International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 05 Issue 09 September 2022
DOI: 10.47191/ijcsrr/V5-i9-16, Impact Factor: 5.995
IJCSRR @ 2022
www.ijcsrr.org

Effects of Moderate Intensity Circuit Exercise Programme on the Blood Oxygen Saturation and Pulmonary Function of People Living With HIV

Davidson Okwudili John[1,2], Maximim Agha[3], Emeka Mong[3], Nnaemeka Nwobodo[4], Nonso Asouzo[1], Vitalis Aneke[1], Ifeoma Maduanusi[1]

[1]Department of physiotherapy Alex Ekwueme Federal University Teaching Hospital, Abakaliki, Ebonyi State, Nigeria
[2]Department of physiotherapy, College of Health Science, Evangel University, Akaeze, Ebonyi State
[3]Department of Human Kinetics and Health Education, Ebonyi State University
[4]Guy's and St. Thomas NHS Foundation, International care center, Brixton, London

ABSTRACT

Introduction: Impaired pulmonary function and arterial oxygen (O_2) saturation are among the symptomatic changes in people living with HIV (PLWH), associated with progression of HIV disease and anti-retroviral therapy (ART). Exercise has been considered an important adjuvant therapy for health promotion and improving the pulmonary function of PLWH. However studies are lacking on the effects circuit exercise training on o2 saturation and pulmonary function of PLWH.

Objective: This study determined the effect of moderate intensity circuit exercise programme on the O_2 saturation and pulmonary function of PLWH.

Methods: The study design was a pretest-posttest randomized controlled design. A total of 120 participants were recruited from the HIV clinic of a teaching hospital. Fish bowl method was used to randomize the participants to control group or exercise group. Moderate intensity (50 – 75% MHR) circuit exercise programme was administered to the participants 3 times a week between 30-60 minutes per session for 8 weeks. Pulse Oximeter and hand held spirometer were used to measure the oxygen saturation and some pulmonary functions respectively. Measurement were taken at baseline and at 8-week. Descriptive statistics of mean, standard deviation and percentages were used to summarize demographic data. Paired sample t-test and Independent sample t-test determined the mean difference within the groups and between the groups respectively. Alpha level was set at $P<0.05$.

Results: There was significant difference in the mean score of O_2 saturation and pulmonary function within the exercise group after 8-week exercise intervention. There was significant difference in the mean score of O_2 saturation and pulmonary function between the control group and exercise group after 8-week exercise intervention.

Conclusion: An 8-week circuit exercise programme brought about improvement in O_2 saturation and pulmonary function of PLWH. Circuit exercise can be effectively employed to improve lung function and ameliorate the exercise hypoxemia associated with decreased O_2 saturation in PLWH.

KEYWORDS: Circuit exercise, HIV, Oxygen saturation, Pulmonary function.

INTRODUCTION

The human immunodeficiency virus (HIV) is a virus that targets the immune system and impairs the body's ability to fight off numerous illnesses and several cancers, which healthy immune systems can handle. The virus replicates inside CD4 cells, which are white blood cells that are part of the immune system. Infected people eventually lose their immunological capacity as the virus damages and affects the function of immune cells [1]. Changes in the cellular profile of the lung's alveolar space are linked to people living with HIV (PLWH) [2]. Multiple host defenses in the lung and respiratory tract are altered as a result of HIV infection, which increases the risk of lung problems. Changes in mucociliary function and the presence of soluble defense molecules such defensins in respiratory secretions are examples of these modifications [2]. Innate and adaptive immune responses to infections may be compromised in the lung parenchyma [3]. For example, alveolar macrophages from HIV-infected individuals have been shown to be deficient in pathogen recognition. HIV also results in chronic stimulation and activation of inflammatory cells within the alveolar space [2]. Lung diseases including chronic obstructive pulmonary disease (COPD) are a significant cause of morbidity and mortality in HIV-infected individuals [4].

