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Participant Adherence Indicators Predict Changes in Blood Pressure, Anthropometric Measures, and Self-Reported Physical Activity in a Lifestyle Intervention: HUB City Steps

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Abstract

The objective of this secondary analysis was to evaluate the utility of several participant adherence indicators for predicting changes in clinical, anthropometric, dietary, fitness, and physical activity (PA) outcomes in a lifestyle intervention, HUB City Steps, conducted in a southern, African American cohort in 2010. HUB City Steps was a 6 month, community engaged, multi component, non controlled, intervention targeting hypertension risk factors. Descriptive indicators were constructed using 2 participant adherence measures, education session attendance (ESA) and weekly steps/day pedometer diary submission (PDS), separately and in combination. Analyses, based on data from 269 primarily African American adult participants, included bivariate tests of association and multivariable linear regression to determine significant relationships between 7 adherence indicators and health outcome changes, including clinical, anthropometric, dietary, fitness, and PA measures. ESA indicators were significantly correlated with 4 health outcomes, body mass index (BMI), fat mass, low density lipoprotein (LDL), and PA ($r = .29$ to $.23$; $P < .05$). PDS indicators were significantly correlated with PA ($r = .27$; $P < .001$). Combination ESA/PDS indicators were significantly correlated with 5 health outcomes, BMI, % body fat (%BF), fat mass, LDL, and PA ($r = .26$ to $.29$; $P < .05$). Results from the multivariate models indicated that the combination ESA/PDS indicators were the most significant predictors of changes for 5 outcomes, %BF, fat mass, LDL diastolic blood pressure (DBP), and PA, while ESA performed best for BMI only. For DBP, a 1 unit increase in the continuous categorical ESA/PDS indicator resulted in .3 mm Hg decrease. Implications for assessing participant adherence in community based, multi component lifestyle intervention research are discussed.

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Declaration of Conflicting Interests

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Keywords

African American; health behavior; community health promotion; diet; physical activity; measurement issues

Introduction

Lack of participant adherence to behavioral program components targeting diet and physical activity is a recurrent challenge in intervention research and major threat to intervention effectiveness (Blue & Black, 2005). Adherence determines the extent an intervention has been received by participants (dose) and can aid in understanding relationships between program elements and participant outcomes (response) (Saunders, Evans, & Joshi, 2005). Higher levels of intervention implementation, including adherence, fidelity, and reach, have been associated with more positive health outcomes, such as improved mental and physical health (Durlak & DuPre, 2008). Thus, implementation data is essential for determining why programs succeed or fail, and participant adherence measures can aid in identifying intervention components that appear to have achieved the largest impact on health outcomes. Data of this nature is especially relevant for health interventions grounded in several theoretical concepts (e.g., Transtheoretical Model of Change and Self Determination Theory) that include multiple components (e.g., social support and nutrition education), or that are designed to effect change in multiple behaviors (e.g., diet and physical activity).

In a descriptive literature review examining conceptual and methodological issues of diet and physical activity interventions, 8 of 17 identified studies reported participant adherence indicators (Blue & Black, 2005). Frequency of class attendance was the most common measure reported (6 of 8 studies), with self report measures of participant adherence presented in 2 studies. In a worksite physical activity program, employee participation was assessed by number of goal sheets submitted (Wilson et al., 2010), while in a worksite nutrition intervention, contest participation and education event attendance were separately assessed (Patterson et al., 1997).

Although the effects of single adherence measures on health outcomes have been reported, little has been reported concerning multiple measures. The relationship between a multi dimensional adherence measure and physical activity participation was reported for Project PRIME, a 2 arm lifestyle physical activity intervention (Heesch, Masse, Dunn, Frankowski, & Mullen, 2003). Similarly, multi dimensional adherence measures were reported for POUNDS LOST, a trial designed to test the efficacy of 4 dietary macro nutrient compositions for promoting weight loss (Williamson et al., 2010). However, the adherence measures were not subsequently linked to the amount of weight lost or other health outcomes.

