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Correlates of accelerometry non-adherence in an economically disadvantaged minority urban adult population

Matthew S. Cato, MPH[1], **Katarzyna Wyka, PhD, MA**[1], **Emily B. Ferris, MPH**[1], **Kelly R. Evenson, Ph.D., MS**[2], **Molly Wen, MS, MCS**[2], **Joan M. Dorn, PhD**[3], **Lorna Thorpe, PhD**[4], **Terry T.-K. Huang, PhD, MPH, MBA**[1]

[1]Center for Systems and Community Design, Graduate School of Public Health and Health Policy, City University of New York, New York, NY

[2]Department of Epidemiology, Gilling's School of Global Public Health, University of North Carolina, Chapel Hill, NC

[3]School of Medicine, City University of New York, New York, NY

[4]Department of Population Health, School of Medicine, New York University, New York, NY

Abstract

Objectives: The purpose of this study was to examine socio-demographic and psychosocial correlates of non-adherence to an accelerometry protocol in an economically disadvantaged urban population.

Design: Cross-sectional study

Methods: We analyzed 985 New York City adult participants aged 18–81 years from the Physical Activity and Redesigned Community Spaces (PARCS) study. Participants were asked to wear a hip-worn ActiGraph GT3X-BT accelerometer for one week. Adherent accelerometer wear was defined as ≥ 3 days of ≥ 8 hours/day of wear over a 7-day period and non-adherent accelerometry wear was defined as any wear less than adherent wear from returned accelerometers. Examined correlates of adherence included sociodemographic and psychosocial characteristics (e.g., general physical/mental health-related quality of life, self-efficacy for exercise, stress, sense of community/neighborhood well-being, and social cohesion).

Results: From the total sample, 636 (64.6%) participants provided adherent wear and 349 (35.4%) provided non-adherent wear. In multivariable analysis, younger age (odds ratio [OR]=0.63, 95% confidence interval [CI]: 0.53–0.75), poorer health-related quality of life (OR=0.80, 95% CI: 0.65–0.98 for physical health and OR=0.77, 95% CI: 0.62–0.94 for mental health), lower sense of community (OR=0.79, 95% CI: 0.62–1.00) and current smoking status (OR=1.97, 95% CI: 1.35–2.86) were associated with non-adherent wear.

Corresponding author: Prof. Terry T-K Huang, terry.huang@sph.cuny.edu.

Conclusions: Non-adherent wear was associated with younger age, smoking, and lower self-reported physical/mental functioning and sense of community. This information can inform targeted adherence strategies to improve physical activity and sedentary behavior estimates from accelerometry data in future studies involving an urban minority population.

Keywords

Accelerometry; adherence; physical activity; sedentary behavior; urban population; vulnerable populations

Introduction

Current US aerobic guidelines for adults aged 18–64 years recommend ≥150 minutes per week of moderate intensity aerobic physical activity or ≥75 minutes per week of vigorous intensity aerobic activity, or an equivalent combination of the two for not only the prevention of chronic diseases, but also for improved sleep, brain function and reduced anxiety.[1] Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure.[2] This includes activities which may be routine in nature, such as walking to work, as well as exercising which is planned and intended to maintain physical fitness. Due to the encompassing definition of physical activity and the cognitive challenge of recalling physically active duration and intensity in questionnaires, the utilization of accelerometry in research has grown over the past two decades.[3,4]

Although accelerometers are well validated for monitoring locomotion that is indicative of various types of physical activity, energy expenditure estimates are contingent on adequate participant wear adherence to a specified accelerometry protocol. A typical adult protocol involves wearing a hip-worn accelerometer for 7 consecutive days during all waking hours for a minimum of 10 hours a day with ≥10 hours of wear being considered an adherent day.[5] However, only 2–3 days of valid wear in adults have been demonstrated to produce reliable (ICC ≥0.80) estimates of habitual physical activity[6,7] and 8 hours has been used as a minimum limit for an adherent day.[8] Typically, the days with insufficient hours of wear and the participants with insufficient data are excluded from analysis which can introduce selection bias and reduce the generalizability of the study.[9] Thus, it is crucial that a study's design prioritizes obtaining sufficient accelerometry wear from each participant.

This US-based study explores the correlates of non-adherence to an accelerometry protocol using cross-sectional demographic and psychosocial survey data from the Physical Activity and Redesigned Community Spaces (PARCS) study. Prior studies have demonstrated that those who were younger,[5,9–11] non-White,[5,12] less educated,[5,11] current smokers,[5,10,11] and have a higher body mass index (BMI)[9,10] were less likely to provide adherent accelerometer wear. However, some of these studies analyzed national populations[5,9,11], non-US populations[9,11] and/or did not examine psychosocial measures as correlates.[5,9–11] To our knowledge, no research has been conducted to examine self-reported psychosocial factors related to insufficient accelerometry wear specifically in an urban minority community. Considering more than 80% of the US population lives in an urban setting and minority populations are at higher risk of many chronic health conditions, this demographic is a prime target for public health interventions.[13]

Another unique element of this study is the inclusion of psychosocial survey correlates with accelerometry wear. Only one other study examined self-reported cognitive and physical functioning as factors and found higher cognitive and physical functioning to be associated with higher adherence.[12] Results from this study may lay the groundwork for future qualitative inquiry by elucidating the psychosocial underpinnings of non-adherence and inform strategies to maximize adherence to an accelerometry protocol.

