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Predictors for Blood Pressure Reduction in American Latinos: Secondary Analysis of the Adelgaza Program Data

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Abstract

Little is known about factors that predict blood pressure (BP) reduction in overweight American Latinos. The aim of this secondary analysis was to explore predictors of changes in mean systolic and diastolic BPs over an 8-week weight loss intervention period in a sample of 54 overweight American Latinos using data collected during the Adelgaza trial. Baseline BP, exercise energy use (in units of metabolic equivalent of task), weight change, average daily intake of calories from beverages, average daily intake of calories from fat, age, and gender were considered as potential predictors of reductions in BP, as measured at baseline, 3, and 8 weeks. Baseline characteristics were as follows: mean age 45.3 (SD = 10.8) years, 3I.5% male, 61.1% born in the United States. Mean baseline systolic and diastolic BPs were 122.1 (*SD* = 14.4) mmHg and 76.6 (*SD* = 9.8) mmHg, respectively. Both baseline systolic and diastolic BPs predicted reductions in systolic BP after adjusting for other factors ($p < .001$). None of the nine variables predicted reductions in diastolic BP ($p > .05$). This finding suggests that overweight American Latinos with higher baseline systolic or diastolic BP should be identified and provided with early intervention education to achieve better hypertension management or prevention.

Keywords

hypertension; weight loss; Latino; exercise; blood pressure

Non-Hispanic Whites with hypertension (HTN) are at high risk for developing vascular complications such as stroke, and may benefit from a well-designed HTN management intervention, but research in the American Latino population is sparse. This study used data collected during the Adelgaza trial to investigate correlates of changes in mean systolic and diastolic blood pressure (BP) in a sample of 54 overweight American Latinos enrolled in an 8-week educational weight loss program.

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Hypertension Management in Overweight American Latinos

HTN is defined as systolic BP 130 mmHg and/or diastolic BP 80 mmHg (P. K. Whelton et al., 2018), based on the guidelines from the American College of Cardiology, the American Heart Association, and nine other health professional organizations that were updated in November 2017 (P. K. Whelton et al., 2018). With the new guidelines, roughly one half of adults in the United States (U.S.) are defined as having HTN (Benjamin et al., 2018). High BP is a known contributor to stroke, ischemic heart disease, and other cardiovascular diseases (Lawes, Vander Hoorn, Rodgers, & International Society of Hypertension, 2008). Research shows that effective HTN management can help reduce mortality associated with stroke and vascular diseases. For example, a meta-analysis of 61 prospective studies showed that reducing systolic BP by 2 mmHg is associated with a 10 reduction in stroke mortality and a 7 reduction in mortality from vascular causes in middle-aged populations (Lewington, Clarke, Qizilbash, Peto, & Collins, 2002). Furthermore, another review article has shown that HTN in midlife is associated with the later development of both Alzheimer's disease and vascular dementia (Kennelly, Lawlor, & Kenny, 2009). Given these, the guidelines emphasize earlier treatment/prevention of HTN via lifestyle changes such as increased physical activity, improvements in diet, and weight loss to lower risk for developing vascular complications in the general U.S. population (Lawes et al., 2008).

American Latinos comprised 18 of the U-S-population in 2015, increasing to a projected 30% by 2060 (Semlitsch et al., 2016). There are little data on the prevalence of HTN as defined by the new guidelines. However, prevalence of HTN as defined by the old guidelines, with cutoffs of 140 and 90 mmHg, was similar in 2012 in the non-Hispanic White (28%) and the American Latino populations (26 %; Luke et al., 2005). Prevalence was 77 % was American Latinos who are overweight (Colin-Ramirez et al., 2009; Neter, Stam, Kok, Grobbee, & Geleijnse, 2003; i.e., body mass index [BMI] 25 kg/m^2; Cornelissen, Buys, & Smart, 2013). Thus, BP control is particularly important for American Latinos who are overweight.

