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RESEARCH

Physical Activity Patterns and Health-Related Fitness Indicators in Adults Living with HIV in South Texas

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Purpose: People living with HIV (PLHIV) are at an increased risk for many chronic diseases due, in part, to low physical activity (PA) levels. The purpose of this study was to examine the relationship between physical activity patterns and health-related fitness indicators of adults living with HIV in South Texas.
Methods: Participants (N = 172) were mostly Hispanic/Latino (n = 105) adults with HIV. Measurements included a 7-day Physical Activity Recall (PAR) assessing light, moderate, and vigorous PA; a 6-minute walk test (6MWT) to assess cardiovascular fitness; a hand grip strength test to assess muscular strength; a back scratch test for flexibility; and anthropometrics (body mass index (BMI) and hip-waist ratio). Data were analyzed utilizing descriptive statistics, an independent samples t-test, Pearson's correlations and partial correlations, and a hierarchical multiple regression analysis (HMRA).
Results: There was a significant relationship between total PA and muscular strength. Light and total PA were associated with lower hip-waist ratios. In Hispanics/Latinos, both moderate and total PA were associated with muscular strength. All findings remained after controlling for age. Hispanics/Latinos had higher hip-waist ratios than non-Hispanics/Latinos.
Conclusions: Results suggest a relationship between PA and muscular strength as well as between PA and hip-waist ratio for this population of adults living with HIV, but not between PA and other health-related fitness indicators. There appears to be some benefit associated with even low intensity PA for PLHIV. Future intervention studies may wish to examine strategies to increase PA- particularly that of moderate and vigorous intensity- in PLHIV.

Keywords: Physical fitness; cardiovascular fitness; muscular strength; flexibility; people living with HIV (PLHIV)

Research shows that nearly everyone benefits from engaging in physical activity (PA). According to the US Department of Health and Human Services, being HIV-positive is no different from being HIV-negative when it comes to PA (USDHHS 2019). People living with HIV (PLHIV) acquire additional chronic diseases earlier and more often than non-HIV infected counterparts (Vancampfort et al. 2016). Current hypotheses link the increased incidence of these comorbidities to the side effects of highly active antiretroviral therapy (HAART), HIV-related chronic inflammation (Hearps et al. 2014), and modifiable lifestyle factors, such as increased tobacco use (Lifson & Lando 2012) and decreased PA (Schuelter-Trevisol et al. 2012). Defined as any bodily movement that works the muscles and requires more energy than resting, PA provides therapeutic benefits for many chronic conditions and is part of the recommended treatment for the condition (USDHHS 2018).

Physical activity is a key strategy for PLHIV that can improve or maintain health (O'Brien et al. 2016). It is known to improve cardiorespiratory fitness (Webel et al. 2019a), strength, and body composition in HIV-infected individuals (Botros et al. 2012). It can also help reduce the risk of developing cardiovascular disease, high blood pressure, type 2 diabetes, and several types of cancer. These are all health conditions that are elevated among PLHIV (USDHHS 2019). Systematic reviews of exercise interventions among adults

living with HIV have found aerobic exercise to be safe and beneficial for HIV-infected adults who are medically stable (O'Brien et al. 2016; Schuelter-Trevisol et al. 2012). Aerobic or a combination of aerobic and resistance exercise performed at least three times per week for at least five weeks is safe and can improve cardiorespiratory fitness, strength, and body composition. Another systematic review (O'Brien et al. 2017) determined that performing resistive exercise or a combination of resistive and aerobic exercise at least three times per week for at least six weeks is safe and can improve cardiovascular fitness, strength, weight, and body composition in adults living with HIV.

