https://doi.org/10.29309/TPMJ/2023.30.07.7485

The Professional Medical Journal
www.theprofesional.com
2023, Volume, 30 Issue, 07

ORIGINAL ARTICLE

Frequency of hyperventilation syndrome in asthma.

Muhammad Waseem[1], Muntazir Mehdi[2], Maryam Rafiq[3], Nauman Aziz[4], Hafiza Swaiba Afzal[5], Muhammad Junaid Iqbal[6]

Article Citation: Waseem M, Mehdi M, Rafiq M, Aziz N, Afzal HS, Iqbal MJ. Frequency of hyperventilation syndrome in asthma. Professional Med J 2023; 30(07):851-857. https://doi.org/10.29309/TPMJ/2023.30.07.7485

ABSTRACT… Objective: Hyperventilation syndrome is not only an important mimicker of asthma but it also increases perception of symptom severity in otherwise known stable asthmatic cases which may lead to increased use of asthma medication and hospital visits. Hyperventilation syndrome recognition is directly related to improvement of quality of life of an asthmatic patient. **Study Design:** Descriptive Cross-sectional study. **Setting:** Department of Pulmonology, Sahiwal Medical College Sahiwal. **Period:** 1st Nov 2019 to 1st May 2020. **Material & Methods:** In 400 confirmed asthma patients diagnosis of hyperventilation syndrome was made through the use of Nijmegen score. Data was analyzed and Nijmegen scores were checked in terms of age, gender, co-morbid state. Association of Nijmegen score with number of hospital visits and frequency of use of rescue medication was also checked. **Results:** Younger females having asthma have the highest frequency of hyperventilation syndrome. Asthmatics with obesity and hypertension as co-morbid conditions are more prone to develop hyperventilation syndrome. Increased Nijmegen scores hence increased severity of hyperventilation syndrome is associated with poor control of asthma, increased use of reliever medicine and more frequent emergency department visits. **Conclusion:** Hyperventilation syndrome is a common cause of deteriorating quality of life of asthmatics however it is ignored most of the time in management of asthma. Every asthmatic with obesity, difficult to control asthma and frequent emergency visits should be looked for underlying hyperventilation syndrome and must be treated accordingly. There should be more research work on causes, diagnosis and management of hyperventilation syndrome.

Key words: Asthma, Hyperventilation Syndrome, Nijmegen Score, The Global Initiative for Asthma, Poor Asthma Control, Severe Asthma.

INTRODUCTION

Breathing, the most vital sign of life also plays a main role in maintaining biological homeostasis.[1] Apart from central control, the regulation of breathing is governed by emotions as well.[2] The importance of this "normal" breathing evenly increases in case of respiratory disorders and dysfunctional breathing is associated with numerous complications in the management of such patients.[3] Hyperventilation syndrome (HVS), periodic deep sighing, thoracic dominant breathing, forced abdominal expiration and thoraco-abdominal asynchrony are different forms of dysfunctional breathing.[4] These different patterns of dysfunctional breathing have been found in COPD, asthma, heart failure, obstruction, neuromuscular disease, respiratory failure and panic disorder.[4]

Hyperventilation syndrome is the most studied among all the dysfunctional breathing types. Nijmegen questionnaire is most reliably used to diagnose HVS with 91% sensitivity and 95% specificity.[4,5]

High score on Nijmegen questionnaire, hypocapnia at rest, direct clinical observation and exercise challenge test are used methods to diagnose HVS.[3] It is a combination of bio-physical and chemical reactions in our body to a "not needed" increased respiratory rate that occurs due to unknown or benign cause, often triggered by the anxiety resulting in dizziness, headache and further anxiety.[1] Due to hypocapnia during hyperventilation the vasoconstrictive effects of CO_2 are decreased which results in relative hypotension which contributes to most

1. MBBS, FCPS, HOD and Assistant Professor Pulmonology, DHQ Teaching Hospital Sahiwal, Pakistan.
2. MBBS, FCPS, HOD and Assistant Professor Psychiatry, DHQ Teaching Hospital Sahiwal, Pakistan.
3. MBBS, FCPS, Assistant Professor Pathology, Sahiwal Medical College Sahiwal, Pakistan.
4. MBBS, M.Phil, Assistant Professor Physiology, Sahiwal Medical College Sahiwal, Pakistan.
5. MBBS, M.Phil, Assistant Professor Physiology, Sahiwal Medical College Sahiwal, Pakistan.
6. MBBS, Assistant Director Medical Education, Sahiwal Medical College Sahiwal, Pakistan.

