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Enhancing Respiratory System Function in Academic Staff of Federal College of Education Kontagora, Niger State through an 8-Week Mixed Aerobics Exercise Program

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Abstract— This study evaluates the impact of an 8-week mixed aerobic exercise program on the respiratory function of academic staff at the Federal College of Education Kontagora (FCEKG), Niger State. The study involved 40 participants, divided equally into a treatment group (TG) and a control group (CG). Forced Vital Capacity (FVC) and Peak Expiratory Flow (PEF) were measured using a spirometer. FVC is measured in litres, while PEF is measured in litres per minute. Respiratory rates were measured with a stethoscope. Results showed no significant difference between the groups in pre-intervention respiratory function. However, post-intervention analysis revealed significant improvements in all measured parameters in the treatment group compared to the control group. Specifically, the treatment group exhibited a significant reduction in RR and significant increases in both FVC and PEF. These findings support the hypothesis that aerobic exercise significantly enhances respiratory function. The study concluded that the 8-week mixed aerobic exercise program significantly improved the respiratory function of academic staff of FCEKG. Amongst other: the study recommended that other institutions like FCEKG should introduce mixed aerobic exercises to enhance respiratory function, workshops and seminars should be conducted to educate academic staff on the benefits of aerobic exercise.

Keywords— Respiratory function, Academic staff, Mixed aerobic exercise, Pulmonary health.

I. INTRODUCTION

To sustain life and live healthily, the human body must generate an adequate amount of energy. This energy production primarily occurs through the combustion of molecules found in food; a process known as oxidation (Dezube, 2023). During oxidation, carbon and hydrogen in these food molecules combine with oxygen, resulting in the formation of carbon dioxide and water. This exchange of oxygen and carbon dioxide is essential for life to continue. The respiratory system plays a crucial role in this process by facilitating the intake of oxygen into the body and the expulsion of carbon dioxide (Heath et al., 2023). The respiratory system begins at the nose and mouth, continuing through the airways and into the lungs. Air enters through the nose and mouth, passes down the throat (pharynx), and through the larynx, where a flap of tissue called the epiglottis automatically closes during swallowing to prevent food or drink from entering the airways (Dezube, 2023).

When an individual's lung function becomes insufficient to carry out daily tasks and maintain usual activities, it indicates some degree of respiratory failure. Respiratory failure is a complex medical condition characterized by

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factors that hinder the lungs' ability to effectively oxygenate blood and remove carbon dioxide, a process known as gas exchange (Heath et al., 2023). People with chronic respiratory failure can experience emotional distress, including feelings of fear, anxiety, depression, and stress, due to the constant struggle to obtain adequate oxygen or limitations in daily activities (Takashi et al., 2018).

Chronic Respiratory Diseases (CRDs) affect the airways and various lung structures, including Chronic Obstructive Pulmonary Disease (COPD), asthma, occupational lung diseases, and pulmonary hypertension (Alvar et al., 2023). COPD, a significant pulmonary condition, manifests with ongoing respiratory symptoms such as shortness of breath, cough, sputum production, and exacerbations. These symptoms result from airway (bronchitis, bronchiolitis) or alveolar (emphysema) abnormalities, leading to persistent and often progressive airflow obstruction. COPD ranks as the third leading cause of global mortality, accounting for 3.23 million deaths in 2019 (Alvar et al., 2023). Nearly 90% of COPD-related deaths under age 70 occur in low to moderate-income countries. COPD is the seventh leading cause of disability-adjusted life years globally (WHO, 2023).

Recent attention has focused on promoting physical activity among individuals with COPD. Numerous interventions have been studied and are supported by COPD management guidelines. This emphasis stems from the understanding that reduced physical activity can significantly impact disease progression and mortality risk (Halpin et al., 2020). Scientific literature highlights the positive effects of regular exercise on cardiovascular and pulmonary health. Aerobic exercise, in particular, has been associated with improved heart function, blood pressure regulation, lung capacity, and overall aerobic fitness which is required for work efficiency in all fields of endeavour, academic staff inclusive.

