Chapter 6.5

Questionnaires and manual methods for assessing breathing dysfunction

Rosalba Courtney, Jan van Dixhoorn

CHAPTER CONTENTS

INTRODUCTION

The assessment of breathing dysfunction includes the evaluation of the patient's symptoms using questionnaires, and of their breathing pattern through the use of instrumentation, or by direct observation and palpation.

Questionnaires or breathing pattern evaluation are often used as the sole basis for assigning to the patient the diagnostic label of dysfunctional breathing. This may not be an appropriate use of these tools. Dysfunctional breathing is not precisely defined and cannot be established on the basis of a single measurement. Subjective symptoms of breathing discomfort may have relatively little correlation with objective signs of breathing dysfunction. Breathing is a dynamic system which is under the influence of many factors. These are of a physical and pathological nature, as well as from psychic and emotional origin and also may be part of social and behavioural patterns. Respiratory disturbances or breathing pattern disorders can arise from a host of causes. Information gleaned from questionnaires and breathing pattern assessments need to be interpreted with attention to the particular context in which they appear, in light of other clinical findings and with an attempt to understand other possible causes of the patient's symptoms and breathing pattern abnormalities.

Questionnaires and assessment of breathing patterns, however, do provide a useful place from which to start to understand the patient, and when used together with other assessment tools, can inform the practitioner about the functionality of a patient's breathing. This chapter will discuss two questionnaires, the Nijmegen Questionnaire (NQ) and the Self-Evaluation of Breathing Questionnaire

(SEBQ), located in the appendices to this chapter, as well as a manual procedure to assess the global quality of respiratory movement called the Manual Assessment of Respiratory Motion (MARM). Alternative/additional evaluation approaches are to be found in the other chapters in Section 6.

The Nijmegen Questionnaire was originally devised to evaluate the symptoms of hyperventilation syndrome and is the questionnaire most commonly used to identify and evaluate dysfunctional breathing. In recent years this questionnaire has also been used to evaluate medically unexplained (respiratory) symptoms whose origins are likely to be rooted in psychic and emotional stress and are variably connected to hypocapnia (Katsamanis et al 2011, Gevirtz 2007, Han et al, 2004). However, it has always been clear that there is a large overlap with symptoms of stress/anxiety. NQ may therefore be helpful to identify the presence of symptoms mediated by general distress as well as symptoms of respiratory distress.

The SEBQ can be a useful complement to the NQ in evaluating breathing dysfunction. It was designed to evaluate a broader range of breathing symptoms than the NQ. It can be useful for monitoring both the extent of respiratory discomfort and the distinct qualities of these uncomfortable breathing sensations.

The efficiency with which the mechanical act of breathing is performed is an important aspect of breathing functionality. Inefficient patterns of breathing can contribute to dyspnoea, musculoskeletal dysfunction and impact on the efficiency of circulatory and homeostatic processes. The MARM is a manual procedure that can be used to quantify the distribution of breathing movement. It has two aspects: the area or extent of breathing movement and the location of breathing on a vertical axis (upper-thoracic, costo-abdominal, abdominal).

Efficient breathing is dependent on the coordination and balanced use of many breathing muscles. The efficiency of particular muscular coordination patterns is dependent on a person's posture, activity level and disease. Breathing patterns considered dysfunctional in some situations may be appropriate in others. During increased activity or at times of increased respiratory drive it is considered normal for the breathing to become more thoracic-dominant, and for there to be increased recruitment of the accessory muscles of respiration (De Troyer & Estenne 1988). In patients with restrictive lung disease or in the advanced stages of chronic obstructive pulmonary disease a thoracic upper chest breathing pattern may be the best adaptation to severe lung pathology (Cahalin et al 2002). Efficient breathing also involves appropriate timing and volume adjustments that are sensitive and responsive to changes in the person's internal and external environment but not excessively chaotic or irregular. Context can be an important factor in differentiating normal from abnormal breathing patterns, i.e. disease, ventilatory drive, states of activity compared with states of rest.

QUESTIONNAIRES

Generally speaking people with breathing dysfunction have more respiratory discomfort than those whose breathing is efficient and functional (Courtney et al 2011a). They may also have complaints in other systems whose function is closely inter-related with breathing such as the cardiovascular or autonomic nervous systems (Wilhelm et al 2001).

The SEBQ focuses on evaluating respiratory symptoms while the NQ evaluates the broader range of symptoms whose presence often accompanies breathing dysfunction.