COPD is one of the most prevalent chronic conditions among HIV-positive individuals. According to a study, COPD may affect one in ten HIV-positive individuals [4]. A meta-analysis revealed that those with HIV had a 15% greater chance of developing COPD, even after accounting for smoking [4]. An indication of COPD is the ratio of forced vital capacity (FVC) to forced expiratory volume in one second (FEV1). The maximum amount of air a person may obtrusively exhale in a single second is known as FEV1. The FVC is the total volume of air that a person can exhale after taking a full, deep breath. People living with HIV who receive effective antiretroviral therapy (ART) have a faster rate of lung function decline than HIV-negative people [5]. The ART has been shown as an independent predictor of increased airway obstruction and reduced pulmonary function [6]. The annual rate of lung function (FEV_1) decline was faster in people with HIV than in controls, with a difference of 8.5ml/year. Likewise, the decline in FVC was greater by 18ml/year in people with HIV (35.2 in HIV-positive people versus 17.5 in controls). Reduced pulmonary function is linked to poor ventilation, which deteriorates over time and may cause life-threatening diseases like hypoxia (reduced oxygen saturation), atelectasis, respiratory failure, and cardiovascular mortality [7]. Additionally, it has been noted that some HIV-positive individuals have decreased diffusion ability [8]. Severe exercise hypoxemia was found in individuals with AIDS, with an average of 79% oxygen saturation as measured by pulse oximetry [9]

Research has shown that circuit exercise improves body composition, VO_{2max}, strength, and alters certain dimensions of QoLin overweight women [10]. Circuits exercise is an efficient and effective way to lose weight, keep it off disease, and increase physical fitness [11]. According to earlier research [12, 13, 14], machine-based circuit exercise training improved the physical performance and body composition of PLWH. Only few studies [9, 15, 16] have looked at how aerobic exercise affects the pulmonary function of PLWH. Studies on the HIV population that use non-machine based circuit training are lacking. Therefore, this study determined how non-machine based circuit exercise training affected O_2 saturation and pulmonary function of PLWH.

MATERIALS AND METHODS

Research Design**:** The study utilized a pretest-posttest randomized control design

Subject Selection: A total of 120 participants were recruited from the communicable disease and control research center of Alex Ekwueme Federal University Teaching Hospital, Abakaliki. Participants were consecutively invited to join the study. Fishbowl method was used to randomly assign the participants to either the exercise group or control group. Inclusion criteria included: current use of ARV drugs, age equal or older than 18 years, availability to attend the study activities. Exclusion criteria included: Pregnancy, active opportunistic infections, age younger than 18 years, contraindications to exercise testing and training [17]**,** significant cognitive impairment or inability to follow instructions, involvement in a regular exercise program (defined as two or more structured exercise sessions weekly for more than, or equal to, six months prior to enrolment).

Ethical consideration**:** An ethical approval was obtained from the Research and Ethics Committee of Alex Ekwueme Federal University Teaching Hospital, Abakaliki. The participants gave their consent by signing an informed consent to participate in the study.

INSTRUMENTS FOR DATA COLLECTION

OLED Digital Finger Pulse oximeter (Shanghai Joylab Medial Instruments Co., Ltd. ISO 9001. Shanghai, china): This was used to measure blood oxygen saturation level (SPO_2). It has a reliability and validity of 0.90 and 0.85 respectively [18].

Micro plus Spirometer (micro medicals limited, SKU 208, England): This was used to measure the lung function parameters: Forced vital capacity (FVC), Forced expiratory volume in 1 minute (FEV_1), and FEV1/FVC ratio. It is a portable hand held electronic spirometer with a disposable mouthpiece connected to the main unit. It has a reliability and validity of 0.94 and 0.73 respectively [19].

