

# Hyperventilation Syndrome

D. Satyanarayana<sup>1</sup>, N. Anusha<sup>2</sup>, R. Bhagawan<sup>3</sup>

## ABSTRACT

**Introduction:** Hyperventilation syndrome refers to a collection of physical and emotional symptoms, brought about by hyperventilation. Though it is a relatively common presentation to the emergency department, there are only a few studies on hyperventilation syndrome (HVS) especially from India. This study aims at studying the factors associated with hyperventilation syndrome in the current study population.

**Material and methods:** A cross sectional study was conducted on 83 patients with HVS. Patient responses were recorded on Nijmegen questionnaire and Perceived stress scale and analyzed with descriptive statistics.

**Results:** Study population included 83 patients, 78.32% of the populations were females and 21.68% were males. The mean age of the population is 19.28 years. 66.26% were adolescents, 81.92% are students and 68.67% were residing in hostel. 12.05% had previous episodes of hyperventilation. Carpo-pedal spasm was the presenting symptom in 40.96% population and exams were the cause of stress for 32.5% population. The mean score on perceived stress scale is 24.92. 59.03% had moderate and 38.55% had severe stress as per scores on perceived stress scale.

**Conclusion:** High student population presenting with HVS and exams being the precipitating stressor, high scores on perceived stress scale emphasizes the need to address the need for stress free curriculum and greater insights in to the issue.

**Keywords:** Hyperventilation Syndrome; Stress; Students

## INTRODUCTION

Hyperventilation syndrome (HVS) represents relatively a common emergency department presentation of young individuals. The term “hyperventilation syndrome” was introduced by Kerr et al in 1937, refers to a collection of physical and emotional symptoms, largely brought about by hyperventilation.<sup>1</sup>

Dysfunctional breathing is a term describing breathing disorders where chronic changes in breathing pattern result in dyspnea and other symptoms. These are evident by the absence of any cardiac or respiratory illness. Boulding et al proposed the classification of dysfunctional breathing disorders into Hyperventilation syndrome, Periodic deep sighing, Thoracic dominant breathing, Forced abdominal expiration and Thoraco-abdominal asynchrony. The most widely recognized form of dysfunctional breathing is hyperventilation syndrome.<sup>2</sup>

Hyperventilation syndrome describes a condition in which an inappropriate increase in minute ventilation happens beyond metabolic needs. It is associated with a wide range of symptoms without a clear organic precipitant. Limited data suggest that hyperventilation syndrome occurs

more commonly in women than in men.<sup>3,4</sup> In a study by Pfortmuller et al on 616 patients, 55.4% were female, mean age was 36.5 years (SD 15.52, range 16-85). 29.4% were in their twenties, 53.7% presented at out-of-office hours. Fear was the most common symptom followed by paresthesia and dizziness (306, 49.7%) and 30.4% had previous episode of hyperventilation.<sup>4</sup>

The mechanisms behind hyperventilation are controversial. The etiology of primary hyperventilation is not yet clear. Many theories have been proposed to describe etiology and symptoms of hyperventilation. Most commonly accepted hypothesis is as follows:

Predisposed/Affected individual → Emotional disturbances or Stress → Activation of pathways (voluntary) of Breathing center → Activation of Neuromuscular apparatus → Irregular and Disorganized Breathing → Increase in Heart Rate, Respiratory Rate & Cardiac Output → Hypocapnea → Respiratory Alkalosis → Hypocalcemia.

Once a conditioned response is produced, many minor stimuli can also provoke the attack in an above mentioned pattern. Predisposing factors include anxiety, depression, hysterical traits and obsessive personality. Emotional disturbances or precipitating factors can be in the form of, bereavement, resentment, hypochondria or disturbing uncertainty.<sup>5</sup> Activated hypersensitive fear network may result in an increased central respiratory drive, to reduce arterial PaCO<sub>2</sub> decreasing direct stimulation of the fear network proposing its association with psychological symptoms.<sup>6</sup>

Cerebral blood flow decreases in a linear fashion with decreasing PaCO<sub>2</sub>.<sup>7</sup> Thus, a reduction in cerebral blood flow in the setting of hyperventilation, hypocapnea, and respiratory alkalosis may explain the neurologic symptoms such as paresthesia, headache, lightheadedness, and tetany.<sup>8</sup> Recent research describes the condition even in the absence of hypocapnea questioning the origin and its mechanism.<sup>9,10,11</sup> Hyperventilation syndrome is a disorder with no widely accepted diagnostic criteria.<sup>12,13</sup> Therefore its diagnosis widely relies on the physician's experience. Although