PLHIV can do the same types of PA as individuals who do not have HIV (USDHHS 2019), but the Physical Activity Guidelines for Americans (2018) state that the type and amount of PA should be determined by a person's abilities and the severity of the chronic condition. Adults with chronic conditions, who are able, should do at least 150 minutes to 300 minutes per week of moderate intensity, or 75 minutes to 150 minutes per week of vigorous intensity aerobic PA, or an equivalent combination of moderate and vigorous intensity aerobic activity. However, adults who sit less and do any amount of moderate to vigorous physical activity (MVPA) gain some health benefits. Examples of vigorous PA include running or taking a strenuous fitness class. Moderate (medium) PA examples include brisk walking or biking. Light PA is a third category and the least intense. Examples include walking at a leisurely pace or light household chores. If able, adults with chronic conditions should also do muscle strengthening activities of moderate or greater intensity and that involve all major muscle groups on two or more days per week, as these activities provide additional health benefits (USDHHS 2018).

Studies indicate that most PLHIV do not meet PA recommendations. Willig, Westfall, and Crane (2017) found that 68% of PLHIV in the United States engaged in low amounts of PA, which was associated with increased cardiovascular disease, obesity, diabetes, hypertension, and cerebrovascular disease. A systematic review of studies examining the prevalence of PA in HIV-infected subjects found that physical inactivity or sedentary lifestyle ranged from 19% to 73%, with PA levels determined by various methods (Schuelter-Trevisol et al. 2012). Vancampfort et al. (2018) reported that only an estimated 50% of PLHIV worldwide met the recommendations of 150 minutes of MVPA per week. Further investigation found that 30% of PLHIV who consented and enrolled in PA interventions dropped out, a higher rate than other chronically ill populations. With this in mind, new interventions to improve PA for PLHIV are needed.

Hispanics/Latinos are the largest minority group in the US and have higher rates of HIV infection compared to some other races/ethnicities. According to the Centers for Disease Control and Prevention, Hispanics/Latinos accounted for over a quarter (26%) of all new HIV diagnoses in the US in 2016 (CDC 2016). This is despite making up only 18% of the population according to the US Census Bureau (USCB 2018). Poverty, language barriers, lower educational level, and migration patterns may make it harder for some Hispanics/Latinos to get HIV testing and care. Furthermore, undocumented Hispanics/Latinos may be less likely to get tested for HIV, use HIV prevention services, or get treatment for HIV due to concerns about being arrested and deported (CDC 2016). Men and women of all races and ethnicities gain benefits from PA (USDHHS 2018). However, significant disparities in PA exist between Hispanics and non-Hispanic whites in the US. National reports have shown that Hispanics consistently report lower levels (14.4%) of PA compared to non-Hispanic whites (22.8%) (Layne et al. 2015).

Limited research is available regarding PA participation among Hispanic/Latino PLHIV. One study examining metabolic syndrome in relation to cardiorespiratory fitness, active, and sedentary behavior in HIV-positive Hispanics found that, on average, the HIV-positive Hispanics in the study did not meet current PA recommendations. It also found that cardiorespiratory fitness is influenced by PA in this population (Ramirez-Marrero et al. 2014). Another study examining physical and leisure activity, body composition, and life satisfaction in HIV-positive Hispanics found that approximately 59% of participants could be categorized as physically active based on a 7-day Physical Activity Recall. The physically active group of participants had a lower body weight, body mass index (BMI), limb and trunk skin folds, and trunk circumference than the physically inactive group (Ramirez-Marrero et al. 2004).

Despite the importance of PA to health outcomes in PLHIV and the rapidly increasing use of such interventions, no study to date has been published that specifically examines PA and health-related fitness, variables among primarily Hispanic/Latino populations living with HIV. The purpose of this study was to examine the relationship between the physical activity patterns and health-related fitness indicators of adults living with HIV in South Texas. The four research questions guiding this study were as follows: 1) Does a relationship exist between the PA patterns and cardiovascular fitness of adults living with HIV in South Texas? 2) Does a relationship exist between the PA patterns and muscular strength of adults living with HIV in South Texas? 3) Does a relationship exist between the PA patterns and

flexibility of adults living with HIV in South Texas? 4) Does a relationship exist between the PA patterns and anthropometric measurements of adults living with HIV in South Texas? It was predicted that those who engage in greater amounts of PA, particularly PA of moderate to vigorous intensity, will have more favorable cardiovascular fitness, muscular strength, flexibility, and anthropometric measurements.

