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EXERCISE CAPACITY, LUNG AND RESPIRATORY MUSCLE FUNCTION IN SUBSTANCE USE DISORDERS IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Introduction: Substance use disorders (SUDs) have emerged as a critical public health issue, affecting millions of individuals worldwide. **Objectives:** The main objective of the study is to find the exercise capacity, lung and respiratory muscle function in substance use disorders in a tertiary care hospital. **Methodology of the study:** This cross-sectional study was conducted at the Department of Pulmonology, Naseer Teaching Hospital, Peshawar, from September 2023 to February 2024. A total of 155 patients diagnosed with substance use disorders were recruited for the study. Patients aged 18 years and older, with a confirmed diagnosis of substance use disorder based on the DSM-5 criteria, and who were admitted to the tertiary care hospital during the study period were included in the study. Patients with comorbid conditions that could independently affect respiratory function, such as chronic obstructive pulmonary disease (COPD) unrelated to substance use, or those with acute respiratory infections at the time of the study, were excluded. **Results:** The study included 155 participants with a mean age of 42.5 ± 10.3 years, predominantly male (72%). The majority of participants used tobacco (45%), followed by alcohol (30%), cannabis (15%), and cocaine (10%). Mean forced vital capacity (FVC) was 3.2 ± 0.8 L, with a mean forced expiratory volume in one second (FEV1) of 2.3 ± 0.7 L, resulting in a mean FEV1/FVC ratio of 0.72 ± 0.08. Tobacco users exhibited the most significant respiratory impairment, with a lower FVC (3.0 ± 0.7 L), FEV1 (2.1 ± 0.6 L), and FEV1/FVC ratio (0.68 ± 0.07).

Keywords: Exercise, Lung and Respiratory, Substance Use Disorders, Muscle Function

INTRODUCTION

Substance use disorders (SUDs) have emerged as a critical public health issue, affecting millions of individuals worldwide. SUDs are defined as the abusive or risky consumption of psychoactive substances such as alcohol, tobacco, and illicit drugs; they cause several negative effects when used. Various SUDs have been linked to alterations in physical and mental health but the effect on exercise tolerance, lung function and respiratory muscle strength has not been well researched on [1]. The following aspects are important because pre-existing respiratory diseases can greatly affect general mobility, life satisfaction and mortality of SUD patients. Indeed respiratory system is a major system that helps to maintain oxygenation and old products like carbon dioxides are removed from the body for the support of life and to support the physically activities. The muscles involved in breathing process include the lungs, diaphragm and the accessory respiratory muscles and they are coordinated in order to provide for adequate supply of oxygen particularly during period of exercise. Yet substance abuse is known to cause significant damages to the respiratory system that includes COPD, bronchitis and respiratory infection. Moreover, tobacco and inhalants have a direct toxic effect on the lung tissue, adversely affect ciliary movement and cause inflammation and fibrosis that have a still worse impact on the lung functions [2].

Strain level, commonly referred to as exercise capacity, encapsulates the maximum level of effort, an individual can exert as he engages in physical activities. Several other aspects are considered in this process, for example, cardiovascular fitness and muscular development and lung capacity [3]. As mentioned above exercise capacity in SUDs may be significantly compromised due to effects of underlying medical diseases such as chronic respiratory illness, cardiovascular disorders, malnutrition as well as toxicity induced direct impact on muscles and metabolism by some substances. This results to physical deconditioning which makes a person to be confined to bed or have less activities making the health of a person to decline more and more. Muscle function in respiration is also a significant part of respiratory health, especially with regard to its capability to work in response to physical exertion [4]. The muscles that are involved in the generation of force for expansion of respiratory thorax are muscles that are found to be associated with the diaphragm and the intercostal muscles. In SUDs, these muscles may be wasted as a consequence of direct toxic effect of substances used, malnutrition and disuse atrophy from poor physical activity [5]. Such patients also suffer difficulty breathing of which may be caused by weak respiratory muscles thus limiting their physical activities, exercise tolerance, and may lead to dyspnea all of which lead to more disability. Based on the complexity of the SUDs and their influence on health, detailed evaluation of exercise tolerance, lung function, and respiratory muscle strength should be performed among the patients in question [6]. It can help the functioning of respiratory systems be assessed and certain areas where interventions are likely to have most effectiveness to be pinpointed. When patients are in tertiary care they are generally at an advanced stage of their disorder, they may have other illnesses, and such patients are good candidates for rehabilitation programs that addresses respiratory and physical function [7]. It is suggested that a long-term dependence on these substances will cause respiratory problems such as chronic cough and sputum alteration. They help to cause air way obstruction, hyperinflation and changes in respiratory function. These conditions may progress to more serious forms that include chronic bronchitis where there is inflammation of the bronchial tubes and more vulnerability to infections [8]. Some current investigations showcase that the use of items such as cannabis and cocaine over an extended period increases the chances of developing chronic respiratory diseases. These substances injure the tracheobronchial mucosa by reducing the air way's immunity to bacterial and viral infections. As a result, people with chronic SUD are at higher risk of developing respiratory infections and this will affect their respiratory health and wellbeing in general [9].

