draft: G. Alvarez, R. Schnall; Data Curation, Formal Analysis: H. Jia; Writing-Review & Editing; N. Reynolds, M. Gradilla, H. Cho, S. Olender, D. Mohr; Project Administration: M. Gradilla, S. Olender, H. Cho, R. Schnall; Funding Acquisition: R. Schnall, D. Mohr, N. Reynolds.

Rebecca Schnall, PhD, MPH, RN-BC, FAAN, FACMI* **[Mary Dickey Lindsay Professor, Professor of Population and Family Health]**
Disease Prevention and Health Promotion, Columbia University School of Nursing, Columbia University, New York, New York, USA

Abstract

Supervised physical activity can increase functional capacity in persons with HIV (PWH); however, aerobic interventions have shown little improvement in overall physical activity in PWH. In response, we sought to assess the effect of wearing a fitness tracker (FitBit) paired with walk step reminders delivered via a mHealth application to improve physical activity and decreasing body mass index (BMI) amongst PWH in New York City. There was no significant difference in the frequency of walk-steps between participants in the control group and intervention group from baseline to 6-month follow-up. These findings show that walk step reminders alone were inadequate for sustained improvement of physical activity. This study highlights the need to develop and test the comparative efficacy of physical activity interventions that are tailored to the unique needs and capabilities of PWH. Future interventions should incorporate fitness tracking with tailored interventions focused on the promotion of physical activity.

Keywords

adherence; clinical trial; HIV; mHealth; physical activity; walk steps

Introduction

In contrast to the early days of the HIV epidemic when “wasting” or uncontrolled weight loss were hallmark signs of living with HIV, today approximately 50% of people with HIV (PWH) in the United States (U. S.) are overweight or obese (Silverberg et al., 2020; Tate et al., 2012; Taylor et al., 2014). In fact, the prevalence of body mass index (BMI) over 25.0 amongst PWH in the U. S. is an estimated 20% higher compared to PWH outside of the U.S. (Castro et al., 2016; Dakum et al., 2021; Guehi et al., 2016). The problem is worsening with rates of overweight and obesity amongst PWH in the United States increasing (Tate et al., 2012; Taylor et al., 2014). While obesity causes untoward health effects in the general population, its effect is even worse in PWH, placing them at increased risk of diabetes mellitus, hypertension, and cardiovascular disease (Fazekas-Lavu et al., 2018; Feinstein et al., 2019). Importantly, recent studies have identified weight gain in participants following the initiation of certain antiretroviral therapies (ART), such as INSTI-based regimens (Bourgi et al., 2020; Eckard & McComsey, 2020).

A potential driver behind this epidemic of overweight and obesity is the lower rate of physical activity amongst PWH as compared to the general population (Kitilya et al., 2022; Webel et al., 2015). People with chronic diseases often have difficulty staying physically active due to limited mobility, increased fatigue, and/or higher rates of depression (Rehm & Konkle-Parker, 2016). When compared to other populations with chronic diseases, PWH specifically are less likely to engage in regular physical exercise (Vancampfort et al., 2018). Moreover, PWH reportedly do not reach the recommended 10,000 walk steps per day, (Tudor-Locke et al., 2008) meeting only half as many steps daily (Ramírez-Marrero et al., 2008; Rehm & Konkle-Parker, 2016). On average, PWH also have lower overall physical activity energy expenditure and self-efficacy for physical exercise ability compared to those without HIV (Kitilya et al., 2022; Webel et al., 2015). Insufficient rates of physical activity can be directly associated with lower aerobic fitness and contribute to increased body fat mass amongst PWH (Ceccarelli et al., 2020). Therefore, addressing lack of physical exercise amongst PWH in the U. S. is a priority,

Previous studies investigating the effect of physical activity interventions for weight loss amongst PWH have attempted to provide exercise plans as a means of increasing physical activity. However, findings suggest that the provision of exercise plans alone does not improve rates of physical activity (Mabweazara et al., 2018; Vancampfort et al., 2018). In a systematic review, supervised physical activity increased functional capacity in PWH. However, combined aerobic/progressive resistance training improved strength, cardiovascular, and flexibility outcomes; aerobic interventions alone showed no significant improvements in physical activity (Voigt et al., 2018). Based on these findings, novel approaches that emphasize self-efficacy for physical activity and provide frequent reminders to initiate exercise may be highly effective. To better understand the potential impact of using step reminders as part of a mHealth intervention, we assessed the effect of wearing a fitness tracker (FitBit) paired with step reminders for improving physical activity and BMI amongst PWH in New York City, New York (USA).

Methods

Study Design

These data were collected as part of the WiseApp Trial (clinicaltrials.gov registration #NCT03205982), a two-arm randomized clinical trial (RCT) with the primary objective of assessing the efficacy of a self-management app (WiseApp) for improving ART adherence in PWH. The application contained real-time medication monitoring through linkage of an electronic pill bottle and fitness tracker for PWH to self-manage their health. In addition to the medication monitoring function, the fitness tracker and app also captured steps (walking data) over the course of the study period. One study arm received medication reminders associated with the timing of their medication each day (i.e. once, twice, three times per day) and the other study arm received reminders to reach their step goals each day. Details on the difference between study arms can be found in Figure 1.

The primary purpose of the RCT was to improve medication adherence in PWH; findings are published elsewhere (Schnall et al., 2022). This paper reports on the secondary objective of assessing the effect of the step reminders to increase physical activity and decrease BMI and waist-hip ratio in PWH as compared to the medication reminder arm who did not receive step reminders.

