



A Randomized Controlled Trial to Examine the Relationship Between Peer Mentoring for Physical Activity and Cardiometabolic Health

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ABSTRACT

Background: Studies examining the effect of peer mentoring on physical activity levels have been conducted in mostly elderly and young populations, and the results have been inconsistent. This study examined the impact of one-on-one peer mentoring on physical activity and cardiometabolic parameters in urban adults.

Methods: The study participants were 353 overweight or obese adults residing in Abuja, Nigeria. They were randomized into two groups, peer-mentored ($n = 128$) and a control ($n = 225$) group. All the participants received nutritional counseling and were invited to attend instructor-led physical activity sessions each week for six months. Differences in the frequency, duration, and intensity of physical activity and cardiometabolic parameters, including body fat, muscle mass and lipids, were evaluated within and between the groups with t and rank sum tests.

Results: At the end of the study period, the average time spent on physical activity increased significantly by 14% ($p = 0.006$), and the average time spent on vigorous physical activity increased by 99% ($p = 0.003$) compared to baseline for participants in the peer-mentored group. For those in the control group, the average time spent on physical activity decreased significantly by 7% ($p = 0.03$), while the average time spent on vigorous physical activity increased by 30%, but this was not statistically significant ($p = 0.34$). In both groups, there were significant improvements in the total cholesterol, low- and high-density lipoproteins and triglycerides levels, at the end of the study period, compared to baseline.

Conclusions: In these overweight or obese adults, we observed that peer mentoring was positively associated with increased physical activity. Peer mentoring also holds great promise for improving cardiometabolic health and promoting a healthy lifestyle in adults.

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INTRODUCTION

Physical activity is an important modifiable determinant of health. The World Health Organization's (WHO) physical activity recommendation for adults aged 18–64 years is at least 150–300 minutes of moderate-intensity aerobic physical activity or at least 75–150 minutes of vigorous-intensity aerobic physical activity or an equivalent combination of moderate- and vigorous-intensity activity per week [1]. Studies have shown that adults who meet the recommended physical activity levels have reduced risks of cardiometabolic disorders, cancer, and all-cause mortality [2–11]. In spite of the well-recognized health benefits of physical activity, global estimates indicate that one in four adults does not meet the WHO recommended physical activity levels [1]. In sub-Saharan Africa (SSA), there is evidence that increasing urbanization and westernization are associated with reduced levels of physical activity [12, 13]. A previous study conducted in Nigeria, the most populous country in SSA, showed that over 80% of urban adults did not meet the WHO recommendation for physical activity [14]. Given the established health benefits associated with physical activity, it is imperative to incorporate strategies to increase physical activity levels, especially in SSA, where the prevalence of cardiometabolic disorders is increasing [15, 16].

Peer mentoring is a relatively inexpensive and adaptable strategy to increase physical activity levels [17]. Peer mentoring for physical activity utilizes the motivational impact of peer-to-peer social interaction and support to increase individual and group participation in physical activity. The effect of peer mentoring on physical activity has mostly been studied in adolescents in school-based settings [18–20] or older adults [21–23] in high-income countries, and the results have been conflicting. There are no studies on the effects of one-on-one peer mentoring on physical activity among professional adults. This study was conducted to determine the effects of one-on-one peer mentoring on the frequency, duration, and intensity of physical activity and cardiometabolic parameters among overweight and obese urban professional adults in Abuja, Nigeria.

METHODS

STUDY DESIGN

This was a randomized controlled trial conducted to evaluate the hypothesis that one-on-one peer mentoring was associated with increased frequency, duration, and intensity of physical activity and cardiometabolic parameters among overweight and obese adults. The study evaluated the effects of peer mentoring on physical activity levels and cardiometabolic parameters, including anthropometric characteristics (weight, body-mass index [BMI], waist and hip circumferences), body fat (total body fat, visceral fat, skeletal muscle), and blood lipid profiles. Participants were randomized using a 1:2 ratio into two groups, the peer-mentor group and the control group. Participants assigned to the peer-mentor group were allowed to identify an individual from their group to be paired with. At baseline, participants in both groups received nutritional counseling based on the healthy eating pyramid [24] and were invited to attend two hours of moderate-to-vigorous physical activity led by a trained physical activity instructor at a fitness center per week (individually for the control group and in pairs for peer-mentor group participants) for six months. Participants were also encouraged to increase, record, and report unsupervised leisure-time physical activity (at home and at work).