Methods

The PARCS study is a longitudinal natural experiment in New York City to assess the impact of citywide park redesign and renovation on local communities' physical activity, park usage, psychosocial and mental health, and community well-being.[14] Participants were recruited from park neighborhoods (defined as a 0.3 mile radius around the study park) that met two of three criteria: an area with high poverty (≥20% population below poverty line), high population growth (25% growth in 2000–2010) and high population density (≥110 people/acre). Other inclusion criteria included being ≥18 years of age, having no physical disability or mobility issues, being speakers of English, Spanish or Chinese (Mandarin or Cantonese), possessing a smartphone (surveys were primarily administered on a mobile phone app), and having no plans of moving out of the neighborhood within 4 years.

Eligible participants provided consent and completed an annual survey via a mobile phone app (PiLR EMA™). Those who were not able to use the app were asked to complete a paper survey. Participants were also instructed to wear the ActiGraph™ GT3X-BT (Pensacola, FL) accelerometer attached to an adjustable elastic belt around their hip for 7 days for ≥10 hours a day during waking hours, except while swimming or bathing. Written instructions of the study protocol were given and participants were called at least twice during their study period to facilitate adherence. Adherent participants were compensated with a gift card and participants with non-adherent wear were invited to re-wear the accelerometer.

Accelerometer non-wear was defined as intervals of at least 90 consecutive minutes of zero vector magnitude counts/15 seconds with allowance of up to 2 minutes of nonzero counts if no counts were detected during both the 30 minutes upstream and downstream from that interval.[14] Accelerometer data were uploaded and stored in ActiGraph's™ cloud system, Centrepoint, where wear time was recorded and used for accelerometer wear adherence categorization.

Accelerometry wear adherence was divided into two categories: adherent, non-adherent. Adherent wear (AW) was defined as ≥3 days of ≥8 hours/day of accelerometer wear. Non-adherent wear (NAW) was defined as any amount of wear data less than that specified of AW.

Coding for accelerometer wear adherence, socio-demographic and psychosocial variables is presented in Table A.1. Sociodemographic measures included self-reported age, gender, Hispanic status, race/ethnicity, household annual income, education, employment status, smoking status, sexual orientation, body mass index (BMI; derived from self-reported height and weight), marital status, and residency status in public housing. The psychosocial survey questionnaires used in this analysis included the Self-Efficacy for Exercise Behaviors Scale (SEEB),[15] Social Support for Exercise Behaviors Scale (SSEB),[16] Sense of Community Index (SCI),[17] Perceived Stress Scale (PSS),[18] Quality of Life Short-Form 12 (SF-12),[19] Social Cohesion and Social Trust-Collective Efficacy Scale (SCT-CE),[20] and Neighborhood Social Ties (NST).[21] All scales were calibrated so that a higher value indicated a healthier level of the construct. Differences in correlates across adherence groups were assessed using logistic regression with the response variable being the likelihood of NAW vs. AW. Demographic and survey score correlates were inserted into the univariate and multivariable models as predictors to measure the strengths of associations and determine the strongest correlates of non-adherent wear. In all regression models, all continuous variables (age, BMI and survey scales) were Z-normalized so that the odds ratios could be easily compared and interpreted as a 1 unit increase in standard deviation.

Three multivariable models with the event of providing NAW as the response variable were constructed. Model 1 regressed adherence status (NAW vs. AW) on all the demographic variables. Model 2 had the same response variable but included only the summary psychosocial scores (subscores were excluded due to multicollinearity concerns). Model 3 included both demographic and summary psychosocial scores (Models 1&2).

A secondary analysis using multiple imputation (MI) was performed to mitigate the effects of missing survey and demographic data and to improve statistical power by approximating a complete dataset. MI uses regression techniques to produce multiple complete versions of the original dataset, each of which contains varying estimates of the missing values based on the observed data. During regression analyses of the MI data, these versions are pooled to generate parameters of interest. Our imputation model contained all the demographic variables, the PARCS survey components of interest, and the categorical wear adherence variables. The multivariable imputation was performed with 30 imputations via chained equations (fully conditional method) which used separate conditional distributions for each imputed variable, allowing for appropriate estimations of the categorical demographic variables and continuous survey scores. Predictive mean matching was employed for all continuous variables to ensure that the imputed variables would be limited to plausible ranges. The multiple imputation regression outputs were reported due to the substantial number of participants excluded from regression via case-wise deletion in the multivariable models from the original data.

As a sensitivity analysis, we tested the robustness our results by modeling the adherence outcome as the number of 8+ hour days and a dichotomous 4-day, 8-hour adherence wear categorization. Additionally, the effects of non-adherence on accelerometry output were assessed. Specifically, we compared average vector magnitude (VM) counts per minute for the study week period across adherence groups. Only the original data was used for these sensitivity analyses.

All statistical procedures were conducted using SAS version 9.4 and statistical significance was set at $\alpha=0.05$.

