

Prevalence of dysfunctional breathing in patients treated for asthma in primary care: cross sectional survey

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Abstract

Objectives To estimate the prevalence of dysfunctional breathing in adults with asthma treated in the community.

Design Postal questionnaire survey using Nijmegen questionnaire.

Setting One general practice with 7033 patients.

Participants All adult patients aged 17-65 with diagnosed asthma who were receiving treatment.

Main outcome measure Score ≥ 23 on Nijmegen questionnaire.

Results 227/307 patients returned completed questionnaires; 219 (71.3%) questionnaires were suitable for analysis. 63 participants scored ≥ 23 . Those scoring ≥ 23 were more likely to be female than male (46/132 (35%) *v* 17/87 (20%), $P=0.016$) and were younger (mean (SD) age 44.8 (14.7) *v* 49.0 (13.8), ($P=0.05$). Patients at different treatment steps of the British Thoracic Society asthma guidelines were affected equally.

Conclusions About a third of women and a fifth of men had scores suggestive of dysfunctional breathing. Although further studies are needed to confirm the validity of this screening tool and these findings, these prevalences suggest scope for therapeutic intervention and may explain the anecdotal success of the Buteyko method of treating asthma.

Introduction

Abnormal breathing patterns have been shown to cause breathlessness, chest tightness, chest pain, light-headedness, paraesthesiae, and anxiety.¹ This symptom complex has been described in different clinical situations and has been referred to as the hyperventilation syndrome,² behavioural breathlessness,³ and dysfunctional breathing.⁴ It often occurs in association with hyperventilation.⁵

Other abnormalities have been shown in patients with dysfunctional breathing. These include unsteadiness of breathing in response to stimuli such as exercise or a period of voluntary overbreathing,⁶ increased respiratory rate, abnormal orthostatic increases of respiratory gas exchange,⁷ a predominantly intercostal respiratory effort, and frequent sighing.¹ The overbreathing aspect of the symptom complex may, however, be episodic and difficult to show without prolonged measurement of the end tidal

or arterial carbon dioxide tension.⁸ Furthermore, some symptoms associated with the syndrome have been shown to be unrelated to hypocapnia and may be mediated by other mechanisms.^{9, 10}

Diagnosis of dysfunctional breathing can therefore be difficult; the characteristic symptoms are common to other diseases and there is no standard diagnostic test.¹¹ This may lead to under-recognition of the effects of abnormal breathing patterns,^{2, 3} and symptoms may be wrongly attributed to other causes, resulting in inappropriate investigations and ineffective treatment.

There is evidence linking dysfunctional breathing with respiratory disorders. Large series of patients with the hyperventilation syndrome have been reported in specialist respiratory clinics.^{3, 12} Asthma has been linked with symptomatic hyperventilation in several studies,¹³⁻¹⁵ and this may be related to the increased anxiety and depression indices found in asthmatic patients.¹⁴ In one series, 42% of patients attending a hospital asthma clinic showed evidence of hyperventilation disorder as assessed by capnographic responses and Nijmegen questionnaire scores.¹⁶ Hyperventilation may be a compounding factor contributing to the symptoms of patients with asthma.¹⁷

The prevalence of dysfunctional breathing in asthmatic patients treated in primary care has not been investigated. We studied the prevalence of dysfunctional breathing in patients treated for asthma in one general practice.

Participants and methods

We identified patients aged 17-65 with a diagnosis of asthma from the medical records of a semirural general practice with a list size of 7033. We included all patients who had had asthma diagnosed on clinical grounds and who had received one or more prescriptions for inhaled or oral bronchodilator or prophylactic asthma in the past year. The study was approved by the local research ethics committee.

Patients were sent the Nijmegen questionnaire for self completion. The questionnaire assesses 16 symptoms associated with abnormal breathing on a five point scale (table 1). A total symptom score of ≥ 23 has been reported as showing a sensitivity of 91% and a specificity of 95% as a screening instrument in patients with diagnosed hyperventilation syndrome.¹⁸ We therefore used this value to divide participants into

two groups. We also obtained the age and sex of participants from patient records and calculated the step of treatment in the British Thoracic Society guidelines¹⁹ from the electronic prescribing records as a guide to severity of asthma.