The Nijmegen Questionnaire (NQ)

(see Appendix 1, at end of this chapter)

Normal and abnormal values

NQ consists of 16 items, to be answered on a five point scale, ranging from 'never', counted as zero, to 'very often', counted as 4. The total score ranges from 0 to 64 (Doorn et al 1983). Completion of the questionnaire is quick, and only takes a few minutes. The items were chosen to represent a range of symptoms:

- Stress and arousal (e.g. feeling anxious, tense, having palpitations)
- Presumed consequences of hypocapnia (e.g. dizziness, blurred vision, tingling and stiffness around mouth and in hands)
- Difficulty breathing (e.g. inability to take a deep breath, tightness in the chest).

However, items presumed to result from hypocapnia could be the result of stress and high sympathetic tone as well.

For its practical use, it is of importance to establish a criterion for the presence or absence of dysfunction and abnormal level of complaints. On average, a normal, healthy individual has a sum score of 11 ± 7, men score somewhat lower than women (Han et al 1997). These data imply that most normal individuals have scores that range from 4 to 18. Note however, that these values have been obtained in Belgium and the UK. In China, by contrast, the normal average value is 5. To define a criterion for dysfunction we used data from over 2000 patients who were referred for treatment with breathing and relaxation therapy, about one quarter of whom were labelled as having 'hyperventilation complaints' (Dixhoorn 2012). Average NQ value of the latter group was 29.5. When taking these patients as the reference for those who most probably would have breathing dysfunction it appears that a value of 20 or higher differentiates them from normal. So, a value of NQ > 19 denotes the presence of (respiratory) distress and dysfunction. The higher the score, the more distress is present. Values below 20 are considered within the normal and functional domain.

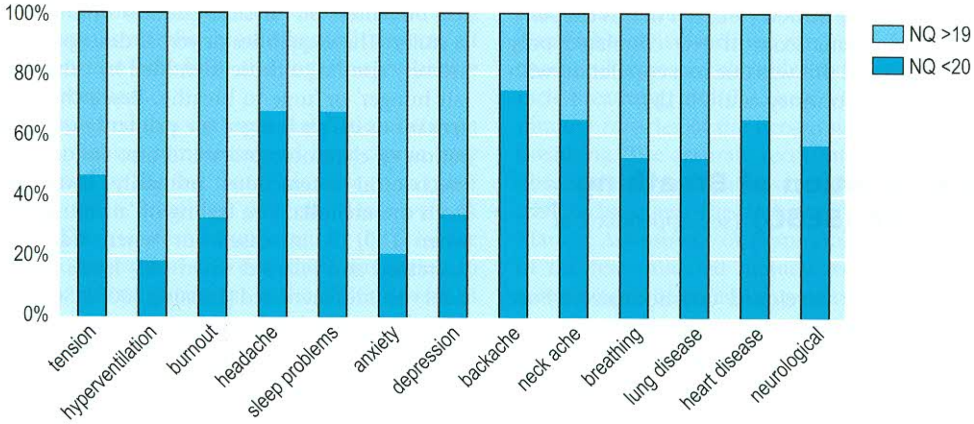

Figure 6.5.1 Distribution of normal (NQ 1–19) versus abnormal NQ scores (NQ 20–64) for different patient groups.

Distress and respiratory distress

However, high NQ scores do not appear to be exclusively present among patients with 'hyperventilation complaints'. The other 1500 patients had stress-related, but not necessarily respiration-related complaints: headaches, sleep problems, fatigue, burnout, anxiety, neck or back ache, voice problems or chronic pain. Some had medical diseases but were referred for the stress complaints. Given this large diversity in conditions and complaints, average NQ value for the group as a whole was elevated (Thomas et al 2005). Thus, contrary to what may be commonly thought, high NQ scores are not specific for 'hyperventilation complaints'.

Figure 6.5.1 shows the distribution of normal versus elevated scores (NQ>19) for the different categories. It is clear that the percentage of patients with high NQ varies considerably, between 80% (hyperventilation complaints and anxiety) and 30–40% (headache, neck ache, sleep problems, heart disease). There is no category where patients with high NQ are absent, even though the problem does not seem to have a respiratory component. This corroborates the fact that NQ does measure both general and respiratory stress. However, when a particular problem has minimal respiratory components, fewer patients have elevated scores. Interestingly, not all patients within the category 'breathing', having problems with nasal breathing, coughing, breathing during speech or effort etc., show an elevated NQ.