Recruitment

Participants were recruited across the five boroughs of New York City (U.S.) through a combination of community outreach, posting flyers, and word of mouth recommendation.

We conducted outreach primarily in locations with populations who are underserved and community HIV care centers/clinics. In addition, we distributed flyers at an urban academic hospital-based HIV program. Study details were also posted to the RecruitME website, a Columbia University Irving Medical Center (CUIMC) research database listing all actively enrolling research studies at CUIMC. Enrolled study participants were provided with study flyers to share with individuals in their community.

All eligible participants needed to meet the following criteria: 18 years of age or older, have a diagnosis of HIV, speak and understand English or Spanish, live in the U.S., own a smartphone, and currently take ART medications. Participants were also required to have an ART adherence rate of 80% or less as measured using the Visual Analogue Scale (VAS) or have a detectable viral load at the time of enrollment. Criteria for study ineligibility included participation in any other mobile app study for PWH, co-current participation in a directly observed therapy program for ART adherence, providing an incorrect response to any question on the short form of the Mini Mental State Examination (Schultz-Larsen et al., 2007), and/or an inability to use apps on their phone. Verbal informed consent was taken at pre-screening over the phone. If found eligible after prescreening, participants provided written consent for participation in the trial during their first study visit before beginning study procedures. A total of 200 participants were screened and enrolled for the trial (N = 200); 2 participants withdrew before completing the baseline survey for a final analytic sample of 198. Data collection occurred between January 2018 and November 2021.

Randomization

Study participants were randomized (1:1) to the WiseApp medication intervention or the “Walk-step reminder” control arm. Randomization codes were generated from a computer random number generator using SAS software. Random assignments were concealed from participants for the duration of study participation. Study staff members were not blinded to the participant’s randomization at baseline. Randomization was assigned at baseline by a study staff member after opening a sealed envelope with the treatment assignment listed inside.

Study Assessments

Participants in both study arms completed surveys at baseline, 3 months, and 6 months. Study assessments included a demographic survey, AUDIT-C score to measure alcohol use (Bush et al., 1998), Newest Vital Sign to measure health literacy (Rowlands et al., 2013) and PROMIS-29 to measure health-related quality of life, which has been validated in a national sample of PWH (Schnall et al., 2017). To calculate BMI, participant height and weight measurements were collected. We also collected hip and waist measurements following standard National Health and Nutrition Examination Survey (NHANES) waist and hip measurement protocol (Centers for Disease Control and Prevention, 2007). BMI data was entered by a study staff member into a Qualtrics survey taken at Baseline, 3-month follow-up, and 6-month follow-up.

The walk-step reminder group was provided with a walk-step goal and reminders through the WiseApp (Figure 2) and linked fitness tracker and received videos and health surveys centered on wellness and healthy lifestyle promotion through diet and exercise. During the baseline visit, study coordinators explained to the participants randomized to walk-step reminder arm how the fitness tracker is linked to the app and that they would receive reminders to complete their step goal through the app. Participants were instructed to wear the fitness tracker daily and to take it off when they shower and sleep. Otherwise, they should put it on when they start their day. Participants would receive reminders within the app and were able to set up notifications and reminders so that they would pop up without needing to open the app. Participants in this study arm were tasked with a “To Do” list which included a daily walk step goal as well as weekly videos and surveys. Participants’ daily walking steps were obtained electronically from the fitness tracker data logs. The Columbia University Institutional Review Board reviewed and approved this study through protocol #AAAQ9957 and determined that the device was of minimal risk. Participants provided written informed consent before participation in the study activities.

Data Analysis

The number of daily steps from the first day of the study to the end of the study (up to day 279) were obtained from electronic fitness trackers. Because the number of daily steps is a count measure, we estimated the number of daily steps from day 1 to the end of the study using a generalized linear mixed model (GLMM) for negative binomial distribution. We used a negative binomial model instead of a Poisson model because variance of number of steps was much greater than its mean for both arms. About 57% of days were recorded as zero steps. For all days with zero steps, we re-coded as missing values because we assumed that the fitness trackers were probably turned off (or the battery was dead). In the model, the main predictors are time (days of the study), study arm, and interaction term between the time and the intervention. To control for potential confounders, we can also include a set of baseline covariates in these models. The GLMM included a person-level random intercept for repeated measured data. GLMM was used because it is easy to handle data with dropouts and missing values which are common in a repeated measured data set.

We conducted the following analyses to evaluate model assumptions. First, we assessed normality assumption for the random effects. Shapiro-Wilk test had a p-value of 0.45. Thus, we cannot reject the normal assumption for the random effect in the generalized linear mixed model. Second, we compared the GLMM to a marginal model (GEE). Both models had same conclusion, i.e., no statistically significantly difference daily step curve for both GLMM and GEE negative binomial models (p value =0.8432 for GLMM and 0.7745 for GEE). Third, we conducted a comparison of GMM Poisson model to the GLMM NB model. The GLMM NB model had much better (smaller) goodness-of-fit indices (−2 log likelihood, AIC, AICC, BIC, CAIC, HQIC) than that for the GLMM Poisson model.

Participants’ BMI and waist-hip ratio were measured at the baseline, 3 months, and 6 months. Linear mixed models (LMM), similar to the GLMM described above, were used to examine change of these outcomes during the study follow-ups.

