

**A psychosomatic treatment model for patients presenting with symptoms of hyperventilation in the general hospital setting. A naturalistic study of effectiveness**

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**Abstract**

Psychiatric treatment often fails in dealing with a somatizing patient. Here we introduce a new psychosomatic treatment for patients with anxiety-related hyperventilation symptoms, developed in the general hospital setting. The model is based on psychophysiology of breathing, on psychodynamic theory of affect regulation with cognitive and psychoeducational elements, and on psychophysic breathing therapeutic methods. To meet the needs of a heterogeneous patient population, the model is stepwise and comprehensive. The core is a time-limited short-term therapy group, a "breathing school" in which breathing disturbances are (1) interpreted in terms of the psychophysiological etiology underlying the symptoms, (2) presented as the primary target of the therapy as well as a motivational factor to spur the patient to psychophysic therapy, and (3) introduced as an aid to enhance self-understanding and to experience mind-body relationships through observing of feelings and thoughts associated with changes of breathing. The effectiveness of the treatment was investigated in a consecutive sample of 64 patients who were first observed in the initial interview, then after attending breathing school, and finally at a half-year follow-up. Post-treatment decrease was observed in hyperventilation symptoms, general stress disorders and depression symptoms. Changes were statistically significant and were sustained at the six months follow-up.

## **Introduction**

The health care is faced with considerable problems caused by patients who recurrently seek medical help for somatic symptoms reflecting psychic stress. The differentiation of psychiatric and somatic diagnoses is often difficult because of the confounding of symptoms due to somatic diseases with those reflecting psychiatric disease, or distress which is expressed in somatic symptoms. The diagnostic problems may lead to costly medical testing, yet with little help to the patient. Quite on the contrary, long lasting testings often increase the stress of the patient. In the absence of overt anxiety, an imperative problem is how to motivate somatizing patients to undertake any of the available therapy modalities traditionally used in psychiatry and behavioral medicine, e.g. psychotropic medication and psychotherapy. Since many patients may be opposed to, or even hurt by the idea of being referred to a psychiatrist or psychologist, this poses a clinical dilemma. Other issues are how the nonpsychiatrist physician can identify the need for referral and how he can persuade the patient to agree to referral.

We believe that paying attention to psychophysiological disturbances of breathing offers a bridge for many somatizing patients motivating them to participate in psychosomatic diagnostic and treatment processes. In Eastern health practices, breathing exercises such as yoga have been practiced for thousands of years to promote psychophysic well-being and to heal illnesses (Chandra 1994). Breathing is a vital function which in many languages is denoted by words that also refer to the mind, e.g., the Greek word *psykhe* and the Latin word *spiritus*.

### *Physiology of normal breathing*

The main function of ventilation is to bring oxygen to the body and to rid the body of carbon dioxide. The process is primarily regulated by complex

physiologic mechanisms. Furthermore, the homeostatic process is sensitive to voluntary input via the cortex, and to emotional, unconsciously mediated input from the limbic system (Homma and Masaoka 1999). Speaking, too, overrides the chemical homeostatic regulation of breathing, and control of the flow and pressure of the expired air is a crucial factor in voice production (Pearce 1994). Whereas breathing is automatic and normally remains unrecognized, its rate, rhythm, and depth may to some extent be consciously altered. Breathing may be voluntarily interrupted for brief periods, as everybody knows. The possibility of becoming aware of one's breathing and to influence it psychologically or behaviorally is what makes breathing a remarkable therapeutic tool.

### *Physiology of hyperventilation*

Hyperventilation is one of the most widely used concepts in the psychosomatics of breathing, though attention has also been paid to the irregularity of breathing (Wilhelm et al 2001, Innocenti 2002). Physiologically hyperventilation is defined as ventilation in excess of momentary bodily demands. The physiology of hyperventilation (Weimann 1968, Lum 1976, 1994, Grossman 1983, Gardner et al 1986, Gardner 1996, Fried 1993, Folgering 1999) is, however, complicated because of homeostatic compensatory mechanisms and interactions of endocrine and autonomic nervous system functions. Immediate consequence of hyperventilation is hypocapnia, i.e., decrease of partial pressure of carbon dioxide, leading to respiratory alkalosis, and to compensatory physiological reactions. The main effects are mediated by vasoconstriction, concomitant decrease of blood flow (in skin, smooth muscles, brain and heart) and by increased neuronal transmission. Thus, in spite of the increased inhaling, the cells paradoxically suffer from lack of oxygen as a result of hyperventilation.

Yet another psychosomatic interactive mechanism is provided by muscle tension. Tensed muscles, skeletal as well as visceral, are often intertwined with hyperventilation as consequence of general arousal or/and via hyperexcitability of nerves due to hypocapnia (Folgering 1999, Schleifer et al. 2002). Further, stiffening of the abdominal and thoracic walls and of the

diaphragm itself hinders the movements of diaphragm which leads to upper chest breathing. Upper chest breathing increases the vulnerability to hyperventilation and may interact with precipitating psychological or physical stimuli to induce acute hyperventilation. (Lum 1976). Further, prolonged use of upper chest musculature in breathing may result to chest pain due to muscle tension and fatigue and also to i.a. chostochondritis, costosternal or costovertebral joint pain (Lum 1976, Innocenti 2002).