STUDY POPULATION

Participants were recruited from the federal secretariat in Abuja, central Nigeria, from July 2013 to May 2014. A random enumerated list of offices at the federal secretariat was generated; at each office assigned an odd number, workers and adult visitors were approached to be part of the study cohort. Informed consent was obtained from interested participants who were 18 to 64 years old, overweight or obese, had no contraindications to exercise, were not already on any type of weight loss intervention, were not pregnant or had not planned to become pregnant, travel, change jobs, or residence during the study period.

The study was conducted according to the Nigerian National Code for Health Research Ethics. Ethical approval to conduct this study was obtained from the Institute of Human Virology, Nigeria, Health Research Ethics Committee and the National Health Research Ethics Committee (NHREC) of Nigeria. Written informed consent was obtained from all participants before enrollment in the study.

SOCIODEMOGRAPHIC CHARACTERISTICS

At baseline, data was collected on ethnicity, religion, marital status, type of profession, and level of education. Socioeconomic status was determined using the Filmer-Pritchett wealth index [25], by constructing a linear index from asset ownership indicators, such as vehicles, information on household type, and the number of residents, using principal component analysis to derive weights.

ANTHROPOMETRIC AND BODY COMPOSITION MEASUREMENTS

Trained research associates measured participant anthropometry at baseline and six months later. Participants' height and weight were measured with a rigid tape measure. Height was measured without shoes. Weight, total body fat, and visceral and skeletal muscle mass were measured using the Omron HBF-510 W Full Body Sensor Body Composition Monitor Scale after the removal of all heavy outer garments and the emptying of pockets. Waist circumference was measured at the widest point between the bottom of the rib cage, and the iliac crest and hip circumference was measured at the widest point of the hip. BMI was calculated as the ratio of weight (kg) to height (m²) and categorized using WHO cut points in units of kg/m² (normal weight = 18.5–24.9, overweight = 25.0–29.9 and obese ≥ 30) [26].

PHYSICAL ACTIVITY LEVELS

Trained research associates monitored the frequency, duration, and intensity of the participants' physical activity at the fitness center. Interviewer-administered questionnaires were used to collect data on the participants leisure-time physical activity at baseline and six months later. Physical activity was recorded as the amount of time spent per week on each of the following activities: running, jogging, riding a bicycle, dancing, table tennis, soccer, basketball, squash, golfing, hiking, swimming, other aerobic exercise, weightlifting, and walking to and from work. MET minutes (METmin/wk) and hours (METhr/wk) per week were calculated by assigning MET values to each activity based on the compendium of physical activity intensities [27] and multiplying them by the duration and frequency of leisure time activity per week. Moderate and vigorous physical activities were categorized as activities with 3.5–6.0 METS and >6.0 METS, respectively. Physical activity levels were also categorized as low (< 200 METmins/wk), moderate (200–450 METmins/wk) and sufficient (>450 METmins/wk), based on WHO definitions.

BIOCHEMICAL MARKERS

Blood samples were collected by a licensed phlebotomist at baseline and six months later; plasma lipoprotein levels were assessed and reported in mg/dl. Lipid profiles were classified according to the American College of Cardiology/American Heart Association clinical guidelines as normal (total cholesterol < 200 mg/dl, triglycerides < 150 mg/dl, low-density lipoproteins (LDL) < 130 mg/dl and high-density lipoproteins (HDL) > 60 mg/dl) and dyslipidemia (cholesterol ≥ 200 mg/dl or triglycerides ≥ 150 mg/dl or LDL ≥ 130 mg/dl or HDL < 40 mg/dl) [28].