Correspondence Address:
Dr. Nauman Aziz
Department of Physiology
Sahiwal Medical College Sahiwal, Pakistan.
nauman188@gmail.com

Article received on: 09/03/2023
Accepted for publication: 16/05/2023

frequently reported symptom of dizziness.[6] Likewise heart rate and stroke volume increases to compensate for drop in blood pressure.[7] These physiological processes produce a range of non-specific symptoms involving cardiovascular, gastro intestinal, respiratory, musculoskeletal and psycho-neurological systems.[1,6,8-10]

The prevalence of HVS in general population ranges from 6-10%, 29-64% in asthmatics with even higher incidence among patients with difficult to treat asthma.[3,4,11] HVS is associated with poor asthma control and is known to complicate and resist the whole management process. Females are more frequent sufferers of HVS.[11] Asthma and HVS result in low quality of life, increased anxiety, lower sense of coherence and reduced asthma control.[3]

HVS is often reported as an emergency and proper identification of the cause is foremost when approaching such situations. Provision of emergency care, immediate conveyance in case of appearance of cyanosis and breathing training are the treatment guidelines.[12]

Different breathing exercises (Papworth and Buteyko methods) along with relaxation techniques are reported to have a better control on frequency and severity of hyperventilation attacks.[3,13] Paper bag breathing (after ruling out metabolic acidosis), pulmonary rehabilitation, yoga and relaxation are other recommendations.[4,13-14]

HVS is not much studied subject and there is poor understanding of the condition, often misused and costs very high to health care providers.[4]

Understanding the etiology and Bio psycho social management should be followed in handling HVS.

MATERIAL & METHODS

This Descriptive cross-sectional study was conducted at Pulmonology Department Sahiwal Medical College Sahiwal and allied hospitals after taking ethical approval from institutional review board of the college vide letter no 06/ ME/SLMC/SWL. The study was completed in six months from 1st Nov 2019 to 1st May 2020. The patients were selected from OPD of Pulmonology Department Sahiwal Medical College Sahiwal and allied hospitals Sahiwal.

The sample size was calculated by using following formula:

$$\text{Sample Size} = \frac{Z1-\alpha\ 2^2\ p(1-p)}{d^2}$$

Z 1-α/2²= is standard normal variate (at 5% type 1 error ($p<0.05$) it is 1.96. As in majority of studies p-values are considered significant below 0.05 hence 1.96 is used in formula.
p = Expected proportion in population based on previous studies or pilot studies = 0.34 [5]
d = Absolute error or precision = 0.09
Sample size = 345

Non-Probability convenience sampling technique was used to collect data. The information about demographic variables, control of asthma, number of rescue therapy canisters used per month, number of emergency visits in last 1 year and co-morbid conditions was obtained in a pre-designed Performa. An informed consent was taken before enrolling the participant. Confirmed cases of asthma of all age and gender were included with the help of suggestive history, examination and pulmonary functions test showing reversibility while those with other lung diseases like Chronic obstructive pulmonary disease (COPD), asthma COPD overlap (ACO) and non-consenting patients were excluded.

The data of the participants was assessed by using Statistical Package for the Social Sciences (SPSS) version 24. Frequency distribution with percentages was calculated for different demographic variables. Association of Nijmegen score with asthma control scores, frequency of use of reliever medication and number of emergency visits was also calculated.

REULTS

Total 400 confirmed cases of asthma were included in the study. Out of 400 cases, 79 were males while 321 were females. A total of 217 patients had good control of asthma. Out of

these 217 patients with good control, 45% (177) patients had Nijmegen score below 24. Nijmegen score in majority of the Patients with partial control of asthma (98-00) lied between 24-44 (59), while majority of those with poor control of asthma (85-00%) had score between 44-64 (54).