All our analyses were conducted with and without adjustment of participants’ baseline covariates (sex, race, viral load, and health literacy NVS scores). We reported only unadjusted results because similar results were observed between unadjusted curves and adjusted curves (adjusted for sex, race, viral load, and health literacy NVS score, see the third paragraph of the Results section). For both unadjusted and adjusted models, there was no statistically significant difference between two study arms (p=0.8432 for unadjusted model and 0.8088 for adjusted model).

Results

There was no significant difference in age, sexual orientation, relationship status, race, ethnicity, viral load or health literacy between study groups at baseline. There was a significant difference in sex/ gender characteristic between the study groups (p=0.0004). The mean age of study participants across groups was 49 (S.D. 10.5) years. 58.2% (n=114) of participants identified as male sex at birth while 53.5% (n=106) identified their gender as male. 41.9% (n=83) of participants identified their gender as female and 1% of participants identified as transgender male and 3% (n=6) as transgender female. 73.7% (n=146) of participants identified as African American/ Black. 51.0% (n=101) of participants reported an annual (individual) income of $10,000 or less. 88% (n=175) of study participants had seen their primary care provider in the last 6 months. 43.4% (n=85) of study participants indicated an alcohol problem in the past year and 67.7% (n=134) indicated use of illegal substances in the past 3 months. Additional demographic characteristics are included in Table 1 and were previously published in the trial outcome paper (Schnall et al., 2022).

The mean number of steps for the walk-step reminder group of participants was 8,410 (S.D. 212) over the 6 months of the study and the mean number of steps for the medication reminder group of participants was 7,837 (S.D. 178). The mean number of steps per day across participants in the walk-step reminder group ranged from 8,780 to 8,052, and the mean number of steps per day across participants in the walk-step reminder group ranged from 8,148 to 7,535. Additional details on the mean number of steps per day across the study period are illustrated in Figure 3.

There was no significant difference in steps between the two study arms at any time during the study period. Further, there was no difference in findings with and without controlling for the demographic characteristics including sex/gender. For both arms, the number of steps decreased significantly during the study period (decreased 4.3% for every 3 months with p=0.002 for the walk step reminder arm; decreased 3.9% for every 3 months with p=0.012 for the medication reminder arm). However, the decrease was not significantly faster for the walk step reminder arm (p=0.84). Similar results were observed between unadjusted curves and adjusted curves (adjusted for sex, race, viral load, and health literacy NVS score). No change in steps was observed for both arms for adjusted curves (decreased 1.1% for every 3 months with p=0.92 for the walk step reminder arm; decreased 0.6% for every 3 months with p=0.95 for the medication reminder arm and no significant difference in change of adjusted steps between the two arms with p=0.83).

We conducted a sensitivity analysis in which we did not code 0 steps as missing values. In the sensitivity analysis, daily steps decreased significantly faster for the study arm which received medication reminders as compared to the arm that received step reminders (decreased 70.8% for every 3 months with p<0.0001 for the walk step reminder arm;

decreased 75.8% for every 3 months with $p<0.0001$ for the medication reminder arm; RR=0.40 in 3 months for the walk step reminder arm relative to the medication reminder arm, $p<0.0001$). The sensitivity analysis had a different result than the main findings. Daily steps decreased significantly faster for the study arm which received medication reminders as compared to the arm that received step reminders.

We observed a very small difference in walk steps between the two study arms (RR=1.07-1.08) during the entire follow-up period (days 1-180). We estimated sample size in order to detect such small difference (RR=1.07). The required minimal total sample is 1854 or 927 per arm. If we limited our analysis to days 1-60, the minimum total sample of 1362 or 681 people per arm is needed to detect a small difference. Further, if we limited the power calculation based on the data from days 1-120 of our study, the minimum total sample size needed is 1528 people or 764 people study per arm.

For the secondary outcomes, there was no significant difference in BMI (both unadjusted and adjusted) at baseline between the two arms ($p=0.28$, 27.5kg/m^2 and 28.5Kg/m^2 for the step and medication reminder arms, respectively). There was no significant change of BMI from baseline for each arm (p-values > 0.15 for all changes in BMI to 3 months and to 6 months for each arm). There was no significant difference in change of BMI between the 2 study arms ($p=0.94$).

There was no significant difference in hip-to-waist ratio (both unadjusted and adjusted) at baseline ($p=0.28$, hip-to-waist = 1.09 and 1.08 for step and medication reminder arms, respectively). There was no significant change in hip-to-waist ratio from baseline for each arm (p-values >0.50 for all change in hip-to-waist ratio to 3 months and to 6 months for each arm). There was no significant difference in change of hip-to-waist ratio between the 2 study arms ($p=0.53$).

For other secondary outcomes (weight, waist, and hip), similar findings were observed. There was not significant difference in change of all outcome scores (unadjusted and adjusted scores) between 2 arms (all $p>0.37$). We conducted an analysis of fatigue and found that there was no significant difference in baseline fatigue between the two study arms ($p=0.21$). Additionally, there was no significant difference in change of fatigue from baseline to 3 and 6 months between the two study arms ($p=0.71$). Therefore, we did not include fatigue as a covariate in the analysis of other outcomes.