STATISTICAL ANALYSIS

Sample size calculations were based on the ability to detect a 10% change in minutes spent on leisure-time physical activity and a 5% change in weight. A sample size of 62 participants per group was predicted to have a power of 80% to detect these changes at a 5% significance level. Accounting for a possible but unlikely 20% attrition rate brought the number to 75 per group. The data was assessed for normality to ensure that the assumptions that informed the analyses were met. *t*-tests were used to assess the difference between the two groups for data

that met the criteria for normality. Otherwise, the Wilcoxon rank sum test was used to compare data between groups. Changes in METmins/wk, moderate and vigorous physical activity levels, cholesterol, triglycerides, LDL, high-density lipoproteins (HDL), and anthropometric measures were analyzed within groups with the paired *t*-test. Per-protocol analyses were planned, and all analyses were conducted with SAS statistical software.

RESULTS

The study flow chart is shown in [Figure 1](#). Three hundred and fifty-three overweight or obese participants (peer-mentor group, *n* = 128; control group, *n* = 225) were included in the analysis. The sociodemographic characteristics of the study participants at baseline are shown in [Table 1](#). Age, gender, marital status, education, occupation, smoking, and alcohol use were similar between the groups. Socioeconomic status differed between the groups.

The anthropometric and clinical characteristics of the study participants at baseline are shown in [Table 2](#). The characteristics were similar between the groups. [Table 3](#) shows the participants' physical activity levels at baseline and follow-up visits (six months after baseline) and the results of tests comparing the mean values of physical activity duration within and between the groups. At baseline, the peer-mentor group reported lower physical activity levels compared to the control group. However, by the end of the six-month study period, the physical activity METS minutes/week increased by 14% (*p* = 0.006) for those in the peer-mentor group and decreased by 7% (*p* = 0.03) for those in the control group ([Figure 2](#)). The average minutes spent on moderate physical activity at baseline versus the end of the study period significantly increased by 124% (347 vs. 776, *p* < 0.0001) in the peer-mentor group and 68% (480 vs. 804 *p* < 0.001) in the control group. However, the average minutes spent on vigorous physical activity at baseline versus the end of the study period significantly increased by 99% (85 vs. 169, *p* = 0.03) in the peer-mentor group. The average minutes spent on vigorous physical activity at baseline versus the end of the study period also increased by 30% (120 vs. 155, *p*-value = 0.34) in the control group, but this was not statistically significant. The proportion of participants with sufficient physical activity levels after the study intervention was also significantly increased in both groups ([Table 4](#)).

Both groups had significant reductions in waist and hip circumferences and nonsignificant reductions in body weight and visceral fat ([Table 5](#)). The levels of LDL, cholesterol, and

