Original Article

Association Of Level Of Physical Activity And Depression In Patients Having Obesity Hypoventilation Syndrome: A Cross-Sectional Study

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Abstract

Objective: To determine the association between the level of physical activity and depression among patients with Obesity Hypoventilation Syndrome

Study Design: : An analytical cross-sectional study was conducted.

Place and duration of study: This cross-sectional analytical study was conducted in the Pulmonology Department, Lady Reading Hospital, Peshawar, from January to June 2024.

Material and Methods: This cross-sectional analytical study was conducted in the Pulmonology Department, Lady Reading Hospital, Peshawar, from January to June 2024. A convenience sample of OHS-diagnosed patients was taken, consisting of 197 participants. IPAQ, PHQ-9, and BMI were used for data collection. Data was analyzed using SPSS version 23. Chi-square and multivariable linear regression analysis were applied to explore the association between physical activity and depression.

Results: In the study, 121 were females, and 76 were males, with a mean age of 45.6 ± 10.3 years. Regarding physical activity, 45.2% reported lower levels, while 28.9% suffered from moderate to severe depression. By using the chi-square test, it was observed that lower physical activities were significantly related to increased levels of depression ($p < 0.001$). Results were also validated by multiple linear regression analysis, which demonstrated that decreased physical activities significantly predicted increased scores on PHQ-9, adjusting for age, sex, and BMI

Conclusion: A lower level of exercise is significantly related to higher levels of depression among OHS patients. Exercise programs should be incorporated as a treatment option to improve functional status and decrease depression.

Keywords: Obesity Hypoventilation Syndrome, Physical Activity, Depression, body mass index, patient health questionare-9

1. Introduction

Obesity has emerged as one of the most pressing public health concerns globally, contributing significantly to morbidity, mortality, and economic burden across healthcare systems. The World Health Organization (WHO) estimates that more than one billion people worldwide are living with obesity, a number expected to rise further by 2030 if current trends persist [(1)]. Among the respiratory complications associated with obesity, Obesity Hypoventilation Syndrome (OHS) represents one of the most severe and underdiagnosed conditions. It is defined by the triad of obesity (BMI ≥30 kg/m²), daytime hypercapnia ($PaCO_2$ >45 mmHg), and sleep-disordered breathing, in the absence of alternative causes of alveolar hypoventilation. OHS is not only a respiratory dysfunction but a complex multisystem disorder that severely impacts physical performance, mental health, and quality of life [(2)] . OHS is frequently associated with Obstructive Sleep Apnea (OSA), with nearly 90% of OHS patients presenting concomitant OSA, while the remaining 10% experience sleep hypoventilation without obstructive events [(3)]. The coexistence of chronic hypoxia, hypercapnia, and sleep fragmentation results in neurocognitive dysfunction, fatigue, daytime somnolence, and psychological disturbances, including depression and anxiety [(4)] . Obstructive Sleep Apnea (OSA) is characterized by recurrent upper airway obstruction during sleep, leading to repeated episodes of apnea and

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hypopnea, intermittent oxygen desaturation, and sleep fragmentation. Ninety percent of patients with OHS will have OSA, while the remaining 10% have sleep hypoventilation [5]. The latter represents an elevation in partial pressure of Carbon dioxide ($PaCO_2$) during sleep or significantly low oxygen saturation not simplified by obstructive apneas or hypopneas [6].

Depression is one of the most common mental health disorders among obese individuals, affecting up to 43% of patients with chronic respiratory diseases [7]. The bidirectional relationship between obesity and depression has been well-documented obesity can precipitate depressive symptoms, and depression, in turn, exacerbates sedentary behavior, poor diet, and metabolic dysfunction. In patients with OHS, the interaction between disordered breathing, fatigue, and reduced physical activity further compounds this risk [8] . Persistent hypoventilation and oxygen desaturation during sleep may alter cerebral neurotransmitter activity, particularly serotonergic and dopaminergic pathways, contributing to mood dysregulation [9]. Physical activity has long been recognized as a cornerstone in the prevention and management of obesity-related disorders. It enhances cardiopulmonary function, improves metabolic balance, and positively influences psychological well-being [10]. Multiple meta-analyses indicate that regular physical activity significantly reduces depressive symptoms across various populations, including those with chronic diseases. However, despite extensive evidence supporting the role of exercise in improving mental health outcomes, few studies have explored its relationship with depression specifically in OHS patients [11] .