Baseline BP, exercise energy use (EEU, in units of metabolic equivalent of task [METs]), weight change, average daily intake of calories from beverages, average daily intake of calories from fat, age, and gender have been associated with HTN in the general U.S. population (Colin-Ramirez et al., 2009; Cornelissen et al., 2013; Duggirala et al., 2005; Inder et al., 2016; Luke et al., 2005; Neter et al., 2003; Semlitsch et al., 2016; S. P. Whelton, Chin, Xin, & He, 2002). Older age has been found to be associated with high BP, explaining 64.9% of the burden of the disease on those 60 years old and above in the U.S. (Ba et al., 2018; Yoon, Carroll, & Fryar, 2015); in addition, males are at higher risk for HTN than females in the 18- to 39- and 40- to 59-year-old age groups (Ba et al., 2018; Yoon et al., 2015). It is essential to identify potential correlates of reductions in BP, with a view toward designing an effective intervention to help American Latinos manage or prevent HTN.

Purpose

Despite the rapidly growing number of American Latinos in the U.S. few studies have focused specifically on this population (Guzman, 2012; Park & Taykor, 2007). The 8-week

Adekgaza trial that tested a weight loss intervention using a commercial mobile application and a physical activity tracker in overweight American Latinos at risk for type 2 diabetes (Fukuoka, Vittinghoff, & Hooper, 2018) showed a statistically significant reduction in body weight. The secondary analysis of data presented in this article was based on the Adelgaza trial. In this article, we explored predictors of changes in mean systolic and diastolic BPs in the target population. We sought to identify predictors of changes in mean systolic and diastolic BPs in American Latinos who are overweight and at risk for type 2 diabetes. Findings might provide information useful for designing more effective HTN management/prevention programs and tailoring these programs to the fast-growing Latino populations in the U.S.

Method

Design and Sample

The participants were enrolled in an 8-week weight loss intervention program. The study was approved by the University of California, San Francisco Committee on Human Research prior to enrollment, and written informed consent was obtained from all participants. Detailed descriptions of the study design and eligibility of the participants have been previously published (Fukuoka et al., 2018). Participants were recruited through mailings to census-defined American Latino households and through flyers posted in hospitals, local businesses, and community centers in San Francisco, CA. Eligibility criteria were as follows: BMI 25 kg/m^2; age 18 years; self-identified as American Latino; owned a smartphone and willing to use an app every day and wear a Fitbit Zip (3-axis accelerometer); no diagnosis of type 1 diabetes, type 2 diabetes with insulin therapy, untreated type 2 diabetes, or other medical condition necessitating special attention in an exercise and/or diet program; and no ongoing participation in a lifestyle modification program. Eligibility was assessed by telephone and in-person screening.

Overview of the 8-Week Intervention and Procedures

The content of the intervention used was adapted by the Diabetes Prevention Program (Diabetes Prevention Program Research Group, 2002) for overweight American Latino adults at risk for type 2 diabetes. Participants were instructed in (1) increasing physical activity (daily steps) by 20 each week until reaching 12,000 steps/day and engaging in at least a 10-minute daily bout of moderate-intensity activity; (2) consuming 5 to 6 small meals a day, using portion control, eating slowly, limiting fat intake to 25% of total caloric intake, increasing water intake, and replacing sugar-sweetened beverages with unsweetened beverages; (3) joining in a password-protected private study Facebook group to view and/or post suggestions and tips for lifestyle modifications; (4) weighing themselves at least twice per week (Mondays and Fridays); and (5) losing 5% body weight loss over 8 weeks, at a rate of 1 to 2 pounds per week. To facilitate weight loss, the intervention included two in-person counseling sessions at the eligibility and 3-week visits, as well as daily use of Fitbit Zip and the Fitbit app to monitor caloric intake, diet, and physical activity. If a participant had a multiple cardiovascular risk factors, a study enrollment information letter was sent to their health care provider prior to enrollment.

Figure 1 shows the flow diagram of participants through the Adelgaza trial (Fukuoka et al., 2018). After the screening/baseline visit, 66 potential participants began a 2-week run-in period aimed at (1) determining if they were able to comply with the requirements of wearing the Fitbit Zip (at least 70 compliance) and using the app daily and (2) collecting baseline average daily steps as a measure of physical activity. Among all 66 participants, 12 were excluded due to noncompliance during the run-in period and not wanting to be in the study; the remaining 54 participants received their first in-person counseling at the eligibility visit (Fukuoka et al., 2018). At that point, participants were also asked to complete the 3-week and final (8-week) visits. About 97 % of enrolled participants completed the 8-week final visit. Participants were compensated up to $60 for their transportation and time for study participation.