The primary analysis of HUB City Steps, a lifestyle intervention conducted in a southern, primarily African American cohort, examined the intervention's effectiveness in achieving improvements in blood pressure (BP), anthropometric measures, biological measures, and diet. Results of this analysis have been reported elsewhere (Zoellner et al., 2014). Because exploratory analysis of the study data revealed differences in outcome changes based on

participant adherence to intervention components, and given the limitations of the literature, the objective of this secondary analysis was to evaluate the utility of several participant adherence indicators, based on educational session attendance (ESA) and pedometer diary submission (PDS), for predicting changes in clinical, anthropometric, dietary, fitness, and physical activity outcomes in HUB City Steps.

Method

Design

Procedures followed in HUB City Steps were in accordance with ethical standards for human subjects research and approval was obtained from the University of Southern Mississippi's Institutional Review Board. Study participants provided informed written consent. HUB City Steps was a 6 month, community based, multi component, educational program designed to improve hypertension and its risk factors in a primarily African American adult cohort. Although the study was designed in two phases, an initial 6 months of intervention followed by 12 months of maintenance, only the non controlled intervention phase is relevant to these analyses. Baseline data was collected from January to February 2010, and 6 month data was collected from July to August 2010.

Recruitment of study participants involved various methods, including flyers, word of mouth, and community events. Recruitment efforts were primarily directed toward African American residents; however, race/ethnicity was not an exclusion criterion. Eligibility criteria included age (18 years or older), English speaker, non institutionalized, and resident of the Hattiesburg, MS area. For safety reasons, individuals with BP $\geq 180/110$ were disqualified from participation and directed to seek immediate medical attention. All other individuals were eligible for participation regardless of BP status and medication regimen.

Intervention

HUB City Steps integrated components from several theoretical concepts and frameworks including social support, Self Determination Theory, and the Transtheoretical Model of Change (Zoellner et al., 2011). The lifestyle intervention consisted of 4 primary components. The first component included 3 sessions of 1 on 1 motivational enhancement, an adaptation of motivational interviewing that uses a feedback approach (Madson, Landry, Molaison, Schumacher, & Yadrack, In press; Miller, Zweben, DiClemente, & Rychtarik, 1992). Trained intervention staff provided these 20 minute sessions at baseline, 3 month, and 6 month health assessments. Each participant received an individualized "Know Your Numbers" (e.g., BP, body mass index [BMI], cholesterol, glucose) card that served as a central point of the discussion, aimed at developing an individualized health behavior change plan. The second component consisted of social support provided by walking group leaders who were indigenous community members. These volunteers served as liaisons between participants and research staff and were trained to encourage walking, goal setting, and submission of pedometer diaries. The third component consisted of pedometer diary self monitoring (described in the Measures section). The fourth component consisted of 5 90 minute monthly education sessions that included key principles of the Dietary Approaches to Stop Hypertension (DASH) diet (Sacks et al., 2001), group physical activity, and sharing

of successes and challenges. The session topics included: negative side effects of high BP and benefits of exercise for controlling BP; DASH diet and community options available for exercise and healthy eating; problem solving techniques related to cooking and role of sodium in controlling BP; empowerment to implement healthy lifestyle changes; and healthy choices when eating out and identification of triggers that influence unhealthy menu choices. Six local community health professionals, including 4 health educators and/or registered dietitians and 2 fitness instructors, were trained to lead the education sessions. Participants received monetary compensation for their time involved in data assessments. Further details regarding study methodology, are published elsewhere (Zoellner et al., 2011).