### *Diagnosing hyperventilation*

Hyperventilation is difficult to diagnose, especially in nonacute cases, as there is no generally accepted testing as pointed out by several authors (Howell 1997, Folgering 1999, Gardner 1996 and 2000, Innocenti 2002, Morgan 2002). A unitary testing procedure is probably even not possible because of the multifactorial character and complex systemic interactions of hyperventilation. Laboratory tests such as provocation to voluntary hyperventilation (van Dixhoorn and Duivendoorden 1985, Vansteenkiste and Rochette 1991) and orthostatic test, preferably combined with capnography and blood gas analysis, can be used to supplement standard somatic differential assessment such as history taking and diagnosing possible somatic diseases. In the provocation test, the resting PCO<sub>2</sub> level, the anamnestic symptoms, the recognition of anamnestic symptoms in the connection of voluntary overbreathing, and the time of recovery from the overbreathing are criteria used for diagnosing hyperventilation. As a self report questionnaire the Nijmegen Hyperventilation Inventory is widely used. Recent, more elaborated, testing procedures has been reported by Gardner (1996) and Folgering (1999).

The hyperventilation syndrome was introduced by Kerr et al (1937) to describe patients who had somatic symptoms due to hypocapnia and anxiety. The concept of a distinct hyperventilation syndrome has been criticized both on the grounds of experimental research (Hornsveld and Garssen et al 1997, Bass 1997) and on clinical grounds (Lum 1994, Gardner 1996). Apart from Hornsveld and Garssen, these authors emphasize the clinical significance of hyperventilation, but also underline its diversity. Lum uses the term

"hyperventilation syndromes" and Gardner "hyperventilation disorders" while Wilhelm et al. (2001) refer to "respiratory dysregulation" (in anxiety, functional cardiac and pain disorders), and Thomas et al (2002) to "dysfunctional breathing". Like Howell (1997), Folgering (1999) still uses the term hyperventilation syndrome, although re-defined so as to reconcile it with studies that do not show correlation between lowered partial pressure of carbon dioxide, hypocapnia, and symptoms. In his definition, the hyperventilation syndrome is "... dysregulation of ventilation, causing hypocapnia, in the absence of organic causes for hyperventilation, with symptoms and complaints not exclusively associated with the hypocapnia". As further pointed out by among others Folgering, the symptoms ascribed to the hyperventilation syndrome are aspecific and varying. In addition to those originating from hypocapnia induced by hyperventilation, symptoms may derive from other biological mechanisms, particularly from increased adrenergic tone. Likewise, symptoms may be affected by psychological mechanisms. The most direct results of hypocapnia (which can also be reproduced by voluntary hyperventilation) are cerebral symptoms such as dizziness and visual disturbances and paresthesias. Neuromuscular cramps may be induced by a more severe hypocapnic state (Weimann 1968). Folgering (1999) has assembled a list of symptoms associated with hyperventilation and their relative occurrence, presented in Table 1. The list is not complete. It lacks e.g. the common visual disturbance of blurred vision. We would also add that in our experience except of acute attacks the patients present themselves mostly as unusual calm.

--- Insert Table 1 ---

### *Hyperventilation and somatic diseases*

There are many ways in which hyperventilation may be linked to medical illnesses. Hyperventilation may be induced directly by biological mechanisms, for instance to compensate a metabolic imbalance in diabetic acidosis, indirectly via anxiety, or in response to pain (Wilhelm et al 2001). Hyperventilation may trigger or exacerbate attacks of asthma (Carr 1999,

Morgan 2002), chronic obstructive pulmonary disease (Dudley et al 1968), arrhythmia or ischemic heart disease (Weiner 1991, Wilhelm et al 2001), esophageal reflux (Lum 1976), irritable bowel syndrome (Ford et al 1995), balance disorders (Yardley and Redfern 2001), epilepsy (Mattson 1991), allergy or oversensitive reactions (Pearson 1988, Lum 1994, Longley et al 1997), vocal dysfunction (Pearce 1994), and musculoskeletal disorders (Monsen 1989, Innocenti 2002, Schleifer et al 2002).

Pain is naturally associated with many medical illnesses as well as with childbirth. Mothers' pain-related hyperventilation during the delivery may induce vasoconstriction in the uterine circulation. This can lead to asphyxia if the fetus is not well, or if placental function is poor (May and Elton 1998).