Results

The sample included 985 participants; 636 (64.6%) provided AW and 349 (35.4%) provided NAW (Table 1). The study sample had a mean age of 40.6 years, included 72.7% female, 43.1% Hispanic, 49.5% Black (92.3% non-Caucasian), and had an average BMI of 29.8 kg/m^2. Overall, 54.2% reported an annual income of ≤20K, 52.3% reported high school or less as the highest education attained, 33.9% reported being retired, unemployed, or don't know, 26.8% reported being a current smoker, 11.6% reported being non-heterosexual, 72.1% reported not being married or living with a partner, and 60.5% reported living in public housing.

Table 1 also shows unadjusted comparisons of NAW vs. AW groups by demographic characteristics. Compared to participants who provided AW, those with NAW were 6.1 years younger on average (p<0.001) and had 1.41 times greater odds of being male vs. female (p=0.02), 1.88 times greater odds of being black vs. white (p=0.027), 1.44 times greater odds of earning less than 20K annually (p=0.017), 1.61 times the odds of reporting less than high school vs. at least some college (p=0.012), 1.48 times the odds of reporting high school vs. at least some college (p=0.015) as the highest education attained, and 2.06 times the odds of being a current smoker vs. non-smoker (p<0.001).

Table 2 shows the unadjusted results of modeling NAW against the individual psychosocial covariates via logistic regression. Significant summary scores inversely correlated with NAW included SCI (p=0.003), PSS (p=0.013), and SCT-CE (p=0.010). Subscores inversely associated with NAW included SSEB- family rewards and punishment (p=0.009), SCI reinforcement of needs (p=0.009), SCI membership (p=0.027), SCI influence (p=0.014), SCI emotional connection (p<0.001), SF-12 physical functioning (p=0.013), SF-12 social functioning (p=0.018), and NST-local sense of community (p=0.003). Except for SSEB friend participation (p=0.010), all the survey scale scores significantly associated with wear adherence were lower in the NAW group compared to the AW group on average.

Table 3 shows the significant predictors of NAW from three multivariable regression models from the original and imputed data. In Model 3 adjusting for all sociodemographic and psychosocial variables using imputed data, younger age (OR=0.63, 95% CI: 0.53–0.75), current smoking status (OR=1.97, 95% CI: 1.35–2.86), SF-12 PCS (OR=0.80, 95% CI: 0.65–0.98), SF-12 MCS (OR=0.77, 95% CI: 0.62–0.94) and the SCI summary score (OR=0.79, 95% CI: 0.62–1.00) were associated with NAW. Put another way, for a 1-unit SD increase in age, SF-12 PCS, SF-12 MCS, and SCI summary score, the odds of providing AW increased by 59%, 25%, 30% and 27%, respectively. Compared to smokers, non-smokers had a 97% increase in odds of providing AW.

On average, those with NAW produced 103 less VM counts (p=0.002) compared to those with AW, a difference maintained after stratifying by age and smoking status and after using a 4-day adherence wear definition (Table A.2). Modeling adherence as the number of adherent wear days in linear regression showed an 11.5 average VM counts/min increase (p=0.025) for a 1 day increase in adherent days (Table A.3).

Discussion

We found that participants who were younger, current smokers and those with lower self-reported measures of physical/mental functioning and sense of community were more likely to provide non-adherent accelerometer wear, after adjusting for other sociodemographic and psychosocial variables. These findings remained consistent when using a 4-day wear adherence definition.

Research has demonstrated that current smokers are typically less physically active which may affect engagement in a physical activity study.[22] Moreover, there is evidence that smoking is associated with lower conscientiousness and greater negative affectivity which have implications for self-discipline and adoption/perseverance with healthy behaviors.[23] Thus, the overrepresentation of current smokers in the NAW group compared to the AW group (36.7% vs. 22.0%) lends further support to these theories. Although smoking may not provide a causal explanation of non-adherence to an accelerometry protocol, it may reflect behavioral and psychosocial features that are unconducive to adherence to an accelerometry protocol.

A novel finding in the multivariable regression analysis was that lower SF-12 composite scores, PCS and MCS, were associated with greater odds of NAW. The SF-12 is a multifunction 12-question survey condensed from the Short form-36 health survey. Its main purpose is to provide a generic self-reported measure of 8 health domains assessing the respondent's mental/physical functioning and overall health-related quality of life.[24] The PCS evaluates one's overall health, physical mobility, limitations due to pain and ability to perform and other activities. The MCS focuses on the respondent's emotional/social well-being and limitations in social behavior. The composite scores and health domain subscores range from 0–100 (lowest to highest level of wellbeing) and were designed to be interpreted against US norm-based scores (Mean = 50.0, SD [standard deviation] = 10.0).[24] On average, our study population scored lower on both composite scores (PCS mean = 41.7, SD = 6.9, MCS mean = 45.2, SD = 8.1), suggesting an overall less healthy sample in comparison to the US population. Except for bodily pain, all the health domain mean subscores were lower among those providing NAW compared to those with AW with the statistically significant mean differences being physical functioning and social functioning. As Lee et al.'s study suggests, it is plausible that individuals who report lower physical and social functioning would be less capable or inclined to adhere to an accelerometry study protocol.[11]

The other summary score associated with NAW was the SCI summary score after adjusting for all other available correlates. This scale was derived from McMillian-Chavis' sense of community theory which conceptualized community through 4 elements: reinforcements of needs, membership, influence, and shared emotional connection, each represented by a separate survey subscore.[25] This interpretation of community relates to the personal relationship one has with the physical and social environment. Adherence to a community-based study may be directly impacted by one's feeling of membership, influence, personal investment and connection to that community. Prior research has shown that an increased sense of community is associated with greater civic engagement, a linkage which may be further stimulated within economically disadvantaged communities.[26] Our findings of the SCI mean summary score and subscores being lower in the NAW group versus the AW group ($p<0.05$) lend support to the above theoretical links.