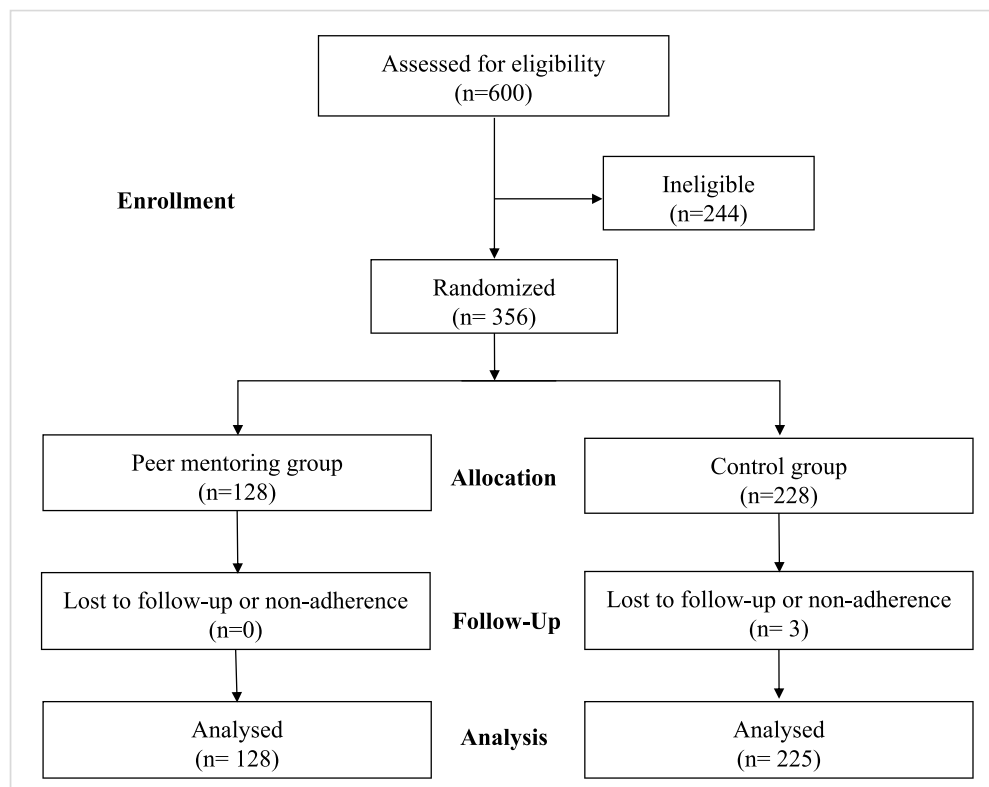


Figure 1 Participant flow chart.

	TOTAL (N = 353)	PEER-MENTOR (N = 128)	CONTROL (N = 225)	P-VALUE
Age, mean ± SD	42.69 ± 8.39	42.99 ± 8.68	42.51 ± 8.23	0.60
Age, %				0.27
– 20–30 years	6.0	8.6	4.4	
– 30–40 years	31.2	26.6	33.8	
– 40–50 years	38.2	39.0	37.8	
– 50–60 years	24.6	25.8	24.0	
Gender, %				0.75
– Male	33.0	32.8	33.0	
– Female	67.0	67.2	67.0	
Marital Status, %				0.33
– Married	77.6	80.5	76.0	
– Not married	22.4	19.5	24.0	
Highest level of education, %				0.18
– Secondary school	5.4	7.8	4.0	
– Post-secondary school	94.6	92.2	96.0	
Occupation, %				0.47
– Professional	92.4	93.0	92.0	
– Others*	7.6	7.0	8.0	
Socio-economic status, %				<0.001
– Low	22.7	17.2	25.8	
– Middle	25.2	14.8	31.1	
– High	52.1	68.0	43.1	
Smoking, %				0.13
– Current smoker	2.8	0.8	4.0	
– Former smoker	7.1	5.5	8.0	
– Never smoked	90.1	93.7	88.0	
Alcohol, %				0.34
– Current drinker	54.1	60.0	52.2	
– Former drinker	8.7	4.0	10.2	
– Never drank	37.2	36.0	37.6	

Table 1 Socio-demographic Characteristics of the Study Participants at Baseline.

Professional occupation includes accountants, lawyers, scientists, teachers; other* occupations include carpenters, homemakers, unemployed.

	TOTAL (N = 353)	PEER-MENTOR (N = 128)	CONTROL (N = 225)
	MEAN ± SD		
Weight, kg	88.89 ± 14.97	89.46 ± 14.21	88.56 ± 15.39
Body Mass Index, kg/m ²	32.32 ± 5.97	33.15 ± 6.67	31.85 ± 5.49
Waist circumference	107.10 ± 11.49	108.46 ± 11.31	106.33 ± 11.54
Hip circumference	116.26 ± 10.33	117.02 ± 10.04	115.82 ± 10.49
Total body fat	40.73 ± 9.06	41.26 ± 8.35	40.43 ± 9.44
Visceral fat	11.37 ± 4.17	11.47 ± 4.01	11.31 ± 4.27
Skeletal muscle	26.35 ± 5.01	26.18 ± 4.73	26.45 ± 5.16
Total cholesterol	206.07 ± 43.68	204.06 ± 43.37	207.23 ± 43.92
Triglycerides	129.06 ± 71.38	123.68 ± 59.83	132.16 ± 77.22

(Contd.)