### *Hyperventilation and psychological functions*

The interrelations of hyperventilation to psychological functions are also complicated. Hyperventilation has been linked to strong emotions and action impulses by clinical observation (Groen 1982, Conway 1994, Zalidis 1994, Folgering 1999) and by experimental research (Dudley 1964). From the psychobiological point of view Cannon's old concept of fight or flight still offers a usable concept for understanding the biology and psychology of hyperventilation, as noted by many authors including Groen (1982) and Zalidis (1994). In a situation experienced as threatening, affects or affect precursors are triggered, the person becomes aroused and action impulses are generated. The organism prepares for increased energy production, i.a. by active or overactive ventilation. If motor action does occur, more carbon dioxide is produced in the muscles and the homeostasis of the acid-base balance is restored. However, if the person is not able to solve the situation by attenuating the affect by psychological processing or by appropriate coping behavior, the overactivation of the organism continues, leading to a hyperventilatory state.

Hyperventilation has still another function, as an anaesthetic influence which is congruent with the fight-flight idea (Hough 1992, Chandra 1994, and Wilhelm et al 2001). This type of hyperventilation is likely to be related to the anticipation, at the physiological level, of becoming injured or attacked

(Wilhelm et al 2001). Hyperventilation was formerly used for pain relief in connection of childbirth, but this practice has now been abandoned with increasing awareness of its otherwise detrimental effects. Chronic hyperventilation has been reported in pain patients in clinical praxis (Hough 1992) and in psychophysiological studies (summarized by Williams, 2001).

The circulus vitiosus of anxiety and hyperventilation is known at least since its description by Kerr et al (1937), although the original anxiety reaction triggering hyperventilation may not always be easily identified. Catastrophical interpretations of the physiologic symptoms of hyperventilation are thought to play a key role in cognitive behavioral theory of panic (Barlow 1997). From the psychodynamic point of view, the psychosomatics of hyperventilation has attracted only marginal attention.

#### *Hyperventilation in psychiatric diagnostics*

Psychiatry has paid only limited attention to breathing or hyperventilation. Whereas hyperventilation has usually been considered in the context of panic disorder, the generally accepted inference is that hyperventilation is neither necessarily involved in all panic attacks, nor does it necessarily lead to a panic attack (Garssen et al 1992, Bass 1997). There is, however considerable empirical evidence suggesting that many of the panic disorder patients have relative hypocapnia during baseline periods and that they recover more slowly from stressors such as carbon dioxide inhalation and hyperventilation provocation test (Gorman et al 2001, Wilhelm et al 2001). On the other hand, clinical observations suggest that hyperventilation may be present in a wide range of psychiatric disorders (Lum 1976, Fensterheim 1994), like anxiety does.

#### *Breathing in therapeutic approaches*

Quite detailed examples showing how a physiotherapist may work with a hyperventilating patient was presented by Holloway (1994) and Innocenti (2002). The patient is informed about hyperventilation and shown how to

recognize the maladaptive breathing pattern and how to consciously convert to a slow, rhythmic diaphragmatic-abdominal pattern. Innocenti emphasizes that the changes have to be made by the patient himself, from within, guided carefully by the therapist. The goal is that the learned pattern should in time become automatic. Emphasis is put on the appropriateness of the air inhaled to the metabolic rate needed for actual function. Patients are also taught to recognize stress and tension in body and mind and offered relaxation training. A detailed description of biofeedback using capnometry to achieve normal PCO<sub>2</sub> levels is to be found in Fried (1993) where the psychophysiology of hyperventilation is also extensively presented.

In somatic medicine, the foremost applications of breathing therapy are in pulmonary diseases. Patients with asthma and symptoms suggesting dysfunctional breathing were observed in the study by Thomas et al (2003). The quality of life was improved and the symptoms suggesting dysfunctional breathing were diminished significantly in half of the patients following a brief breathing physiotherapy intervention carried out according to Innocenti (2002). However, the clinically relevant improvements were maintained in only a quarter of these patients at a 6-month follow-up. Other applications within somatic care are in myocardial infarction (van Dixhoorn and Duivenvoorden 1999) and in preoperative intervention for pain reduction and mobility improving (Heye et al 2002).

Systematic psychophysiologic studies of breathing therapies, either traditional physiotherapy or biofeedback-assisted, in general medical and in patients with symptoms of anxiety and hyperventilation have been reviewed by Wilhelm et al (2001). In these approaches, the goal was to re-establish normal partial pressure of carbon dioxide. In addition to the increased PCO<sub>2</sub> levels, decreased respiratory rates were noted in these studies as well as overall relief of anxiety in some of the studies. In one study of patients with hyperventilation and associated functional cardiac symptoms, the frequency of cardiac symptoms was reduced in addition to the normalizing of the physiological breathing parameters in the 3-year follow-up (DeGuire et al 1996). Studies by Garssen et al (1992) and Han et al (1996) showed that breathing frequency was reduced along with decreasing of anxiety after retraining, although hyperventilation-induced hypocapnia was not affected,

except in young women, in the study of Han et al.(1996). In the studies by Garssen and Han the usefulness of breathing retraining is thought to be associated with relaxation and increasing sense of mastery in difficult situations. Concentrating on breathing makes it easier to distract one's thoughts from other symptoms.