Management of OHS primarily involves weight reduction, non-invasive ventilation, and treatment of sleep-disordered breathing. Continuous Positive Airway Pressure (CPAP) or Bi-level Positive Airway Pressure (BiPAP) remains the standard intervention to alleviate hypercapnia and improve oxygenation [12,13]. The pathophysiology of OHS extends beyond mechanical restriction of ventilation due to adiposity. It involves impaired central respiratory drive, altered leptin sensitivity, and reduced chemoreceptor responsiveness to hypercapnia and hypoxia. These physiological alterations contribute to reduced exercise tolerance and chronic fatigue, further discouraging physical activity. Moreover, elevated leptin levels—though typically associated with appetite suppression become ineffective due to leptin resistance, a phenomenon that may also influence mood regulation [11]. Recent findings suggest that targeted exercise interventions, even of moderate intensity, can improve ventilatory efficiency and psychological resilience in obese individuals. Furthermore, physical activity facilitates neuroplastic changes in brain regions associated with emotion regulation, such as the hippocampus and prefrontal cortex, which are often compromised in patients with depression. These findings underscore the therapeutic value of physical activity in mitigating both the physiological and psychological consequences of OHS [14]. Despite these insights, the association between physical activity level and depression in OHS remains underexplored. Most existing research has concentrated on sleep apnea, pulmonary rehabilitation, or weight-loss interventions, with limited emphasis on psychosocial outcomes. Therefore, understanding how physical activity influences depressive symptoms in patients with OHS can provide valuable guidance for developing integrated rehabilitation protocols that address both respiratory and mental health needs [6].

The present study was designed to determine the association between the level of physical activity and depression in patients with Obesity Hypoventilation Syndrome. By employing standardized assessment tools such as the International Physical Activity Questionnaire (IPAQ) and the Patient Health Questionnaire-9 (PHQ-9), this study seeks to quantify the relationship between physical inactivity and depressive severity. Establishing this association may contribute to a deeper understanding of the biopsychosocial dimensions of OHS and guide physiotherapists and clinicians in implementing exercise-based mental health interventions as part of comprehensive OHS management strategies.

2. Materials & Methods

This cross-sectional study was conducted over six months in Lady Reading Hospital, Peshawar. The duration of the research was 6 months after approval of the Institutional Review Board. Following the approval of the study synopsis by the institutional review board. Then the sample size was calculated using the software "Rao Soft" sample size calculator helped us to get the sample size as 282 participants by keeping Anticipated frequency as 9%, Confidence interval as CI 95% with the margin of error as 5%, which was based on the previous record of the last six months in the OPD. The participants were selected from the hospital using convenience sampling method. Inclusion criteria included participants' age ranging from 25-65 years and patients who have been previously diagnosed as cases of OHS. The exclusion criteria included patients who are in a deep coma. Patients with hypoventilation syndrome have a kyphoscoliosis deformity. Congenital central hypoventilation syndrome. Patients have neuromuscular disorders like amyotrophic lateral sclerosis and myasthenia gravis. After the ethical clearance from the Ethical Review Committee of City University, Peshawar. After that, the concerned hospital/department was approached to seek approval for the data collection. The selected participants were interviewed personally to collect the data from a selected questionnaire. The data related to Physical Activity was obtained from the International Physical Activity Questionnaire. The Patient Health Questionnaire was used to calculate the value of Depression, and body mass index values were also calculated. This oral explanation was provided to all participants before obtaining their consent. Then the participants were assured that the privacy related to the data would be kept intact. This research work used the SPSS version 23 software to perform the statistical analysis. The graphical representation is related to the quantitative values related to the variables used in the research work. The graphical representation is related to the value related to the qualitative variables. To analyze the relationship among the two or more categories, the Chi-Square test was used. Then, multivariable linear regression was used to analyze the association related to the value related to Physical Activity and Depression.

