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Effects of 12-Week Aerobic Dance on Haematological Variables and Health-Related Quality of Life of Individuals with Sickle Cell Anaemia

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Abstract

Introduction: Sickle cell disease is a common condition that negatively impacts on quality of life. This study investigated the effects of a 12-week aerobic dance programme on heamatological variables and health status of individuals with sickle cell anaemia (SCA).

Methods: Participants (N=104) with SCA attending Hematology clinic at the Lagos State University Teaching Hospital, Nigeria were randomly assigned into two groups. The control group (n=50) received routine medications while the experimental group (n=54) received 36 sessions of aerobic dancing for 12 weeks in addition to routine medications. Participants' health-related quality of life (HRQoL) measured with SF-36 and the packed cell volume (PCV), platelet count (PC) and mean corpuscular hemoglobin concentration (MCHC) measured with standardized instruments were assessed at baseline, and at 6 and 12 weeks. Frequency of crisis (FC), frequency of hospitalization (FH) and length of hospitalization (LH) were self-reported at 6 months before and after the study.

Results: The groups were comparable in all variables of interest at baseline and 6 months before the study ($p>0.05$). Compared to the control, the experimental group had significantly better PCV and health-related quality of life score at 6th week and PCV, PC and HRQoL score at 12th week. The experimental group had significantly lower FC ($p<0.0001$), lower FH ($p=0.001$) and shorter LH ($p<0.0001$) than the control group at 6 months after the study.

Conclusion: Aerobic dancing improves PCV, PC and health status, and reduces FC, FH and LH in individuals with SCA. Aerobic dancing could be included as a routine cost-effective adjunct therapy in the management of SCA.

Keywords: Sickle cell anemia; Aerobic dancing; Health related quality of life

Introduction

Sickle-cell anaemia (a form of sickle-cell disorder or sickle-cell disease) is a common genetic condition due to a haemoglobin disorder – inheritance of mutant haemoglobin genes (HbS) from both parents [1,2]. The clinical manifestations are diverse and may include vaso-occlusive, hematological and infectious crises [3]. Its management is multidisciplinary and usually aims at relieving pains and other associated clinical symptoms. The life expectancy of individuals with sickle cell disease has improved considerably since 1960 when Sir John Dacie described it as essentially a 'disease of childhood'. Estimated number of new-borns with SCA globally will increase from 305,800 (confidence interval [CI]: 238,400–398,800) in 2010 to 404,200 (CI: 242,500–657,600) in 2050. It is likely that Nigeria (2010: 91,000 newborns with SCA [CI: 77,900–106,100]; 2050: 140,800 [CI: 95,500–200,600]) and the Democratic Republic of the Congo (2010: 39,700 [CI: 32,600–48,800]; 2050: 44,700 [CI: 27,100–70,500) will remain the country's most in need of policies for the prevention and management of SCA. According to World Health Organization [1], in the United States of America, median survival was estimated in 1994 to be 42 years for men and 48 years for women, whereas comparable figures for Jamaica published in 2001 suggested 53 years for men and 58.5 years for women. In Jamaica, the greatest mortality occurs between 6 and 12 months old when 10% of patients die despite considerable experience in the diagnosis and therapy of the condition and absence of malaria. There are, however, no concrete data on the average survival years for patients with sickle-cell anaemia on the African continent [1].

Patients' quality of life is an important outcome measure in medicine and healthcare that is now widely used in patient management [4,5]. The concept of health-related quality of life represents the satisfaction and well-being of an individual relating to the physical, psychological, social, economic, and spiritual domains of his/her state of health [6]. Health related quality of life (HRQOL). The relationship between health measurements and chronic conditions are well studied in a variety of age groups [7].

Short form 36 version 2 (SF-36v2) is a widely used as an extensive health related quality of life measurement. The major domains of SF-36v2 form are physical functioning (PF), social functioning (SF), role-emotional (RE), role-physical (RP), bodily pain (BP), vitality (VT), mental health (MH) and general health perception (GH). The calculated score of each scale was transformed to have a mean of 50 and standard deviation of 10 in general population, with higher scores indicating a better state of health [8].

There is evidence that sickle cell disease directly impairs health-related quality of life and that patients with SCA experienced worse health related quality of life than the general population [9-11]. The overall impairment in quality of life is more pronounced among the adults and under-15 years adolescents with SCA [12,13].

Although exercise capacity and cardiovascular responses to exercise testing have been studied in patients with SCA [14-16], the effect of aerobic exercise on health-related quality of life has been relatively unstudied in this clinical population. A recent cross-sectional study found SCA patients with regular exercise tend to have improvement in the QoL domains of vitality, social function, general health, and reduce pain [17]. A single case study showed that aquatic treatment including warm water exercises, stretching, aerobic exercise, and relaxation, during two sessions of 45 min per week for 5 weeks improved the quality of life of a patient with SCD [18].