Methods

Study design

This study was conducted as part of the International Nursing Network for HIV Research's multi-site cross-sectional study to describe PA and cardiorespiratory fitness by sex and age in PLHIV (Holzemer 2007; Webel et al. 2019b). Consistent with this network's procedural framework, a coordinating site (Case Western Reserve University) finalized the study protocol, developed the standardized training modules, and obtained the primary Institutional Review Board (IRB) approval. All site Principal Investigators provided input to enhance the final study design, were trained and certified in all study procedures, and obtained local IRB approval prior to data collection. The data for the current analyses are based on one study site in South Texas.

Sample and recruitment

Participants (N = 172) were adults ≥18 years of age with a confirmed positive HIV test (HIV+ ELISA with confirmatory polymerase chain reaction (PCR) or Western blot). Those who had a medical contraindication for exercise (e.g., a recent cardiac event) as determined by the American Heart Association criteria (Fletcher et al. 2001), were not able to be physically active without an assistive device (i.e. cane, walker, wheelchair), or were not able to communicate in English or Spanish were excluded. Recruitment and data collection took place in a community health clinic. Participants were recruited in person using locally approved IRB procedures, responding to study advertisements in the clinic waiting room. If interested, a clinic case worker screened potential participants with an IRB-approved script to describe the study purpose and to determine whether candidates met eligibility criteria. Those who were eligible for the study were given informed-consent documents to review, including a consent for the study team to access patient medical records. Data collection then took place during a single visit on one of several scheduled data collection days.

Procedures

Study staff met with eligible participants on the day of data collection and reviewed an informed consent form that described the study's purpose, procedures, risks, and potential benefits. After confirming understanding, the staff member obtained written informed consent and worked with participants to complete the study measures. Study staff collected anthropometric assessments and conducted a PA recall, a 6-minute walk test (6MWT), a hand grip strength test, and a back scratch test. All data were entered in a central Research Electronic Data Capture (RedCAP) database, and it was cleaned and regularly checked for quality. Upon completion of the procedures, participants received an incentive amount (USD $30) in the form of a gift card. All study procedures for this analysis occurred between April 2016 and March 2017.

Measures

The primary predictor variable was PA. The primary outcome variables were cardiorespiratory fitness as measured by the 6MWT, muscular strength as measured by hand grip strength, flexibility as measured by a back scratch test, and anthropometrics as measured by BMI and hip-waist ratio. Demographic and clinical variables were collected either to describe the sample or to examine as potential moderating variables. All participants completed self-reported sociodemographic items. Instrumentation for the primary predictor and outcomes variables are detailed in the sections that follow.

Physical activity

PA was assessed using the 7-day Physical Activity Recall (PAR). The 7-day PAR is a semi-structured interview that estimates a participant's time spent in light, moderate, and vigorous PA for the seven days prior to the interview (Sallis et al. 1985). Its validity and reliability have been evaluated in diverse samples over the past 20 years and its psychometric properties are sound (Sarkin et al. 1997). It has been correlated with an objective measure of accelerometer (*rho* = 0.50–0.54, $p < 0.001$) (Schilling et al. 2018). The standardized interview format was as follows: An interviewer explained (e.g. defined) light, moderate, and vigorous PA to the participant and asked the participant to recall activities performed over the past seven days. An interviewer guided each participant through the recall process day-by-day to determine duration and

intensity of the physical activities. REDCap's calculation feature was used to sum the time spent doing light, moderate, and vigorous physical activities in the past seven days.