Responsive to treatment

The advantages of the NQ is that it is responsive to treatment effect and that it is short. Thus, it can be administered repeatedly over the course of treatment to assess progress. Among the 2000 patients, referred for breathing therapy, those who responded well and had a clear reduction in their main complaint, showed on average near normal values at the end of treatment. This applied to patients with 'hyperventilation complaints', but equally to all other patients. By contrast, when treatment was less or not successful, the NQ score decreased slightly but on average it remained elevated and above 19. Therefore, the NQ seems a useful evaluation tool in the treatment of patients with stress-related and unexplained problems. When the NQ does not normalize, treatment strategy should be re-evaluated. As to a cut-off score, it appears that a decrease of at least 10 points, calculated for hyperventilation patients with Jacobson's formula for 'reliable change index', indicates a clinically significant change (Jacobson & Traux 1991). This applies when the initial NQ score is clearly elevated.

Not all patients with medically unexplained symptoms have elevated NQ scores. In those cases NQ reflects treatment outcome less well, and it is difficult to obtain a decrease of 10 points or more. For instance, patients with asthma have on average slightly elevated NQ scores, around 19 in one study (Holloway & West 2007). Their response to breathing therapy (Papworth method) was positive and the final NQ score normalized (around 11–12). Nevertheless, the criterion of at least 10 points decrease was not reached by most of them. Thus, the clinician should evaluate the meaning of changes in NQ scores individually (Holloway & West 2007).

Sub scores

It is sometimes useful to inspect the individual items in the NQ. For instance, among asthma patients it was found that the relatively modest elevation on NQ is caused by high scores on the respiratory items, but relatively low scores on the other items. Thus, when the sum score appears to be unexpectedly low, given the nature of the complaints, the advice is to inspect the individual items. Another reason to select the respiratory items is in comparing the NQ to the MARM (see later in this chapter). In one data set, the sum score of NQ correlated only slightly with MARM and this was due to a correlation with the respiratory items (Courtney et al 2011b).

The Self-Evaluation of Breathing Questionnaire (SEBQ) (see Appendix 2 at end of this chapter)

The SEBQ is a recently developed questionnaire whose items were drawn from the various descriptions in the scientific and popular literature of respiratory symptoms and breathing behaviours proposed to be associated with breathing dysfunction (Courtney & Greenwood 2009). The most current versions of the SEBQ (Version 3), appearing in Appendix 2, contains 25 items to be answered on a three-point scale, ranging from 'never', counted as zero, to 'very frequently/very true', counted as 3. One study of 180 individuals found that scores on this version of the SEBQ range from 0–64. This study also found that the SEBQ has a high level of test re-test reliability (ICC=0.88, 95%CI=84–91). Mean values in this study were 16, with smokers scoring 51% higher than non-smokers and sufferers of respiratory disease scoring 69% higher than those without respiratory disease (Mitchell 2011).

The SEBQ is useful as a means of evaluating the quality and quantity of uncomfortable respiratory sensations, and the person's perception of their own breathing, and may help to give insight into the origins of the discomfort.

Research into the language of dyspnoea (or breathing discomfort) has established that the different types of dyspnoea or uncomfortable respiratory sensation have their origins in different receptors and different pathophysiological processes and that people given similar breathing challenges or suffering with similar diseases will use the same sort of words to describe their sensations or respiratory difficulty or discomfort (Simon et al 1989, Simon & Schwartzstein 1990, Elliot et al 1991).

Analysis of the SEBQ using a statistical technique called factor analysis showed that this questionnaire can differentiate two distinct categories or dimensions of breathing discomfort. The first of these dimensions, called 'lack of air', is related to 'air hunger' (as described below) and the second of these, related to the work, or effort of breathing, is called a perception of 'inappropriate or restricted breathing'. The two dimensions of the SEBQ may represent strongly related, but distinct, aspects of breathing perception and dysfunction representing biochemical and biomechanical mechanisms, and also sensory and cognitive aspects of interoception. The clinical assessment of these two dimensions may prove useful for understanding more about the nature of a person's breathing dysfunction, so that treatment can be individualized.

The SEBQ category called 'lack of air' contains items such as 'I feel short of breath', 'I can't catch' my breath', 'I feel breathless on physical exertion' and 'I feel that the air is stuffy'. These qualities or verbal descriptors of dyspnoea are very similar to those identified by other researchers as 'air hunger' or 'urge to breathe'. Research has shown that sensations of 'air hunger' are primarily related to the activation of chemoreceptors and also influenced by neuromechanical interactions primarily involving feedback from the medulla. The feeling of 'air hunger' is produced when CO_2 is increased, or when tidal volumes are decreased and relieved when CO_2 levels are lowered and tidal volumes increased (Lansing 2000). Studies of patients with suspected hyperventilation syndrome have shown that the dyspnoea symptoms have no relationship to low CO_2 levels (Hornsveld & Garssen 1996).