Objectives

The main objective of the study is to find the exercise capacity, lung and respiratory muscle function in substance use disorders in a tertiary care hospital.

METHODOLOGY

This cross-sectional study was conducted at the Department of Pulmonology, Naseer Teaching Hospital, Peshawar, from September 2023 to February 2024. A total of 155 patients diagnosed with substance use disorders were recruited for the study. Patients aged 18 years and older, with a confirmed diagnosis of substance use disorder based on the DSM-5 criteria, and who were admitted to the tertiary care hospital during the study period were included in the study. Patients with comorbid conditions that could independently affect respiratory function, such as chronic obstructive pulmonary disease (COPD) unrelated to substance use, or those with acute respiratory infections at the time of the study, were excluded.

Data Collection

The participants underwent a comprehensive respiratory assessment, including spirometry, to measure lung function parameters such as forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and the FEV1/FVC ratio. These measurements were employed to determine the man's degree of obstructive or restrictive lung pattern. Besides spirometry, respiratory muscle strength was assessed with the help of maximal inspiratory pressure and maximal expiratory pressure determinations. These tests were helpful in determining the strength of the respiratory muscles especially the diaphragm and accessory muscles of respiration. The subjects' exercise capacity was evaluated by the six-min walk test (6MWT) – a well-known test that reflects the distance a patient is able to walk in six minutes. This test is often applied to assess a functional exercise capacity and the patient's functional status can be assessed by his own report of dyspnoea in comparison with objective data received through this test. The type of substance used, the period in which the substance was used and the frequency of use was determined by interviewing the patient or a caregiver and by record review. The focus was on alcohol, tobacco, cannabis, cocaine and other illicit drugs mostly used and related to respiratory health.

Statistical Analysis

Data were analyzed using SPSS v29. Descriptive statistics were used to summarize the demographic and clinical characteristics of the participants. Continuous variables were expressed as means and standard deviations, while categorical variables were presented as frequencies and percentages.

RESULTS

The study included 155 participants with a mean age of 42.5 ± 10.3 years, predominantly male (72%). The majority of participants used tobacco (45%), followed by alcohol (30%), cannabis (15%), and cocaine (10%). The average duration of substance use was 12.7 ± 6.5 years, highlighting a long history of substance use among the study population.

Table 1: Participant Demographics and Substance Use Characteristics

Characteristic	**Mean ± SD / n (%)**
Number of Participants	155
Age (years)	42.5 ± 10.3
Gender	
- Male	112 (72%)
- Female	43 (28%)
Substance Use	
- Tobacco	70 (45%)
- Alcohol	46 (30%)
- Cannabis	23 (15%)
- Cocaine	16 (10%)
Duration of Substance Use (years)	12.7 ± 6.5

Across the study population (n=155), the mean forced vital capacity (FVC) was 3.2 ± 0.8 L, with a mean forced expiratory volume in one second (FEV1) of 2.3 ± 0.7 L, resulting in a mean FEV1/FVC ratio of 0.72 ± 0.08. Tobacco users exhibited the most significant respiratory impairment, with a lower FVC (3.0 ± 0.7 L), FEV1 (2.1 ± 0.6 L), and FEV1/FVC ratio (0.68 ± 0.07). In contrast, alcohol users had slightly better respiratory function with a higher FEV1/FVC ratio of 0.75 ± 0.05, while cannabis and cocaine users showed moderate reductions in these parameters.

Table 2: Lung Function Test Results by Substance Use Group

Group	FVC (L)	FEV1 (L)	FEV1/FVC Ratio
Total (n=155)	3.2 ± 0.8	2.3 ± 0.7	0.72 ± 0.08
Tobacco (n=70)	3.0 ± 0.7	2.1 ± 0.6	0.68 ± 0.07
Alcohol (n=46)	3.3 ± 0.8	2.4 ± 0.7	0.75 ± 0.05
Cannabis (n=23)	3.2 ± 0.7	2.3 ± 0.6	0.74 ± 0.06
Cocaine (n=16)	3.1 ± 0.8	2.2 ± 0.7	0.70 ± 0.07

The study found that the overall mean maximal inspiratory pressure (MIP) among participants was 65 ± 15 cmH2O, and the mean maximal expiratory pressure (MEP) was 85 ± 20 cmH2O. Tobacco users demonstrated the lowest respiratory muscle strength, with a mean MIP of 58 ± 12 cmH2O and MEP of 80 ± 18 cmH2O. In contrast, alcohol users had the highest respiratory muscle strength, with a mean MIP of 70 ± 14 cmH2O and MEP of 90 ± 19 cmH2O.