Cardiorespiratory fitness

Cardiorespiratory fitness, also known as aerobic fitness, is defined as the ability of the body's large muscles to move in a rhythmic manner for a sustained period of time and in a way that causes a person to breathe harder and for the heart to beat faster (USDHHS 2018). Cardiorespiratory fitness was measured with the 6MWT (Noonan & Dean 2000; Ross et al. 2016). The 6MWT was conducted according to American Thoracic Society guidelines (Laboratories 2002). Prior to each test, participants remained seated for 10 minutes. After this rest period, blood pressure, heart rate, dyspnea, and fatigue were obtained using the Borg scale. Participants were then instructed to walk as far as possible for six minutes, in a 30-meter long pre-measured course on a flat surface, with the distance marked. Participants were instructed not to run or jog during the test. Standard phrases of encouragement were given during the test.

After each test, the participant's heart rate, dyspnea and fatigue levels, and the distance covered were recorded. The total distance walked was rounded to the nearest meter. This submaximal measure was recently validated against maximal cardiorespiratory fitness tests in PLHIV, and it was found to be associated with VO_2 Peak (Oliveira et al. 2018). Sex- and age-predicted distance was calculated using the Ross et al. (2010) validated equation to estimate VO_2 Peak from total distance achieved on the 6MWT (VO_2 Peak [ml/kg/min] = 4.948 + 0.023 × 6 MWD [meters]). REDCap's calculation feature was used to ensure accurate conversion of participant weights (kg) and 6MWT distances (meters) collected across sites. The calculation yielded a value which can be interpreted as participants' VO_2 Peak (Ross et al. 2010).

Muscular strength, flexibility, and anthropometric measurements

Muscular strength, defined as the ability of the muscles to work or hold against an applied force or weight (USDHHS 2018), was measured by hand grip strength in each hand using the Jamar hand-held dynamometer. Flexibility, defined as the ability of a joint to move through a full range of motion (USDHHS 2018) was measured by the back scratch test for flexibility. Each was administered according to their standardized protocols (Roberts et al. 2011). Both assessments are safe, widely-used, and validated in adults throughout the lifespan and across chronic health conditions (Rikli & Jones 1999). Participants' standardized height, weight, and waist and hip circumferences (in triplicate, to the nearest cm) were measured by the study staff. BMI was calculated in REDCap using participants' height and weight. Hip-waist ratio was calculated using participants' waist and hip circumferences. The average hip-waist ratio measurement was used for analysis purposes.

Data analysis

Frequencies and percentages were calculated for all categorical variables, including gender identity, ethnicity, marital status, education level, and monthly income. Descriptive statistics were calculated for all continuous variables, including age, PA (light, moderate, vigorous, and total), total distance on the 6MWT, percentage who achieved sex- and age-predicted distance on the 6MWT, hand grip strength (right and left), flexibility on the back scratch test, BMI, and hip-waist ratio. Data within three standard deviations of the mean for each variable were kept and outliers removed. Depending on the skewness of their distribution, continuous variables are discussed in this report using either median values, or mean values and standard deviations.

Given the large proportion of individuals who identify as Hispanic/Latino in Texas (39.4%) and particularly in the South Texas region in which the study took place (63.9%) (USCB 2018), ethnicity was a variable of interest in the analyses. An independent samples *t*-test was performed to determine differences in results based on participants' ethnicity (Hispanic/Latino vs. non-Hispanic/Latino). Pearson's correlations were performed to determine whether any relationships existed between the predictor and outcome variables. This test was performed for all participants (N = 172), Hispanic/Latino participants only (n = 105), and non-Hispanic/Latino participants only (n = 67). Partial correlations were then performed to determine relationships between independent and dependent variables controlling for age. This was also performed for all participants, Hispanic/Latino participants only, and non-Hispanic/Latino participants only. A hierarchical multiple regression analysis (HMRA) was performed to examine the unique contributions of light, moderate, vigorous, and total PA in explaining cardiovascular fitness, strength, flexibility, and anthropometric measurements. Due to the exploratory nature of the study, the *p*-value was set at .05 for all analyses. SPSS software was used for all statistical analyses.