Compared to the national average, our study sample's overrepresentation of current smokers (29.6% vs. 15.5%)[27] and lower mean scores on the SF-12 PCS and MCS may help explain the high level of NAW (35.4%) relative to other accelerometry studies.[5,12–15] However, these characteristics do not inevitably portend adherence challenges. One study with a large Black sample (n=4473) was able to achieve 76% adherence (accelerometer return with ≥4 days of ≥10 hours of wear).[28] However, that sample was older (≥45 years of age) and less urban (23% living in rural/suburban area) than ours. Another study examining adherence among primarily African American women was able to achieve 95% adherence after a concerted pre-study effort to ensure participants' understanding and comfort with the accelerometer protocol.[29] Although the study sample was much smaller (n=60) and less urban than ours, Sharpe et al. laid the groundwork for future accelerometry study designs for a similar population.[29]

Economically disadvantaged, minority urban populations may face unique obstacles for collecting accelerometry data including competing responsibilities of higher priority, pressing chronic health conditions, inexperience with research and technology, cultural differences and wariness of research institutions.[29] Furthermore, variance in observed accelerometer wear may be due to forgetfulness, motivation to participate, irregular sleep-wake cycles, employment demands, shift work and perception of fashion-acceptability. The complex interplay of these factors leading to non-adherence demands the application of both investigator and participant-based strategies.

Currently, 24-hour wrist accelerometer protocols are increasingly being deployed to enhance compliance and provide comprehensive daily estimates of energy expenditure, even during sleep periods. After the U.S. National Health and Nutrition Examination Survey (NHANES) switched from hip to wrist- based accelerometry in their 2011–2012 cycle, wear adherence markedly improved, specifically among younger participants.[3] Along with Sharpe et al.'s aforementioned tailored pre-study orientation to familiarize prospective participants to the accelerometry protocol, some other investigator-based adherence-promoting methods include follow-up calls, daily activity logs, incentives and creating research partnerships with participants.[29] Proactive efforts to identify, target and allocate resources towards those who at highest risk of non-adherence with these strategies are likely to maximize compliance.

From our sensitivity analyses, we observed that those who were less adherent produced less accelerometry VM counts/min which suggests that analysis that excludes those who are non-adherent or does not account for the association between non-adherence and lower physical activity estimates can lead to overestimated estimates of physical activity for the general population.

Some limitations of this analysis should be considered. The omission of other adherence-related factors specific to this population may limit causal explanations for non-adherence.

For example, immigration status, which was not collected in this study, may be an important consideration in today's sociopolitical climate affecting one's will to engage and provide information in a voluntary study. However, inquiring such delicate information in this population would require a considerable amount of trust and could hinder recruitment efforts. Additionally, the cross-sectional nature of the data precludes the ability to discover a causal explanation of non-adherence. Further research, including qualitative studies, is warranted to further contextualize our findings and capture the latent causes of non-adherence.

Conclusion

This paper broadens the existing body of literature on accelerometry wear adherence with a unique focus on an urban, minority, and economically disadvantaged population and with the inclusion of a vast range of psychosocial and community well-being measures as potential correlates. We found that non-adherent accelerometry wear was cross-sectionally associated with younger age, smoking, and lower self-reported measures of physical/mental functioning and sense of community. Future investigators can apply this information when designing targeted strategies to facilitate accelerometry wear adherence. Particularly in longitudinal studies, insufficient accelerometry data are a threat to a study's internal and external validity, which necessitates implementing measures to mitigate NAW.

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APPENDIX

Table A.1 –

Definition and categorization of all study variables, survey scales and constructs

Variable categories	Definition/Survey Scores
Accelerometry Protocol Adherence (*Primary Outcome*)	• Adherent wear (AW) - ≥3 days of ≥8 hours of accelerometer wear • Non-adherent wear (NAW) - <3 days of accelerometer wear
Demographic Variables (*Independent Variables*)	• Age *(continuous)* • Gender *(Male/Female)* • Hispanic Status *(Yes/No)* • Race *(Black/White/Other)* • Annual Income *(≤$20K/ >$20K)* • Highest Education Attained *(Less than high school/High School/Some College)* • Employment Status *(Employed, Self-employed, or Homemaker or Student/ Retired or Unemployed or Don't Know)* • Sexual Orientation *(Heterosexual/Non-heterosexual)* • Marital Status *(Married, Living with Partner/Never Married, Divorced, Separated or Widowed)* • NYCHA residency status *(Yes/No)*
Health Behavior (*Independent Predictors)*	• Smoking *(Current Smoker/Non-Smoker)* • BMI *(continuous)*