A group treatment for patients with panic disorder, or panic disorder with agoraphobia, that concentrates on the hyperventilation syndrome as the primary target for treatment has been described by Fensterheim and Wiegand (1991). The authors emphasize the usual benefits of the group sharing of suffering and coping, as relevant additions to the hyperventilation therapies. Although no systematic outcome data were provided, the authors consider the group treatment to be encouraging.

Breathing retraining is a central element in cognitive-behavioral therapy models of panic disorder (Barlow 1997). Similar to the psychophysiological approach, faulty interpretations of symptoms and sensations due to hyperventilation and arousal are identified in the cognitive behavioral treatment. To minimize bodily alarm reactions, conditioned interoceptive reacting is extinguished by exposure training. Similarly to psychophysiological and physiotherapeutic approaches patients are also taught diaphragmatic breathing.

Changes of breathing are observed and breathing exercises are practiced in most western relaxation and hypnosis techniques (Lehrer and Woolfolk 1994) as well as in mindfulness meditation (Reibell et al 2001). Mindfulness meditation is an integral part of the well established stress reduction therapy model which has been used and investigated in heterogenous medical and psychiatric patient populations. Relaxation training is also part of many cognitive-behavioral individual and group therapy models for somatization and symptom syndromes like tension headache and irritable bowel syndrome (Kroenke and Swindle 2000). Many psychosocial or psychophysic treatment models applied in the care of somatizing or somatically ill patients in fact utilize a synthesis of behavioral, cognitive, psychophysiological and, less often of psychodynamic, approaches and techniques.

In the psychodynamic physiotherapies (Monsen 1989, Proskauer 1994) and body oriented psychotherapies (Downing 1996, Mehling 2001) there are

schools with slightly different emphases. Generally, however, the goal is more than just to teach proper breathing and to reduce the symptoms due to irregular breathing. Rather, the ultimate aim is to help the patient to identify, verbalize and elaborate psychically tensions which initially have been experienced as somatic symptoms only. The psychological theoretical basis is essentially psychodynamic in these modes of therapy. These breathing therapies start by developing an increased and differentiated perception and accepting awareness of the body's physical sensations and especially as they are related to the individual's breathing. The goal is to gain an integrated sense of self, based on the understanding of "the inseparable personal, physical, and psychological qualities of the individual" (Mehling 2001). Breathing therapy has a long history in Central Europe, though until recently outside the academic field. Systematic studies of their effectiveness are just beginning to be published, e.g. the study by Aust and Fischer (1997) of the effect of breathing therapy to body equilibrium. According to a survey (Mehling 2001) among breath therapists in Germany, breathing therapy is applied in a wide range of psychiatric disorders as well as in psychosomatic and somatic pain treatment, e.g. relief in back pain, and in preparation for childbirth.

Psychosomatic treatment models with initial focus on hyperventilation have been used and described by Kerr et al (1937), Lum (1976), Tessman and Möhlenkamp (1979), Paulley (1990), Pinney et al (1987), Zalidis(1994), and Homnick and Pratt (2000). In these models, suitable for patients presenting symptoms of hyperventilation in general practice or somatic health care, the primary physician explains to the patient the pathophysiological mechanism of hyperventilation and its symptoms as well as the possible role of psychic stress in triggering the hyperventilation. Breathing therapy is carried out either by the physician himself, by a physical therapist, or by a specially trained nurse. Psychotherapeutic elements, psychodynamically and/or cognitively based, are embedded in these approaches.

The treatment model developed by us is based on the psychophysiology of breathing, psychodynamic theory of affect regulation with cognitive and psychoeducational elements, and on psychophysic breathing therapeutic methods resembling those used in psychodynamic physiotherapy and body oriented psychotherapies. The model is designed for patients with symptoms

of hyperventilation whose psychiatric diagnoses conform to the diagnostic criteria of one or several anxiety disorders, mostly panic, panic with agoraphobia, social phobia or generalized anxiety disorder, allowing comorbid depression diagnoses (Lehtinen et al 1998). The model has been in clinical use continuously since 1985. Whereas the symptoms of hyperventilation constitute the first target for intervention in our approach, the core of the treatment model is a short term time-limited psychophysic therapy group which we call “breathing school”. To date, some 650 patients have attended the breathing school. The purpose of this article is to describe the treatment model and to evaluate its effectiveness in a naturalistic study design.

### **Treatment model**

Figure 1 describes the comprehensive and stepwise process of our treatment model. By comprehensive we mean that an overall psychiatric diagnosis is made, and that the patient is treated according to his needs including additional medical investigation if warranted, even if he is not attending the breathing school. All patients are initially assessed for psychotropic medication and also later during the treatment process whenever appropriate. At each step of the treatment process, the patient is referred to the form of therapy most suitable to him.