AHA-ACSM pre-participation screening questionnaire: This was used to screen participants for cardiovascular risk factors and readiness to exercise before the individual starts an exercise program. The questionnaire contains three sections. Section one assesses for history of cardiovascular disease, section two assesses for symptoms, section three assesses for cardiovascular risk factors. The experimental group was screened with this instrument before starting the exercise regimen.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 05 Issue 09 September 2022
DOI: 10.47191/ijcsrr/V5-i9-16, Impact Factor: 5.995
IJCSRR @ 2022
www.ijcsrr.org

Height Meter**:** A locally made height meter was used to measure the subject's height in centimeter. It is a medical device that is used in human height measurement. It is normally made from a ruler and a horizontal headpiece that is sliding and can be adjusted to rest on the top of the head. Height meters are used routinely in medical assessment, tests and researches.

METHOD OF DATA COLLECTION

Blood oxygen saturation: This was measured while the patient is in sitting position. The right middle finger was inserted in to the clamp of the oximeter. The pulse rate and oxygen saturation was read off from the display unit of the oximeter after one minute.
Lung Function: FVC, FEV_1, FEV_1/FVC were measured with a hand held spirometer. The breathing protocol was taken with the patients in a relaxed and upright sitting position. The participants were instructed to breathe in and out in a relaxed position, breathe in as much as possible and breathe out as fast as and as long as possible (forced expiration) through the mouthpiece into the spirometer. The values of FVC, FEV_1, were computed by the spirometer and was read off from the display screen. FEV_1/FVC was calculated mathematically. The protocol was repeated three times in a session for each of the participants with 1–2 minutes interval of rest and the best of the three results with less than 5% deviation from the other readings was used in this study.

Height: Height was measured in meter (m) using a height meter with subject barefooted. The feet of the participant was placed together on a level floor, and the upper back, buttocks and heels touching the scale, while the head was held erect, then with the aid of a ruler, the point of greatest height perpendicular to the height meter reading was taken in meters (m) to two decimal places.

CIRCUIT EXERCISE TRAINING

Before starting the exercise training, the participants filled out the demographic data sheet (age, gender, and educational status). Participants were screened for cardiovascular risk factors using AHA-ACSM Preparticipation Screening Questionnaire. After being certified fit for exercise, the exercise session commenced. Before the training period, the patients underwent an exercise familiarization session to ensure proper execution of technique. The participants trained 3 times a week (with at least 1 day of rest between sessions) at moderate intensity (50 – 75% MHR), and between 30- 60 minutes per session for 8 weeks under the supervision of the researchers. Each session included a warm-up and cool-down period involving 10 min of low-intensity and light stretching activities. The training program is as shown in table 1. Each exercise in the training program was performed for 60 sec, and resting time was 20 seconds between stations and 3 min between sets

Table 1: Circuit Training Programme

Parameter	**Events**	**Week**	**Intensity**	
Warm up 10min	**Circuit training 40 min**			**Cool down 10 min**
Over-head triceps &shoulder stretch, cross-body shoulder stretch, Wrist extension &flexion stretch, Hamstring stretch	Push-ups, running on the spot, jumping jack, squat	weeks 1–3	40 – 50% HR_{max}	
Calf stretch, Adductor stretch, Quadriceps stretch, Cow & cat stretch	A light jumping, jumping jack, Lunge, foot stamping	Weeks 4-6	50 – 60% HR_{max}	Seated forward bend, light walking
Calf stretch, quadriceps stretch, standing side bend, quadriceps stretch, Hamstring stretch	Superman exercise, crunches steps, light jumping	weeks 7-8	60-75% HR_{max}	

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 05 Issue 09 September 2022
DOI: 10.47191/ijcsrr/V5-i9-16, Impact Factor: 5.995
IJCSRR @ 2022
www.ijcsrr.org

DATA ANALYSIS

Data was analyzed using SPSS (Statistical Package for Social Sciences) Version 16.0 (SPSS Inc, Chicago, IL). Mean, standard deviation, and percentages were used to summarize descriptive data. Paired sample t-test and independent sample t-test were used to determine the mean difference within and between the groups. The differences between mean values were expressed at a confidence interval of 95%.