Discussion

Increased physical activity is a crucial yet overlooked component of quality-of-life improvement in PWH. Despite the perceived barriers to engaging in regular exercise, increased physical activity has been associated with reductions in physical pain and experiences with severe comorbidities. Our study assessed the effectiveness of a fitness tracker alone on the number of walk-steps completed by study participants to investigate this approach to physical activity promotion amongst PWH. There was no significant difference in the frequency of walk-steps between participants in the control group and intervention group from baseline to 6-month follow-up. In both groups, the number of walk-steps decreased significantly over the study period. These findings show that the use of the step reminders alone was inadequate for sustained improvement of physical activity in our study sample.

In addition, there was no significant difference in the speed of decline in walk-steps for those in the medication reminder group as compared to those receiving the walk-step intervention only. This suggests that the presence of a physical activity tracker and walk step reminders does not provide a meaningful effect on frequency of walk-steps in PWH. However, our findings suggest that daily steps decreased significantly faster for the study arm which received medication reminders as compared to the arm that received step reminders (RR=0.40 in 3 months for the walk step reminder arm relative to the medication reminder arm, $p<0.0001$). Therefore, the walk step reminders intervention was still effective to some extent.

Further, the potential shortcomings of fitness tracker-only interventions for the promotion of physical activity in PWH does not discount the potential use of fitness trackers in tandem with multi-component mobile interventions. A study by Bonato et al. (2020) assessed the impact of a 16-week coordinated exercise program paired with a tailored mobile app system. The mobile app monitored physical activity over the 16-week period while prompting reminders for pre-defined exercise sessions. Researchers found that those using the multi-component mHealth system significantly increased their aerobic fitness compared to those who used the app alone. A similar study by Cook et al. (2022) found that PWH who used a fitness tracker to monitor their walk steps reported increased physical activity when they addressed psychosocial components of their lifestyle such as decreased stress and higher self-esteem (Cook et al., 2022). Moreover, a study by Henry et al. (2019) suggests the potential for high acceptability of fitness tracker adherence amongst PWH for the intention of increasing physical activity (Henry et al., 2019). It is possible that multi-component physical activity interventions geared towards PWH may be most effective when capitalizing on the acceptability of fitness tracking technology whilst simultaneously addressing additional health management needs.

Notably, 51.0% of participants reported an annual income of $10,000 or less, which means that more than half of the study sample is below the poverty line. This is not atypical of many PWH in the United States.(Edmonds et al., 2021; Sprague et al., 2020; Wiewel et al., 2016). Nonetheless, further consideration is needed to better address the social determinants of health which are especially relevant for PWH and physical activity may not be their priority. Given that there was some improvement in our study sample despite the many challenges related to socioeconomic status, other social determinants of health and the COVID-19 pandemic, replication of this study should be considered (Hill et al., 2015).

As part of the inclusion criteria, participants were required to report ART adherence of 80% or less as measured using the VAS or have a viral load of over 400 copies/mL (detectable). Considering that these criteria can contribute to a weaker immune system and a potential increase in fatigue levels, we examined whether fatigue may have influenced the study results and found no significant difference in baseline fatigue between the two study arms and no significant difference in change of fatigue from baseline to 3 and 6 months between the 2 arms Therefore, we did not include fatigue as a covariate in the analysis of other outcomes.

There were several limitations to this study. Since we did not collect physical activity data on the participants at baseline, we do not know if the participants walked more than usual at the beginning of the study and then eventually went back to their normal exercise routine. Second, there was a significant difference in sex/ gender of participants randomized to each study group. To mitigate this limitation, we did control for this covariate in our analysis and did not find a significant difference between study arms. Importantly this study took place during the depths of the COVID-19 pandemic in New York City. Given the low overall use of the fitness tracker and other serious social and health challenges during much of the follow-up period of this study, further investigation is needed to better examine physical activity and the effect of walk-step reminders when participants are not grappling with lockdowns and barriers to accessing social and healthcare services. Finally, while we did not identify detectable effect sizes based on the sample available, there was a measurable difference in walk steps in the walk-step reminder group as compared to the medication reminder group. Further study is warranted to better understand the clinical implications of these differences.

Conclusions

Our findings suggest that mobile app interventions should not rely solely on exercise monitoring functions for the promotion of physical activity amongst PWH (McKay et al., 2018). Importantly, the main purpose of the WiseApp was to serve as a medication reminder which may also explain why the intervention was not efficacious at improving physical activity since participants may have thought they were in a medical adherence study and were therefore not motivated to change their physical activity behavior. Furthermore, this study highlights the need to develop and test the comparative efficacy of physical activity interventions that are tailored to the unique needs and capabilities of PWH. Future interventions should incorporate fitness tracking with tailored interventions focused on the promotion of physical activity. Our findings support the need for a more robust intervention that promotes physical activity for PWH. This is especially crucial given the aging of PWH and the excess of comorbidities compared with HIV negative controls.

Acknowledgments

This study was funded by the Agency for Healthcare Research and Quality under grant number # R01HS025071 (PI: Schnall). The content is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research and Quality. The funding source had no role in the design of the study; the collection, analysis, and interpretation of data; the writing of the report; or the decision to submit the paper for publication.