Measures

Gender, age, marital status, acculturation, years living in the U.S., smoking, use of BP medication, and the Short Acculturation Scale for Hispanics were collected from participants at the screening/baseline visit. The Short Acculturation Scale for Hispanics uses Spanish versus English language preferences in media use and social relations to assess acculturation, with those using more English receiving a higher acculturation score (Marin, Sabogal, & Marin, 1987).

Five additional independent variables were measured: (1) baseline systolic BP, (2) baseline diastolic BP, (3) weight (kg), (4) EEU in MET-minutes per week, (5) total average daily beverage calories (calories/day), and (6) total average daily fat calories (calories/day). Weight was measured twice with participants wearing a cloth hospital gown without shoes using the Tanita WB-110 digital electronic scale. EEU in minutes per week was estimated using International Physical Activity Questionnaire (IPAQ) short version (Fan, Lyu, & He, 2014). The short 9-item IPAQ assesses three types of physical activity: vigorous activity such as aerobics, with METs > 6 O_2 $kg^{-1}min^{-1}$; moderate-intensity activity such as leisure cycling (3–6 METs); and low-intensity activity (>0–3 METs). Total EEU was calculated for all activities at baseline, and Week 3 and Week 8 visits. Total average daily beverage calories (calories/day) was measured using the modified Beverage Intake Questionnaire (Hedrick et al., 2012), a scale to quantify habitual beverage sugar intake in adults. Average total daily fat calories per day was measured using the Fat Intake Screener questionnaire (Wakimoto, Block, Mandel, & Medina, 2006), a scale assessing percent energy from fat. More detailed descriptions of IPAQ, Beverage Intake Questionnaire and Fat Intake Screener have been previously published (Fukuoka et al, 2018).

Systolic and diastolic BPs were measured at the screening/baseline, 3- and 8-week visits using the Omron Pro IntelliSense Professional Digital Blood Pressure Monitor HEM-907XL (Fukuoka et al, 2018). This commercial oscillometric BP monitor was also used in the recent Systolic Blood Pressure Intervention trial (Drawz et al, 2017) and has been validated in previous studies (Cohen, Wong, Alpert, & Townsend, 2017; Ostchega, Nwankwo, Sorlie, Wolz, & Zipf, 2010). After each participant sat quietly with their feet flat on the floor for 5 minutes, a trained research staff member measured the patient’s arm circumference, selected the appropriate BP cuff of four available sizes, and took a total of four BP measurements (2 per arm). The average of these four measurements was recorded.

Data Analysis

Descriptive statistics were used to summarize demographic and clinical variables. Linear mixed models were used to estimate average percent changes since baseline in systolic and diastolic BPs at 8 weeks, as well as the associations of these changes with age, sex, baseline systolic and diatolic BPs, baseline values of EEU, average daily calories from sweetened beverages and from fat, and concurrent percent changes in EEU and weight. The linear mixed models included a fixed effect for time, scaled so that model coefficients are interpretable as average 8-week changes, as well as random intercepts, to account for clustering of repeated percent changes in BP assessed at Weeks 3 and 8. All analyses were conducted using Stata, Version 15.1 (Statacorp, LLC, College Station, TX). p Values <.05 were considered statistically significant.

Results

Baseline Demographics and Clinical Factors

Table 1 shows the baseline demographics, medical history, and BP risk factors of participants. About one third (n = 17; 32 %) of participants were male, 57 % (n = 31) were married, 9 % (n = 5) smoked, and 13% (n = 9) took BP medication. Mean participant age was 45.3 (SD = 10.8), ranging from 24 to 65 years old. Mean BMI was 31.4 (SD = 4.1) with a range of 25.1 to 42.0 kg/m^2. Mean baseline systolic and diastolic BPs were 122.1 (SD = 14.4) mmHg with a range of 84 to 157 and 76.6 (SD = 9.8) mmHg with a range of 55 to 101. Proportion of participants with systolic BP 130 or diastolic BP 80 mmHg was 51.9% (n = 28). Thirteen percent (n = 7) reported that they took antihypertensive medications. Mean percent adherence to self-weighing at least twice a week over the 8-week period was 49.3%. There were no serious adverse events associated with their participation in the trial.