The SEBQ category called 'perception of inappropriate or restricted breathing' contains descriptors such as 'I cannot take a deep and satisfying breath' and 'My breathing feels stuck or restricted' that convey a sense of restricted or otherwise unsatisfied respiration. These types of sensations arise, as least in part, from receptors in the chest wall and muscles of breathing and also represent the qualities of dyspnoea that arise when the motor output of the respiratory system is not able to match the expectations generated in the sensory cortex by corresponding discharges from the motor cortex (Beach & Schwatrzstein 2006). These types of sensations are reported in situations where the work of breathing is made more difficult such as when the chest wall is strapped (O'Donnell et al 2000) or when there is impaired function of the respiratory muscles and rib cage and when neuromuscular coupling and respiratory muscle functioning is impaired because the lungs are hyperinflated (Lougheed et al 2006).

The two dimensions identified in the SEBQ also describe different aspects of interoception with the first being related to the sensory and often using the words, 'I feel', and the second indicating the more cognitive or evaluative aspects of interoception. It is interesting that the sensations related to the urge to breathe or SEBQ 'lack of air' category come from the medulla, and the sensations related to the work of breathing and using the words 'I notice' arise from the cortex.

Comparing the SEBQ and the NQ

The symptoms measured by the NQ represent a cluster of complaints long recognized to exist together in people whose breathing disorders accompany stress, anxiety and hyperarousal and in many instances also to acute or chronic hypocapnia (hyperventilation complaints). The NQ does not enquire as extensively as the SEBQ into the different qualities of respiratory discomfort.

In patients given both questionnaires, the NQ scores were found to correlate with the SEBQ total score and with Factor 1 of the SEBQ – 'Lack of air' but not with Factor 2 of the SEBQ – 'Perception of inappropriate or restricted breathing'. This suggests that the SEBQ is useful as an additional questionnaire to the NQ for differentiating symptoms arising from the biomechanical aspects of breathing dysfunction and from the cognitive/evaluative aspects of interoception.

It has been suggested that the weak association between dysfunctional breathing symptoms and hypocapnia may be partly explained by the fact that these arise from other causes such as tense breathing patterns (Hornsveld & Garssen 1997). This assertion is supported by the presence of a separate biomechanical and evaluative dimension to dysfunctional breathing symptoms in the SEBQ, as well as by the mediating role of MARM in the presence of breathing discomfort.

Practical uses of the SEBQ

The two dimensions of the SEBQ may represent strongly related, but distinct, aspects of breathing perception and dysfunction, and might prove to be useful as a means for differentiating breathing symptoms that are more connected to medullary and biochemical mechanisms from those that have a greater contribution from dysfunction of the neuromuscular aspects of breathing. This can guide the practitioner in performing further evaluation with manual techniques, capnometry or of the person's psychological state and stress level.

Research to establish normative values for the SEBQ has not been formally undertaken. However, in one study examining the relationships between measures of dysfunctional breathing, it was found that individuals with NQ scores below 20 had a mean score of 11 for the SEBQ (Courtney et al 2011a).

MANUAL TECHNIQUES FOR EVALUATING BREATHING PATTERN

In the research setting, instrumentation is used to determine breathing pattern whilst in the clinical environment, the cheaper and less time-consuming methods of observation and palpation are the mainstay of breathing pattern assessment.

The main types of instrumentation used to evaluate the breathing pattern are respiratory induction plethysmography (RIP), magnetometry and a new technique called optoelectronic plethysmography. These types of instrumentation which can collect a large number of volume, movement and timing measures enable a sophisticated and precise assessment of breathing pattern, but their cost is prohibitively expensive for the average clinician.

In the clinical environment, the practitioner who is evaluating breathing pattern dysfunction relies primarily on their senses and powers of observation. By observing the patient's posture, demeanour and speech pattern it is frequently possible to begin to recognize breathing pattern disorders. In looking more closely at breathing itself, clinicians who are so inclined can easily identify the heaving chest and increased shoulder movement of excessive thoracic breathing, and the chest wall rigidity and tense respiratory muscles of the person with stressed and effortful breathing. The accurate recording and reporting of these observational and palpatory findings requires standardized techniques. The following section focuses on the Manual Assessment of Respiratory Motion (MARM), one of the few validated manual techniques that quantifies some aspects of breathing pattern.