Measures

Questionnaire data included demographics, medical history, medication use, and fasting and smoking status. The National Cancer Institute's 18 item, Five Factor Screener was used to assess dietary intake (Thompson et al., 2004). An OMRON HEM 907XL automatic inflation sphygmomanometer, portable stadiometer, Tanita body fat analyzer model TBF 310T, and Cholestech LDX Lipid Analyzer were used to measure BP, height, weight and body composition, and non fasting cholesterol and glucose, respectively. As a fitness measure, the 6 minute walk test was assessed (American Thoracic Society: Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories, 2002). Pedometers (model SW 701, Yamax Corporation, Tokyo, Japan) were used to record steps/day, a physical activity measure. Participants were instructed to wear the provided pedometer on the waist during waking hours and to self monitor their steps/day using weekly PDS via mailed postcards or logging into the intervention's website. To track ESA, participants signed in upon arrival at these sessions.

Two participant adherence measures, ESA and PDS, and several methodological approaches to computing descriptive indicators were explored and included continuous and categorical, as well as singular (ESA or PDS alone) and combination (ESA/PDS) variables. Seven adherence indicators were analyzed: continuous ESA (range = 0 5 sessions), continuous PDS (range = 0 27 weeks), categorical ESA (low = 0 2 sessions vs. high = 3 5 sessions; based on median split), categorical PDS (low = 0 13 weeks vs. high = 14 27 weeks; based on median split), continuous ESA/PDS ($[6*ESA]+PDS$), categorical ESA/PDS ($ESA[low/high]*PDS[low/high] = 4$ categories), and continuous categorical ESA/PDS (ESA quartiles $*PDS$ quartiles, range = 1 16). Median and quartile splits were used because of their intuitive interpretation and for consistency with adherence reports in other behavioral studies (Bergh et al., 2012; Tussing Humphreys, Thomson, Mayo, & Edmond, 2013; Zoellner et al., 2013). For the continuous ESA/PDS indicator, ESA was multiplied by 6 to approximate the range (weighting) of PDS. For the continuous categorical ESA/PDS indicator, ESA and PDS were first separately split into quartiles, and these quartiles were subsequently multiplied together to obtain an ordinal variable that was treated in a continuous manner (similar to the continuous ESA indicator). Although motivational enhancement session participation could be considered a measure of program adherence, the sessions occurred at each assessment point immediately following data collection. Hence, it was not possible to use motivational enhancement session participation as a measure of program adherence due to confounding with time.

Statistical Analyses

Statistical analyses were performed using SAS software, version 9.3 (SAS Institute Inc., Cary, North Carolina). Bivariate tests (Pearson correlation coefficients, *t* tests, and ANOVA) were used to determine significant associations between participant adherence indicators and health outcome changes (baseline to 6 months follow up), including anthropometric [waist circumference, body mass index (BMI), % body fat (%BF), fat mass, and lean body mass], clinical [systolic BP (SBP), diastolic BP (DBP), total cholesterol, high density lipoprotein, low density lipoprotein (LDL), triglycerides, and glucose], fitness (6 minute walk test), and dietary intake (calcium, dairy, fiber, fruit and vegetables, and sugar) measures. While we used change in pedometer determined mean steps/day as the physical activity outcome, change was not from baseline to 6 months follow up because no baseline steps/day data was collected. Hence, change was calculated as the difference between steps/day reported during the first 2 weeks of the intervention and the remaining weeks (3–27). Positive changes represent an increase in steps/day between the initial and remaining weeks of the intervention period. Thus change in intervention steps/day represents persistence in or maintenance of step defined physical activity rather than true change from pre intervention baseline. Further details regarding the rationale, methodology, and utility of this steps/day indicator may be found elsewhere (Thomson et al., 2012). Multiple group comparisons for the categorical indicators were based on least squares means using Tukey Kramer adjusted *p* values. Multivariable linear regression was used to determine the predictive ability of the adherence indicators for health outcome changes in the presence of covariates. Baseline covariates included age, gender, marital status, education level, income level, smoking status, BMI, and outcome value of interest (e.g., baseline SBP). Steps/day reported during the first 2 weeks of the intervention was used as the steps/day baseline value. For modeling purposes, marital status was dichotomized to married and not married (including widowed, divorced, separated, and never married), while education level was collapsed to high school graduate or less (including GED) and at least some college (including trade or vocational school, some college, college degree, some graduate/professional school, and graduate/professional degree). Further, income level was modeled as a continuous variable due to its relatively large number of categories (*n*=12). A significance level of .05 was used, though we built multivariate models for both significant and trending ($.05 < p \leq .10$) associations between participant adherence indicators and health outcome changes.