Academic staff members play a crucial role in the education system, responsible for imparting knowledge and shaping students' academic experiences. Their effectiveness in these roles is closely tied to their health and well-being. Respiratory function, critical for sustaining energy levels, combating fatigue, and supporting vitality, plays a fundamental role in their overall health. Academic staffs at the Federal College of Education in Kontagora, like their peers in other Nigerian higher education institutions, face various health concerns. With a significant portion of this workforce aged 35 and above, non-communicable diseases such as diabetes, hypertension, and overweight/obesity are prevalent (Halpin et al., 2020). These conditions are recognized risk factors for respiratory dysfunction, leading to reduced vitality, diminished quality of life, and compromised job performance (Takashi et al., 2018; Martin et al., 2021; Halpin et al., 2020).

Respiratory function is inherently linked to overall health and fitness. Any decline in respiratory function among academic staff can have far-reaching implications, potentially hindering their ability to maintain an active teaching and research schedule. Furthermore, compromised respiratory function can increase susceptibility to respiratory infections, leading to increased absenteeism and potentially undermining the quality of education delivered to students (Budreviciute et al., 2020).

While the benefits of exercise on health and respiratory function are well-documented, there is a notable lack of research specifically addressing academic staff in Nigerian higher education institutions. Moreover, existing studies often lack specificity in targeting the unique characteristics and health challenges faced by this

demographic. There is a clear need for research that tailors interventions to the needs of academic staff, considering their work-related stressors and the specific context of Nigerian higher education institutions.

This study aims to fill this research gap by investigating the potential impact of an 8-week mixed aerobic exercise program on the respiratory function of academic staff at the Federal College of Education in Kontagora. Given the aging workforce and high prevalence of health risk factors within this population, understanding the effectiveness of such an intervention is crucial. This research will provide valuable insights into the potential benefits of exercise for academic staff and serve as a reference point for addressing similar health challenges in Nigerian higher education institutions and potentially beyond.

The purpose of this study is to investigate the impact of an 8-week mixed aerobic exercise programme on respiratory function of the academic staff of Federal College of Education Kontagora (FCEKG), Niger State, Nigeria.

The study provided answers to the following research questions.

- What is the impact of an 8-week mixed aerobic exercise programme on respiratory rate (RR) of the academic staff of Federal College of Education Kontagora (FCEKG), Niger State, Nigeria?
- What is the impact of an 8-week mixed aerobic exercise programme on forced vita capacity (FVC) of the academic staff of Federal College of Education Kontagora (FCEKG), Niger State, Nigeria?
- What is the impact of an 8-week mixed aerobic exercise programme on peak expiratory flow (PEF) of the academic staff of Federal College of Education Kontagora (FCEKG), Niger State, Nigeria?

The following hypotheses were tested.

- H_O1: There would be no significant mean effect of an 8-week mixed aerobic exercise programme on respiratory function (RR) of the academic staff of FCEKG.
- H_O2: There would be no significant mean effect of an 8-week mixed aerobic exercise programme on (FVC) of the academic staff of FCEKG.
- H_O3: There would be no significant mean effect of an 8-week mixed aerobic exercise programme on (PEF) of the academic staff of FCEKG.

METHODOLOGY

The study employed a pre-test-post-test quasi-experimental design with two groups: an experimental group (EXG) participated in mixed aerobics exercise and a control group (COG) received a placebo intervention. Purposeful sampling was used to select forty academic staff members from the Federal College of Education in Kontagora, ensuring age and sex matched between groups. Participants underwent medical certification to ascertain medical fitness before participating in the exercise invention program.

Pre-test and post-test assessments were conducted for all participants to collect data before (pre-test) and after (post-test) the intervention. Forced Vital Capacity (FVC) and Peak Expiratory Flow (PEF) were measured using a spirometer. FVC is measured in litres, while PEF is measured in litres per minute. Respiratory rates were measured with a stethoscope.

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The 8-week mixed aerobic training program for the experimental group consisted of continuous moderate-impact exercises performed three times a week for one hour, following principles of progression and FITT (Frequency, Intensity, Type, and Time). The control group participated in placebo activities focused on health talks and nutrition education.

Mean and standard deviation was used to answer the research questions. Hypotheses were tested using T-tests at a significance level of 0.05.

RESULTS

RQ1. What is the impact of an 8-week mixed aerobic exercise programme on respiratory rate (RR) of the academic staff of Federal College of Education Kontagora (FCEKG), Niger State, Nigeria?