<sup>1</sup>Associate Professor, Department of Psychiatry, <sup>2</sup>Assistant professor, Department of Psychiatry, <sup>3</sup>Senior Resident, Department of Psychiatry, Gayatri Vidya Parishad Institute of Healthcare and Medical Technology, Visakhapatnam, Andhra Pradesh, India

**Corresponding author:** Dr. N.Anusha, MD, Assistant Professor, Department of Psychiatry, GVPIHC & MT, Marikavalasa, Visakhapatnam - 48, Andhra Pradesh, India

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hyperventilation is a widely recognized medical condition, there have been few studies on the population presenting with primary hyperventilation syndrome to the Emergency Department(ED). Therefore, the primary aim of this study was to characterize patients diagnosed with primary hyperventilation.

## MATERIAL AND METHODS

The present study is conducted in Gayatri Vidya Parishad Institute of Health Care and Medical Technology. Institutional ethics committee approval was obtained. The study is a cross sectional study conducted during September 2019 to February 2020.

Patients presenting with symptoms of breathlessness to the emergency department were screened. After ruling out acute emergencies (Both cardiac and respiratory emergencies), A detailed history including general and systemic examination was conducted. If SpO<sub>2</sub> >92%, vitals are stable and chest is clear on auscultation, patients were stabilized with O<sub>2</sub> inhalation, they were referred to department of Psychiatry for further evaluation with possibility of HVS.

Patients were screened and managed. Those who are willing to participate in the study were recruited in to the study after taking consents. Patients were asked to fill a semi-structured questionnaire on socio demographic information, illness parameters and possible stressors. Responses were recorded on Nijmegen questionnaire and Perceived Stress Scale.

Nijmegen Questionnaire (NQ) is the most widely used

instrument for identifying individuals with Dysfunctional Breathing. The NQ was developed by van Dixhoorn and Duivenvoorden in 1985 as a tool for screening hyperventilation syndrome. The NQ consists of 16 questions related to complaints, and the frequency of symptoms are indicated on a scale ranging from 1 (never) to 5 (very often). It has a sensitivity and specificity of 91% and 95%, respectively, in relation to the clinical diagnosis of HVS. A score >23 are considered positive.<sup>14</sup>

Perceived stress scale was designed by Sheldon Cohen. The Perceived Stress Scale SV 10 item (PSS) is the most widely used psychological instrument for measuring the perception of stress. It measures the stress in a quantitative fashion giving a near closer view of his/her perception towards the situation. The questions in the PSS ask about feelings and thoughts during the last month. The score ranges from 0 - 40. A score less than 13 is categorized as mild stress, 14-26 as moderate and more than 27 as severe stress.<sup>15</sup> The results are analyzed by descriptive statistical methods.

## RESULTS

A total of 123 patients presented to emergency department during the study period with probable diagnosis of HVS. 91 patients consulted Psychiatry department after referral from emergency department and 83 patients consented to participate in the study. The results are presented in Table no 1.

Majority of population were females 78.32% (65) and

Sex	Male	18(21.68)
	Female	65(78.32)
Education	School	24(28.91)
	Intermediate	39(46.98)
	Degree	20(24.11)
Occupation	Student	68(81.92)
	Home maker	9(10.84)
	Employed	6(7.24)
Socio-economic status	Low	16(19.27)
	Middle	49(59.03)
	High	18(21.07)
Residence	Hostel	57(68.67)
	Home	26(31.33)
Past hyperventilation episodes	Nil	73(87.95)
	Present	10(12.05)
Presentation	Emergency	83(100)
Presentation timing	8am-4pm	35(42.16)
	4pm-8am	48(57.84)
Most common presenting symptoms	Chest pain	8(9.63)
	Shortness of breath	29(34.93)
	Stiff hands/feet	34(40.96)
	Dizziness/syncope	7(8.4)
	Anxiety	5(6.02)
Precipitating stressors	Exams	27(32.5)
	Quarrel with family/friends	13(15.66)
	Can't meet parents' expectations	9(10.84)
	Home sickness	14(16.86)
	Financial issues	6(7.22)
	Breakup	8(9.63)
	No stressors identified	6(7.22)

Table-1:

21.68% (18) were males. The mean age of the population is 19.28 with a SD of 4.91. 66.26% were adolescents. 81.92% (68) are students and 68.67% (57) were residing in hostel. 59.03% belonged to middle socio economic status. 46.98% (39) were studying intermediate (10+2). 12.05% (10) had previous episodes of hyperventilation.