Results

Baseline demographic, anthropometric, clinical, fitness, step defined physical activity, and dietary characteristics are presented in Table 1. Most participants were African American (94%), female (85%), overweight or obese (91%), with a mean age of 44 (SD=12.2) years. The majority (75%) of participants had at least some college education and 27% reported household incomes greater than \$50,000 per year. Diagnosed high BP was self reported by 42% of participants; 65% of participants were classified as low ESA and 40% as low PDS. The retention rate was 71% (190/269) at 6 months. Significant decreases of approximately 6 and 4 mm Hg in SBP and DBP, respectively, were apparent at 6 months, as was an approximate 3 teaspoons decrease in sugar intake (Zoellner et al., 2014). Significant improvements were not found in any other health outcomes.

Bivariate relationships among participant adherence indicators and health outcome changes are presented in Table 2. Because results for continuous and categorical indicators were similar (i.e. significant or non significant for both) except for 1 dietary measure, only the continuous indicator results are presented in the table. Significant associations were observed between the continuous and categorical ESA indicators and BMI, fat mass, LDL, and change in mean steps/day ($.29$ r $.23$). Only change in mean steps/day was significantly associated with the continuous ($r=.27$) and categorical PDS indicators. For the 3 ESA/PDS indicators, significant associations were observed for BMI, %BF, fat mass, LDL, and change in mean steps/day ($.26$ r $.29$). Significant correlations were not apparent between the continuous adherence indicators and the dietary measures. However, a significant association was observed between the categorical ESA/PDS indicator and fruit and vegetable intake with the largest increase observed in the high/low ESA/PDS group, similar increases between the low/low ESA/PDS and low/high ESA/PDS groups, and a decrease in the high/high ESA/PDS group (data not shown).

Multivariable regression model results are presented in Table 3. To simplify the table, only those health outcome models for which an adherence indicator remained significant in the presence of covariates were included. Additionally, only the “best predictive” (lowest p value and largest coefficient of determination [R^2]) adherence indicators are presented. For BMI, a 1 unit increase (additional class attendance) in continuous ESA resulted in $.2$ kg/m² decrease. For %BF and fat mass, the high/high ESA/PDS categorical group's decrease was significantly greater than the low/low group's change. Similarly, for change in mean steps/day, the high/high ESA/PDS categorical group's increase was significantly greater than the low/low and high/low groups' changes. Further, 6 units increase (additional class attendance or approximately 5 additional diaries submitted) in the continuous ESA/PDS indicator resulted in $.2\%$ decrease in %BF and 58 steps/day increase in step defined physical activity. For fat mass, LDL, and DBP, 4 units (quartile) increase in the continuous categorical ESA/PDS indicator resulted in $.5$ kg, 2.3 mg/dL, and 1.2 mm Hg decreases, respectively.

Discussion

This is one of the few studies to examine relationships between multiple participant adherence measures and post intervention changes in health outcomes; and possibly the only study to evaluate several adherence indicators, created using 2 measures, separately and in combination, for predicting health outcome changes. Using both an observational (ESA) and a self reported (PDS) adherence measure., we found 4 significant (BMI, fat mass, LDL, change in mean steps/day) and 2 trending (%BF and SBP) associations with ESA., Only 1 significant (change in mean steps/day) and 3 trending associations (%BF, DBP, and LDL) were apparent with PDS, suggesting the observational ESA was the stronger predictive indicator. However, in the multivariable models, the combined (ESA/PDS) adherence indicators performed better (i.e., retained prediction significance) as compared to the single (ESA or PDS) indicators, with the exception of ESA for predicting changes in BMI. This is likely explained by the multi component design of HUB City Steps.