When the frequency of reliever drug used was tailored with Nijmegen score. The score was found below 24 in 45% (145) of patients using 1 canister / month. Nijmegen score increased as the number of canisters of reliever drug used per month is increased, majority (88, 18%) of those using more than 2 canister / month had score between 22-44, while significant number (57,14.2%) of those with use of more than 2 canister per month had higher score i.e., 45-64.

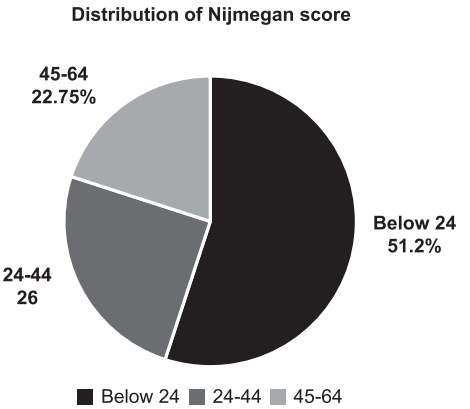


Figure-1. Distribution of Nijmegen score

Demographic Characteristics	Groups- n (%)	Nijmegen Score		
		<24 n (%)	24-44 n (%)	45-64 n (%)
Gender	Male- 79 (20)	57	12	10
	Female-321(80)	148	92	81
Age	<20 years- 128(30)	39	25	64
	20-35years- 117(25)	26	77	14
	36-50years-94(25)	69	19	6
	>50years-61 (20)	52	5	4

Table-I. Demographic characteristics and Nijmegen Score. (N=400)

Variable	Nijmegen Score n (%)		
	Below 24	24-44	45-64
Control of Asthma			
Good (217-55)	177(45)	24 (6.2)	16 (3.7)
Partial (98-00)	32 (7.5)	59 (15)	7 (2.5)
Poor (85-00)	5 (1.2)	26(3.7)	54 (15)
Reliever Use Frequency			
1 canister/ month (201-00)	145(42.5)	32 (7)	24 (5.5)
2 canister/ month (114-00)	17 (4.5)	88 (18)	09 (2.5)
>2canister/ month (85-00)	11 (1.59)	17 (4.2)	57(14.2)
Emergency visit in 6 months			
0 (39-00)	31	2	6
1 (118-00)	76	13	29
2 (107-00)	24	64	19
3 (67-00)	7	43	17
4 (69-00)	14	18	37

Table-II. Association of different variables with Nijmegen Score

Comorbidity	Nijmegen Score n (%)		
	Below 24	24-44	45-64
None (158-00)	107	21	30(7.5)
Diabetes Mellitus (27-00)	15	4	8
Hypertension (59-00)	14(3.7)	34	11
Obesity (137-00)	11	51	75
Others (19-00)	3	12	4
Total (400-00)	150	122	128

Table-III. Association of different comorbidities with Nijmegen score

DISCUSSION

In this study, of the total 400 included participants, 128 (30%) were of age below 20 years, 117 (25%) were from 20 to 30 years old, 94 (25%) were from 36 to 50 years old, and 61 (20%) of them were above 50 years of age. 79 (20%) of the participants were males and the majority i.e., 321 (80%) were females. 205 (55%) out of 400 participants had Nijmegen score less than 24. 103 (25%) had score 24-44 which is considered moderately high, and 91 (25%) had scores 45-64 considered very high. 158 (40%) had no co-morbidities while 137 (35%) were obese, 59 (15%) had hypertension, and 27 (10%) had diabetes.

Very high Nijmegen scores (45-64) were observed in majority of obese person included in the study population i.e., 75 (57.1%) out of 137, while 45 out of 59 hypertensive cases had moderately high Nijmegen scores (24-44). From this we concluded that obese and hypertensive participants had more hyperventilation symptoms.