A comprehensive multidisciplinary approach to the management of patients with sickle cell anaemia has been advocated because of its potential to produce the best results [19]. Aerobic exercise has been used in patients with severe rheumatoid arthritis to improve their locomotor ability [20] and prevent disability resulting from coronary disease in cardiac patients [21]. Yet, no study has reported on the effects of aerobic exercise on quality of life, heamatologica variables, frequency of crisis, frequency of hospitalization and length of hospitalization in patients with sickle cell anaemia, especially in Nigeria. An understanding of these issues can inform cost effective targeted interventions for patients with SCA in Nigeria. This aim of this study was to investigate the effects of a 12-week aerobic dance programme on health-related quality of life, hematological variables and hospitalization history of individuals with sickle cell anaemia in Nigeria.

Methods

The study's protocol was approved by the University of Ibadan/ University College Hospital, Ibadan Nigeria Ethics Committee and Research and Ethics Committee of the Lagos State University Teaching Hospital, Ikeja, Lagos. Participants provided written informed consent after the study's protocol have been explained to them and they have been assured of the confidentiality of the collected data and were not under any obligation to participate in the study.

Setting and participants

This study was carried out at the Haematology Clinic of the Lagos State University Teaching Hospital, Ikeja, Lagos, South-West, Nigeria. The hospital provides tertiary level care and serves about 17.5 million people. Adolescents and adults with SCA attending Hematology clinic at the teaching hospital for routine assessment, follow-up and management were recruited into the study. To qualify for inclusion in the study, prospective participants must have been screened by the referring physician and found fit by not having any symptom of dyspnea, fainting and syncope following three minutes of step test. Patients with sickle cell anaemia that had complications of sickle cell anaemia such as organ damage, priapism and retinopathy were excluded from the study. Participants were recruited consecutively.

Procedure and instruments

Participants were assigned to either the aerobic exercise group (Experimental group) or the no exercise group (control group). The first participant was randomly assigned to either of the groups while consequent participants were alternately and consecutively assigned to the groups as they became available. The study had the following three phases:

Observational phase: Data on frequency of crisis, frequency of hospitalization and length of hospitalization at six months before the study were retrieved from the participants' case files.

Experimental phase: Data on haematological variables and quality of life were recorded at baseline (week 0), end of 6th week and end of 12th week of the study.

Follow-up phase: Data on frequency of crisis, frequency of hospitalization and length of hospitalization at six months after the study were recorded.

The participant's demographic data such as age, sex, and occupation were sought and documented on the data sheet, while their weight and height were measured using standardized instruments and procedures. Data on haematological variables namely: packed cell volume (PCV), platelet count (PC), mean corpuscular haemoglobin concentration (MCHC) was measured by analyzing the blood sample of the participants. A blood sample of 4.5mls was collected from both groups into Ethylene Diamene Tetraacetic Acid (EDTA) anticoagulant bottle for Haematological variables and analysis was done on the same day of collection using the Sysmex blood analyzer KN-21N (manufactured by Sysmex Corporation Kobe, Japan), a three-part auto analyzer able to run 19 parameters per sample. The health-related quality of life data (QOL) was assessed using SF-36.

Intervention

Participants in the aerobic exercise group had 12 weeks of aerobic dancing held thrice weekly. Each session comprised 5minutes of warm-up, 20-45 minutes of main menu and 5 minutes of cool down. The warm-up comprised breathing, arm rotation and body rotation exercises while the cool down phase involved slow down steps and breathing exercises. The aerobic dance progressively lasted 20, 25, 30, 35, 40 and 45 minutes during the course of the study; the duration being progressively increased every two weeks. Participants were lightly clothed and training was undertaken in the morning between 8am-12pm in order to reduce the effect of temperature on the participants. Participants also continued on their prescribed drugs. Participants who were absent from training for three consecutive sessions were excluded from the study. The following precautionary measures were taken:

1. As recommended by [21], all participants danced tall to prevent muscle strain and fatigue.

2. As recommended by [22], participants were allowed and encouraged to drink water as necessary during workout to prevent dehydration and its consequences.

3. A doctor was always on standby during all training sessions to handle any emergency and need for resuscitation [23].

Participants in the control group did not participate in the aerobic dance program, but continued on their prescribed drugs and were assessed at the same intervals like those in the experimental group.