Table 1.1: Mean scores of treatment on RR

	group	N	Mean	Std. Deviation	Std. Error Mean
RR	CG	20	26.3000	2.61775	.58535
	TG	20	21.3000	1.17429	.26258

Table 1.1 reveals a mean score of 26.30 was obtained in the control group (CG) with a standard deviation 2.618 while a mean score of 21.30 with a standard deviation of 1.174 was obtained by the treatment group (TG). A lower mean score of TG implies that the intervention had a great impact on RR of the academic staff of Federal College of Education Kontagora (FCEKG), Niger State, Nigeria.

RQ2. What is the impact of an 8-week mixed aerobic exercise programme on forced vita capacity (FVC) of the academic staff of Federal College of Education Kontagora (FCEKG), Niger State, Nigeria?

Table 1.2: Mean scores of treatment on FVC

	group	N	Mean	Std. Deviation	Std. Error Mean
FVC	CG	20	2.4090	.85758	.19176
	TG	20	3.6605	.91605	.20483

Table 1.2 shows that the CG had a lower mean score of 2.41 with a standard of .858 while the TG had a mean score of 3.66 with a standard deviation of .916. A higher mean score obtained by the TG indicates that the 8 weeks mixed aerobic exercise intervention had a positive impact on FVC of the academic staff of FCEKG, Niger State, Nigeria.

RQ3. What is the impact of an 8-week mixed aerobic exercise programme on peak expiratory flow (PEF) of the academic staff of Federal College of Education Kontagora (FCEKG), Niger State, Nigeria?

Table 1.3: Mean scores of treatment on PEF

	group	N	Mean	Std. Deviation	Std. Error Mean
PEF	CG	20	415.10	118.617	26.52366
	TG	20	523.40	107.984	24.14598

Table 1.3 shows that the CG had a lower mean score of 415.10 with a standard deviation of 118.62 while the TG had a mean score of 523.40 with a standard deviation of 107.89. A higher mean score obtained by the TG indicates that the 8 weeks mixed aerobic exercise intervention had a positive impact on PEF of the academic staff of FCEKG, Niger State, Nigeria.

HYPOTHESES TESTING

Table 2.1 Respiratory Rate

	group	N	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed
RR	CG	20	26.30	2.617	.585	7.79	38	.000
	TG	20	21.30	1.174	.262	7.79	26.34	.000

H_O1: There was a significant main effect of the 8-week mixed aerobic exercise programme on respiratory rate (RR) of the academic staff of FCEKG (t = 7.79, df=38 α=0.00). The hypothesis was therefore rejected.

Table 2.2 Forced Vita Capacity

	group	N	Mean	Std. Deviation	Std. Error Mean	T	df	Sig. (2-tailed)
FVC	CG	20	2.40	.8575	.1917	-4.46	38	.000
	TG	20	3.66	.9160	.2048	-4.46	37.83	.000

H_O2: There was a significant main effect of the 8-week mixed aerobic exercise programme on forced vital capacity (FVC) of the academic staff of FCEKG (t = -4.46, df=38 α= 0.000). The hypothesis was therefore rejected.

Table 2.4 Peck Expiratory Flow

	group	N	Mean	Std. Deviation	Std. Error Mean	T	df	Sig. (2-tailed)
PEF	CG	20	415.10	118.61	26.523	-3.019	38	.005
	TG	20	523.40	107.98	24.145	-3.019	37.670	.005

HO3: There was a significant mean effect of the 8-week mixed aerobic exercise programme on peak expiratory flow (PEF) of the academic staff of FCEKG (t = -3.019, df=38, α = 0.005). The hypothesis was therefore rejected.

DISCUSSION

The findings of this study demonstrated that an 8-week mixed aerobic exercise program significantly improved the respiratory function of the academic staff at the Federal College of Education Kontagora (FCEKG), Niger State. The results align with previous research, confirming the efficacy of aerobic exercise in enhancing various aspects of lung function, including Forced Expiratory Volume in 1 second (FEV1), Forced Vital Capacity (FVC), and Peak Expiratory Flow (PEF).