The Manual Assessment of Respiratory Movement (MARM)

The MARM is similar to manual assessments of lateral rib cage motion, long used by manual therapists to assess diaphragm function. However, the MARM also interprets and quantifies this motion in relationship to other aspects of global respiratory motion. The MARM procedure was first developed and applied in a follow-up study of breathing and relaxation therapy with cardiac patients in the 1980s. Patients who were treated solely with exercise rehabilitation showed clear differences in MARM values, as compared to those who had additional breathing retraining therapy, and these were evident up to 2 years after rehabilitation (Dixhoorn 1994). Later tests have shown that the MARM has good (ICC=0.85, p=0.0001, CI 0.78, 0.89) inter-examiner reliability and is better able to determine changes in extent of thoracic breathing in response to changes in posture and verbal instruction than respiratory induction plethysmograph (Courtney et al 2008).

Performing the MARM

In performing the MARM the examiner sits behind the subject and places their hands at the posterior and lateral aspect of their rib cage. The whole hand rests firmly and comfortably so as not to restrict breathing motion. The examiner's thumbs are approximately parallel to the spine, pointing vertically, and the hands are comfortably open with fingers spread so that the little fingers of both hands approach a horizontal orientation. The 4th and 5th fingers reach below the lower ribs so that they can feel abdominal expansion. With this particular hand position the examiner brings their attention to the breathing motion of the whole rib cage and abdomen in the lateral, vertical and anterior/posterior directions (see Fig. 6.5.2). An assessment is then made of the extent of overall vertical motion, relative to the overall lateral motion, in order to determine whether the motion is predominantly upper rib cage, lower rib cage/abdomen or relatively balanced.

Recording the MARM

The examiner then records the findings using two lines drawn in one half of a circle to form a pie chart (see

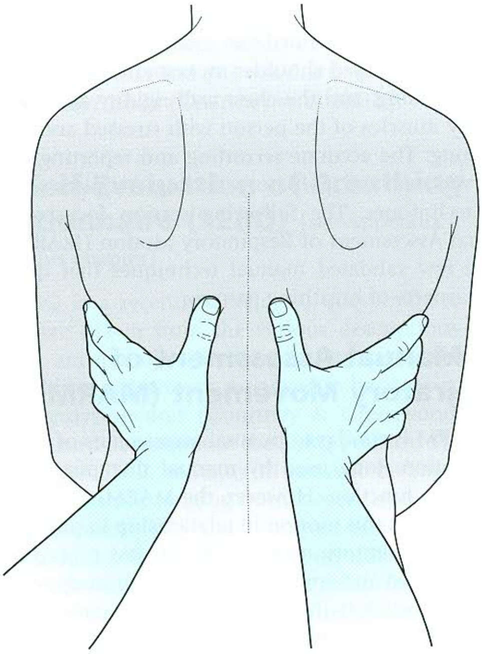

Figure 6.5.2 Performing the MARM.

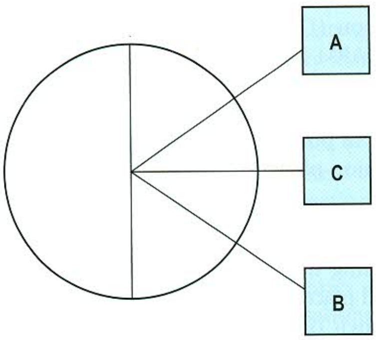

Figure 6.5.3 The MARM graphic notation. See text for explanation of lettering.

Fig. 6.5.3). The upper line (A in Fig. 6.5.3) represents motion occurring in the upper rib cage combined with extent of motion in the vertical direction. The lower line (B in Fig. 6.5.3) represents motion in the lower rib cage combined with extent of movement in the lateral direction for the rib cage and downward push of the diaphragm to the abdomen. In deciding where to put these two lines the examiner needs to keep in mind the global or spherical nature of breathing motion. A horizontal line (C in Fig. 6.5.3) represents the middle of this globe. The upper line will be further from the horizontal and closer to the top if there is more vertical and upper rib cage motion. The lower line will be further from the horizontal and closer to the bottom if there is more lateral and lower rib cage/abdomen motion. Finally the examiner can also report on their sense of the overall magnitude and freedom of rib cage motion by placing lines further apart to represent greater overall motion and closer for less motion.