Changes in Blood Pressure

Table 2 shows changes in BP over the 8-week intervention period. Statistically significant reductions in both systolic BP (4.9 mmHg, 95 % confidence interval [CI: 2, 6.5],$p < .005$) and diastolic BP (3.1 mmHg, 95% CI [1.1, 4.6], $p = .001$) were observed.

Factors Associated With Change in Mean Systolic and Diastolic BPs

Table 3 shows the results of an unadjusted/adjusted linear mixed models for percent change in mean systolic BP (observation $n = 101$). Out of nine predictors, both baseline systolic and diastolic BPs were independently associated with percent reduction in mean systolic BP after adjustment for other factors (systolic BP: adjusted standardized effect = −1.03, 95% CI [−1.41, −0.64], $p < .001$; diastolic BP: adjusted standardized effect = −0.58, 95% CI [−0.90, −0.26], $p < .001$).

Table 4 shows the results of an unadjusted/adjusted linear mixed models for percent change in mean diastolic BP. None of the nine predictors were significantly associated with percent change in mean diastolic BP (all $p > .05$).

Discussion

In this mobile app-based intervention with in-person counseling sessions, 54 overweight American Latinos at risk for type 2 diabetes were followed for 8 weeks. Statistically significant reductions in both systolic and diastolic BPs over the 8 weeks of the intervention were observed (Fukuoka et al., 2018). In this secondary analysis, only baseline systolic and diastolic BPs were independently associated with reductions in systolic BP, after adjustment for other factors. Although these associations could result from regression to the mean, they also suggest that interventions attempting to improve BP in American Latinos may have larger effects among participants with higher baseline BP. The previous study conducted in the general U.S. population showed that patients with higher baseline BP are at high risk for vascular complications, such as stroke, so should be targeted for optimal HTN control (Duggirala et al.,2005). No associations of changes in systolic or diastolic BPs were found with changes in EEU or weight, nor with age, sex, or baseline calorie consumption. Thus, the study provides no other evidence for differential effectiveness that could guide targeting or refinement of the intervention.

Previous studies have also shown that weight loss and reductions in fat and sugary beverage calories are associated with lowering BP in non-Hispanic Whites (Brown et al., 2011; Colin-Ramirez et al., 2009; Santos Silva, Petroski, & Peres, 2012; Winnicki et al., 2006). In the Adelgaza trial, these factors were not associated with reductions in systolic or diastolic BP in American Latinos, but confidence intervals for these effects were wide, due to small sample size, and do not exclude moderate-to-large associations. Other possible explanations are that BP is less responsive to weight loss in American Latinos than non-Hispanic Whites, and that diet patterns differ (e.g., consumption of different kinds of sugar). In addition, this group of American Latino participants were mostly female, and interpersonal factors such as family responsibilities may have affected their BP levels.

Unlike systolic BP, baseline systolic and diastolic BPs were not associated with changes in diastolic BP. It hs known that increased diastolic BP can lead to adverse vascular complications (e.g., abdominal aortic aneurysm; Blanchard, Armenian, & Friesen, 2000; Hatakeyama, Shigematsu, & Muto, 2001) and cognitive decline (Kennelly et al., 2009; Novak & Hajjar, 2010; Tsivgoulis et al., 2009). However, very limited research has been done investigating factors associated with management/prevention of diastolic HTN in American Latinos. The Framingham Heart Study found that older age, being male, and being overweight were connected with increased diastolic BP in the general U.S. population (Cheng, Xanthakis, Sullivan, & Vasan, 2012). Larger samples of American Latinos may help clarify these discrepancies.

Limitations

Despite the strengths of the study, several limitations need to be acknowledged. First, the study had no randomized control group for comparison. Thus, causation cannot be established. Second, the sample was primarily composed of American Latinos living in the San Francisco Bay Area with disproportionately high education levels (69 of the American Latino sample had a bachelor’s degree or higher, compared with 20% nationally; U.S. Census Bureau, 2016). Therefore, the results may not be generalizable to the American

Latino population as a whole. Third, physical activity (EEU data) was collected by the self-report, which often leads to overestimation of physical activity (Fukuoka, Haskell, & Vittinghoff, 2016).

Conclusion

The findings of this study provide the important information on the relationship between higher baseline systolic/diastolic BPs and reduction of systolic BP. However, this relationship was not observed in reduction of diastolic BP in the sample of American Latino participants who were overweight. This association needs further study in a larger sample to establish more robust findings. In addition, further research needs to be done to investigate factors associated with reduction of diastolic BP to help American Latino patients manage or prevent diastolic HTN. This in turn will help prevent vascular complications and decline in cognitive function.