	TOTAL (N = 353)	PEER-MENTOR (N = 128)	CONTROL (N = 225)
	MEAN ± SD		
Low density lipoprotein	135.66 ± 40.16	133.81 ± 41.00	136.77 ± 39.71
High density lipoprotein	44.30 ± 14.64	44.41 ± 9.90	44.23 ± 16.83
Systolic blood pressure	127.62 ± 20.56	128.18 ± 19.01	127.30 ± 21.42
Diastolic blood pressure	84.66 ± 13.64	85.52 ± 11.79	84.17 ± 14.59
	%		
Body Mass Index, kg/m ²			
– Overweight	36.75	30.08	40.67
– Obese	63.25	69.92	59.33
Lipid Profile			
– Normal Lipid Profile	26.63	26.56	26.67
– Dyslipidemia	73.37	73.44	73.33
Cholesterol, mg/dl			
– Normal, < 200	45.82	48.03	44.55
– Borderline, 200 –< 240	34.87	36.22	34.09
– High, ≥ 240	19.31	15.75	21.36
Triglycerides, mg/dl			
– Normal, < 150	70.61	70.08	70.91
– Borderline, 150 –< 200	15.27	17.32	14.09
– High, ≥ 200	14.12	12.60	15.00
Low density lipoprotein (LDL), mg/dl			
– Normal, 100 –< 130	20.12	22.76	18.54
– Borderline, 130 –< 160	55.18	54.47	55.61
– High, ≥ 160	24.70	22.76	25.85
High density lipoprotein (HDL), mg/dl			
– Ideal, ≥ 60	10.40	7.87	11.87
– Moderate, ≥ 40–60	26.30	29.92	24.20
– Low, < 40	63.29	62.20	63.93
Medical history			
– Family history of hypertension	42.9	40.1	44.4
– Family history of diabetes	23.0	23.6	22.7
– Doctor diagnosed hypertension	26.6	26.6	26.7
– Doctor diagnosed diabetes	6.2	4.7	7.1

Table 2 Anthropometric and Clinical Characteristics of the Study Participants at Baseline.

triglycerides were significantly reduced, and the level of HDL was significantly increased in both groups at the end of the study period compared to baseline (Figure 3).

DISCUSSION

In this study, we observed that one-on-one peer mentoring was positively associated with increased duration of physical activity in overweight and obese adults. Health education and access to instructor-led physical activity sessions were associated with an increase in total time spent on physical activity and moderate physical activity (MPA) for both groups. At the

PHYSICAL ACTIVITY (MINUTES)	PEER MENTORED GROUP			CONTROL GROUP			P-VALUE#		
	BASELINE	FOLLOW-UP	DIFFERENCE	P-VALUE*	BASELINE	FOLLOW-UP		DIFFERENCE	P-VALUE*
Weekly METS	9443.8 ± 4123.9	10750.3 ± 3751.4	+ 21.7	0.006	11131.4 ± 4304.4	10366.3 ± 3052.9	-12.8	0.03	0.0005
Duration of moderate physical activity	347.1 ± 458.9	776.0 ± 697.7	+ 428.9	<0.0001	480.2 ± 577.8	804.6 ± 800.4	+ 324.4	<0.001	0.30
Duration of vigorous physical activity	85.0 ± 213.2	169.3 ± 332.9	+ 81.6	0.003	120.3 ± 368.4	155.6 ± 442.1	+ 35.3	0.34	0.18

Table 3 Participants Baseline and Follow-up Physical Activity, by Group.

Difference = difference between means. P-value* = P-value comparing the mean values within each group, with a paired t-test. P-value# = P-value comparing the difference in mean values between the groups, with a t-test.