Similar to our ESA findings, a significant positive association between participant attendance during the first 6 months of intervention and weight loss was reported for Trials

of Hypertension Prevention II (Stevens et al., 2001). In contrast to our non significant results, others have reported positive associations between participant adherence indicators and dietary measures. Call completion of telephone counseling sessions for adult patients with type 2 diabetes or hypertension was significantly associated with improvements in self reported measures of diet (fat, saturated fat, and fiber intake) and physical activity (minutes of moderate to vigorous) (Goode et al., 2011). The Working Well Trial, a randomized controlled trial of worksite based nutrition promotion, reported significant positive relationships for dietary intake with direct education (fruit and vegetable) and with contest participation (fruit and vegetable, and fiber) (Patterson et al., 1997). In contrast to our significant PDS results, employee participation, as measured by submission of biweekly goal sheets, had no effect on change in physical activity in Move to Improve, a worksite physical activity intervention (Wilson et al., 2010). It should be noted that participation was dichotomized as full (returned all 6 goal sheets) or partial. It is not clear why we found significant predictability for our adherence indicators with more “downstream” outcomes such as BMI and DBP versus more direct outcomes, such as dietary and fitness measures (with the exception of step defined physical activity). It is possible that our measures of diet and fitness were not sufficiently sensitive to detect changes that may have occurred during the intervention. More research is needed in this area to determine why some studies find associations between participant adherence indicators and health outcomes while others do not.

Of the 2 studies that reported results for multi dimensional participant adherence indicators, only 1 linked the indicator to a study outcome. In Project PRIME, multi dimensional adherence indicators were created for both arms of this 2 year physical activity intervention (Heesch et al., 2003). The 2 indicators were based upon 3 markers of adherence – completion of homework, self monitoring physical activity, and either class attendance (G arm) or completion of scheduled telephone calls (C arm). Both adherence indicators were found to predict participation in 150 minutes or more of moderate to vigorous physical activity per week at 6 months follow up (Heesch et al., 2003). Likewise, we also found our adherence indicators significantly predicted step defined physical activity as well as anthropometric, BP, and lipid changes. Similar to Project PRIME, 2 multi dimensional adherence indicators were created in the POUNDS LOST trial which tested the efficacy of 4 dietary macro nutrient compositions for promoting weight loss (Williamson et al., 2010). The first indicator, dietary adherence, was based upon adherence to total caloric goal and 3 macro nutrient goals (protein, fat, and carbohydrate). The second indicator, behavioral adherence, was based upon attendance at individual and group sessions, number of daily food intake entries, and number of daily physical activity entries. These indicators were not linked to study outcomes (i.e., weight loss) as the purpose of the ancillary study was to determine if adherence was a uni or multi dimensional construct (Williamson et al., 2010). However, these findings do support our study's use of multi component adherence indicators that combine both dietary and physical activity measures.

This study's strengths included the use and comparison of 2 measures to create adherence indicators, and the variety of indicators created and compared. While we used an observational (ESA) and a self reported (PDS) adherence measure, some researchers suggest that observational data are more likely to be linked to outcomes than are self report

(Lillehoj, Griffin, & Spoth, 2004). Few studies have compared these 2 strategies, and unfortunately, we also are not able to compare the collection modes of our 2 adherence measures since they represent different intervention components. Indeed, the self report nature of PDS may have weakened associations with outcome changes. Additionally, we used common quantiles (i.e., median and quartile) for our categorical splits which may allow for comparisons to other studies. However, designations of “low” and “high” adherence are study specific, and thus may not be directly comparable to another study's indicator, a potential limitation of our study (Durlak & DuPre, 2008). Because our participants were primarily African American residents of a southern community, study results may not be generalizable to other populations.