References:

Bourgi K, Jenkins CA, Rebeiro PF, Palella F, Moore RD, Altoff KN, Gill J, Rabkin CS, Gange SJ, Horberg MA, Margolick J, Li J, Wong C, Willig A, Lima VD, Crane H, Thorne J, Silverberg M, Kirk G, . . . Koethe JR (2020). Weight gain among treatment-naïve persons with HIV starting integrase inhibitors compared to non-nucleoside reverse transcriptase inhibitors or protease inhibitors in a large observational cohort in the United States and Canada. Journal of the International AIDS Society, 23(4), e25484. 10.1002/jia2.25484 [PubMed: 32294337]

Bush K, Kivlahan DR, McDonell MB, Fihn SD, Bradley KA, & Project, f. t. A. C. Q. I. (1998). The AUDIT Alcohol Consumption Questions (AUDIT-C): An Effective Brief Screening Test for Problem Drinking. Archives of Internal Medicine, 158(16), 1789–1795. 10.1001/archinte.158.16.1789 [PubMed: 9738608]

Castro C, Silveira EA, Falco Mde O, Nery MW, & Turchi MD (2016). Overweight and abdominal obesity in adults living with HIV/AIDS. Revista da Associacao Medica Brasileira (1992), 62(4), 353–360. 10.1590/1806-9282.62.04.353 [PubMed: 27437682]

Cook P, Jankowski C, Erlandson KM, Reeder B, Starr W, & Flynn Makic MB (2022). Low- and High-Intensity Physical Activity Among People with HIV: Multilevel Modeling Analysis Using Sensor- and Survey-Based Predictors. JMIR Mhealth Uhealth, 10(4), e33938. 10.2196/33938 [PubMed: 35436236]

Dakum P, Avong YK, Okuma J, Sorungbe T, Jatau B, Nedmbi N, Odutola MK, Abimiku A, Mensah CO, & Kayode GA (2021). Prevalence and risk factors for obesity among elderly patients living with HIV/AIDS in a low-resource setting. Medicine (Baltimore), 100(15), e25399. 10.1097/md.0000000000025399 [PubMed: 33847636]

Eckard AR, & McComsey GA (2020). Weight gain and integrase inhibitors. Current Opinion in Infectious Diseases, 33(1), 10–19. 10.1097/qco.0000000000000616 [PubMed: 31789693]

Edmonds A, Breskin A, Cole SR, Westreich D, Ramirez C, Cocohoba J, Wingood G, Cohen MH, Golub ET, Kassaye SG, Metsch LR, Sharma A, Konkle-Parker D, Wilson TE, & Adimora AA (2021). Poverty, Deprivation, and Mortality Risk Among Women With HIV in the United States. Epidemiology, 32(6), 877–885. 10.1097/ede.0000000000001409 [PubMed: 34347686]

Guehi C, Badjé A, Gabillard D, Ouattara E, Koulé SO, Moh R, Ekouevi D, Ahibo H, N'Takpé JB, Menan GK, Deschamps N, Lecarrou J, Eholié S, Anglaret X, & Danel C (2016). High prevalence of being Overweight and Obese HIV-infected persons, before and after 24 months on early ART in the ANRS 12136 Temprano Trial. AIDS Research and Therapy, 13, 12. 10.1186/s12981-016-0094-y [PubMed: 26925155]

Henry BL, Quintana E, Moore DJ, Garcia J, & Montoya JL (2019). Focus groups inform a mobile health intervention to promote adherence to a Mediterranean diet and engagement in physical activity among people living with HIV. BMC public health, 19(1), 101. 10.1186/s12889-018-6386-5 [PubMed: 30669986]

Hill CV, Pérez-Stable EJ, Anderson NA, & Bernard MA (2015). The National Institute on Aging Health Disparities Research Framework. Ethnicity & Disease, 25(3), 245–254. 10.18865/ed.25.3.245 [PubMed: 26675362]

Kitilya B, PrayGod G, Peck R, Changalucha J, Jeremiah K, Kavishe BB, Friis H, Filteau S, Faurholt-Jepsen D, Krogh-Madsen R, Brage S, & Olsen MF (2022). Levels and correlates of physical activity and capacity among HIV-infected compared to HIV-uninfected individuals. PLoS One, 17(1), e0262298. 10.1371/journal.pone.0262298 [PubMed: 35061774]

Mabweazara SZ, Leach LL, Ley C, & Smith M (2018). A six week contextualised physical activity intervention for women living with HIV and AIDS of low socioeconomic status: a pilot study. AIDS Care, 30(sup2), 61–65. 10.1080/09540121.2018.1470309 [PubMed: 29848009]

McKay FH, Cheng C, Wright A, Shill J, Stephens H, & Uccellini M (2018). Evaluating mobile phone applications for health behaviour change: A systematic review. Journal of Telemedicine and Telecare, 24(1), 22–30. 10.1177/1357633x16673538 [PubMed: 27760883]

Ramírez-Marrero FA, Rivera-Brown AM, Nazario CM, Rodríguez-Orengo JF, Smit E, & Smith BA (2008). Self-reported physical activity in Hispanic adults living with HIV: comparison with accelerometer and pedometer. The Journal of the Association of Nurses in AIDS Care : JANAC, 19(4), 283–294. 10.1016/j.jana.2008.04.003 [PubMed: 18598903]

Rehm KE, & Konkle-Parker D. J. A. c. (2016). Physical activity levels and perceived benefits and barriers to physical activity in HIV-infected women living in the deep south of the United States. AIDS Care, 28(9), 1205–1210. 10.1080/09540121.2016.1164802 [PubMed: 27023306]

Rowlands G, Khazaezadeh N, Oteng-Ntim E, Seed P, Barr S, & Weiss BD (2013). Development and validation of a measure of health literacy in the UK: the newest vital sign. BMC public health, 13, 1–9. 10.1186/1471-2458-13-116 [PubMed: 23280303]