---Insert Figure 1---

#### *Somatic screening and referral to psychosomatic consultation.*

After somatic screening, the psychophysiological mechanism of hyperventilation is explained to the patient by the medical specialist. The role of stress as a possible precipitating factor is emphasized. The patient is referred to a psychosomatic/psychiatric consultation.

#### *Psychosomatic/psychiatric consultation.*

The consultation starts out by exhaustively addressing the symptoms which brought the patient to the somatic investigations. The pathophysiologic mechanism of hyperventilation is reviewed and explained, again with particular emphasis laid on the role of stress as a common precipitating factor. A preliminary psychiatric diagnosis is made. Empathetic attention is given to the distress that the patient feels about his health and about losing control of his vital functions. If the patient does not seem to be properly concerned about his/her health, such concerns are encouraged. The situations, thoughts and affects preceding and surrounding the first and any subsequent somatic symptoms are explored, including related changes in breathing noticed by the patient. We also note whether the patient has been able to mitigate or prevent the worsening of the symptoms on his own, for example through relaxed breathing, by pacifying thoughts and mental images, or by analyzing the precipitating factors.

The present life circumstances and stress factors in the patient's life history are reviewed including, of course, past and previous somatic and psychic illnesses. We explore life experiences with particular reference to the personal significance attached to each experience, especially any threatening aspects which may result in hyperventilation or in otherwise dysfunctional breathing. When enough material has been accumulated, a hypothesis about the precipitating factors and affects triggering the symptoms is suggested to the patient, provided that he is ready for it. If the patient is not aware of any precipitating factors, we explain that this is common because of the unconscious nature of the mental processes. The functioning of the mind and the body-mind interrelationships are repeatedly explained to the patient throughout the assessment and treatment. This is done in a non-normative atmosphere, leaving it up to the patient whether to use the information or not. The patient is actively encouraged to attend the individual assessment sessions with the breathing school therapist.

#### *Therapist assessment for breathing*

Assessment consists of two separate sessions in which the therapist

observes the patient's mode of breathing (rapid/slow, regular/irregular, upper chest/diaphragmatic), tension of respiratory muscles, ability to tolerate closeness and being touched, and ability to use imagery. She also listens to the patient's narrative account of what brought him to ask for help. Life history and present life situation are covered to the extent that they naturally come up in the session. The therapist seeks to conduct the assessment in cooperation with the patient in an observant and non-directive manner. Avoiding explicit statements as to whether the way the patient breathes is right or wrong, the therapist does advise the patient how to change his breathing and how to relax. The patient is also given written material about breathing and stress. The reaction of the patient to the first session helps evaluate whether or not this treatment approach is appropriate for him.

### *Breathing school*

The breathing school consists of 12 weekly group sessions. During the first two sessions, the patients are familiarized with the working principles. They are then offered to accept a contract of participation for the remaining sessions. Each group has between five and ten participants. The group members in the present study were alike, within feasible limits, in terms of age, sex, and severity of the symptoms.

The first sessions consist of breathing and relaxation exercises and seek to generate interest in the role of the inner, psychic world, and in bodily experiencing. Another initial goal is to help the patients find first-aid measures such as relaxed diaphragmatic breathing and pacifying attitudes like "just keep breathing whatever happens." The patients are encouraged to find measures best suited for their personal needs.

Learning to perceive physical sensations is essential, especially to increase body awareness related to breathing. Some breathing school patients may not at first be able to tell even the difference between inhaling and exhaling. Later they can use their increased perceptive abilities to find associations between modes of breathing, muscle tensions and affects. By means of combined breathing and relaxation exercises some patients even reach "state of being" (Winnicott 1965) where he/she can observe and integrate mental images with his bodily reactions. The patients are encouraged to find fantasies relating to vocalizations, words, and bodily sensations linked to various modes of breathing. Awareness of one's own

experiences, attitudes and existence in general is emphasized as well as awareness of one's boundaries with other people. Bodily exercises are often employed in interaction with another patient. These serve as "here and now" material in the psychotherapeutic process. Methods typical of short-term psychodynamic psychotherapy are applied along with psychodynamic group therapy techniques (Mackenzie 1965) wherever possible, depending on the reflective ability of the members of each group.

#### *Additional treatment during breathing school*

Sessions related to medicine prescription, individual psychotherapy sessions, sometimes couple therapy, are made available according to the needs of each patient both before and during the breathing school treatment.

#### *Assessment of the results of the breathing school with the breathing school therapist*

The therapist meets each patient in a separate session at the end of breathing school as well as delivers feedback to the referring psychologist or psychiatrist. Her report outlines the observed changes in the patient's breathing, comments about his psychic resources and eventual psychopathology, personality, observations on the quality of his interactions in the group, and possible suggestions for further care.