Calculating MARM variables

MARM variables are calculated by measuring angles determined from the two lines drawn by examiners, with the top taken to be 180 degrees and the bottom at 0 degrees. An upper line (A) represents the 'highest point of inhalation' and is made by the examiner's perception and estimation of the relative contribution of upper rib cage, particularly the extent of vertical motion of the sternum and upper rib cage. The lower line (B) represents the 'lowest part of inhalation' and this corresponds to the examiner's perception and estimation of the relative contribution of lower rib motion and abdominal motion, particularly the extent of sideways and downward expansion. With more thoracic breathing the upper line A is placed higher and when breathing is more abdominal with greater involvement of the lower rib cage and abdominal cavity, line B is placed lower. Thus, two kinds of variables are derived: firstly, the distance between the two lines representing the extent or area of breathing movement. This can also be called 'volume' because it will increase when breathing is deeper and decreases when inhalation is shallower. However, absolute values of the MARM 'area' variable have little correlation with measures of tidal volume. More accurately it represents the extent or area of the trunk that is involved in breathing movement. The second set of MARM variables concerns the location of breathing on the vertical axis: upper body, middle or lower part. The two lines can be averaged, where an average value of 90 represents the middle position. Higher values represent more upper thoracic breathing and lower values represent more abdominal breathing. Two derivatives are firstly MARM 'balance' where the two parts above and below the midline are subtracted. A value of zero represents the middle position or perfect balance. A positive value indicates thoracic dominant breathing, a negative value representing less thoracic mobility and more diaphragmatic activity. The second derivative is percentage of rib cage motion, a measure that corresponds to one of the respiratory induction plethysmography (RIP) parameters. Both are linear transformations and express the location of breathing on a vertical axis.

The MARM measurement variables are:

1. Area = angle formed between upper line and lower line (area AB)

2. MARM average = (A + B)/2

2a) Balance = difference between angle made by horizontal axis (C) and upper line (A) and horizontal and lower line (AC-CB)

2b) Percent rib cage motion = area above horizontal/ total area between upper line and lower line × 100. (AC/AB×100)

The MARM and balanced breathing

It appears that functional breathing consists of a balance between upper and lower compartments of breathing. This would result in average values of 'percent rib cage' of around 50, of 'balance' of around zero and of 'average' of 90. The diaphragmatic, abdominal and rib cage muscles all have optimal length tension relationships and coordination patterns that make breathing most efficient when all muscle groups are equally involved (De Troyer and Estenne 1988). This suggests that 'optimal' breathing occurs when there is an even distribution of breathing effort between the two main functional compartments of the body involved in breathing, i.e. upper rib cage and lower rib cage/abdomen. Such a balance also provides the greatest flexibility of the respiratory system to respond to any internal or external alterations to respiratory drive. An uneven breathing distribution, without good reason, may be considered to be unnecessary, effortful and dysfunctional.

Using the MARM to assess functionality of breathing

An important assumption is that healthy functioning includes variability of biological systems, including respiration. So, functional breathing is responsive, variable and flexible (Dixhoorn van 2007). This can be tested by asking the patient to voluntarily change their breathing or by observing the changes in breathing that come about as posture changes (Courtney et al 2011b). For instance, the person can be asked to breathe normally and more deeply, to breathe with emphasis on upper thoracic or more abdominal inhalation, or to breathe in an upright or easy sitting posture. The position of the upper and lower lines of the MARM are then used to assess the range of responses. A larger range, calculated as the difference between the highest and the lowest value across the protocol, may then indicate greater functionality.

MARM testing protocol and normal values

Data on normal values are available from therapists, which can be compared to COPD patients and patients with stress and tension complaints (Table 6.5.1).

Table 6.5.1 MARM values for different groups

Category	MARM average	MARM area
Breathing therapists (n = 67)	90.5 ± 6.9	58 ± 15.8
Physiotherapists (n = 16)	90.8 ± 7.9	44 ± 10.7
COPD patients (n = 35)	103.2 ± 20.8	42.3 ± 17.9
Stress and tension patients (n = 62)	112 ± 10.2	20.4 ± 5.4

It appears that therapists indeed have average values of 90. The difference between experienced and non-experienced breathers does not lie in the average value, but in the area of breathing involvement. Experienced breathers show on average a larger area of involvement. As a rule of thumb, an average value of 90 and an area value of 60 appears to be more or less optimal.

By contrast, COPD patients have similar MARM area values as physiotherapists but their average MARM is higher, indicating more thoracic breathing. In particular, the standard deviation is much higher. This results from the fact that many have normal or even below normal values, whereas only a subgroup have high values. Thus, not all COPD patients show upper thoracic breathing and many handle their breathing problem adequately, when in an unchallenged situation. Moreover, the presence of high values and upper thoracic breathing appears unrelated to the severity of the COPD.