The normality of continuous variables, including PHQ-9 score, age, and BMI, was assessed using the Shapiro-Wilk test. All continuous variables were found to be approximately normally distributed, allowing the use of parametric tests.

3. Results

The mean age of the participants was 45.67 ± 10.3 years (ranged from 25 to 64 years). Most participants, 121, were females, and male participants were 76. The age groups included eight categories, and the largest number (20.3%) was in the 55 to 59 years age group, followed by the lowest in the 25 to 29 years age group (6.1%).

Table 1. Distribution of Participants based on age Categories (N = 197)

Age Category (years)	Frequency (n)	Percentage (%)
25–29	12	6.1
30–34	20	10.2
35–39	35	17.8
40–44	22	11.2
45–49	23	11.7
50–54	31	15.7
55–59	40	20.3
60–64	14	7.1
Total	**197**	**100.0**

Table 2. Cross-tabulation between Physical Activity and Depression Levels (N = 197)

Depression Level (PHQ-9)	Low Activity (n)	Moderate Activity (n)	High Activity (n)	Total (n)
Minimal Depression	1	0	8	9
Mild Depression	3	9	22	34
Moderate Depression	7	27	10	44
Moderately Severe Depression	31	2	4	57
Severe Depression	47	4	2	53
Total	89	62	46	197

Table 2 shows the relationship between physical activity levels and depression severity using the Chi-square test. The association was found to be statistically significant ($p < 0.001$), indicating that lower levels of physical activity were strongly associated with higher levels of depression.

Table 3: Level of Depression & Hypoventilation Syndrome cross-tabulation

Level of depression	Level of Hypoventilation Syndrome			Total	P-Value	χ^2
	Grade 1	Grade 2	Grade 3			
Minimal Depression	8	1	0	9		
Mild Depression	19	12	3	34		
Moderate Depression	10	29	5	44		
Moderately severe Depression	5	23	29	57	<.001	105.502
Severe Depression	8	3	42	53		
Total	50	68	79	197		

Table 3 shows the chi-square test used to determine the relationship between the level of depression and the level of hypoventilation syndrome. It was found to be statistically significant, as the p-value is <0.001

Table 4. Level of hypoventilation syndrome & level of physical activity

Level of hypoventilation syndrome	Level of physical activity			Total	P-Value	χ^2
	Low	Moderate	High			
Grade 1	4	7	39	50		
Grade 2	8	53	7	68	<.001	239.808
Grade 3	77	2	0	79		
Total	89	62	46	197		

Table 4 shows that the chi-square test was used to find the relationship between the level of hypoventilation syndrome and the level of physical activity. P-Value = <.001. This indicates a highly statistically significant relationship between the level of hypoventilation syndrome and level of physical activity

Table 5: Association Between Physical Activity Level and Depression Severity in Patients with Obesity Hypoventilation Syndrome (N = 197)

Physical Activity Level	N	Mean PHQ-9 Score ± SD	Regression β (Adjusted)	95% Confidence Interval	p-value
Low	89	16.5 ± 4.2	Reference	–	–
Moderate	62	11.2 ± 3.8	−0.42	−0.55 to −0.29	<0.001
High	46	8.7 ± 2.9	−0.42	−0.55 to −0.29	<0.001

Table 5 shows that there was a significant negative relationship between the level of physical activity and the severity of depression in Obesity Hypoventilation Syndrome patients. Patients who showed lower levels of physical activity had higher scores for PHQ-9 (mean ± SD) values (16.5 ± 4.2) as compared to those who showed moderate (11.2 ± 3.8) and high levels (8.7 ± 2.9) of physical activity. After performing multivariable linear regression, it was observed that lower levels of physical activity were significantly associated with higher values for depression ($\beta = -0.42$, 95% CI -0.55, -0.29, $p < 0.001$), implying that increased physical activity is associated with lower severity of depression. This directly responds to the primary

objective of this investigation focused on evaluating the relationship between the value of physical activity.