RESULTS

A total of 120 participants were recruited for this study. The participants comprised of males 38 (31.7%), and females 82(68.3%), aged between 18 and 66 years. They were randomized 60 participants each to either the control group or exercise group.

Table II shows the socio-demographic characteristics of the participants.

Table II: Socio-Demographic Characteristics of the Participants

Variable	**Control group (N=60) Mean±SD**	**Exercise group (N=60) Mean±SD**	**Total**
Age(Years)	41.20± 7.96	42.83±9.10	
Height (m)	1.61 ±0.74	1.61± 0.08	
Gender			
Male	18 (30%)	20 (33.3%)	38 (31.7%)
Female	42 (70%)	40(66.7%)	82(68.3%)
Educational Level			
No education	2 (3.33%)	5 (8.33%)	7 (5.84%)
Primary	18 (30%)	15 (25%)	33 (27.5%)
Secondary	18 (30%)	19 (31.7)	37 (30.83%)
Tertiary	22 (36.7)	21(35%)	43 (35.83)

N= Number of participants; SD= Standard deviation; %=Percentage

Table III shows mean significant difference in blood oxygen saturation and pulmonary function within the exercise group after 8-week circuit exercise intervention.

Table III: Within Group Comparison of Blood Oxygen Saturation (Spo_2) and Pulmonary Function

Variable	**Mean**	**SD**	**Mean**	**SD**	**MD**	***t*-value**	***P*-value**
	Pre		Post				
Control group (N=60)							
SPO_2 (%)	96.47	1.44	96.50	1.32	-0.03	-0.17	0.862
FEV1(L)	1.95	0.59	1.90	0.60	0.05	0.62	0.533
FVC(L)	2.03	0.76	1.98	0.76	0.05	0.41	0.681
FEV1/FVC ratio	1.08	0.47	1.05	0.46	0.03	0.55	0.587

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 05 Issue 09 September 2022
DOI: 10.47191/ijcsrr/V5-i9-16, Impact Factor: 5.995
IJCSRR @ 2022
www.ijcsrr.org

Exercise group (N=60							
SPO_2 (%)	96.37	0.50	98.53	0.50	-2.16	-10.12	0.000*
FEV1(L)	1.56	0.74	4.00	0.56	-2.44	-30.29	0.000*
FVC(L)	1.74	0.85	3.94	0.59	-2.20	-23.76	0.000*
FEV1/FVC ratio	0.97	0.40	1.36	0.82	-0.39	-3.29	0.002*

N= Number of participants; SD= Standard deviation; %=Percentage; MD= Mean difference; *=Significant difference

Table IV shows mean significant difference in blood oxygen saturation and pulmonary function between the control and exercise groups after 8-week circuit exercise intervention.

Table IV: Between Group Comparison Of Blood Oxygen Saturation (Spo2) And Pulmonary Function

	Control group (N=60)		**Exercise group (N=60)**			***t*-value**	***P*-value**
	Mean	**SD**	**Mean**	**SD**	**MD**		
Pre							
SPO_2 (%)	96.47	1.44	96.37	1.71	0.10	0.35	0.730
FEV_1(L)	1.94	0.59	1.56	1.56	0.38	3.15	0.002
FVC (L)	2.03	0.76	1.74	0.85	0.29	1.92	0.570
FEV_1/FVC ratio	1.08	0.47	0.97	0.40	0.17	1.38	0.169
Post							
SPO_2 (%)	96.50	1.32	98.53	0.50	-2.03	-11.14	0.000*
FEV_1 (L)	1.90	0.60	4.00	0.56	-2.1	-19.84	0.000*
FVC (L)	1.98	0.76	3.94	0.59	-1.96	-15.74	0.000*
FEV_1/FVC ratio	1.05	0.46	2.00	1.51	-0.95	-4.67	0.000*

N= Number of participants; SD= Standard deviation; %=Percentage; MD=Mean difference; *=Significant difference