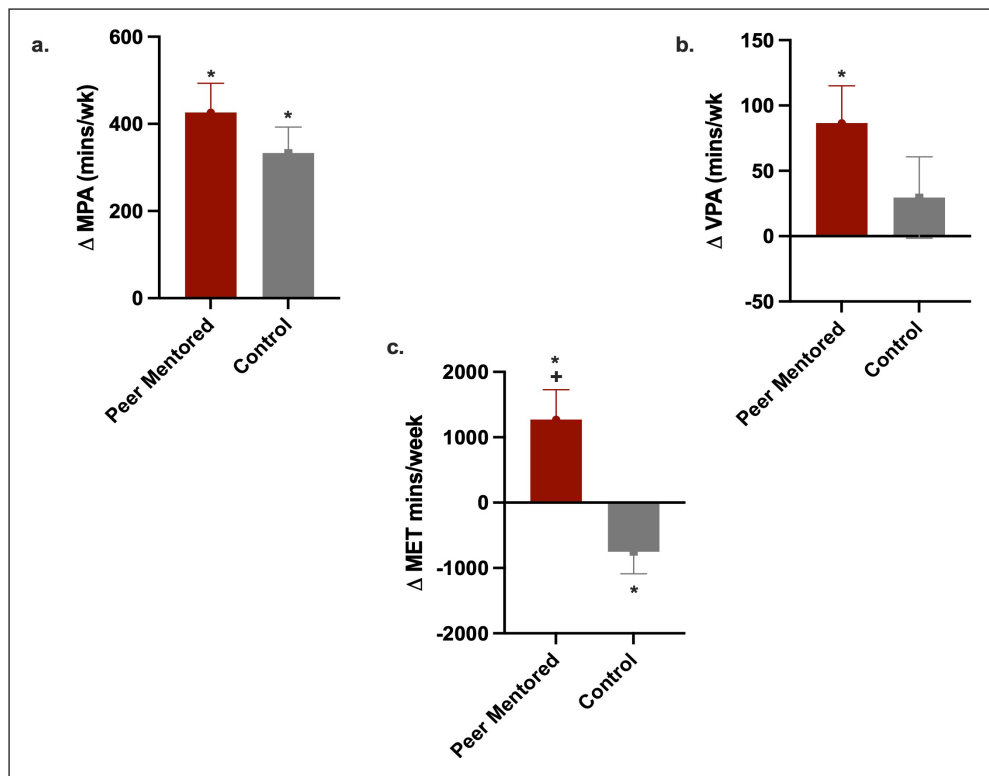


Figure 2 Change in physical activity by group.
a. Change in moderate-intensity physical activity (MPA). **b.** Change in vigorous-intensity physical activity (VPA). **c.** Change in total MET minutes spent of physical activity per week.

SUFFICIENT ACTIVITY, %	PEER-MENTOR	P-VALUE	CONTROL	P-VALUE
- Baseline	67.2	<0.0001	75.1	<0.0001
- 6 months	93.8		90.7	

Table 4 Comparison of sufficient physical activity within groups, at baseline and 6 months.

end of the study period, the average amount of time spent on vigorous physical activity (VPA) levels significantly increased by 99% for participants in the peer-mentored group compared to baseline.

Our results are similar to those in other studies [21, 22, 29–31]. In a study comparing 81 sedentary adults randomized to either peer-delivered support for physical activity or basic education, gym membership, or a pedometer for self-monitoring, both groups had similar improvements in MPA at four months, while the group supplemented with peer support had significantly more MPA at 18 months [21]. In another study with 11 peer mentors and 44 participants with developmental disabilities, it was shown that a seven-month program consisting of peer mentoring, health education, and supervised physical activity was associated with increased exercise frequency [29]. Castro et al. also showed that trained peer volunteers can effectively promote physical activity in adults over 50 years of age through telephone-based advice [22]. Other studies also showed peer mentoring was associated with increased physical activity in children [30, 31].

However, some studies that compared the effectiveness of physical activity interventions delivered by peer mentors versus other mentors showed improvement in physical activity but no difference between the groups. In one study that examined changes in physical activity over four months among individuals with diabetes, there were no significant differences in outcomes between groups led by professionals versus peers [32]. Similarly, another study that examined the effectiveness of an eight-month fitness program among adults showed that mentoring by peers versus young students were both associated with improved physical fitness, but there were no significant differences in the fitness measures between the groups [23]. These findings suggest that mentoring is beneficial for increasing physical activity and fitness levels.