Results

A profile of subjects and descriptive statistics for continuous variables are presented in **Tables 1** and **2**, respectively. Participants (N = 172) predominantly identified as male (66%), Hispanic/Latino (61%), and single (51%). The participants were 45 ± 12.8 years old and overweight based on BMI (27.6 ± 6.79). Participants walked a median of 361 meters on the SMWT and achieved an average of 64.6% (SD = 16.7) of their sex- and age-predicted distance. On the hand grip strength test, participants produced an average of 60.8 pounds of force (SD = 26.5) with the right hand and 56.9 pounds of force (SD = 25.0) with the left hand. The average score on the back scratch test was –2.66 inches (SD = 4.98). The results of the independent samples t-test are presented in **Table 3**. One statistically significant ethnicity difference was found between Hispanic/Latino (M = .67, SD = .128) and non-Hispanic/Latino (M = .620, SD = .11) participants for hip-waist ratio ($t(150) = -.270$, $p < .01$).

Table 1: Profile of Subjects.

		Frequency	Percent
Gender Identity	Male	115	65.7
	Female	56	32.6
	Transgender Male/Transman/FTM	2	1.2
	Transgender Female/Transwoman/MTF	1	.6
	Total	172	100
Ethnicity	Hispanic/Latino	105	61.0
	Not Hispanic/Latino	67	39.0
	Total	172	100
Marital Status	Single	88	51.2
	Married or Partnered	37	21.5
	Divorced	20	11.6
	Widowed	15	8.7
	Separated	11	6.4
	Other	1	.6
	Total	172	100
Education Level	11th grade or less	41	23.8
	High school or GED	59	34.3
	Some college or technical school training	37	21.5
	2 years of college or technical school training	23	13.4
	College (BS or BA)	10	5.8
	Master's degree or higher	2	1.2
	Total	172	100
Monthly Income	No monthly income	37	21.5
	Less than $200	10	5.8
	$200–$399	14	8.1
	$400–$599	8	4.7
	$600–$799	32	18.6
	$800–$999	25	14.5
	$1000 or more	46	26.7
	Total	172	100

Table 2: Descriptive Statistics for Continuous Variables.

	N	Min	Max	Mean	Median	SD
Age	172	20	78	45.0	47.0	12.8
Light Physical Activity (Minutes/Week)	167	0	1800	262	145	349
Moderate Physical Activity (Minutes/Week)	168	0	765	111	42.5	163
Vigorous Physical Activity (Minutes/Week)	166	0	250	14.3	0	44.6
Total Physical Activity (Minutes/Week)	167	0	2130	419	265	435
SMWT Total Distance (Meters)	168	120	660	394	361	94.8
% Achieved Predicted Distance	165	26.3	111	64.6	62.8	16.7
Right Hand Grip Strength (Pounds)	172	0	140	60.8	60.0	26.5
Left Hand Grip Strength (Pounds)	172	0	140	56.9	57.5	25.0
Back Scratch Test (Inches)	166	−14	9	−2.66	−2.0	4.98
BMI	172	13.9	47.4	27.6	26.3	6.79
Hip-Waist Ratio	169	.187	1.03	.651	.610	.124

Note: There were 172 total participants, however, not all participants completed every test and outliers were removed.

Table 3: Independent Samples T-Test Results for Hispanic/Latino and Non-Hispanic/Latino Participants.

	Hispanic/Latino					Non-Hispanic/Latino					t
	N	Min	Max	M	SD	N	Min	Max	M	SD	
Age	105	20	73	44.4	13.2	67	23	78	45.9	12.1	.767
Light PA (Minutes/Week)	103	0	1710	259	331	64	0	1800	268	380	.158
Moderate PA (Minutes/Week)	102	0	765	105	154	66	0	750	120	177	.604
Vigorous PA (Minutes/Week)	100	0	250	16.3	48.0	66	0	210	11.3	39.0	−.703
Total PA (Minutes/Week)	102	0	2130	394	415	65	0	1920	458	466	.928
SMWT Total Distance (Meters)	102	120	660	394	95.7	66	210	660	394	94.1	−.007
% Achieved Predicted Distance	99	26.3	111	64.6	15.6	66	31.7	109	64.6	18.2	−.011
Right Hand Grip Strength (Pounds)	105	0	140	58.8	24.2	67	0	140	63.8	29.7	1.19
Left Hand Grip Strength (Pounds)	105	0	140	56.1	23.9	67	0	130	58.0	26.8	.488
Back Scratch Test (Inches)	101	−14	9	−2.94	5.13	65	−14	5	−2.23	4.73	.899
BMI	105	13.9	47.4	28.0	7.26	67	17.1	42.9	26.9	5.97	−1.03
Hip-Waist Ratio	103	.47	1.03	.67	.128	66	.48	1.00	.620	.11	−2.70**