No adherence indicator emerged as the “best” overall predictor of clinical and anthropometric outcome changes in this cohort of southern, primarily African American adults. However, since the multi component indicators were predictive of several health outcomes, we advocate the use of a multi factorial adherence indicator for predicting health outcome changes in multi component lifestyle interventions. It may be that an overall measure of adherence has the most power to predict changes in multiple health outcomes. Additionally, similar to others (Durlak & DuPre, 2008; Mowbray, Holter, Teague, & Bybee, 2003), we advocate using individual adherence indicators for measuring each component of lifestyle interventions. A single composite adherence score may obscure implementation differences that are important on an individual component level (e.g., participants attending nutrition education classes have the largest changes in diet, but not increased physical activity). Clearly, more research is necessary to determine whether adherence should be considered singularly or in combination when predicting health outcome changes. Further, while our results indirectly suggest that observational adherence measures may prove to be the most useful in terms of significant relationships with outcome changes, the question concerning use of observational versus self report measures largely remains unanswered.

Achieving high participant adherence may lead to larger health improvements for participants and statistically significant intervention effects on targeted health outcomes. Therefore, practitioners and researchers should carefully consider the choice of adherence measures, as well as methodological and statistical approaches for analyzing different participant adherence measures in behavioral lifestyle interventions. These findings support the importance of practitioners advocating high adherence when communicating program benefits to participants or patients. This study highlights options for creating and interpreting several participant adherence indicators for predicting changes in study outcomes.

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Table 1

Baseline Demographic, Anthropometric, Clinical, Fitness, and Dietary Characteristics: HUB City Steps

	N=269	
	n	%
Female	229	85.1
African American ^a	254	94.4
Married ^b	113	42.0
> High school education ^c	216	80.3
Household income		
<\$10,000	40	14.9
\$10,000-\$19,999	36	13.4
\$20,000-\$29,999	54	20.1
\$30,000-\$39,999	37	13.8
\$40,000-\$49,999	30	11.2
>\$50,000	71	26.5
Current smoker	23	8.6
Diagnosed high blood pressure	112	41.6
Diagnosed high blood glucose	42	15.6
Diagnosed high cholesterol	52	19.3
	Mean	SD
Age (years)	44.3	12.2
Waist circumference (cm)	102.1	18.1
Body mass index (kg/m ²)	34.7	8.1
Body fat (%)	43.0	8.8
Fat mass (kg)	42.5	17.5
Lean body mass (kg)	53.2	11.1
Systolic blood pressure (mm Hg)	126.0	19.1
Diastolic blood pressure (mm Hg)	83.2	12.3
Total cholesterol (mg/dL)	177.2	39.1
High density lipoprotein (mg/dL)	51.9	15.0
Low density lipoprotein (mg/dL)	100.2	35.4
Triglycerides (mg/dL)	130.9	79.8
Glucose (mg/dL)	104.5	37.4
6-minute walk test (distance = m)	440.0	69.0
Steps/day ^d	1996	3257
Calcium intake (mg/day)	635.4	420.9
Dairy intake (cups/day)	1.0	0.7
Fiber intake (g/day)	14.1	5.9
Fruit and vegetable intake (cups/day)	2.6	1.3
Sugar intake (tsp/day)	17.1	9.0

^a Other race includes white and American Indian/Alaska native.

^b Not married includes widowed, divorced, separated, and never married.

^c > High school education includes trade/vocational school, some college, college degree, some graduate/professional school, and graduate/professional degree.

^d Pedometer-determined change in mean steps/day; change is difference between intervention weeks 1-2 and weeks 3-27.

Table 2

Correlations Between Continuous Participant Adherence Indicators and Outcome Changes at 6 Months: HUB City Steps