Data analysis

Data were summarized using mean and standard deviation. Repeated measures Analysis of Variance (ANOVA) was used to

compare each of packed cell volume, platelet count, mean corpuscular hemoglobin concentration and health status scores of the experimental group across weeks 0, 6 and 12 of the study and the control group across week 0, 6 and 12 of the study. Independent t- test was used to compare the Packed Cell Volume, Platelet Count, Mean Corpuscular Heamoglobin Concentration and Quality of life between the experimental and control groups at the baseline, 6 weeks and 12 weeks of the study:

Independent t- test was also used for between-group comparison of Frequency of crisis, Frequency of hospitalization, and Length of hospitalization at 6 months before the study while paired t-test was used to compare the Frequency of crisis, Frequency of hospitalization, and Length of hospitalization in the experimental group 6 months before and after the study. The alpha level for t-test and ANOVA was set at 0.05. Post-hoc analysis for significant repeated measures ANOVA was done using paired t-test with the alpha level at 0.017 using the Bonferroni adjustment. Analysis was done using the Statistical Package for the Social Sciences (SPSS) Version 16.

Results

104 participants (54 experimental and 50 control respectively) participated and completed this study. The group's physical characteristics are not significantly different (Table 1).

	Group			
Variables	**Experimental (n=54) Mean ± SD**	**Control (n=50) Mean ± SD**	**95% CI**	**p**
Age (years)	26.06 ± 6.67	5.86 ± 5.59	-2.97 to1.96	0.686
Height (m)	1.61 ± 0.07	1.61 ± 0.06	-0.02 to 0.03	0.656
Weight (kg)	52.39 ± 5.66	50.82 ± 6.10	-1.45 to 3.08	0.476
BMI (kg/m^2)	20.24 ± 2.02	19.64 ± 1.60	-0.11 to 1.31	0.097

Table 1: Physical Characteristics of the participants (Key: CI=Confidence Interval).

The groups' PCV, PC and MCHC at the different time points of the study are compared in Table 2.The experimental group had significantly higher PCV at weeks 6 and 12 while the control group had significantly higher PC at week 12 but the groups were not significantly different in their MCHC at any time point of the study.

	Group			
Variables	**Experimental (n=54) Mean ± SD**	**Control (n=50) Mean ± SD**	**95% CI**	**p**
PCV%	24.72 ± 3.16	24.39 ± 3.4	-0.81to1.74	0.61
	26.06 ± 3.44	23.24 ± 3.79	1.02 to 3.81	0.002
	26.80 ± 3.29	23.32 ± 3.45	2.48 to5.04	0.000*
PC×109 /L	364.61 ± 127.46	343.58 ± 128.81	-28.89 to 70.90	0.4
	322.41 ± 100.90	335.20 ± 132.21	-58.34 to 32.75	0.57
	269.37 ± 86.29	331.12 ± 122.28	-102.67 to -20.83	0.003*
MCHCg/dl	33.67 ± 1.04	33.85 ± 1.06	-0.59 to 0.23	0.3
	34.03 ± 1.30	34.27 ± 1.84	-0.86 to 0.37	0.434
	34.05 ± 1.01	34.13 ± 1.12	-0.49 to 0.34	0.709

Table 2: Comparison of Haematological Parameters of Participants at Week0, Week 6 and Week 12 of the study (*Significant difference between experimental and control groups at p=0.05; Key: PCV=Packed cell volume PC=Platelet count, MCHC=Mean corpuscular haemoglobin concentration).

Comparison of the groups' quality of life score showed that the experimental group had significantly higher HS scores at weeks 6 and 12 of the study (Table 3).

	Group		

Time Frame	Experimental (n=54) Mean ± SD	Control (n=50) Mean ± SD	95% CI	p
Week 0	65.06 ± 8.17	65.38 ± 10.13	-3.64 to 3.49	0.86
Week 6	69.22 ± 8.09	65.06 ± 12.49	0.51 to 8.60	0.045*
Week 12	72.90 ± 7.31	64.44 ± 11.15	4.82 to 12.11	0.000*

Table 3: Comparison of Health-related quality of life of Participants at Baseline, Week 6 and Week 12 of the study (*Significant difference between experimental and control groups at p=0.05, HSS=Health Status Score).

Table 4 shows that the groups were not significantly different in their frequencies of crisis at 6 months before the study but the experimental group had significantly lower frequency of crisis at 6 months after the study. Further, within-group comparisons indicated that the frequency of crisis significantly decreased and increased in the experimental and control groups respectively at 6 months after the study.

	Group			
Frequency of Crisis, Time Frame	Experimental	Control	95% CI	p-value
6 months before	1.37 ± 1.52	1.42 ± 1.73	-0.68 to 0.58	0.877
6 months after	0.46 ± 0.57	1.58 ± 1.32	-1.51 to -1.52	0.000*
95% CI	0.51 to 1.31	-0.42 to 0.02		
P	0.000*	0.033*		

Table 4: Comparison of Frequency of Crisis of Participants at 6 months before and 6 months after the study (*Significant difference between experimental and control groups at p=0.05).

Table 5 shows that though the groups were not significantly different in their length of hospitalization at 6 months before the study but the control group had significantly longer hospitalization at 6 months after the study.