Schnall R, Liu J, Cho H, Hirshfield S, Siegel K, & Olender S (2017). A health-related quality-of-life measure for use in patients with HIV: a validation study. AIDS patient care and STDs, 31(2), 43–48. 10.1089/apc.2016.0252 [PubMed: 28051875]

Schnall R, Sanabria G, Jia H, Cho H, Bushover B, Reynolds NR, Gradilla M, Mohr DC, Ganzhorn S, & Olender S (2022). Efficacy of an mHealth self-management intervention for persons living with HIV: the WiseApp randomized clinical trial. Journal of the American Medical Informatics Association: JAMIA, 30(3), 418–426. 10.1093/jamia/ocac233

Schultz-Larsen K, Lomholt RK, & Kreiner S (2007). Mini-Mental Status Examination: a short form of MMSE was as accurate as the original MMSE in predicting dementia. Journal of clinical epidemiology, 60(3), 260–267. 10.1016/j.jclinepi.2006.06.008 [PubMed: 17292020]

Silverberg M, Leyden W, Alexeeff S, Lam J, Anderson A, Hechter R, . . . & Horberg M (2020, July). Changes in body mass index over time in persons with and without HIV (abstractOAB0603). Journal of the International AIDS Society, 23 (S4, 23rd International AIDS Conference Abstract Supplement), e25547. 10.1002/jia2.25547. [PubMed: 32649039]

Sprague C, Brown SM, Simon S, McMahan LD, Kassiel I, & Konkle-Parker D (2020). Towards ending the US HIV epidemic by 2030: Understanding social determinants of health and HIV in Mississippi. Global Public Health, 15(1), 31–51. 10.1080/17441692.2019.1631366 [PubMed: 31221026]

Tate T, Willig AL, Willig JH, Raper JL, Moneyham L, Kempf MC, Saag MS, & Mugavero MJ (2012). HIV infection and obesity: where did all the wasting go? Antiviral Therapy, 17(7), 1281–1289. 10.3851/imp2348 [PubMed: 22951353]

Taylor BS, Liang Y, Garduño LS, Walter EA, Gerardi MB, Anstead GM, Bullock D, & Turner BJ (2014). High risk of obesity and weight gain for HIV-infected uninsured minorities. Journal of Acquired Immune Deficiency Syndromes, 65(2), e33–40. 10.1097/qai.0000000000000010 [PubMed: 24121754]

Tudor-Locke C, Hatano Y, Pangrazi RP, & Kang M (2008). Revisiting "How Many Steps Are Enough?". Medicine & Science in Sports & Exercise, 40(7). 10.1249/MSS.0b013e31817c7133

Vancampfort D, Mugisha J, De Hert M, Probst M, Firth J, Gorczynski P, & Stubbs B (2018). Global physical activity levels among people living with HIV: a systematic review and meta-analysis. Disability and Rehabilitation, 40(4), 388–397. 10.1080/09638288.2016.1260645 [PubMed: 27929355]

Voigt N, Cho H, & Schnall R (2018). Supervised Physical Activity and Improved Functional Capacity among Adults Living with HIV: A Systematic Review. Journal of the Association of Nurses in AIDS Care, 29(5), 667–680. 10.1016/j.jana.2018.05.001

Webel AR, Barkley J, Longenecker CT, Mittelsteadt A, Gripshover B, & Salata RA (2015). A cross-sectional description of age and gender differences in exercise patterns in adults living with HIV. Journal of the Association of Nurses in AIDS Care, 26(2), 176–186. 10.1016/j.jana.2014.06.004

Wiewel EW, Bocour A, Kersanske LS, Bodach SD, Xia Q, & Braunstein SL (2016). The Association Between Neighborhood Poverty and HIV Diagnoses Among Males and Females in New York City, 2010-2011. Public Health Reports, 131(2), 290–302. 10.1177/003335491613100213 [PubMed: 26957664]

Key Considerations

- Many PWH have persistent low physical activity levels which may exacerbate the cardiovascular and metabolic risk factors in this population.
- Step reminders alone are inadequate for sustained improvement of physical activity in our sample of PWH.
- A more robust intervention that promotes physical activity for PWH should be considered for sustained change in health behaviors.