DISCUSSION

Results from this study showed significant difference in blood oxygen saturation and pulmonary function within the exercise group after 8-week exercise intervention. There was also significant difference in blood oxygen saturation and pulmonary function (FEV_1, FVC and FEV_1/FVC) between the control and exercise group after 8-week circuit exercise intervention. This result is in tandem with the report of a previous study that reported significant improvement in pulmonary variables (FEV_1, FVC and PEF) of the study group compared to the control group after 6-week aerobic exercise [16]. In contrast, Smith et al [9], reported that aerobic exercise did not have significant effect on the FEV_1 in the experimental group.

The long-term effects of exercise, which result in an expansion of the oxygen transport system and an increased capacity for maximal effort, may be the cause of the improvement in pulmonary function in the current study [20]. During exercise there is larger lung size and vital capacity, higher blood volume and total hemoglobin, larger stroke volume, maximal oxygen uptake and arterio-venous oxygen difference [20]. The improvement in FVC and FEV_1 mean that 8-week moderate intensity circuit exercise improved air flow in the respiratory tract. Moreover, repeated stimulation of inspiration and expiration would increase alveolar compliance. As a result, FVC would increase. The significant improvement in the FEV1, FVC and FEV1/FVC may indicate better lung status. This may imply that circuit exercise could reduce the impact of COPD on airflow through the respiratory tract or reduce the likelihood of development of COPD or the progression of the impact of COPD on the respiratory system of PLWH.

The present study corroborates with the findings of Perna et al [15], which showed significant improvement in oxygen saturation in the HIV exercise group. Severe exercise hypoxemia was found in individuals with AIDS, with an average of 79% oxygen saturation as measured by pulse oximetry [9]. The significant increase in the O_2 saturation of the exercise group in the present study may indicate better exercise capacity and stamina to carry out physical function and activities of daily living by PLWH.

CONCLUSION

From the result of the study, 8-week circuit exercise intervention had a significant positive effect on the blood oxygen saturation and pulmonary function of PLWH.

Conflict of interest

The authors declare that there is no potential conflict of interest

REFERENCES

1. WHO. HIV. 2022. https://www.who.int/news-room/fact-sheets/detail/hiv-aids
2. Shellito JE. Failure of host defenses in human immunodeficiency virus. Seminar in Respiratory and Critical Care Medicine, 2004;25:73–84.
3. Beck JM. The immunocompromised host: HIV infection. Procceding of American Thorac *Society*, 2005;2:423–427.
4. Crothers K et al. *COPD and the risk for myocardial infarction by type in people living with HIV.* Conference on Retroviruses and Opportunistic Infections, Seattle, abstract 31, 2019.
5. Thudium RF, Ronit A, Afzal S et al. *Faster lung function decline in well-treated people living with HIV compared with uninfected controls: a longitudinal matched cohort study.* 18th European AIDS Conference, London, abstract OS2/2, 2021.
6. Gingo MR, George MP, Kessinger CJ, Lucht L, Rissler B, Weinman R. et al. Pulmonary function abnormalities in HIV-infected patients during the current antiretroviral therapy era. *American Journal of Respiratory and Critical Care Medicine.* 2010;182(6):790–796.
7. Schunemann HJ, Dorn J, Crant BJ. Pulmonary function is a longterm predictor of mortality in general population 29 year follow up of the Buffalo Health Study. *Chest.* 2000;118:656–664.
8. Crothers K, Thompson BW, Burkhardt K, Morris A, Flores SC, Diaz PT, Chaisson RE, Kirk GD, Rom WN, Huang L; Lung HIV Study. HIV-associated lung infections and complications in the era of combination antiretroviral therapy. Proceeding of American Thoracic Society. 2011 Jun;8(3):275-81. doi: 10.1513/pats.201009-059WR. PMID: 21653528; PMCID: PMC3132785.
9. Smith, B. A., Neidig, J. L., Nickel, J. T., Mitchell, G. L., Para, M. F., & Fass, R. J. Aerobic exercise: effects on parameters related to fatigue, dyspnea, weight and body composition in HIV infected adults. *AIDS*, 2001; 15, 693-701.
10. Sperlich B, Wallmann-Sperlich B, Zinner C, Von Stauffenberg V, Losert H, Holmberg HC. Functional High-Intensity Circuit Training Improves Body Composition, Peak Oxygen Uptake, Strength, and Alters Certain Dimensions of Quality of Life in Overweight Women. Frontiers of Physiology. 2017 3;8:172. doi: 10.3389/fphys.2017.00172.
11. Klika, B. and Jordan, S. High-Intensity Circuit Training Using Body Weight: Maximum Results with Minimal Investment. ACSM'S Health & Fitness Journal, 2013 17, 8-13. https://doi.org/10.1249/FIT.0b013e31828cb1e8
12. Dudgeon, W. D., Jaggers, J. R., Phillips, K. D., Durstine, J. L., Burgess, S. E., Lyerly, G. W., Davis, J. M., and Hand, G. A. . Moderate-Intensity Exercise Improves Body Composition and Improves Physiological Markers of Stress in HIV-Infected Men. *International Scholarly Research Notices AIDS*, 2012 ;https://doi.org/10.5402/2012/145127