Pre-Intervention Status of Respiratory Function

Before the intervention, a comparative analysis between the control group (CG) and the treatment group (TG) revealed no significant difference in their baseline respiratory function. Specifically, the mean respiratory rate was 432.95 (±123.29) for the control group and 459.07 (±107.43) for the treatment group, with a t-value of -0.714 and

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a significance level of α = 0.479. This suggests that the groups were comparable in terms of respiratory function before the exercise program commenced.

Impact of the Aerobic Exercise Program

The hypothesis that an 8-week mixed aerobic exercise program would not significantly impact respiratory function (HO1) was tested, and the results indicated a substantial improvement in respiratory rate (RR). The treatment group exhibited a significantly lower mean respiratory rate (21.30 ± 1.17) than the control group (26.30 ± 2.62), with a t-value of 7.79 and a significance level of α = 0.000. Consequently, the null hypothesis (HO1) was rejected, confirming that the aerobic exercise program significantly affected RR.

Similarly, the effect on Forced Vital Capacity (FVC) was tested (HO2). The treatment group showed a significantly higher mean FVC (3.66 ± 0.92) than the control group (2.40 ± 0.86), with a t-value of -4.46 and a significance level of α = 0.000. This significant increase in FVC suggests enhanced lung capacity and respiratory muscle strength following the exercise program, leading to the rejection of HO2.

Furthermore, the study examined the impact on Peak Expiratory Flow (PEF) (HO3). The treatment group demonstrated a significantly higher PEF (523.40 ± 107.98) than the control group (415.10 ± 118.61), with a t-value of -3.019 and a significance level of α = 0.005. This significant improvement in PEF indicates better airway resistance and lung function after the exercise program, leading to the rejection of HO3.

The observed improvements in respiratory function are consistent with existing literature. Wu et al. (2020) conducted a meta-analysis that confirmed aerobic exercise's positive effects on lung function metrics, including FEV1, PEF, and FVC. Studies by Almeida-Oliveira (2019), Zhang (2019), Abu Seman (2022), Shadmehri (2021), and İşleyen and Dağlıoğlu (2020) similarly support these findings.

The increase in FEV1 observed in this study is consistent with the work of Peters et al (2019), who attributed such improvements to enhanced respiratory function resulting from increased oxygen demand during exercise. Additionally, Paull and Van Guilder (2019) noted that exercise-induced oxygen debt could strengthen respiratory muscles, leading to better pulmonary function and reduced body fat, as also suggested in Vishal et al (2019).

Regarding FVC, the study's findings align with those of Angane and Navare (2017) and Fritz et al. (2020), who reported significant increases in lung elasticity and respiratory muscle function following regular aerobic exercise. This improvement in FVC reflects enhanced lung capacity and reduced airway resistance.

The increase in PEF observed in this study is supported by Agrawal and Taruna (2022), who noted that regular aerobic exercise could improve lung function and metabolic activity. Similar improvements were reported by Imanita et al. (2022) and Astuti and Huriah (2022), with Halabchi et al. (2017) and Mohamed and Alawna (2020) further confirming that moderate aerobic exercise strengthens respiratory muscles and increases aerobic capacity.

In conclusion, the 8-week mixed aerobic exercise program had a significant positive effect on the respiratory function of the academic staff at FCEKG, as evidenced by improvements in respiratory rate, forced vital capacity,

and peak expiratory flow. These findings contribute to the growing body of evidence supporting the benefits of aerobic exercise in enhancing pulmonary health and overall respiratory function.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

Institutions such as FCEKG should consider implementing regular aerobic exercise programs for academic staff to promote better respiratory health and overall well-being. Such programs can be integrated into workplace wellness initiatives.

Workshops and seminars on the benefits of aerobic exercise should be organized for academic staff, emphasizing the importance of regular physical activity for maintaining and improving respiratory health.

Health and wellness policies within educational institutions should include provisions for regular physical activity, encouraging staff to engage in aerobic exercises as part of their daily routines.

Regular assessments of respiratory function should be conducted among staff participating in exercise programs to monitor progress and make necessary adjustments to the exercise regimen for optimal benefits.

Additional studies with larger sample sizes and diverse populations should be conducted to further explore the long-term effects of aerobic exercise on respiratory function. This could include investigations into the impact of varying exercise intensities and durations.

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