We entered data on a computerised spreadsheet and analysed them using standard SPSS software. Data on sex and asthma severity in the two groups were compared with the χ^2 test. We analysed differences in age using Student's *t* test.

Results

Of the 4381 patients aged 17 to 65 registered with the practice, 307 (7%) met the entry criteria and were posted the questionnaire (128 men, 179 women, mean (SD) age 44 (14.7) years). A total of 227 questionnaires were returned after one mailing (response rate 74%, 89 men, 138 women), of which 219 were suitable for analysis (87 men, 132 women, mean (SD) age 46.7¹⁴ years). Eight questionnaires were returned incorrectly completed, unlabelled, or illegible. Sixty three respondents (29%, 95% confidence interval 23% to 35%) had scores ≥ 23 on the Nijmegen questionnaire.

The mean age was 44.8 (14.7) years for patients scoring ≥ 23 and 49.0 (13.8) years for those scoring < 23 (difference -4.2 years, $P=0.05$). Table 2 shows that women were more likely than men to have scores ≥ 23 (46/132 (35%, 95% confidence interval 27% to 43%) *v* 17/87 (20%, 11% to 28%); $\chi^2=5.83$, $df=1$, $P=0.016$).

Table 3 shows the numbers of respondents at each British Thoracic Society treatment step who had positive and negative screening scores. There were no significant differences in severity of asthma between those who did and did not achieve questionnaire scores indicative of dysfunctional breathing ($\chi^2=3.17$, $df=4$, $P=0.53$).

Discussion

This study shows that about one third of women and one fifth of men with asthma in a single practice had symptom scores on the Nijmegen questionnaire suggestive of dysfunctional breathing. The Nijmegen questionnaire is a simple self completed questionnaire that takes only a few minutes to complete and is thus a practicable screening instrument in primary care. The high prevalence of positive scores suggests that in this practice there may be an important unrecognised diagnostic overlap between asthma and dysfunctional breathing. As a result, a large minority of patients may be experiencing avoidable morbidity because of inappropriate diagnoses and ineffective treatment. The problem affects patients at all levels of asthma treatment but particularly women and younger adults.

Limitations of study

The limitations of this study are twofold. The first applies to its generalisability; the practice may have been more or less likely than others to diagnose asthma. However, the prevalence of asthma and the levels of treatment by British Thoracic Society treatment step in the practice are similar to the national figures.²⁰ We did not require objective confirmation of the diagnosis of asthma, such as show-

Table 1 Nijmegen questionnaire. Respondents are asked to ring the score that best describes the frequency with which they experienced the symptoms listed

Symptom	Never	Seldom	Sometimes	Often	Very often
Chest pain	0	1	2	3	4
Feeling tense	0	1	2	3	4
Blurred vision	0	1	2	3	4
Dizziness	0	1	2	3	4
Confusion or loss of touch with reality	0	1	2	3	4
Fast or deep breathing	0	1	2	3	4
Shortness of breath	0	1	2	3	4
Tightness across chest	0	1	2	3	4
Bloated sensation in stomach	0	1	2	3	4
Tingling in fingers and hands	0	1	2	3	4
Difficulty in breathing or taking a deep breath	0	1	2	3	4
Stiffness or cramps in fingers and hands	0	1	2	3	4
Tightness around the mouth	0	1	2	3	4
Cold hands or feet	0	1	2	3	4
Palpitations in the chest	0	1	2	3	4
Anxiety	0	1	2	3	4

ing reversible airflow obstruction on spirometry or variation in peak flow. This is appropriate in a general practice based study because asthma remains a clinical diagnosis supported by, but not reliant on, objective measurements.²¹ Larger studies will be needed to confirm the suggested high prevalence of dysfunctional breathing among patients with asthma and the validity of the diagnostic label of asthma in patients with symptoms suggestive of dysfunctional breathing.