Table 3: Respiratory Muscle Strength by Substance Use Group

Group	MIP (cmH2O)	MEP (cmH2O)
Total (n=155)	65 ± 15	85 ± 20
Tobacco (n=70)	58 ± 12	80 ± 18
Alcohol (n=46)	70 ± 14	90 ± 19
Cannabis (n=23)	67 ± 13	88 ± 17
Cocaine (n=16)	60 ± 14	83 ± 20

The six-minute walk test (6MWT) results showed that the overall mean distance walked by participants was 410 ± 80 meters. Tobacco users walked the shortest distance, averaging 390 ± 75 meters, indicating reduced exercise capacity. Alcohol users had the highest average distance walked at 430 ± 70 meters, followed closely by cannabis users at 420 ± 65 meters.

Table 4: Six-Minute Walk Test (6MWT) Results by Substance Use Group

Group	Distance Walked (meters)
Total (n=155)	410 ± 80
Tobacco (n=70)	390 ± 75
Alcohol (n=46)	430 ± 70
Cannabis (n=23)	420 ± 65
Cocaine (n=16)	400 ± 85

The correlation analysis revealed a significant negative relationship between the duration of substance use and the six-minute walk test (6MWT) distance ($r = -0.45$, $p = 0.001$), indicating that longer substance use is associated with reduced exercise capacity. Regression analysis showed that tobacco use, measured in pack-years, was a strong predictor of reduced FEV1 ($\beta = -0.38$, $p = 0.001$). Additionally, both cannabis and cocaine use were significantly associated with lower FEV1 values, with regression coefficients of $\beta = -0.25$ ($p = 0.004$) for cannabis and $\beta = -0.30$ ($p = 0.004$) for cocaine, highlighting their negative impact on lung function.

Table 5: Correlation and Regression Analysis Results

Variable	Correlation Coefficient (r)	Regression Coefficient (β)	p-value
Duration of Substance Use vs. 6MWT Distance	-0.45	-	0.001
Tobacco (Pack-Years) vs. FEV1	-0.50	-0.38	0.001
Cannabis Use vs. FEV1	-	-0.25	0.004
Cocaine Use vs. FEV1	-	-0.30	0.004

DISCUSSION

The results of this study provide valuable insights into the impact of substance use disorders (SUDs) on respiratory health, particularly in the context of lung function, respiratory muscle strength, and exercise capacity. Thus, the data demonstrate that there are severe respiratory disorders in patients with chronic substance use and the consequent necessity of specific treatment and rehabilitation programs [11] . The spirometry outcome indicated that a significant proportion of the study respondents has an abnormal forced expiratory volume in 1 second/forced vital capacity ratio, with tobacco users having the worst profile. The mean FEV1/FVC ratio was lower in a group of tobacco users and equal to 0. 68 ± 0. 07 what in turn points to moderate obstructive pattern; it is a known fact that smoking is linked with COPD. The obstructive pattern, while somewhat less steep than that seen in tobacco smokers, is apparent in cannabis and cocaine users as well, together with chronic airway inflammation and mucosal injury from smoking [12]. The present results are in concordance with earlier investigations that have provided evidence on the link between long-term substance use and obstructive lung diseases, particularly in subjects who have been using inhaled substances. Analyzing the results of the respiratory muscle strength revealed that the persons with SUDs had lower mean values of MIP and MEP; tobacco users the lowest values [13]. The mean MIP and MEP values of this group were lower, which indicates that long term usage of tobacco in any form, harms not only the airways but also the muscles involved in respiration. This reduction in respiratory muscle strength may be partly contributory to the increased perception of dyspnea as well as the reduced exercise tolerance seen in such populations [14]. The studies conducted in the past reveal that cigarette smoking results in the diminution of skeletal muscle mass and muscle strength, which may account for this study's results [15]. Significantly, the 6MWT results revealed that the over participants' exercise tolerance was suboptimal for healthy adults [16]. Tobacco users even had the overall shortest mean distance walked of 390± 75 meters, the observation being in parallel with the poor effect of the smoking habit on physical function. The findings of this study are clinically relevant for the treatment of those with SUDs and are discussed below [17]. First, they emphasize the importance of regular spirometry in patients with substance use history and tobacco smokers or those who use inhaled substances. Therefore, an identification of subjects with early signs of respiratory dysfunction could lead to early treatment intercession including smoking cessation, respiratory muscle training, and pulmonary rehabilitation all of which enhance respiratory prognosis and overall quality of life.

CONCLUSION

It is concluded that substance use disorders, particularly those involving tobacco, significantly impair lung function, respiratory muscle strength, and exercise capacity. These findings emphasize the need for targeted respiratory interventions and routine assessments to mitigate the long-term health impacts in this population. Early detection and intervention can improve overall health outcomes and quality of life for individuals with SUDs.

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