Outcome	ESA		PDS		Continuous ESA/PDS ^a		Cont-Cat ESA/PDS ^b	
	r	p	r	p	r	p	r	p
WC	-0.03	0.730	-0.05	0.481	-0.04	0.562	-0.05	0.529
Body mass index	-0.29	<0.001	-0.03	0.651	-0.22	0.002	-0.26	0.000
% Body fat	-0.12	0.102	-0.13	0.079	-0.15	0.045	-0.15	0.038
Fat mass	-0.20	0.005	-0.09	0.224	-0.19	0.010	-0.21	0.004
Lean body mass	-0.10	0.167	0.09	0.240	-0.03	0.657	-0.05	0.505
Systolic BP	-0.13	0.078	0.00	0.970	-0.09	0.195	-0.11	0.127
Diastolic BP	-0.09	0.239	-0.14	0.056	-0.13	0.084	-0.14	0.059
Total cholesterol	-0.09	0.202	0.00	0.965	-0.07	0.345	-0.09	0.221
HDL	0.11	0.131	0.08	0.252	0.12	0.102	0.08	0.288
LDL	-0.17	0.032	-0.09	0.235	-0.17	0.034	-0.18	0.023
Triglycerides	0.01	0.862	-0.02	0.769	0.00	0.991	-0.01	0.842
Glucose	0.00	0.981	-0.05	0.488	-0.02	0.733	-0.02	0.820
6-minute walk test	0.04	0.583	0.00	0.979	0.03	0.700	0.00	0.974
Steps/day ^c	0.34	<0.001	0.43	<0.001	0.45	<0.001	0.42	<0.001
Calcium intake	0.09	0.208	0.06	0.428	0.09	0.204	0.05	0.523
Dairy	0.04	0.558	0.10	0.176	0.08	0.272	0.03	0.705
Fiber	0.08	0.267	0.03	0.656	0.07	0.322	0.05	0.498
Fruit & vegetables	-0.04	0.588	-0.10	0.154	-0.08	0.269	-0.09	0.229
Sugar	0.09	0.227	0.08	0.262	0.10	0.160	0.07	0.374

Notes: ESA = education session attendance; PDS = pedometer diary submission; r = Pearson's correlation coefficient; p = p-value; WC = waist circumference; BP = blood pressure; HDL = high density lipoprotein; LDL = low density lipoprotein.

^a(6*ESA)+PDS.

^bContinuous-categorical; ESA quartiles*PDS quartiles; range = 1-16.

^cPedometer-determined change in mean steps/day where change is difference between intervention weeks 1-2 and weeks 3-27.

Table 3

Multivariable Regression Model Results for Outcome Changes at 6 Months Predicted by Participant Adherence Indicators: HUB City Steps

Outcome	Indicator		β	p	Covariates ^a	Model R ²
	Type					
BMI	Continuous ESA		-0.17	<0.001	BOV	0.18
% Body Fat	Categorical ESA/PDS	GD1	0.010		BOV, Gender	0.17
% Body Fat	Continuous ESA/PDS		-0.03	0.003	BOV, Gender	0.16
Fat Mass	Categorical ESA/PDS	GD1	0.007		BOV, Age, Gender	0.27
Fat Mass	Cont-Cat ESA/PDS		-0.13	<0.001	BOV, Age, Gender	0.26
LDL	Cont-Cat ESA/PDS		-0.57	0.041	BOV	0.15
DBP	Cont-Cat ESA/PDS		-0.27	0.014	BOV	0.33
Steps/day ^b	Categorical ESA/PDS	GD2	<0.001		NS	0.09
Steps/day ^b	Continuous ESA/PDS		58	<0.001	NS	0.08

Notes: β = regression coefficient; p = p-value; R² = coefficient of determination; BMI = body mass index; ESA = educational session attendance; BOV = baseline outcome value (e.g., baseline BMI); PDS = pedometer diary submission; GDI = group difference (decrease in high/high ESA/PDS adherence group significantly greater than low/low group); Cont-Cat = continuous-categorical; LDL = low density lipoprotein; DBP = diastolic blood pressure; GD2 = group difference (increase in high/high ESA/PDS adherence group significantly greater than low/low and high/low groups; NS = No covariate remained significant in the model, including BOV.

^a Significant at the 0.05 level; included age, gender, marital status, education level, income level, smoking status, BMI, and BOV.

^b Pedometer-determined change in mean steps/day; change is difference between intervention weeks 1-2 and weeks 3-27.