The second limitation applies not only to this study but to much of the data on the hyperventilation syndrome and dysfunctional breathing—that of definition and diagnosis. The Nijmegen questionnaire identifies patients with characteristic symptom patterns, but the lack of a standard diagnostic test means the diagnosis cannot be certain. The questionnaire has been used extensively as a research and diagnostic tool, and studies have validated the questionnaire against other accepted diagnostic methods, including production of symptoms by voluntary hyperventilation (the hyperventilation provocation test) and capnography measurements during various manoeuvres and exposure to stressors.¹⁸ The validity of the hyperventilation provocation test, and even the existence of the hyperventilation syndrome, has been questioned because isocapnic hyperventilation studies showed that many of the symptoms produced by

Table 2 Numbers (percentages) of respondents with positive scores for dysfunctional breathing by age and sex

	Age <40 years	Age ≥ 40 years	Total
Men	7/25 (28)	10/62 (16)	17/87 (20)
Women	14/38 (37)	32/94 (34)	46/132 (35)
Total	21/63 (33)	42/156 (27)	63/219 (29)

Table 3 Numbers (percentages) of patients with positive and negative screening scores for dysfunctional breathing according to British Thoracic Society asthma treatment steps

British Thoracic Society treatment step	Positive score* n=63	Negative score (n=156)
1	14 (22)	35 (22)
2	21 (33)	51 (33)
3	14 (22)	45 (29)
4	14 (22)	23 (14)
5	0	2 (1)

* ≥ 23 on Nijmegen questionnaire.

What is already known on this topic

Abnormal breathing patterns may cause characteristic symptoms and impair quality of life

Effective interventions exist for dysfunctional breathing

Dysfunctional breathing has been described in patients attending hospital respiratory clinics

What this study adds

29% of adults treated for asthma in primary care had symptoms suggestive of dysfunctional breathing

Affected patients were more likely to be female and younger, but no differences were found with severity of asthma

Some patients with asthma may benefit from breathing therapy

overbreathing are independent of hypocapnia.⁹ Many patients, however, do experience appreciable symptoms from overbreathing and disordered breathing, possibly through proprioceptive pathways.¹⁰ van Dixhoorn has stated that the diagnosis of dysfunctional breathing can be confirmed only by successful treatment with breathing therapy.²²

Implications

It is important to recognise dysfunctional breathing because interventions are available to improve symptoms and quality of life.¹²⁻²³⁻²⁴ These interventions include explanation, reassurance, reattribution of symptoms, relaxation exercises, and specific breathing retraining exercises. Teaching diaphragmatic breathing exercises has been shown to be highly effective in secondary care.²⁵ Although the mechanism by which retraining breathing improves symptoms in patients with the hyperventilation syndrome has been questioned,²⁶ important and persistent clinical improvements result from this type of intervention. If dysfunctional breathing is as common as our data show, facilities for breathing retraining need to be available as part of the overall management of asthmatic patients.

Our finding of undiagnosed dysfunctional breathing in patients with asthma may also explain the anecdotal reports of efficacy of the Buteyko method. Much publicity has been given to this method, which claims to treat asthma by retraining the breathing pattern to correct hyperventilation.²⁷ The Buteyko method has, however, had limited scientific scrutiny.²⁷

Our data suggest that large numbers of asthmatic patients may have developed abnormal breathing patterns, causing symptoms that could be improved by appropriate interventions. Further studies are needed to investigate the effects of breathing retraining on patients identified by questionnaire tools and to confirm the high prevalence of dysfunctional breathing in asthmatic patients.