Variable categories	Definition/Survey Scores
Psychosocial/mental health (*Independent Variables*)	• Self-Efficacy for Exercise Behaviors Scale (SEEB)[19] ○ Stick to it, time • Social Support for Exercise Behaviors Scale (SSEB)[20] ○ Family Participation, Family Rewards and Punishment, Friend Participation • Perceived Stress Scale (PSS)[*][22] • Quality of Life Short-form 12 (SF-12)[23] ○ Composite Physical Score (PCS), Composite Mental Score (MCS) ■ Physical Functioning, Role Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role Emotional, Mental Health
Community Well-being (*Independent Variables*)	• Social Cohesion and Trust - Collective Efficacy (SCT-CE)[*][24] • Neighborhood Social Ties (NST)[*][25] ○ Socializing, Nearby Neighbors, Local Sense of Community • Sense of Community Index (SCI)[*][21] ○ Reinforcements of needs, Membership, Influence, Shared Emotional Connection

[*] Denotes the survey scales which have one summary score

Except for the PSS and SCT-CE, all the summary scores were comprised of subscores. The SEEB and SSEB subscores were treated separately and did not contribute to a summary score. For NST and SCI, summary scores were calculated by summing the subscores, while the SF-12 composite scores were calculated by summing the subscores multiplied with their associated factor scores.

APPENDIX

Table A.2:

Average accelerometer vector magnitude (VM) per minute ± standard deviation by age category and smoking status stratified by adherence

	Adherent (n = 623)	Non-adherent (n = 138)	Mean VM Difference	P value
Age (years)				
18–33	783 ± 280	708 ± 364	75	0.137
34–49	731 ± 255	563 ± 374	168	**<0.001**
50–65	679 ± 247	535 ± 293[1]	144	**0.016**
> 65	616 ±213	448 ±271[2]	168	0.150
Smoking status				
Non-smoker	713 ±260	603 ± 337	110	**0.011**
Current smoker	741 ± 264	648 ± 370	93	0.142
Total sample	**724 ± 262**	**622 ± 362**	**103**	**0.002**
Total sample using 4- day adherence criteria	**723 ± 251**	**662 ± 357**	**61**	**0.024**

Vector magnitude is equal to the square root of the sum of the squared accelerometer counts in the three-dimensional space ($\sqrt{x^2 + y^2 + z^2}$). P values were derived from two sample t-tests. [1]n=20, [2]n=4

APPENDIX

Table A.3:

Average vector magnitude (VM) per minute by the number of adherent days with at least 8 hours of accelerometer wear in the study week period

Physical activity variable	Number of adherent days							Total sample mean
	1	2	3	4	5	6	7	
Average VM per minute	602	683	712	739	754	692	716	706

Vector magnitude is equal to the square root of the sum of the squared accelerometer counts in the three-dimensional space ($\sqrt{x^2 + y^2 + z^2}$).

References

1. Piercy KL, Troiano RP, Ballard RM, et al. The Physical Activity Guidelines for Americans. Jama. 2018;320(19):2020. [PubMed: 30418471]
2. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Reports. 1985;100(2):126–131. [PubMed: 3920711]
3. Skender S, Ose J, Chang-Claude J, et al. Accelerometry and physical activity questionnaires - a systematic review. BMC Public Health. 2016;16:515. [PubMed: 27306667]
4. Troiano RP, McClain JJ, Brychta RJ, Chen KY. Evolution of accelerometer methods for physical activity research. Br J Sports Med. 2014;48(13):1019–1023. [PubMed: 24782483]
5. Loprinzi PD, Cardinal BJ, Crespo CJ, et al. Differences in Demographic, Behavioral, and Biological Variables between Those with Valid and Invalid Accelerometry Data: Implications for Generalizability. Journal of Physical Activity and Health. 2013;10(1):79–84. [PubMed: 22398390]
6. Trost SG, Mciver KL, Pate RR. Conducting Accelerometer-Based Activity Assessments in Field-Based Research. Medicine & Science in Sports & Exercise. 2005;37(Supplement).
7. Kocherginsky M, Huisingh-Scheetz M, Dale W, Lauderdale DS, Waite L. Correction: Measuring Physical Activity with Hip Accelerometry among U.S. Older Adults: How Many Days Are Enough? Plos One. 2017;12(3)
8. Jacobi D, Charles M-A, Tafflet M, Lommez A, Borys J-M, Oppert J-M. Relationships of self-reported physical activity domains with accelerometry recordings in French adults. European Journal of Epidemiology. 2009;24(4):171–179. [PubMed: 19283494]
9. Roth MA, Mindell JS. Who Provides Accelerometry Data? Correlates of Adherence to Wearing an Accelerometry Motion Sensor: The 2008 Health Survey for England. Journal of Physical Activity and Health. 2013;10(1):70–78. [PubMed: 22398686]
10. Evenson KR, Sotres-Alvarez D, Deng Y, et al. Accelerometer Adherence and Performance in a Cohort Study of US Hispanic Adults. Medicine & Science in Sports & Exercise. 2015;47(4):725–734.
11. Lee PH, Macfarlane DJ, Lam T. Factors associated with participant compliance in studies using accelerometers. Gait & Posture. 2013;38(4):912–917. [PubMed: 23688408]
12. Gemmill E, Bayles CM, McTigue K, et al. Factors associated with adherence to an accelerometer protocol in older adults. J Phys Act Health. 2011;8:1152–1159. [PubMed: 22039134]
13. U.S. Census Bureau. New Census Data Show Differences Between Urban And Rural Populations; 2016.
14. Huang T, Wyka K, Ferris E et al. The Physical Activity and Redesigned Community Spaces (PARCS) Study: Protocol of a natural experiment to investigate the impact of citywide park redesign and renovation. BMC Public Health. 2016;16(1).
15. Sallis J, Pinski RB, Grossman RM, et al. The development of self-efficacy scales for health related diet and exercise behaviors. Health Educ Res. 1988;3(3):283–92.