* $p < .05$; ** $p < .01$.

Note: There were 105 participants who identified as Hispanic/Latino and 67 who identified as non-Hispanic/Latino, however, not all participants completed every test and outliers were removed.

Physical activity and health-related fitness indicators

The results of the Pearson's correlations are presented in **Tables 4** and **5**, and partial correlations controlling for age in **Tables 6** and **7**. When examining all participants ($N = 172$), there were four statistically significant correlations (**Table 4**), two positive and two negative, which remained after controlling for age (**Table 6**). When examining Hispanic/Latino participants only ($n = 105$), there were four statistically significant positive correlations (**Table 5**), which also remained after controlling for age (**Table 7**). None of the associations in the non-Hispanic/Latino group ($n = 67$) were statistically significant either before or after controlling for age. These results are further discussed in the sub-sections below, which correspond to the four research questions that guided this study.

Table 4: Correlation Matrix for Independent and Dependent Variables.

		SMWT Total Distance	% Achieved Predicted Distance	Right Hand Grip Strength	Left Hand Grip Strength	Back Scratch Test	BMI	Hip-Waist Ratio
Light PA	Pearson Correlation	–.024	–.035	.066	.072	.069	.049	–.159*
	N	163	160	167	167	161	167	164
Moderate PA	Pearson Correlation	–.138	–.125	.134	.124	.116	–.083	–.046
	N	164	161	168	168	162	168	165
Vigorous PA	Pearson Correlation	.078	–.001	.051	.066	.151	.022	–.103
	N	162	159	166	166	160	166	163
Total PA	Pearson Correlation	–.043	–.067	.205**	.178*	.129	–.023	–.200**
	N	163	160	167	167	161	167	164

* $p < .05$; ** $p < .01$.
Note: There were 172 total participants, however, not all participants completed every test and outliers were removed.

Table 5: Correlation Matrix for Independent and Dependent Variables in Hispanic/Latino Participants.

		SMWT Total Distance	% Achieved Predicted Distance	Right Hand Grip Strength	Left Hand Grip Strength	Back Scratch Test	BMI	Hip-Waist Ratio
Light PA	Pearson Correlation	–.068	–.055	.108	.133	.074	.148	–.192
	N	100	97	103	103	99	103	101
Moderate PA	Pearson Correlation	–.086	–.065	.194*	.206*	.068	–.075	–.036
	N	99	96	102	102	98	102	100
Vigorous PA	Pearson Correlation	.122	.062	.042	.076	.194	.014	–.098
	N	97	94	100	100	96	100	98
Total PA	Pearson Correlation	–.110	–.062	.214*	.232*	.133	.101	–.190
	N	99	96	102	102	98	102	100

* $p < .05$.
Note: There were 105 participants who identified as Hispanic/Latino, however, not all participants completed every test and outliers were removed.

Table 6: Partial Correlations Controlling for Age for Independent and Dependent Variables.

		SMWT Total Distance	% Achieved Predicted Distance	Right Hand Grip Strength	Left Hand Grip Strength	Back Scratch Test	BMI	Hip-Waist Ratio
Light PA	Correlation	–.025	–.023	.062	.068	.051	.049	–.157*
	N	163	160	167	167	161	167	164
Moderate PA	Correlation	–.139	–.134	.137	.127	.135	–.083	–.046
	N	164	161	168	168	162	168	165
Vigorous PA	Correlation	.074	.078	.027	.049	.094	.021	–.096
	N	162	159	166	166	160	166	163
Total PA	Correlation	–.044	–.056	.202**	.175*	.120	–.023	–.198*
	N	163	160	167	167	161	167	164

* $p < .05$; ** $p < .01$.
Note: There were 172 total participants, however, not all participants completed every test and outliers were removed.