High Nijmegen score (45-64) is associated with increased number of emergency visits. It was found in 66.7% (37) patients with four emergency visits. This made us conclude that high Nijmegen score is related to more emergency visits.

Patients with high Nijmegen scores had partially controlled and uncontrolled asthma according to GINA control. 85 of the total 400 participants (20%), had uncontrolled asthma and majority of them had Nijmegen score in the range of 45-64. From this data we can concluded that high Nijmegen score is also related to more poor asthma control.

Patients with high Nijmegen 45-64 had more use of rescue drugs (greater than two canisters per month). 85 of the total 400 participants (20%), had greater than two canister per month use of the drug and reported very high score (45-64) while 137 of the totals 400 (25%), had moderately high score (24-44). This made us conclude that high Nijmegen is related to more reliever use (rescue drugs like Ventolin).[15]

We assessed difficulty in breathing in asthma and demonstrated that high Nijmegen score was associated with poor asthma control and hence abnormality. Half of the patients included in our study belonged to younger age group (up to 35 years of age) and the female participants outnumbered male participants up to 80%. Females have high Nijmegen score.[16,17,18] High Nijmegen scores are reported in young age.[19]

The term dysfunctional breathing was initially used to describe having breathing difficulties without having attribution to its medical cause. There is no consensus about exact definition of dysfunctional breathing and psychological factors such as anxiety depression, emotional disturbances, and altered cognition may indicate or contribute to dysfunctional breathing. Studies have indicated that dysfunctional breathing is more common in asthmatics than in healthy individuals.

We obtained Nijmegen questionnaire score in various distinct groups and found significant increase in dysfunctional breathing in asthmatics. 55% of the participants (205 of the total 400) had Nijmegen score less than 24. 25% (103) had moderately high scores, while 20% (91) had very high score 45-64. (158 of the total 400 participants) had no comorbidities. 195(20%) of participants had hyperventilation syndrome i.e., high Nijmegen score which is in accordance with the previous studies.

Patients with dysfunctional breathing report a poor quality of life and poor asthma control, independent of airway hyper responsiveness or airway inflammation. In our study, measurements were conducted using NQ scores. Adopting this methodology can be criticized as being non-specific but it is noteworthy that it has been in use in the past 30 years and that any reliable replacement instrument has not been proposed and validated. There is scarcity of data on dysfunctional breathing and little is known about its various associations this study may provide fruitful avenues for future research.

Obesity is associated with multiple pathophysiological processes and mostly they

are interrelated. Instead of treating them as isolated issues the core issue i.e., obesity should not be ignored.[20] Lung compliance, pulmonary atelectasis and hypoxemia are direct results of obesity, requiring increased work of breathing and higher oxygen consumption. Children are more prone.[21] Strict control of weight should be advised along with other guidelines to control its attacks in obese asthmatics while keeping in mind that exercise itself is a common trigger of asthma called exercise induced bronchoconstriction.[22] Hypertension and obesity usually share the pathogenesis and most frequent comorbidities of asthma.[23]

So, we conclude that high Nijmegen score is related to more emergency visits poor asthma control and more relief drugs use such as Ventolin. Breathlessness is common in patients with difficult asthma and this breathlessness may be sometimes disproportionate to the degree of airway pathology.[24] Due to its pattern dysfunctional breathing leads to misperception about the severity of asthma. Asthma control leads to overtreatment and further complications. The result of this is in accordance with the previous studies.[25,26]

Asthma control leads to overtreatment and further complications. It is commonly observed that as the patient use increased quantities of reliever drugs, usually short-term beta blockers like albuterol. The paradoxical bronchoconstriction, which is an uncommon but serous side effect of using bronchodilator drugs, can be precipitated, further aggravating the breathing difficulty of the patient and causing him to report higher Nijmegen score when assessed. This type of acute attacks of bronchoconstriction can also increase the number of emergency visits of such a patient, a factor also found related to the increase in Nijmegen scores.[27]

A 12-month controlled study showed the effectiveness of education and positive behavioral change in improvement of hyperventilation syndrome and development of self-efficacy.[28] Asthma and its comorbidities should be identified as early as possible, and the course of management should always be multi-dimensional and multi-disciplinary.[29]

In this condition, ventilation exceeds metabolic demands causing hemodynamic and chemical changes producing characteristic symptoms and has various causes including cardio logical, respiratory, organic and psychiatric.