#### *Reviewing the experiences of the breathing school and assessing the need for further treatment*

During the final feedback session, the psychologist/psychiatrist and the patient review the his/her experiences of the breathing school and assess the need of further treatment. Further therapy may be may recommended in the form of individual psychophysic therapy, dynamic or cognitive psychotherapy (individual or group therapy), supportive contact therapy, physiotherapy to chronically tensed muscles, or mainly medication. Psychotherapeutic treatment is recommended on clinical grounds, taking into consideration existing psychological and situational barriers.

### **An empirical study**

A naturalistic study was conducted in which the patients were systematically assessed and the effectiveness of our treatment model was evaluated.

#### *The research patients*

The patients had initially referred to the somatic departments of the Turku University Hospital for somatic diagnostic investigations and subsequently to the Psychiatric Outpatient Clinic for psychiatric assessment and short term care. They were sent for breathing school assessment either primarily, or because of symptoms resembling hyperventilation and not entirely explainable by somatic diseases. The research protocol was approved by the Research Ethics Committee of Turku University Central Hospital. All of the potential participants were examined by one of the present authors (PL or SL). Based either on the formal referral or the first interview, patients with acute crises, suicidality, acute psychosis, substance abuse, severe personality disorder, or total disinterest in breathing therapy were excluded. The present study is based on data of the 64 patients who were selected among 116 consecutive patients interviewed for breathing school during the time period 5/96-2/98. The patient selection is described in Figure 2.

--- Insert Figure 2 ---

#### *Procedure*

All patients received the standard treatment as described above. The study design is presented in Figure 3.

--Insert Figure 3 --

In the first visit to the Outpatient Clinic of Psychiatry the 64 research patients were interviewed, and the patients filled in the self report questionnaires. The same was repeated after the breathing school and in the six-month follow-up. Thirty of the 64 patients were obliged to wait for admittance to the breathing school for more than one and half months. These

patients submitted another set of self reports also at the start of the breathing school. This group was examined in order to get an idea about the effects of the initial interview, the assessment sessions with the breathing school therapist, and the expectancies linked to the imminent therapy.

### *Clinical interviews*

The clinical interviews were conducted by one of the present authors (PL or SL) as described in connection with the treatment model. The psychiatric diagnoses were made according to DSM IV. Separate clinical assessments were drawn up by the interviewers. These were jointly reviewed to achieve consensus.

Awareness of any problems or irregularities in breathing and the ability to relieve symptoms by altering ways to breath or by psychic means was explored with the patient. Initially and at the follow-up, the researchers explored whether a precipitating psychosocial or other factor could be found, and also probed the patient's own awareness of any particular cause or situation that might have triggered the hyperventilation symptoms. Attitude toward psychotropic medication was rated by the patients at a 5-point scale in the interview.

### *Self-report measures*

At each assessment, the patients completed the Nijmegen Hyperventilation Symptom Inventory (van Dixhoorn J, Duivendoorden 1985, the BSI-53 Brief Symptom Inventory (Derogatis and Melisaratos 1983) for general distress symptoms, and the 21-item Beck Depression Inventory (Beck 1961).

### *Assessing hyperventilation*

Patients with self reported anamnestic symptoms suggesting hyperventilation were admitted to our treatment. Available corroborating data recorded in the clinical case histories were noted.

### *Breathing school*

All breathing schools were carried out by one of the present authors (MS) who was primarily responsible for the development of the treatment techniques and underlying theoretical concepts.

### **Statistical analysis of the self-report measures**

Analysis of variance for repeated measures was applied to the pre- and postintervention data to estimate the statistical significance of the observed changes. Changes taking place from the initial interview to the end of breathing school and between the end of breathing school and follow-up were examined in all 64 patients. The mean waiting time from the initial interview to the group to start was 72 days (Md 70 days, range 4-365 days). Additional comparisons were made for the 30 patients who had to wait for treatment and who completed the questionnaires again at the start of the breathing school. Their mean waiting time was 105 days (Md 92 days, range 45-365 days). The changes between their initial interviews and those conducted at the start of breathing school, and the changes between those obtained at the start and end of breathing school were analyzed.

Post-hoc comparisons t-tests with Bonferroni corrections were used. Dependent variables were square root transformed to satisfy required assumptions for normality. To test whether the duration of the symptoms reported in the initial interview affected outcomes, irrespective of the patient's age, appropriate change scores were calculated for the self reports and analyzed by a repeated-measures variance analysis with age as a covariate. The SAS System for Windows, (Release 8.02/2001) was used in all analyses.

### **Results**

47 of our patients were women and 17 were men. Their age ranged from 18 to 69 years with a median age of 43.5 years. Mean age was  $42.5 \pm 12.2$  years (SD). The demographic characteristics of the patients are presented in detail in Table 2.

--- Insert Table 2 ---

### *Medical and psychiatric characteristics*

The medical and psychiatric characteristics of the patients are given in Table 3. The mean duration of the hyperventilation symptoms reported by the patients was 5 years 10 months, SD  $\pm 7$  years 5 months, median 2 years 6 months, range 1 month – 40 years. The diagnosed somatic diseases among the patients were: allergy 12 (19%), asthma 7 (11%), other pulmonary disease 5 (8%), sleep apnea 6 (9%), endocrinologic or metabolic disease 6 (9%), coronary disease 4 (6%), other vascular disease 7 (11%), and gastro-esophageal reflux 5 (8%).