Table 7: Partial Correlations Controlling for Age for Independent and Dependent Variables in Hispanic/Latino Participants.

		SMWT Total Distance	% Achieved Predicted Distance	Right Hand Grip Strength	Left Hand Grip Strength	Back Scratch Test	BMI	Hip-Waist Ratio
Light PA	Correlation	–.071	–.045	.102	.128	.068	.151	–.190
	N	100	97	103	103	99	103	101
Moderate PA	Correlation	–.088	–.066	.195*	.207*	.072	–.074	–.035
	N	99	96	102	102	98	102	100
Vigorous PA	Correlation	.111	.144	.005	.043	.146	.022	–.087
	N	97	94	100	100	96	100	98
Total PA	Correlation	–.115	–.047	.207*	.227*	.106	.106	–.187
	N	99	96	102	102	98	102	100

* $p < .05$.

Note: There were 105 participants who identified as Hispanic/Latino, however, not all participants completed every test and outliers were removed.

Research question 1: PA and cardiovascular fitness

No statistically significant correlations were found between PA and cardiovascular fitness in any group analyzed (all participants, Hispanic/Latino, or non-Hispanic/Latino), even after controlling for age.

Research question 2: PA and muscular strength

When examining all participants ($N = 172$), there were significant positive correlations between total PA and right hand grip strength ($r(165) = .205$, $p < .01$) as well as between total PA and left hand grip strength ($r(165) = .178$, $p < .05$) (**Table 4**). After controlling for age, there remained significant positive correlations between total PA and right hand grip strength ($r(164) = .202$, $p < .01$) as well as between total PA and left hand grip strength ($r(164) = .175$, $p < .05$) (**Table 6**).

When examining Hispanic/Latino participants only ($n = 105$), there were significant positive correlations between moderate PA and right hand grip strength ($r(100) = .194$, $p < .05$); moderate PA and left hand grip strength ($r(100) = .206$, $p < .05$); total PA and right hand grip strength ($r(100) = .214$, $p < .05$); and between total PA and left hand grip strength ($r(100) = .232$, $p < .05$) (**Table 5**). After controlling for age, there remained significant positive correlations between moderate PA and right hand grip strength ($r(99) = .195$, $p < .05$); moderate PA and left hand grip strength ($r(99) = .207$, $p < .05$); total PA and right hand grip strength ($r(99) = .207$, $p < .05$); and between total PA and left hand grip strength ($r(99) = .227$, $p < .05$) (**Table 7**).

Research question 3: PA and flexibility

No statistically significant correlations were found between PA and flexibility in any group analyzed, even after controlling for age.

Research question 4: PA and anthropometric measurements

When examining all participants ($N = 172$), there were significant negative correlations between light PA and hip-waist ratio ($r(162) = –.159$, $p < .05$) as well as between total PA and hip-waist ratio ($r(162) = –.200$, $p < .01$). After keeping age constant, there remained significant negative correlations between light PA and hip-waist ratio ($r(161) = –.157$, $p < .05$) as well as between total PA and hip-waist ratio ($r(161) = –.198$, $p < .05$). No statistically significant correlations were found between PA and BMI in any group analyzed, even after controlling for age. The regression analysis found total PA to be a significant predictor of hip-waist ratio, accounting for 2.7% of the variation in this outcome variable ($F(1, 155) = 4.29$, $p < .05$). The contributions of light, moderate, and vigorous PA alone were statistically insignificant predictors of hip-waist ratio.

Discussion

This study examined the relationship between the physical activity patterns and health-related fitness indicators of adults living with HIV in South Texas. Based on the overall findings of this study, at least two conclusions can be drawn.