Only a few studies have evaluated changes in anthropometric or cardiometabolic parameters after physical activity interventions. In one study, a six-month physical activity program was associated with 2.6 pounds of weight loss (1.18 kg) among overweight and obese adults with developmental disabilities (n = 44) [29]. Another study found that a four-month physical activity

CARDIOMETABOLIC PARAMETERS	PEER MENTORED GROUP			CONTROL GROUP			P-VALUE#		
	BASELINE	FOLLOW-UP	DIFFERENCE	P-VALUE	BASELINE	FOLLOW-UP		DIFFERENCE	P-VALUE
Weight, kg	89.5 ± 14.2	89.1 ± 14.5	-0.4	0.24	88.6 ± 15.3	87.8 ± 14.7	-0.8	0.07	0.42
BMI, kg/m ²	33.2 ± 6.6	33.0 ± 6.6	-0.2	0.23	31.9 ± 5.4	31.6 ± 5.3	-0.3	0.07	0.48
Waist-Hip Ratio	0.927 ± 0.05	0.910 ± 0.07	-0.017	0.002	0.919 ± 0.06	0.915 ± 0.07	-0.0009	0.83	0.014
Total body fat, %	41.3 ± 8.3	41.4 ± 9.2	+0.1	0.63	40.4 ± 9.4	39.6 ± 9.7	-0.8	0.02	0.09
Visceral fat, %	11.5 ± 4.0	11.3 ± 3.6	-0.2	0.55	11.3 ± 4.2	11.1 ± 3.8	+0.2	0.93	0.67
Skeletal muscle, %	26.2 ± 4.7	26.3 ± 4.8	+0.1	0.84	26.5 ± 5.1	26.8 ± 5.3	+0.3	0.11	0.49
T-Chol, mg/dl	204.1 ± 43.3	183.8 ± 38.8	-20.3	<0.0001	207.2 ± 43.9	182.4 ± 40.4	-24.8	<0.0001	0.29
TG, mg/dl	123.7 ± 59.8	101.1 ± 45.0	-22.6	<0.0001	132.2 ± 77.2	102.4 ± 50.5	-29.8	<0.0001	0.81
LDL-Chol	133.8 ± 41.0	113.3 ± 36.1	-20.5	<0.0001	136.8 ± 39.7	113.0 ± 37.3	-23.8	<0.0001	0.63
HDL-Chol	44.4 ± 9.9	50.1 ± 7.6	+5.7	<0.0001	44.2 ± 16.8	48.9 ± 8.3	+4.7	<0.0001	0.72

Table 5 Impact of physical activity on participants cardiometabolic parameters.

Difference = difference between means. P-value* = P-value comparing the mean values within each group, with a paired t-test. P-value# = P-value comparing the difference in mean values between the groups, with a t-test.