	Group			
Length of Hospitalization (days), Time Frame	Experimental (n=54) Mean ± SD	Control (n=50) Mean ± SD	95% CI	p
6 months before	0.59 ± 0.94	0.66 ± 1.04	-0.45 to 0.32	0.73
6 months after	0.13 ± 0.34	1.30 ± 1.90	-1.69 to -0.65	
95% CI	0.22 to 0.71	-1.04 to -0.16		
p	0			

Table 5: Comparison of Length of Hospitalization of Participants at 6 months before and 6 months after the study (*Significant difference between experimental and control groups at p=0.05).

Further within-group comparison indicated that while the length of hospitalization decreased significantly for the experimental group during the 6-month follow-up, it increased significantly for the control group during same period.

Discussion

The objective of this study was to explore the effects of 12-week aerobic dancing exercise training on participant's selected haematological variables, health- related quality of life, frequency of crisis as well as frequency and length of hospitalization. The experimental and control groups were not different in their pack cell volume (PCV), platelet count (PC) and Mean Corpuscular Haemoglobin Concentration (MCHC) at baseline but at 6th and 12th weeks the experimental group had significantly higher PCV and significant lower PC than the control group. The findings with respect to PCV are in line with the known effects of exercise training on PCV and PC. Aerobic training has been reported to increase the amount of red blood cells in circulation thereby increasing the PCV [21]. Also, long term aerobic training has been reported to decrease PC while increasing the bleeding time [24]. Babara et al. [25] explained that there is an improvement in the platelet and PCV Count of individual with SCD.

We found less frequency of crisis and hospitalization in the experimental group but more frequency of crisis and hospitalization in the control group 6 months after the study. Interestingly, during the study, only one (0.78%) experimental group participants had crisis

while, 7 (5.43%) control group participants had crisis. The reduced frequency of crisis in the experimental group may be consequent on the increased PCV and VC and reduced PC which would reduce haemolysis. A study by Akinbami et al., [26] reported that sickle cell anaemia patients who had blood transfusion had more viable red blood cells in circulation and had reduced crisis. Similarly, Robert et al., [27] reported improvement in exercise capacity of sickle cell anaemia patients subjected to submaximal exercise as a result of increased haemoglobin concentration. More oxygenated blood in circulation will reduce the number of haemolysed red blood cells thereby reducing frequency of pain crisis, infection and other related crisis which in turn could minimize the frequency and length of hospitalization in patients with SCA.

There was significant effect of aerobic dancing on health- related quality of life at the ends of the 6th week and 12th week of this study. This finding confirms a recent cross-sectional study that found regular aerobic exercise to improve the vitality, social function and general health quality of life of individuals with SCA in Saudi Arabia [28]. It also support the conclusion of a single case study that found the combination of warm water exercises, stretching, aerobic exercise, and relaxation to improve the quality of life of a patient with SCAs [29]. The present experimental study adds to these previous studies by providing evidence that aerobic dancing can also improve the quality of life of individuals with SCA. This is plausible considering the numerous benefits of aerobic exercise in health and disease [30]. Aerobic exercise, through its influence in enhancing aerobic capacity, improving tolerance for activities of daily living and reducing psychological stress, could positively impact on the quality of life of individuals with Expectedly, with reduced frequency of crisis the groups' health- related quality of life, will be better.

Clinical implication of findings

The outcome of this study has shown that aerobic dance, a type of aerobic exercise, could have positive effects on the haematological parameters (PCV and PC) and quality of life of individuals with sickle cell anemia. Additionally, the aerobic dance training also reduced the frequency of crisis, frequency of hospitalization and length of hospitalization of individuals with sickle cell anemia at 6 months follow-up. This finding suggests that the effects of aerobic dance training lasts beyond the training period and could be sustained over a subsequent period of 6 months. Aerobic dance is therefore an adjunct intervention in the treatment of patients with sickle cell anemia. It has the additional advantages that it is inexpensive and could be safely prescribed as an enjoyable home programme for suitable patients with sickle cell anemia.

Conclusion

Findings from this study showed that the 12-week aerobic exercise programme improved the quality of life and reduced the HR, frequencies of crisis and hospitalization and length of hospitalization of individuals with sickle cell anaemia. Aerobic exercise training is not only effective in producing health-enhancing effects in individuals with sickle anaemia but that such effects on frequency of crisis, frequency of hospitalization and length of hospitalization could be sustained over subsequent period of 6 months. Therefore, aerobic exercise should be routinely included as an adjunct therapy in the total management of patients with sickle cell anaemia because it is not expensive, it could be prescribed to the sickle cell patients as an enjoyable home programme since it has been documented that music and dance improves psychological well-being of human beings.

Recommendation

The outcome of this study showed that aerobic dance could be prescribed as an enjoyable home programme for suitable patients with sickle cell anaemia.

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