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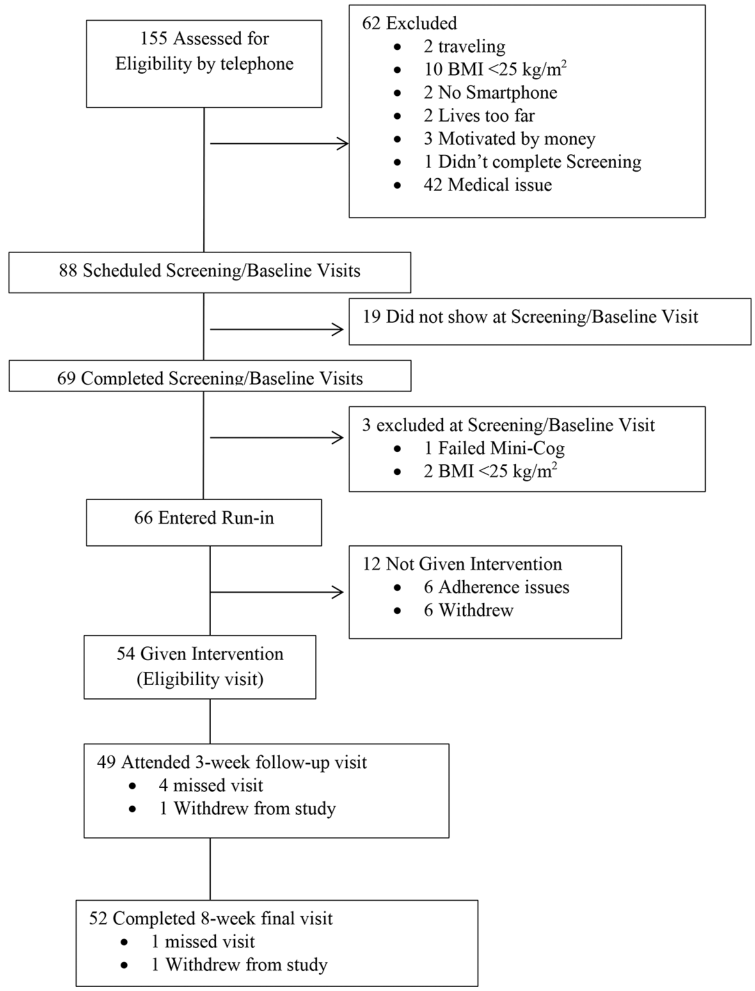

Figure 1.

Flow diagram: Screening, enrollment, and follow-up of study participants.

Table 1.

Baseline Characteristics of the Sample of American Latinos Who Are Overweight (*N* = 54).

Variables	Mean SD or % (n)
Age (years)	45.3 10.8
Gender	
Men	31.5 (17)
Women	68.5 (37)
Education	
Completed college or graduate school	68.5 (37)
Completed high school, some college, or less than high school	31.5 (l7)
Marital status	
Married/cohabitating	57.4 (31)
Single/divorced/widowed	42.6 (23)
Employment	
Employed for pay	77.8 (42)
Unemployed/home maker/disabled/other	22.2 (12)
No. of years living in the United States	
Born in the United States	6l.l (33)
> 10 years	38.9 (2l)
Past pedometer use	
Yes	55.6 (30)
Smoking	
Yes	9.3 (5)
BP medication	
Yes	13.0 (9)
Proportion of participants with systolic BP 130 or diastolic BP 80 mmHg	51.9 (28)
Acculturation[a]	
Language subscale	3.8 0.8
Media subscale	4.5 0.7
Social subscale	3.2 0.6
Baseline BMI (kg/m^2)	31.4 (4.1)
Baseline physical activity (total MET-min/week)[b]	2443.6 (2,285)
Waist circumference (cm)	98.6 (10.3)
Hip circumference (cm)	109.4 (9.2)

Note. MET = metabolic equivalent of task; BP = blood pressure; BMI = Body mass index.

[a]The Short Acculturation Scale for Hispanics was used. A potential score ranges from 1 to 5, and higher scores indicate greater acculturation. An average score above 2.99 indicates more acculturation.