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- Lum LC. Symptoms and signs of hyperventilation. In: Timmons B, Ley R, eds. *Behavioural and psychological approaches in breathing disorders*. London: Plenum Press, 1994.
- Margarian GJ. Hyperventilation syndromes: infrequently recognised common expressions of anxiety and distress. *Medicine* 1982;61:219-36.
- Howell JBL. Behavioural breathlessness. *Thorax* 1990;45:287-92.
- van Dixhoorn J. Hyperventilation and dysfunctional breathing. *Biol Psychol* 1997;46:90-1.
- Gardner WN. The pathophysiology of hyperventilation disorders. *Chest* 1996;109:516-34.
- Han JN, Stegen K, Simkens K, Caubergs M, Schepers R, Van den Bergh O, et al. Unsteadiness of breathing in patients with hyperventilation syndrome and anxiety disorders. *Eur Respir J* 1997;10:167-76.
- Malmberg LP, Tamminen K, Sovijarvi ARA. Orthostatic increase of respiratory gas exchange on hyperventilation syndrome. *Thorax* 2000;55:295-301.
- Gardner WN, Meah MS. Controlled study of respiratory responses during prolonged measurement in patients with chronic hyperventilation. *Lancet* 1986;i:30.
- Hornsveld HK, Garssen B. Double-blind placebo-controlled study of the hyperventilation provocation test and the validity of the hyperventilation syndrome. *Lancet* 1996;348:154-8.
- Howell LBL. The hyperventilation syndrome: a syndrome under threat? *Thorax* 1997;52(suppl):S30-4.
- Lewis RA, Howell JB. Definition of the hyperventilation syndrome. *Bull Eur Physiopathol Respir* 1986;22:201-5.
- Lum LC. Physiological considerations in the treatment of hyperventilation syndromes. *J Drug Res* 1983;8:1867-72.
- Carr R. Panic disorder and asthma: causes, effects and research implications. *J Psychosom Res* 1998;44:43-52.
- Carr RE, Lehrer PM, Hochron SM, Jackson A. Effects of psychological stress on airways impedance in individuals with asthma and panic disorder. *J Abnorm Psychol* 1996;105:137-41.
- Demeter S, Cordasco EM. Hyperventilation syndrome and asthma. *Am J Med* 1986;81:989-94.
- McClean AN, Howells J, Chaudri G, Boyd G. Use of the Nijmegen hyperventilation questionnaire and hyperventilation provocation test in a hospital asthma clinic. *Am J Respir Crit Care Med* 1999;159:A652.
- Han JN, Hu Z, Zhu YJ, Van den Bergh O, Van de Woestijne KP. The complaints in patients with asthma are compounded by hyperventilation [abstract]. *Am J Respir Crit Care Med* 1999;159:A788.
- Van Dixhoorn J, Duijvenvoorden HJ. Efficacy of Nijmegen questionnaire in recognition of the hyperventilation syndrome. *J Psychosom Res* 1985;29:199-206.
- British Thoracic Society, National Asthma Campaign, Royal College of Physicians of London, General Practitioner in Asthma Group, British Association of Accident and Emergency Medicine, British Paediatric Respiratory Society, et al. The British guidelines on asthma management: 1995 review and position statement. *Thorax* 1997;52(suppl):S1-21.
- Lung and Asthma Information Agency. Prevalence of asthma treated in general practice. Factsheet 99/1. London: LAIA, 1999. www.ghms.ac.uk/depts/laia/laia.htm (accessed 7 February 2001).
- Britton J, Lewis S. Objective measures and the diagnosis of asthma. *BMJ* 1998;317:227-8.
- van Dixhoorn J. *Ontspanningsinstructie, principes en oefeningen*. Maarssen: Elsevier/Bunge, 1998.
- DeGuire S, Gevirtz R, Hawkinson D, Daxon K. Breathing retraining: a three-year follow-up study of treatment for hyperventilation syndrome and associated functional cardiac symptoms. *Biofeedback Self Regul* 1996;21:191-8.
- Grossman P, De Swart JC, Defares PB. A controlled study of a breathing therapy for treatment of hyperventilation syndrome. *J Psychosom Res* 1985;29:49-58.
- Maskell N, Prior J. The value of an intensive physiotherapy course in patients with hyperventilation. *Am J Respir Crit Care Med* 1999;159:A832.
- Garssen B. Breathing retraining: a rational placebo? *Clin Psychol Rev* 1992;12:141-53.
- Bowler SD, Green A, Mitchell CA. Butekyo breathing techniques in asthma: a blinded randomised controlled trial. *Med J Aust* 1998;169:575-8.

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