Corroborating data for hyperventilation were present in 60 patients, while four cases had anamnestic symptoms only. Clinical observations of hyperventilation at any time during the investigation were recorded in 24 cases. The blood-gas analysis was made in seven patients, in all cases positive for hyperventilation. The voluntary hyperventilation test was administered to 56 patients according to the clinical routines of the hospital physiological laboratory. The findings were interpreted according to the criteria laid out by Vansteenkiste and Rochette (1991). The test was assessed as positive or probable for hyperventilation in 52/56 cases. When asked at the baseline interview, 50 patients reported some problematic breathing and 18 had been able to relieve some of their symptoms by conscious modification of their breathing, and 18 by psychic means.

--- Insert Table 3 ---

### *Self-reports*

The mean scores and the results of the analyses of variance of the 64 research patients on the Nijmegen Hyperventilation Inventory (HYP), the Brief Symptom Inventory (BSI 53) and the Depression Inventory (BDI) are

presented in Table 4 obtained in the initial interview, after the breathing school, and at the six-month follow-up.

--- Insert Table 4 ---

The mean scores and the results of post-hoc t-tests of the 30 patients, who also filled the questionnaires at the start of the breathing school, are given in Table 5.

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On the average, the symptoms of hyperventilation, general distress symptoms, and the depression symptoms were significantly reduced after the breathing school. These decreases were sustained at the six months follow-up. When the patients were examined individually at the end of the breathing school, the symptoms of hyperventilation were decreased (compared to the initial interview) in 57 patients, the general distress symptoms in 43 patients (in two patients remaining unchanged), and depression symptoms in 47 (in five unchanged). At the follow-up, compared to the initial interview, fewer hyperventilation symptoms were reported by 50 patients (two unchanged), fewer distress symptoms by 49 patients (one unchanged), fewer depression symptoms by 42 patients (three unchanged).

In order to gauge the extent to which the magnitude of changes in the reported symptoms was affected by age, the patients were divided into an older group (age > 45 years) and a younger group (< 45 years). A significant interactive effect of dichotomized age was found in the general distress scores ( $F(2,124) = 4.60, P < .05$ ) but only a marginally significant interaction of age with the hyperventilation scores ( $F(2,124) = 2.73, P = .07$ ). Changes were greater in younger patients for both distress and hyperventilation. The depression scores were unrelated to patient age.

In the group as a whole the duration of the symptoms of hyperventilation was inversely related to magnitude of changes in general distress ( $F(2,124) = 6.01, P > 0.01$ ) as well as depression scores ( $F(2,124) = 6.32, P < 0.01$ ) but not significantly related to the decrease of the hyperventilation symptoms

( $F(2,124)=2.29, P=0.11$ ). Repeated-measures analyses of covariance with age indicated that changes in general distress were significantly related to the pre-treatment duration of hyperventilation symptoms ( $F(2,124)=6.01, P < 0.01$ ). Thus, more relief from the general distress was reported by patients with a shorter history of symptoms, irrespective of age. This was also case for depression symptoms ( $F(2,124)=6.32, P < 0.01$ ) but not for the hyperventilation symptoms ( $F(2,124)=2.29, P=0.11$ ).

At the group level psychiatric main diagnosis, presence of a somatic diagnosis, regular psychotropic medication or individual psychotherapy at any phase of the study were not associated to the outcome in the analysis of variance for repeated measures.

Attitudes toward psychotropic medication at the baseline were positive or curious in 18, neutral in 8 and reserved or negative in 38 cases. At the follow-up 24 patients reported positive or curious attitudes. Reserved or negative attitudes were reported by 33 patients and neutral by 7 patients. A precipitating psychosocial factor could be traced in 55 patients: stress in work or studies (19), stress in couple relation (4), illness or death of a family member (10), own somatic illness (11), and other causes 11 cases. In 9 patients the precipitating cause could not be traced. Thirty seven patients got in touch with emotions and thoughts preceding the occurrence of symptoms and 24 got in touch at a more superficial level referring e.g. to stress. Three patients did not get any contact to their affects or precipitating psychosocial factors.

## **Discussion**

### *Quantitative results*

The use of hyperventilation as an intervention target resulted not only in substantially decreased hyperventilation symptoms but also in significantly reduced general distress and depression. The relieving of the symptoms was sustained at the 6 months follow-up.

Nearly all participants gained some understanding of the psychosocial factors underlying their complaints, only three did not. Problems related to

work or studies, illness (own or family member), or death in the family were most often brought up as the precipitating psychosocial factors.