[b]MET is a measure of energy expenditure during exercise rest.

Table 2.

Changes in Blood Pressure (BP) Over the 8-Week Intervention Period (mmHg).

	Baseline		Week 3		Week 8		Mean change		Standardized change
Outcomes	***N***	***M* (*SD*)**	***N***	***M* (*SD*)**	***N***	***M* (*SD*)**	***M* [95% Cl]**	***p***	***M* [95% Cl]**
Systolic BP	54	122.1 (14.4)	49	117.9 (12.3)	52	007.2 (02.8)	−4.9 [−2.0, −6.5]	<.001	−0.32 [−0.15, −0.49]
Diastolic BP	54	76.6 (9.8)	49	74.4 (10.5)	52	73.5 (00.6)	−3.1 [−1.1, −4.6]	.001	−0.28 [−0.1 1, −0.45]

Table 3.

Linear Mixed Model for Percent Change in Mean Systolic Blood Pressure (Observation $n = 101$).

	Standardized unadjusted			Standardized adjusted		
	β	**95% CI**	***p***	**β**	**95% CI**	***p***
Baseline EEU[a] (min/week)	−0.12	[−0.3 1, 0.07]	.21	−0.01	[−0.20, 0.19]	.95
Baseline systolic BP (mmHg)	−0.44	[−0.66, −0.23]	<.001	**−1.03** [b]	**[−1.41, −0.64]**	**<.001**
Baseline diastolic BP (mmHg)	−0.14	[−0.38, 0.10]	.26	**−0.58** [c]	**[−0.90 −0.26]**	**<.001**
% change in EEU	0.08	[−0.12, 0.28]	.44	0.06	[−0.14, 0.27]	.55
% change in weight (kg)	0.00	[−0.20, 0.21]	.98	0.17	[−0.03, 0.38]	.10
Total beverage calories per day	0.00	[−0.19,0.19]	.99	−0.06	[−0.24, 0. 11]	.48
Total fat calories per day	0.07	[−0.14, 0.28]	.51	0.08	[−0.10, 0.27]	.38
Age (per year)	−0.18	[−0.43, 0.07]	.17	0.20	[−0.04, 0.44]	.11
Female sex	0.08	[−0.17, 0.32]	.54	−0.17	[−0.38, 0.04]	.11

Note. Items in boldface = Statistical significance: CI = confidence interval; BP = blood pressure.

[a] EEU = exercise energy use (in units of metabolic equivalent of task [METs]).

[b] Adjusted for baseline EEU, baseline diastolic BP, % change in EEU, % change in weight, total beverage calories per day, total fat calories per day, age, and female sex.

[c] Adjusted for baseline EEU, baseline systolic BP, % change in EEU, % change in weight, total beverage calories per day, total fat calories per day, age, and female sex.

Table 4.

Linear Mixed Model for Percent Change in Mean Diastolic Blood Pressure (Observation *n* = 101).

	Standardized unadjusted			Standardized adjusted		
	β	**95% CI**	***p***	**β**	**95% CI**	***p***
Baseline EEU (min/week)	−0.08	[−0.28, 0.12]	.45	−0.09	[−0.32, 0.14]	.46
Baseline systolic BP (mmHg)	−0.19	[−0.41, 0.02]	.08	−0.16	[−0.59, 0.28]	.48
Baseline diastolic BP (mmHg)	−0.05	[−0.37, 0.06]	.17	−0.02	[−0.38, 0.34]	.90
% change in EEU	0.07	[−0.14, 0.28]	.49	0.14	[−0.10, 0.38]	.26
% change in weight (kg)	0.13	[−0.08, 0.35]	.22	0.07	[−0.09, 0.42]	.19
Total beverage calories per day	−0.05	[−0.25, 0.15]	.62	−0.05	[−0.26, 0.16]	.66
Total fat calories per day	0.14	[−0.08, 0.36]	.20	0.13	[−0.10, 0.35]	.26
Age (per year)	−0.09	[−0.42, 0.03]	.09	−0.06	[−0.33, 0.22]	.69
Female sex	0.01	[−0.21, 0.22]	.96	−0.12	[−0.36, 0. 11]	.3 1

Note. CI = confidence interval; BP = blood pressure; EEU = exercise energy use.