Hyperventilation is one of the most commonly overlooked signs in all of the clinical medicine, baffling family physicians and several specialty groups; notably neurologists, cardiologists, pulmonologists and psychiatrists. Although associated panic with extreme anxiety is normally obvious during the episodes, apparent somatic manifestations such as dizziness, weakness, chest pain, dry mouth, numbness and tingling often direct attention from the underlying breathing disorder. Patients often describe breathing difficulties, but may be totally unaware themselves of the significance of such rapid respiration. There should be a detailed bio psycho social assessment when hyperventilation syndrome is observed in the patients. Such measures if employed earlier in management, allow avoidance of costly and complex additional interventions saves time and allow better control of the problem. Further research is needed to evaluate the prevalence and diagnostic accuracy of hyperventilation and its efficient management.

CONCLUSION

Hyperventilation syndrome is a common cause of deteriorating quality of life of asthmatics however it is ignored most of the time in management of asthma. Every asthmatic with obesity, difficult to control asthma and frequent emergency visits should be looked for underlying hyperventilation syndrome and must be treated accordingly. There should be more research work on causes, diagnosis and management of hyperventilation syndrome.

REFERENCES

1. Koniukhovskaia J, Pewichko E. **Psychological mediation of dysfunction and hyper function of respiratory regulation.** Behav Sci (Basel). 2020 Jan; 10(5):1-9.

2. Ma X, Yue Z, Gong Z, Zhang H, Duan N, Shi Y, er al. **The effect of diaphragmatic breathing on attention, negative effect and stress in healthy adults.** Front Psychol 2017; 8:874.

3. Courtney R. **Breathing training for dysfunctional breathing in asthma: Taking a multidimensional approach.** ERJ Open Red 2017; 3:00065-2017.

4. Boulding R, Stacey R, Niven R, Fowler SJ. **Dysfunctional breathing: A review of the literature and proposal for classification.** Eur Respir Rev. 2016 Sep; 25(141):287-94.

5. Grammatopolou EP, Skordilis EK, Georgoudis G, Haniotou A, Evangelodimou A, Fildissis G, et al. **Hyperventilation in asthma: A validation study of Nijmegen Questionnaire-NQ.** J Asthma 2014; 51(8):839-46.

6. Evans RW 2005. **Unilateral paresthesias due to hyperventilation syndrome.** Pract Neurol 2005;65-8. http://tinyurl.com/yba3a8je

7. Marieb EN, Hoehn K. **Human anatomy and physiology.** 10th ed. Harlow,Essex, United Kingdom; Pearson education Ltd;2016.

8. Caroline N 2016. **Nancy Caroline's Emergency care in the streets.** 7th revised Edition- UK version. 7th ed. Jones and Bartlett; 2016.

9. Blaber A, Harris G. **Assessment skills for paramedics.** 2nd Ed. Maidenhead, England: Open Univ Press; 2016.

10. Wilson. **Hyperventilation syndrome: Diagnosis and reassurance.** Journal of Paramedic Practice 2018; 10(9):370.

11. D'Alba I, Carloni I, Ferrante AL, Gesvita R, Pallazi ML, Benedictis FM. **HVS In adolescents with and without asthma.** Pediatr Pulmonol 2015; 50(12):1184-90.

12. JRCALC J, AACE A. **UK Ambulance Services Clinical Practice guidelines 2016.** Class professional publishing; 2016.

13. Jones M, Harvey A, Marston L, O'Connell NE. **Breathing exercises for dysfunctional breathing/ hyperventilation syndrome in adults.** Cochrane Database Syst Rev 2013;3(5):10.1002/14651858. cd009041.pub2

14. Brouchard 2017. **Treating hyperventilation syndrome with a paper bag.** (Accessed June 2020)

15. Magee JS, Pittman LM, Jette-Kelly LA. **Paradoxical bronchoconstriction with short-acting beta agonist.** The American Journal of Case Reports. 2018; 19:1204.