Carpo-pedal spasm was the presenting symptom in 40.96% followed by shortness of breath in 34.93%. Exams were the cause of stress for 32.5% followed by home sickness in 16.86%, quarrel with family/friends in 15.66%, fear of not being able to meet parent's expectations in 10.84%. Recent break up was the reason in 9.63%. Of all the patients presented to the emergency department 42.16% patients presented during office hours and 57.84% presented after office hours. No patients were hospitalized during this study period.

The mean score on Nijmegen Questionnaire is 33.97 with a SD of 6.52. The mean score on Perceived Stress Scale is 24.92 with a SD of 5.1. 2 patients (2.42%) had mild stress, 49(59.03%) had moderate and 32(38.55%) had severe stress.

## DISCUSSION

The present study is one of the few studies on hyperventilation syndrome in India. Though Hyperventilation syndrome involves a comprehensive care from departments of Medicine, Pulmonology, Psychology, and Psychiatry, its place can't be confined to any of these specialties.

In the current study the mean age is 19.28 with a SD of 4.91. The mean age is less compared to previous studies.<sup>4</sup> Females outnumber males consistent with previous studies.<sup>3,4</sup> The majorities of patients were students and were residing in hostel facility. The high percentage of student population is due to the location of our hospital in proximity to various residential schools and colleges. A large number of them presented after office hours with Carpo-pedal spasm as the most common presenting symptom. Most of the students were brought by wardens who described the spasm as horrifying experience mistaking it as seizures resulting in prompt seeking of medical care. It could be well attributed to poor nutritional intake leading to low level baseline Calcium levels in the body. It could probably be result of poor eating habits and hostel diet patterns.

12 percent had previous episodes of hyperventilation which is less compared to previous study.<sup>4</sup> The recurrence of HVS may be attributed to conditioned response elicited to repetitive stressors one experiences in his/her life.

Scores on Nijmegen questionnaire are more than 22 in all indicating a possible diagnosis of HVS. Though Nijmegen questionnaire is not a diagnostic instrument, it can be used as a screening tool for HVS. Most of the patients had moderate to severe levels of stress as depicted on Perceived Stress Scale. The most common stressors in students are exams followed by quarrel and home sickness. In female married population financial issues and quarrel with partner or family members was the cause of stress.

Stress is so common these days and HVS is precipitated by stressors as evident in the current study. Stress due to

academics, non-emphasis on coping techniques among students, staff and parents is adding to the burden.

Too many assignments, competition with other students, peer pressure, parental expectations, failures, long study hours, lack of recreational facilities builds up stress in students. They are wedged in balancing between studies, coaching and deadlines. The lack of time, fear of failure in the exam, uncooperative school environments make students physically and mentally sick.<sup>16</sup> Unable to cope up with stress, many presented with symptoms of HVS. There were also instances where more than one student presented with HVS at the same time from hostels indicating possibility of shared stressors or the ability of voluntary control pathway of breathing to provoke hyperventilation.

Certain patients with previous attacks of HVS who presented to other medical facilities were admitted, investigated for a variety thereby increasing the cost and anxiety to the patient for a relatively benign condition. Experienced ED team is essential for screening and initial referral to cut down unnecessary costs of multiple tests and hospitalization. This may be due to the lack of awareness among the professionals on HVS. Lack of established diagnostic criteria and not able to use screening tools is causing under reporting. Therefore it is necessary that further studies should target on a working for a diagnostic criteria and screening tool which will help in early diagnosis and prompt referral.

## Limitations

Study population is small.

This is a cross sectional study so long-term manifestations were not dealt.

## CONCLUSION

The present study emphasizes the need to have a probable diagnosis of HVS as a differential when an adolescent or a young female presents with symptoms of breathlessness to the ED. There is a strong need for change in education system and stress free measures to be adopted by the schools and colleges. Ability to cope up in a given situation is a great life skill which should be taught to kids from a younger age. There is a need to develop a diagnostic tool for the diagnosis of HVS. All the staff working in ED and primary care should be well versed with the entity of HVS. Emphasis should be on the way to reduce academic stress in students and make education stress free.

## List of abbreviations used:

HVS - hyperventilation syndrome, NQ - Nijmegen questionnaire, PSS - Perceived Stress Scale, ED - Emergency Department, SD - Standard Deviation

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