16. Sallis JF, Grossman RM, Pinski RB, et al. The development of scales to measure social support for diet and exercise behaviors. Prev Med. 1987;16(6):825–36. [PubMed: 3432232]
17. Chavis D, Lee KS, Acosta JD. The Sense of Community (SCI) Revised: The Reliability and Validity of the SCI-2. 2nd International Community Psychology Conference. Lisboa, Portugal; 2008.
18. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav. 1983;24(4):385–96. [PubMed: 6668417]
19. QualityMetric. QualityMetric Releases SF-12V2™ Health Survey Manual. Available at: https://www.qualitymetric.com/Portals/0/Uploads/Documents/Public/release_SF-12v2.pdf.
20. Sampson RJ, Raudenbush SW, Earls F. Neighborhoods and violent crime: a multilevel study of collective efficacy. Science. 1997;15(5328):918–20.
21. Kuo FE, Sullivan WC, Levine Coley R, et al. Fertile ground for community: inner-city neighborhood common spaces. Am J Commun Pyschol. 1998;26(6):823–51.
22. Kaczynski A. Smoking and Physical Activity: A Systematic Review. American Journal of Health Behavior. 2008;32(1).
23. Rondina Rde C, Gorayeb R, Botelho C. Psychological characteristics associated with tobacco smoking behavior. Brazilian Journal of Pulmonology. 2007;33(5).
24. Utah Department of Health. Interpreting the SF-12. 2001.Available at http://health.utah.gov/opha/publications/2001hss/sf12/SF12_Interpreting.pdf. Accessed 10 March 2019
25. Mcmillan DW, Chavis DM. Sense of community: A definition and theory. Journal of Community Psychology. 1986;14(1):6–23.
26. Talò C. Community-Based Determinants of Community Engagement: A Meta-Analysis Research. Social Indicators Research. 2017;140(2):571–596.
27. Office of the Surgeon General. The Health Consequences of Smoking−−50 Years of Progress: A Report of the Surgeon General.; 2014.
28. Howard VJ, Rhodes JD, Mosher A, et al. Obtaining Accelerometer Data in a National Cohort of Black and White Adults. Med Sci Sports Exerc. 2015;47(7):1531–7. [PubMed: 25333247]
29. Sharpe physical activity, Wilcox S, Rooney LJ, et al. Adherence to accelerometer protocols among women from economically disadvantaged neighborhoods. J Phys Act Health. 2011;8(5):699–706. [PubMed: 21734316]

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Practical Implications

- Those who were non-adherent to the accelerometry protocol were more likely to be younger, current smokers and to self-report lower physical and mental health-related quality of life and sense of community.
- Excluding or not accounting for those who are non-adherent in analysis can lead to overestimated physical activity estimates for the overall study population.
- This knowledge can inform targeted adherence strategies to improve physical activity estimates from accelerometry data in future research involving similar populations.

Table 1:

Descriptive table of sociodemographic variables across adherence groups

	Total n=985 (Col %)	**Participants with Adherent Wear (AW) n=636 (Col %)**	**Participants with Non-adherent Wear (NAW) n=349 (Col %)**	**NAW vs. AW Crude Odds Ratios (95% CI)[1]**	**P Value[1]**
Mean Age (SD) Range: 18–82	40.6 (13.8)	42.8 (14.0)	36.7 (12.5)	0.62 (0.54, 0.72)	**<0.001**
Gender [2]				1.41 (1.05,1.88) ref	**0.020**
Male	268 (27.3)	158 (24.9)	110 (31.8)		
Female	713 (72.7)	477 (75.1)	236 (68.2)		
Hispanic Status				1.01 (0.78,1.32) ref	0.932
Yes	415 (43.1)	268 (43.0)	147 (43.2)		
No	549 (57.0)	356 (57.1)	193 (56.8)		
Race					0.072
White	74 (7.7)	56 (9.0)	18 (5.3)	ref	
Black	477 (49.5)	297 (47.7)	180 (52.9)	1.88 (1.07,3.31)	
Other	412 (42.8)	270 (43.3)	142 (41.8)	1.64 (0.93,2.89)	
Annual Income					**0.017**
≤$20,000	439 (54.2)	280 (51.3)	159 (60.2)	1.44 (1.07,1.94)	
>$20,000	371 (45.8)	266 (48.7)	105 (39.8)	ref	
Highest Education Attained					**0.012**
Less than High School	170 (18.9)	105 (17.3)	65 (22.2)	1.61 (1.11,2.35)	
High School	301 (33.4)	192 (31.6)	109 (37.2)	1.48 (1.08,2.03)	
Some College or Higher	429 (47.7)	310 (51.1)	119 (40.6)	ref	
Employment Status					0.356
Employed/Self-Employed/ Homemaker/Student	580 (66.1)	383 (65.0)	197 (68.2)	ref	
Retired/Unemployed/Don't Know	298 (33.9)	206 (35.0)	92 (31.8)	0.87 (0.64,1.17)	
Smoking					**<0.001**
Current Smoker	292 (26.8)	126 (22.0)	103 (36.7)	2.06 (1.47,2.87)	
Non-Smoker	626 (73.2)	448 (78.1)	178 (63.4)	ref	
Sexual Orientation [2]					0.855
Heterosexual	739 (88.4)	496 (88.3)	243 (88.7)	ref	
Non-heterosexual	97 (11.6)	66 (11.7)	31 (11.3)	0.96 (0.61,1.51)	
Mean BMI (SD)	29.8 (7.3)	30.0 (7.5)	29.6 (6.9)	0.95 (0.33,1.09)	0.501
Marital Status					**0.008**
Married/Living with partner	253 (27.9)	180 (29.7)	73 (24.4)	ref	
Never Married/Divorced/	653 (72.1)	427 (70.4)	226 (75.6)	1.27 (0.93,1.74)	
Separated/Widowed					
NYCHA Residence					0.508