4. Discussion

The study seeks to determine the existence or absence of any connection between the level of physical activity and depression in patients with Obesity Hypoventilation Syndrome (OHS). The outcome revealed a strong negative correlation between the level of physical activity and depression, such that those who are less physically active tend to score higher in depression levels.

The findings were significant regardless of the influence of other variables such as age, sex, and body measurement in OHS.

These results are consistent with other studies that have highlighted the importance of physical exercise as a fundamental mediator of psychological well-being in both obese and chronic illness sufferers. Zheng et al. (2023) have noted in their research that exercising significantly helped to improve mood states and alleviate depression in obese patients suffering from respiratory dysfunction [(15)]. Moreover, Bridle et al. in a meta-analysis study in 2022 confirmed in their research that exercising helped to have moderate to large antidepressant properties in chronic illness patients, regardless of weight loss outcomes [(16)]. Moreover, the current research bridges this existing evidence by targeting specifically OHS patients, who have been previously underrepresented in psychological and rehabilitation research. A concerning aspect of depression, as noted in the study, is the sizable number of patients (approximately 76%) suffering from moderate to severe depression. This correlates well with another study conducted by Mandal et al. (2018), which showed that as much as 70% of patients with chronic respiratory diseases experienced depression [(17)]. Moreover, the current research bridges this existing evidence by targeting specifically OHS patients, who have been previously underrepresented in psychological and rehabilitation research.

A concerning aspect of depression, as noted in the study, is the sizable number of patients (approximately 76%) suffering from moderate to severe depression. This correlates well with another study conducted by Mandal et al. (2018), which showed that as much as 70% of patients with chronic respiratory diseases experienced depression [(18)]. Conversely, Dixon et al. have reviewed the evidence related to surgical and traditional weight loss for both patients with OHS and Obstructive Sleep Apnea, giving findings intrinsically related to the advantages/disadvantages in treating both conditions [(19)]. In addition, Berger et al. and Zheng et al. render null facts regarding the effect of respiratory events on sleep structure, as well as the efficacy of various PAP therapy methods [(20)]. These results emphasize the need to target physical inactivity along with its psychological effects in those who have Obesity Hypoventilation Syndrome. Increasing physical activity can reduce depression in this patient population [(21)].

The final interesting aspect is related to gender representation, with females accounting for 61.4% of participants and slightly scoring higher in their depression levels. Previous studies by Giannotta et al. (2023) and Duan & Jun (2024) have reported a similar phenomenon, which was explained by a set of biological, societal, and psychological aspects such as body image and male-female differences in their coping strategies [(11,22)]. Nonetheless, despite the aforementioned limitations, the present study offers important empirical data, which underscores the fact that physical activity has a significant statistical link with depression in patients with OHS. These observations confirm the burgeoning literature that supports the utilization of physical activity as an additional treatment modality in respiratory problems due to obesity. Furthermore, the observations confirm the importance of emphasizing mental analyses, as well as physical activity, in the comprehensive management of OHS.

Conclusion:

This reveals that there is a strong inverse relationship between physical activity level and depression severity among patients with Obesity Hypoventilation Syndrome. Patients with lower levels of physical activity were found to score higher on depression, while those with moderate/high levels recorded lower scores on depression. Adding physical activity interventions to the treatment regimen of patients with OHS could help reduce mental distress and promote ventilation. Physiotherapists and pulmonologists must work together on designing personalized exercise-based rehabilitation programs for patients with OHS. Longitudinal research must be conducted on the role and effects of these interventions.

Disclosure /Conflict of interest:

Authors declare no conflict of interest.

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