13. Paes, LS, Borges, P.B, Santos, E.M, Olivera, T.P, Dupin, L.G, Farinatti, P. Effects of a 2-year supervised exercise programme upon the body composition and muscular performance of HIV-infected patients. Open AIDS Journal, 2015; 9(1:M4): 80-88.
14. Kubeyinje, O., & Efe-Aigbovo, A. Anthropometric changes following aerobic and resistance training programs among HIV-seropositive female patients. Turkish Journal of Kinesiology, 2020; 6 (3): 101-108. DOI: 10.31459/turkjkin.735636
15. Perna, F.M..; laperriere, A., klimas, N.,Ironson, G., Perry, A., Pavone, J., Goldstein, A., Majors, P., Makemson, D., Talutto, C., Schneiderman, N., Ann fletcher, M., Meijer, O.G., & Koppes, l. Cardiopulmonary and CD4 cell changes in response to exercise training in early symptomatic HIV infection, Medicine & Science in Sports & Exercise, 1999;31 (7): 973-979.
16. Aweto, H. A., Aiyegbusi, A. I., Ugonabo, A. J., and Adeyemo, T. A.. Effects of Aerobic Exercise on the Pulmonary Functions, Respiratory Symptoms and Psychological Status of People Living With HIV. *Journal of research in health sciences*, 2016; 16(1), 17–21.
17. American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription;. 9th ed. Philadelphia, PA: Wolters Kluwer/Lippincott Williams & Wilkins 2014
18. Munoz, X, Torres, F, Sampol, G, Rios, J,Marti, S, Escrich, E. Accuracy and reliability of pulse oximeter at different arterial carbon dioxide pressure level. European Respiratory Journal, 2008; 32; 1053-1059.
19. Finkelstein, S.M., Lindgren, B., Prasad, B., Snyder, M., Edin, C., Wielinski, C., and Hertz, M. Reliability and validity of spirometry measurements in a paperless home monitoring diary program for lung transplantation. *Heart Lung*,1993; 22(6): 523-533.
20. Wilmore, J.H, & Costill, D.L. Physiology of Sport and Exercise: 3rd Edition. Human Kinetics Publishing. 2005; p56-75

Cite this Article: Davidson Okwudili John, Maximim Agha, Emeka Mong, Nnaemeka Nwobodo, Nonso Asouzo, Vitalis Aneke, Ifeoma Maduanusi (2022). Effects of Moderate Intensity Circuit Exercise Programme on the Blood Oxygen Saturation and Pulmonary Function of People Living With HIV. International Journal of Current Science Research and Review, 5(9), 3387-3393