	Total n=985 (Col %)	Participants with Adherent Wear (AW) n=636 (Col %)	Participants with Non-adherent Wear (NAW) n=349 (Col %)	NAW vs. AW Crude Odds Ratios (95% CI)[1]	P Value[1]
Yes	593 (60.5)	379 (59.7)	214 (61.9)	1.10 (0.84,1.43)	
No	388 (39 6)	256 (40 3)	132 (38 2)	ref	

[1]P value for the comparison across wear adherence groups using logistic regression modeling the likelihood of NAW versus AW (reference group) as the response variable.

[2]There were 21 people who identified as Transgender but not included in this table

Abbreviation: CI = confidence interval. Ref = reference group

Bold denotes significance at $p < 0.05$

[*]Missing responses: Age n=11, Gender n=5, Hispanic n=29, Race n=30, Income n=224, Education n=123, Employment status n=149, Smoking n=172, Sexual Orientation n=189, BMI n=103, Marital Status n=115 , NYCHA n=5

Table 2:

Mean psycho-social survey scores and odds ratios from univariate regression using Z-standardized survey scores modeling the likelihood of providing non-adherent wear (NAW) compared to providing adherent wear (AW)

Survey Scale-Subscore (n[1],range)	Adherent wear Mean Scores ± SD	Non-adherent wear Mean Scores ± SD	Total Mean Scores ± SD	NAW vs. AW Crude Odds Ratios (95% CI)	P value[2]
SEEB-stick (n=687 ,0–5)	2.72 ± 1.11	2.81 ± 1.24	2.74 ± 1.15	1.08 (0.91,1.29)	0.394
SEEB-time (n=496, 0–5)	2.89 ± 1.01	2.97 ± 1.20	2.91 ± 1.06	1.08 (0.88,1.31)	0.475
SSEB-Family Participation (n=703, 0–40)	10.71 ± 9.62	11.50 ± 10.16	10.92 ± 9.86	1.09 (0.91,1.29)	0.352
SSEB-Family Rewards and Punishment (n=698, 0–12)	7.69 ± 1.45	7.34 ± 1.67	7.60 ± 1.51	0.80 (0.67,0.95)	**0.009**
SSEB-Friend Participation (n=700, 0–40)	9.18 ± 9.11	11.27 ± 9.51	9.70 ± 9.24	1.25 (1.05,1.48)	**0.010**
SCI Summary Score (n=727, 0–72)	27.40 ± 15.17	23.32 ± 15.62	26.43 ± 15.93	0.76 (0.63,0.91)	**0.003**
SCI-Reinforcement of Needs (n=726, 0–18)	7.04 ± 4.44	6.04 ± 4.20	6.80 ± 4.40	0.79 (0.66,0.94)	**0.009**
SCI-Membership (n=724, 0–18)	6.71 ± 4.08	5.92 ± 4.12	6.52 ± 4.10	0.82 (0.68,0.98)	**0.027**
SCI-Influence (n=724, 0–18)	6.13 ± 4.21	5.22 ± 4.59	5.92 ± 4.23	0.79 (0.66,0.95)	**0.014**
SCI-Shared Emotional Connection (n=723, 018)	7.62 ± 4.58	6.24 ± 5.57	7.29 ± 4.58	0.73 (0.60,0.87)	**0.001**
Perceived Stress Scale (n=722, 0–56)	32.31 ± 7.56	30.71 ± 6.54	31.93 ± 7.36	0.80 (0.67,0.96)	**0.013**
QoL SF-12 Composite Physical Score (n=486, 0–100)	41.75 ± 6.60	40.70 ± 7.84	41.51 ± 6.91	0.86 (0.70,1.06)	0.160
QoL SF-12 Composite Mental Score (n=486, 0–100)	45.79 ± 7.86	44.23 ± 8.60	45.43 ± 8.05	0.83 (0.67,1.02)	0.075
SF-12-Physical functioning (n=678, 0–100)	70.08 ± 32.98	62.42 ± 37.51	68.22 ± 34.27	0.81 (0.68,0.96)	**0.013**
SF-12-Role Physical (n=670, 0–100)	65.82 ± 43.70	59.32 ± 44.09	64.25 ± 43.85	0.86 (0.73,1.03)	0.102
SF-12-Bodily Pain (n=679, 0–100)	69.02 ± 32.17	70.61 ± 29.60	69.40 ± 31.55	1.05 (0.88,1.26)	0.574
SF-12-General Health (n=685, 0–100)	64.14 ± 27.82	64.06 ± 27.81	64.12 ± 27.80	1.00 (0.84,1.19)	0.973
SF-12-Vitality (n=503, 0–100)	59.38 ± 27.01	56.52 ± 30.70	58.73 ± 27.89	0.90 (0.73,1.11)	0.334
SF-12-Social Functioning (n=679, 0–100)	72.31 ± 30.74	65.49 ± 35.12	70.66 ± 31.96	0.81 (0.69,0.97)	**0.018**
SF-12-Role Emotional (n=534, 0–100)	66.10 ± 41.62	58.85 ± 42.90	64.46 ± 41.98	0.84 (0.69,1.04)	0.107
SF-12-Mental Health (n=679, 0–100)	67.98 ± 22.37	65.37 ± 25.02	67.35 ± 23.05	0.89 (0.75,1.06)	0.206
Collective Efficacy/Social Cohesion and Trust (n=680, 0–20)	11.01 ± 3.37	10.23 ± 3.38	10.82 ± 3.39	0.79 (0.66,0.95)	**0.010**
NST Summary Score (n=767, 0–28)	11.82 ± 6.52	10.84 ± 6.43	11.56 ± 6.51	0.86 (0.73,1.01)	0.066
NST-Socializing (n=766, 0–8)	2.17 ± 1.79	2.25 ± 1.84	2.19 ± 1.81	1.05 (0.89,1.24)	0.544
NST-Nearby Neighbors (n=765, 0–8)	3.70 ± 3.50	3.44 ± 3.09	3.63 ± 2.48	0.90 (0.76, 1.06)	0.194