Patients with stress and tension however, do show an upper thoracic breathing pattern, with a small area of movement. The breathing movement is relatively restricted, indicated by the average value of the area of involvement (20.4) and the standard deviation, which are 2–3 times smaller than in all others. It implies that stress and anxiety result in a more or less homogeneous breathing pattern. Average MARM is markedly elevated, even in contrast to COPD patients. This confirms the idea that dysfunctional and thoracic-dominant breathing results more from stress and tension than from somatic causes. The cut-off value to differentiate normal from abnormal values can be calculated, using Jacobson's formula (Jacobson & Traux 1991), by comparing the breathing therapists to the stress patients. When average MARM value is 100 or higher, it can be classified as abnormal. For MARM area the cut-off value that indicates an abnormally small area of involvement is 30 or lower.

Using the MARM to assess other aspects of breathing

The MARM can be used to assess asymmetry between the two sides of the body. In case of scoliosis or sideways distortion of the spinal column there is a marked difference in breathing movement between the left and right sides of the body and this can be registered clearly by the examiner's two hands. Such asymmetry is unlikely to be adequately assessed by instrumentation such as RIP.

CONCLUSION

Breathing dysfunction is difficult to define precisely and cannot be assessed by one single measure. It involves breathing discomfort as well as inappropriate breathing movement. There can be a host of causes and it is sensitive to excess stress and tension. It can occur with and without somatic pathology and produces additional stress and tension, which aggravates symptoms. Three assessment procedures are presented. They are complementary to each other. Each of them indicates the presence of breathing dysfunction and is a reason to take further steps.

REFERENCES

Beach, D., Schwatrzstein, R.M., 2006. The genesis of breathlessness. In: Booth, S., Dudgeon, D. (Eds.), Dyspnoea in advanced disease: a guide to clinical management. Oxford University Press, Oxford.

Cahalin, L., Braga, M., Matsuo, Y., et al., 2002. Efficacy of diaphragmatic breathing in persons with chronic obstructive pulmonary disease. A review of the literature. Journal of Cardiopulmoary Rehabilitation 22, 7–21.

Courtney, R., Greenwood, K., Cohen, M., 2011a. Relationships between measures of dysfunctional breathing in a population with concerns about their breathing. Journal of Bodywork and Movement Therapies 15, 24–34.

Courtney, R., Greenwood, K.M., 2009. Preliminary investigation of a measure of dysfunctional breathing symptoms: the Self Evaluation of Breathing Questionnaire (SEBQ). International Journal of Osteopathic Medicine 12, 121–127.

Courtney, R., Van Dixhoorn, J., Cohen, M., 2008. Evaluation of breathing pattern. Comparison of a manual assessment of respiratory motion (MARM) and respiratory induction plethysmography. Applied Psychophysiology and Biofeedback 33, 91–100.

Courtney, R.C., Greenwood, K.M., Dixhoorn, J., et al., 2011b. Medically unexplained dyspnea partly moderated by dyfunctional (thoracic dominant) breathing pattern. Journal of Asthma 48, 259–265.

De Troyer, A., Estenne, M., 1988. Functional anatomy of the respiratory muscles. Clinics in Chest Medicine 9, 175–193.

Dixhoorn, J., 2012. Nijmegen Questionnaire in the evaluation of medically unexplained symptoms, including hyperventilation complaints. Biological Psychology *(in press)*.

Dixhoorn, J.V. 1994. Two year follow up of breathing pattern in cardiac patients. In: Proceedings 25th Annual meeting, Wheat Ridge, CO, USA. Association for Applied Psychophysiology and Biofeedback.

Dixhoorn Van, J., 2007. Whole-Body breathing: a systems perspective on respiratory retraining. In: Lehrer, P.M., Woolfolk, R.L., Sime, W.E. (Eds.), Principles and practice of stress management. Third ed. Guilford Press, New York.

Doorn, P., Folgering, H., Colla, P., 1983. Een vragenlijst voor hyperventilatieklachten. De Psycholoog 18, 573–577.

Elliot, M.W., Adams, L., Cockcroft, A., et al., 1991. The language of breathlessness: use of verbal descriptors by patients with cardiorespiratory disease. Am Rev Respiratory Diseases 144, 826–832.

Gevirtz, R. (Ed.), 2007. Psychophysiological perspectives on stress related and anxiety disorders. Guilford Press, New York.

Han, J., Stegen, K., Simkens, K., et al., 1997. Unsteadiness of breathing in patients with hyperventilation syndrome & anxiety disorders. Euro Respiratory Journal 10, 167–176.