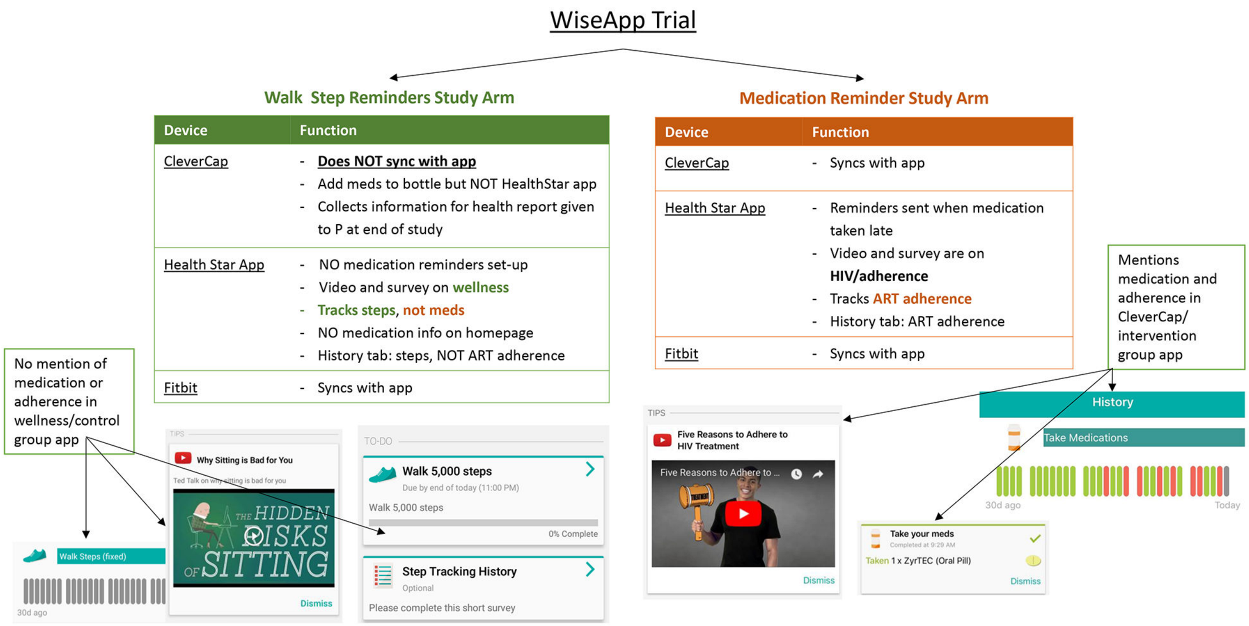

Figure 1.

Details on differences between the study arms.

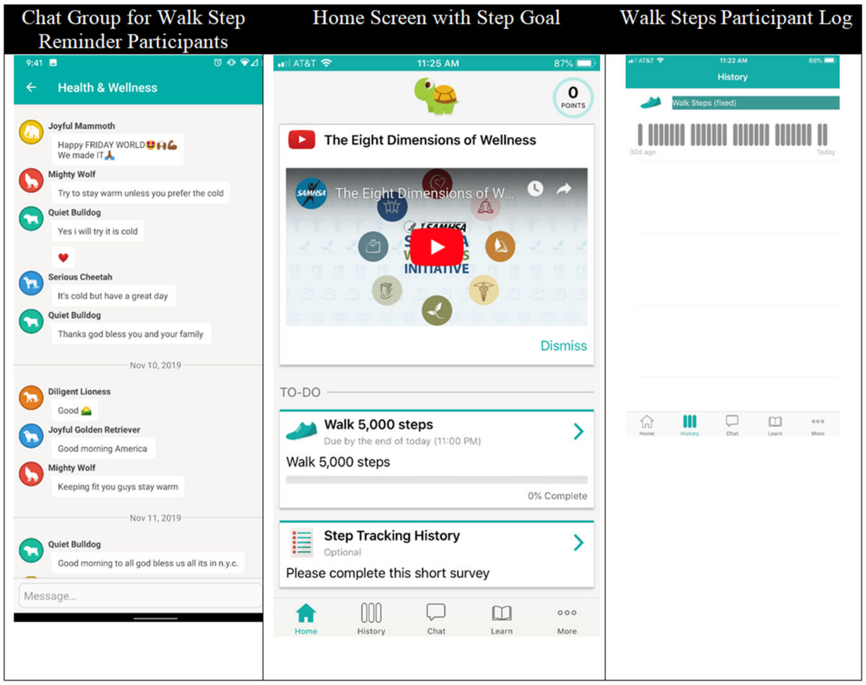

Figure 2.
Screenshots of Wellness arm participant app

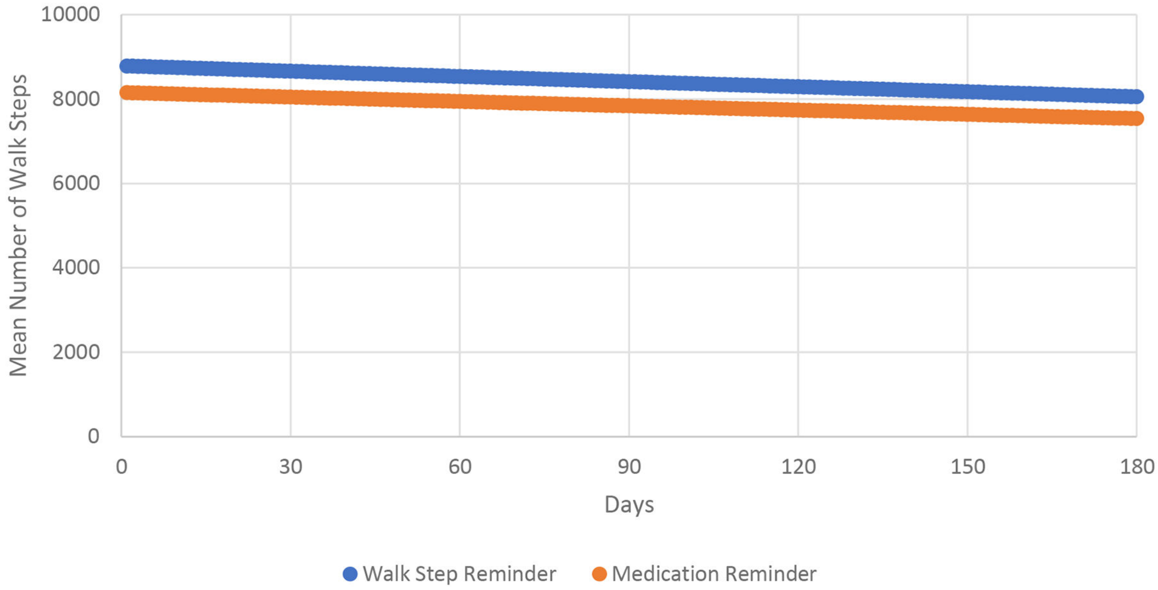

Figure 3.
Mean Number of Walk Steps by Study Arm on Each Day

Table 1:

Characteristics of N=198 WiseApp RCT Participants, Overall and by Study Condition

Characteristic	Walk Step Reminder Arm (n=101)	Medication Reminder Arm (n=97)	Total (N=198)
	Mean (SD)	Mean (SD)	Mean (SD)
Age, in years[1]	49.34 (10.2)	49.19 (10.9)	49.26 (10.5)
Sex at Birth[2]	**N (Col%)**	**N (Col%)**	**N (Col%)**
Male	72 (72.0)	42 (43.8)	114 (58.2)
Female	28 (28.0)	54 (56.3)	82 (41.8)
Gender Identity	**N (Col%)**	**N (Col%)**	**N (Col%)**
Male	67 (66.3)	39 (40.2)	106 (53.5)
Female	28 (27.7)	55 (56.7)	83 (41.9)
Transgender Male/Transman/FTM	2 (2.0)	0 (0.0)	2 (1.0)
Transgender Female/Transwoman/MTF	4 (4.0)	2 (2.1)	6 (3.0)
Other	0 (0.0)	1 (1.0)	1 (0.5)
Race	**N (Col%)**	**N (Col%)**	**N (Col%)**
African American/Black	71 (70.3)	75 (77.3)	146 (73.7)
American Indian/Alaskan Native	1 (1.0)	0 (0.0)	1 (0.5)
Native Hawaiian or Other Pacific Islander	2 (2.0)	0 (0.0)	2 (1.0)
White	8 (8.0)	5 (5.2)	13 (6.6)
Multiracial	2 (2.0)	5 (5.2)	7 (3.5)
Unknown/Missing	17 (16.8)	12 (12.4)	29 (14.7)
Ethnicity	**N (Col%)**	**N (Col%)**	**N (Col%)**
Hispanic/Latinx	27 (26.7)	24 (24.7)	51 (25.8)
Not Hispanic/Latinx	74 (73.3)	73 (75.3)	147 (74.2)
Employment Status	**N (Col%)**	**N (Col%)**	**N (Col%)**
Working full-time	6 (5.9)	5 (5.2)	11 (5.6)
Working part-time	14 (13.9)	12 (12.4)	26 (13.1)
Working off the books	1 (1.0)	3 (3.1)	4 (2.0)
Unemployed/Retired	54 (53.5)	48 (49.5)	102 (51.5)
Student	2 (2.0)	5 (5.2)	7 (3.5)
Disabled	32 (31.7)	32 (33.0)	64 (32.3)
Highest Education Level	**N (Col%)**	**N (Col%)**	**N (Col%)**
None	0 (0.0)	3 (3.1)	3 (1.5)
Elementary school	2 (2.0)	1 (1.0)	3 (1.5)
Some high school, no diploma	16 (15.8)	23 (23.7)	39 (19.7)
High school diploma or equivalent	25 (24.8)	34 (35.1)	59 (29.8)
Some college, associate degree, or technical degree	49 (48.9)	23 (23.8)	72 (36.4)
Bachelor/college degree	8 (7.9)	8 (8.3)	16 (8.1)

Professional or graduate degree	1 (1.0)	5 (5.2)	6 (3.0)
Annual Income	**N (Col%)**	**N (Col%)**	**N (Col%)**
Less than $10,000	52 (51.5)	49 (50.5)	101 (51.0)
$10,000-$19,999	25 (24.8)	22 (22.7)	47 (23.7)
$20,000-$39,999	13 (12.9)	8 (8.3)	21 (10.6)
$40,000 or more	2 (2.0)	5 (5.2)	7 (3.5)
Don't know	9 (8.9)	13 (13.4)	22 (11.1)
Last Primary Care Visit	**N (Col%)**	**N (Col%)**	**N (Col%)**
Last 3 months	87 (86.1)	88 (90.7)	175 (88.4)
3 to 6 months ago	8 (7.9)	6 (6.2)	14 (7.1)
6 to 9 months ago	2 (2.0)	1 (1.0)	3 (1.5)
9 to 12 months ago	1 (1.0)	0 (0.0)	1 (0.5)
I don't know	3 (3.0)	2 (2.1)	5 (2.5)
Indication of Past-Year Alcohol Problem[2]	47 (47.0)	38 (39.6)	85 (43.4)
Past 3-Month Substance Use	74 (73.3)	60 (61.9)	134 (67.7)
Detectable Viral Load (≥20 copies/ml) via Blood Draw[2]	64 (63.4)	55 (56.7)	119 (60.1)
	Mean (SD)	**Mean (SD)**	**Mean (SD)**
ART Adherence Visual Analog Scale[1]	71.8 (26.1)	66.8 (26.6)	69.4 (26.4)
Newest Vital Sign Health Literacy Score	1.5 (1.7)	1.6 (1.4)	1.6 (1.5)

[1] n=197 due to missing data

[2] n=196 due to missing data

[3] n=121 due to missing data

[4] n=183 due to missing data; SD=standard deviation; Col%=column percent; SE=standard error; percent may not add to 100% due to rounding error.