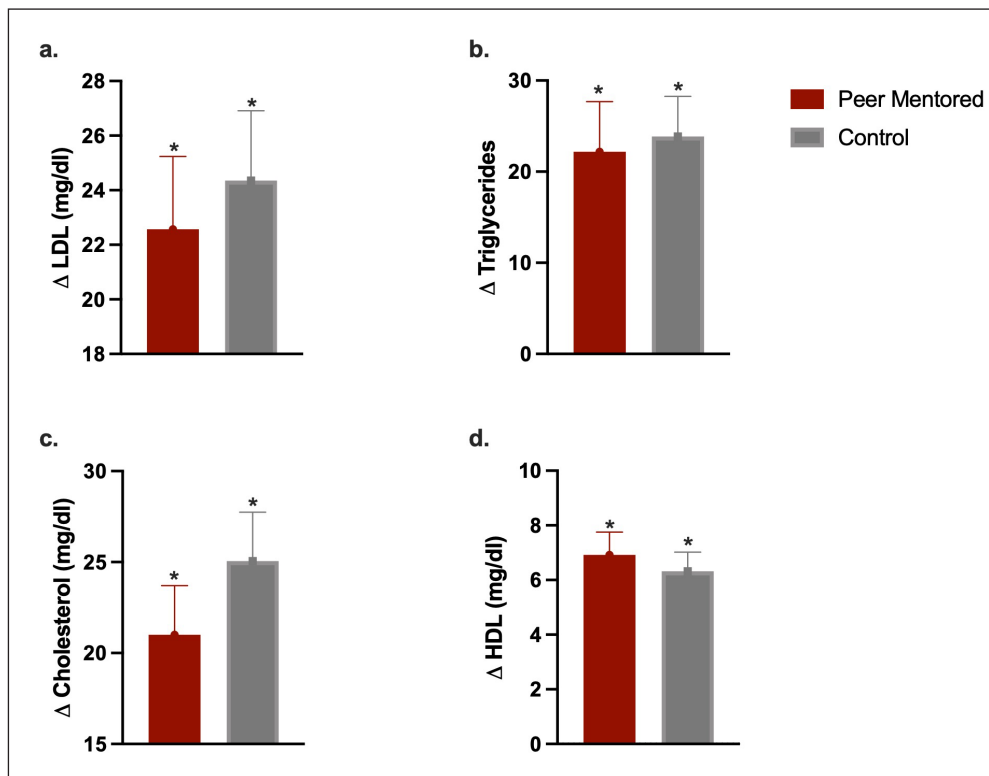


Figure 3 Change in cardiometabolic parameters (lipid profile) by group. **a.** Change in low-density lipoproteins (LDL). **b.** Change in triglycerides. **c.** Change in cholesterol. **d.** Change in high-density lipoproteins (HDL).

intervention was associated with statistically significant changes in weight, waist circumference, blood pressure, and resting heart rate among diabetic adults. However, there were no significant differences in outcomes between the participants led by professionals, $n = 157$, and those led by peers, $n = 63$ [32]. In the present study, we found significant improvements in cardiometabolic parameters, including waist circumference, blood pressure, and plasma lipid profiles, in both groups. Our results on changes in plasma lipid profile with minimal changes in weight are similar to those in other studies, which showed an association between moderate-to-vigorous intensity physical activity and improved plasma lipid profiles, even in the absence of weight loss [33, 34]. These improvements in clinically relevant health metrics further reinforce the benefits of physical activity interventions for cardiometabolic health.

Our study has some limitations. We observed that those in the peer-mentor group had higher socioeconomic status compared to those in the control group. This may be because the peers were self-selected, and participants probably chose people from their social class to be paired with. Though we randomized participants to either group to reduce bias, we cannot rule out selection bias in this study. Nonetheless, our findings contribute important knowledge to the field by examining an indigenous African population and employing one-on-one mentoring by self-selected peers. We used interviewer-administered questionnaires to collect data on the participants leisure-time physical activity at baseline and six months, which may have led to an overestimation of their physical activity levels. However, since this procedure was the same for all participants, it could not lead to random errors and variability between the groups. Moreover, we observed and recorded moderate and vigorous physical activity levels during instructor-led sessions at a fitness center. Although we did not evaluate the cost-effectiveness of the intervention, this mentoring structure is inexpensive because it does not require training individuals as mentors to engage with the study participants, and it mimics real-life dynamics where adults are more likely to engage in physical activity with peers of their choice.

In conclusion, our study shows that peer mentoring was positively associated with increased physical activity levels among overweight and obese adults. Peer mentoring also holds great promise for improving cardiometabolic health and promoting a healthy lifestyle in adults.

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COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

MB analyzed the data and drafted the manuscript. DA and SY implemented the study and contributed to the data analysis and manuscript development. EA and CA contributed to the manuscript development. SNA had the idea for the study, obtained funding and supervised the study implementation, data analysis, interpretation of the results, and provided critical revisions of the manuscript. All the authors reviewed and approved the final version of the manuscript.

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