Survey Scale-Subscore (n[1],range)	Adherent wear Mean Scores ± SD	Non-adherent wear Mean Scores ± SD	Total Mean Scores ± SD	NAW vs. AW Crude Odds Ratios (95% CI)	P value[2]
NST Local Sense of Community (n=766, 0–12)	5.98 ± 3.42	5.15 ± 3.19	5.76 ± 3.38	0.78 (0.66,0.92)	**0.003**

[1]Denotes the total sample that provided data for each survey scale

[2]P value for the comparison between wear adherence groups using logistic regression modeling the likelihood of NAW versus AW (reference group) as the response variable.

Abbreviation: SD = standard deviation. CI = confidence interval. SEEB = Self-Efficacy for Exercise Behaviors. SSEB = Social Support for Exercise Behaviors. SCI = Sense of Community of Index. QoL SF-12 = Quality of Life Short Form 12. NST = Neighborhood Social Ties.

Bold denotes statistical significance at $p < 0.05$.

Note. All scores were calibrated so that a higher score indicates better health/psychosocial measures. Regression input was Z-standardized so that the ORs can be interpreted as the odds of NAW vs. AW for a 1 standard deviation unit increase in score.

Table 3

Statistically significant correlates and odds ratios (OR) of the likelihood of providing non-adherent wear (NAW) vs. adherent wear (AW) from multivariable regression models adjusting for demographic and survey variables

	Original Data			**Imputed Data (n=985)**		
	Significant Predictors	**Adjusted OR (95% CI)**	**P value**	**Significant Predictors**	**Adjusted OR (95% CI)**	**P value**
Model 1 (n=737)*	Age	0.58 (0.47, 0.70)	<0.001	Age	0.60 (0.51, 0.71)	<0.001
	Current Smoker	2.09 (1.42, 3.06)	<0.001	Current Smoker	2.10 (1.78, 2.46)	<0.001
Model 2 (n=410)*	SCI summary	0.64 (0.45, 0.91)	0.013	SF-12 PCS	0.79 (0.66, 0.95)	0.015
				SF-12 MCS	0.75 (0.62, 0.90)	0.002
				SCI Summary	0.74 (0.59, 0.93)	0.009
Model 3 (n=337)*	Age	0.31 (0.20,0.50)	<0.001	Age	0.63 (0.53, 0.75)	<0.001
				Current Smoker	1.97 (1.35, 2.86)	<0.001
				SF-12 PCS	0.80 (0.65, 0.98)	0.033
				SF-12 MCS	0.77 (0.62, 0.94)	0.011
				SCI summary	0.79 (0.62, 1.00)	0.048

Model 1 includes all sociodemographic variables in Table 1

Model 2 includes Self-Efficacy for Exercise Behaviors (SEEB) subscores, Social Support for Exercise Behaviors (SSEB) subscores, Sense of Community (SCI) summary, Perceived Stress Scale (PSS), Quality of Life by Short-Form 12 (QoL SF-12) Physical and Mental composite scores (PCS and MCS), Social Cohesion and Social Trust-Collective Efficacy (SCT-CE), Neighborhood Social Ties (NST) summary

Model 3 includes all variables in Models 1 & 2

Note: All scores were calibrated so that a higher score indicates better health/psychosocial measure. Age, BMI and all survey scores were Z-standardized. Regression input was Z-standardized so that the adjusted odds ratios (ORs) could be interpreted as the odds of NAW vs. AW for a 1 standard deviation unit increase in score.

CI = confidence interval.

*Sample size in regression models using case-wise deletion from the original data