The first conclusion is that there appears to be a relationship between PA participation and muscular strength in this population of adults living with HIV. This was particularly true for Hispanic/Latino adults living with HIV. When examining all participants together, total PA (all light, moderate, and vigorous PA combined) was associated with greater muscular strength as measured by hand grip strength even after controlling for age as a variable. When examining participants by ethnicity, both moderate and total PA were associated with greater muscular strength in the Hispanic/Latino group. This was also true after controlling for age. These findings are supported by the literature, which says that engaging in PA can increase strength in PLHIV (Botros et al. 2012; CDC 2018; O'Brien et al. 2017; Jacobs 2018).

A second conclusion is that there appears to be relationship between PA and hip-waist ratio in adults living with HIV. When examining all participants, both light and total PA were associated with lower (more favorable) hip-waist ratios, even after controlling for age as a variable. This finding is also supported by the literature on PA participation in PLHIV, which says that engaging in PA can decrease central body fat distribution (Jacobs 2018) and increase fitness in this population (CDC 2018). When examining participants by ethnicity, the Hispanic/Latino participants had higher hip-waist ratios on average than the non-Hispanic/Latino participants. However, the two groups were similar in terms of all other measures and there did not appear to be an association between PA and hip-waist ratio when analyzing this anthropometric measurement by ethnicity. This is in contrast to the study by Ramirez-Marrero et al. (2004), which found that physically active HIV-positive Hispanics had significantly lower trunk circumferences than HIV-positive Hispanics who were inactive.

The significant findings are noteworthy given that the average participant did not meet the PA recommendations for adults (USDHHS 2018). Per week, participants reported engaging in a median of 145 minutes of light PA, 42.5 minutes of moderate PA, and no vigorous PA. Those numbers may be even lower considering that one study found Hispanics with HIV highly overestimated self-reported PA (Ramirez-Marrero et al. 2008). Even if the reported amounts of PA are accurate, this still falls far short of the recommended minimum of 150 to 300 minutes per week of moderate intensity PA, or 75 to 150 minutes per week of vigorous PA. This finding is consistent with that of other studies that report low levels of PA amongst PLHIV (Vancampfort et al. 2018; Vancampfort et al. 2017; Willig, Westfall, & Crane 2017). Therefore, it appears that engaging in some PA, even if it is of predominantly light intensity, can offer some health-related fitness benefits to adults living with HIV.

Conversely, the lack of a relationship between PA and the other health-related fitness variables measured in this study (cardiovascular fitness, flexibility, and BMI) may be due to the fact that participants were not getting enough PA to actualize these benefits. Future research might examine interventions and programs geared towards increasing PA, particularly MVPA, in PLHIV. One study found an inverse relationship between PA intensity and symptom intensity in PLHIV, suggesting that more intense PA could lower symptom intensity in this population (Webel et al. 2019c). Given that the dropout rate from PA interventions is much higher in PLHIV than in many other populations living with chronic morbidities (Vancampfort et al. 2017), future research might also focus on strategies to maintain PA participation among PLHIV once sufficient PA levels have been established.

One limitation of this study is that the data were self-reported. It is possible that participants over- or under-reported the amount of light, moderate, and vigorous PA that they engaged in during the previous week. The study also did not account for diet, which can greatly impact participants' BMI and hip and waist circumference. Furthermore, motivation to perform well on the tests of cardiovascular fitness and flexibility could have impacted the results of this study.

In conclusion, regular PA and exercise are part of a healthy lifestyle for nearly everyone, including people living with HIV (USDHHS 2019). It is recommended that PA be incorporated into daily life activities for PLHIV (Botros et al. 2012). The evidence about the health benefits of regular PA is well established, and research continues to provide insight into interventions at the individual, workplace, and community levels to get people to become more active (USDHHS 2018). This study suggests a relationship between PA and one health-related fitness indicator (muscular strength), as well as between PA and hip-waist ratio. Strategies to increase PA in PLHIV and to specifically target other health-related fitness indicators in this population are warranted.

Competing Interests

The authors have no competing interests to declare.

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