16. Connett GJ, Thomas M. **Dysfunctional breathing in children and adults with asthma.** Frontiers in pediatrics. 2018 Dec 20; 6:406.

17. Ok JM, Park YB, Park YJ. **Association of dysfunctional breathing with health-related quality of life: A cross-sectional study in a young population.** PloS one. 2018 Oct 11; 13(10):e0205634.

18. Veidal S, Jeppegaard M, Sverrild A, Backer V, Porsbjerg C. **The impact of dysfunctional breathing on the assessment of asthma control.** Respiratory Medicine. 2017 Feb 1; 123:42-7.

19. Denton E, Bondarenko J, Tay T, Lee J, Radhakrishna N, Hore-Lacy F, Martin C, Hoy R, O'Hehir R, Dabscheck E, Hew M. **Factors associated with dysfunctional breathing in patients with difficult to treat asthma.** The Journal of Allergy and Clinical Immunology: In Practice. 2019 May 1; 7(5):1471-6.

20. Blackstone RP. **Obesity-Related Diseases and Syndromes: Cancer, Endocrine Disease, Pulmonary Disease, Pseudotumor Cerebri, and Disordered Sleep.** InObesity 2016 (pp. 109-132). Springer, Cham.

21. Lang JE. **Contribution of comorbidities to obesity-related asthma in children.** Paediatric Respiratory Reviews. 2020 Jul 31.

22. Oudjedi A, Aissa KS. **Associations between obesity, asthma and physical activity in children and adolescents.** Apunts Sports Medicine. 2020 Jan 1; 55(205):39-48.

23. Christiansen SC, Schatz M, Yang SJ, Ngor E, Chen W, Zuraw BL. **Hypertension and asthma: A comorbid relationship.** The Journal of Allergy and Clinical Immunology: In Practice. 2016 Jan 1; 4(1):76-81.

24. Depiazzi J, Everard ML. **Dysfunctional breathing and reaching one's physiological limit as causes of exercise-induced dyspnoea.** Breathe. 2016 Jun 1; 12(2):120-9.

25. Veidal S, Jeppegaard M, Sverrild A, Backer V, Porsbjerg C. **The impact of dysfunctional breathing on the assessment of asthma control.** Respiratory Medicine. 2017 Feb 1; 123:42-7.

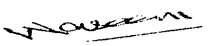
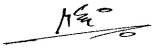
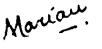
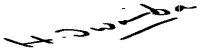
26. Sedeh FB, Von Bülow A, Backer V, Bodtger U, Petersen US, Vest S, James HH, Porsbjerg C. **The impact of dysfunctional breathing on the level of asthma control in difficult asthma.** Respiratory Medicine. 2020 Mar 1; 163:105894.

27. Denton E, Bondarenko J, Tay T, Lee J, Radhakrishna N, Hore-Lacy F, Martin C, Hoy R, O'Hehir R, Dabscheck E, Hew M. **Factors associated with dysfunctional breathing in patients with difficult to treat asthma.** The Journal of Allergy and Clinical Immunology: In Practice. 2019 May 1; 7(5):1471-6.

28. Grammatopoulou E, Skordilis EK, Haniotou A, John Z, Athanasopoulos S. **The effect of a holistic self-management plan on asthma control.** Physiotherapy theory and practice. 2017 Aug 3; 33(8):622-33.

29. Rogliani P, Sforza M, Calzetta L. **The impact of comorbidities on severe asthma.** Current Opinion in Pulmonary Medicine. 2020 Jan 1; 26(1):47-55.

AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Muhammad Waseem	Conception and design of work, results compiling.	
2	Muntazir Mehdi	Help in biostatics and data analysis.	
3	Maryam Rafiq	Supervision and revising it critically for important intellectual content.	
4	Nauman Aziz	Final approval of the version to be published.	
5	Hafiza Swaiba Afzal	Analysis and interpretation.	
6	Muhammad Junaid Iqbal	Write-up of the article.