Han, J., Zhu, Y., Li, S., et al., 2004. Medically unexplained dyspnea, psychological characteristics and role of breathing therapy. Chinese Medical Journal 117, 6–13.

Holloway, E., West, R.J., 2007. Integrated breathing and relaxation training (Papworth Method) for adults with asthma in primary care: a randomised controlled trial. Thorax 62, 1039–1042.

Hornsveld, H., Garssen, B., 1996. The low specificity of the hyperventilation test. Journal of Psychosomatic Research 41, 435–449.

Hornsveld, H.K., Garssen, B., 1997. Hyperventilation syndrome: an elegant but scientifically untenable concept. Neth J Med 50, 13–20.

Jacobson, N.S., Traux, P., 1991. Clinical significance: a statistical approach to defining meaningful change in psychotherapy research. J Consult Clin Psychol 59, 12–19.

Katsamanis, M., Lehrer, P.M., Escobar, J.I., et al., 2011. Psychophysiological treatment for patients with medically unexplained symptoms: a randomized controlled trial. Psychosomatics 52, 218–229.

Lansing, R.W., 2000. The perception of respiratory work and effort can be independent of the perception of air hunger. Am J Respir Crit Care Med 162, 1690–1696.

Lougheed, D., Fisher, T., O'Donnell, D., 2006. Dynamic hyperinflation during bronchoconstriction in asthma: implications for symptom perception. Chest 130, 1072–1081.

Mitchell, A., 2011. Test/retest reliability and determinants of the Self Evaluation of Breathing Questionnaire. Masters of Osteopathy Research, Unitec Institiute of Technology.

O'Donnell, D.E., Hong, H., Webb, K., 2000. Respiratory sensation during chest wall restriction and dead space loading in exercising men. Journal of Applied Physiology 88, 1859–1869.

Simon, P., Schwartzstein, M., 1990. Distinguishable types of dyspnea in patients with shortness of breath. Am Rev Respiratory Diseases 142, 1009–1014.

Simon, P., Schwartzstein, R., Weiss, J., et al., 1989. Distinguishable sensations of breathlessness induced in normal volunteers. Am Rev Respiratory Diseases 140, 1021–1027.

Thomas, M., Mckinley, R.K., Freeman, E., et al., 2005. The presence of dysfunctional breathing in adults with and without asthma. Prim Care Respir J. 14, 78–82.

Wilhelm, F.H., Gertivz, R., Roth, W., 2001. Respiratory dysregulation in anxiety, functional, cardiac, and pain disorders: assessment, phenomenology, and treatment. Behavioral Modification 25, 513–545.

APPENDIX 2 **The Self-Evaluation of Breathing Questionnaire**

Scoring this questionnaire: (0) never/not true at all; (1) occasionally/a bit true; (2) frequently/mostly true; and, (3) very frequently/very true

1) I get easily breathless out of proportion to my fitness	0	1	2	3
2) I notice myself breathing shallowly	0	1	2	3
3) I get short of breath reading and talking	0	1	2	3
4) I notice myself sighing	0	1	2	3
5) I notice myself yawning	0	1	2	3
6) I feel I cannot take a deep or satisfying breath	0	1	2	3
7) I notice that I am breathing irregularly	0	1	2	3
8) My breathing feels stuck or restricted	0	1	2	3
9) My ribcage feels tight and can't expand	0	1	2	3
10) I notice myself breathing quickly	0	1	2	3
11) I get breathless when I'm anxious	0	1	2	3
12) I find myself holding my breath	0	1	2	3
13) I feel breathless in association with other physical symptoms	0	1	2	3
14) I have trouble coordinating my breathing when speaking	0	1	2	3
15) I can't catch my breath	0	1	2	3
16) I feel that the air is stuffy, as if not enough air in the room	0	1	2	3
17) I get breathless even when resting	0	1	2	3
18) My breath feels like it does not go in all the way	0	1	2	3
19) My breath feels like it does not go out all the way	0	1	2	3
20) My breathing is heavy	0	1	2	3
21) I feel that I am breathing more	0	1	2	3
22) My breathing requires work	0	1	2	3
23) My breathing requires effort	0	1	2	3
24) I breathe through my mouth during the day	0	1	2	3
25) I breathe through my mouth at night while I sleep	0	1	2	3

Courtney, R., Greenwood, K.M., 2009. Preliminary investigation of a measure of dysfunctional breathing symptoms: the Self Evaluation of Breathing Questionnaire (SEBQ). International Journal of Osteopathic Medicine 12, 121–127.