Our clinical experience suggests that patients benefited from treatment in different ways. Some patients simply acquired a first-aid method to master difficult situations while other patients - perhaps at the beginning the treatment not at all "psychologically minded" - got in touch with their feelings. Data were collected also about changes of the patients' awareness of the bodily sensations, especially of the breathing, mind-body relationships and of using breathing as a coping means in stressing situations. These data will be reported in a separate article.

The shorter history of hyperventilation symptoms (when the age was standardized) was related to the reduction of general distress and depression symptoms but only very marginally to the relief from hyperventilation symptoms. Thus, even elderly patients with long history of hyperventilation symptoms may benefit of our treatment.

Whereas treatment outcome was explored as a function of psychiatric main diagnosis, coexistent somatic diagnosis, regular psychotropic medication, and individual psychotherapy during the study, none of these factors were significantly predictive of the outcome at the group level, although positive effects of medication and/or additional psychotherapy were found in some patients when the data were explored individually. We also consider it a positive outcome that some patients entered further treatment as they became more aware of their psychic and psychosomatic problems and symptoms.

There was not either any statistically significant difference between those who had regular psychotropic medication, in the majority antidepressive only or together with anxiolytic medication. Many of our patients had negative attitudes toward psychotropic medication despite having resorted to their use. According to Milrod and Bush (1998), and to our experience, reluctance to take psychotropic medication may be related to realistic fear of side effects or to psychologically based fears. Further, many patients prefer doing something within their own control and to be able to relieve anxiety by one's own means and thus to increase their self confidence. However, our treatment had positive effects also in those using medication.

### *Diagnosing hyperventilation*

In our research patients corroborating data for hyperventilation in addition to anamnestic symptoms were obtained in 60 out of 64 patients. The diagnosis of hyperventilation is often either dismissed or considered relatively harmless, needing no further attention. The lack of clearly interpretable laboratory tests, which are the usual prerequisite for a diagnosis in medicine, is a significant problem as is the difficulty of finding a diagnostic label or description to patients who suffer of hyperventilation. Like Gardner (1996) and Folgering (1999), we take a positive hyperventilation test to mean a heightened probability that the patient is prone to hyperventilate also outside the laboratory, while negative test results do not exclude that possibility. Adhering to strict diagnostic criteria for hyperventilation would probably result in the exclusion of many patients who would benefit from our treatment. We do not know how often that happened in our potential patient population because of relevant information was missing.

On the other hand, the fear of missing a somatic diagnosis may be a significant reason why psychophysiological hyperventilation may not be recognized as such. Hyperventilation can be intertwined with somatic diseases in many ways and its symptoms overlap with numerous medical diseases. Good teamwork between the psychiatric and somatic specialists is therefore important. It also helps motivating the patient for referral and for psychophysic treatment.

### *Psychiatric diagnostics*

A psychiatric diagnosis could be made for all of the research patients. Most had no previous psychiatric assessment or diagnosis, nor had there been any clarifying of the psychodynamics or surrounding psychosocial circumstances underlying the occurrence of the symptoms. The majority of the patients (67 %) were diagnosed with panic disorder, or panic disorder with agoraphobia. Their psychiatric disease picture was, however, not clear-cut. In the attacks, the patients emphasized the fears of somatic illness rather than the feeling of panic. Comorbidity included 6 cases of major depression and 14 of dysthymia.

Six patients reporting dyspnoea as the major and almost only symptom received the diagnosis of undifferentiated somatoform disorder.

### *Hyperventilation and psychological functions*

Another reason why patients with hyperventilation-related symptoms may not be referred to psychosomatic/psychiatric consultation is that they may not necessarily be overtly anxious, nor may they present with psychological problems. Understanding the psychodynamics of hyperventilation and the personality of individuals prone to hyperventilate helps to explain why they do not express their psychic problems or symptoms, and do not seek psychological or psychopharmacological help very easily, accepting only strictly medical help.

Like Lum (1976), we consider hyperventilation to be an initial, indiscriminate anxiety-equivalent response to a noxious stimulus, whether physical or psychological. In people who recognize the source and meaning of their affects, the emotion runs its short lived course (Zalidis 1994) and so does hyperventilation. Many psychological characteristics of somatization described by McDougall (1989) and Bagby and Taylor (1997) apply equally well to hyperventilation. Anyone may hyperventilate momentarily when the mind is flooded with overwhelming affects and as the consequence the ability to process affects mentally is impaired. If hyperventilation continues it may assume various functions. Thus, it may persist as a somatized equivalent of anxiety, or it may acquire various symbolic meanings and become a hysteric/dissociated symptom like any somatic symptom may. It is not uncommon for hyperventilation to serve as a defense mechanism against forbidden and shameful affects, used both unconsciously and deliberately (Horowitz 1967, Groen 1982, Folgering 1999).

More prone to hyperventilate are persons (Lum 1976, Tessman and Möhlenkamp 1979, Groen 1982, Conway 1994, Zalidis 1994) who are generally inhibited in their expression, less skilled in the processing of their affects, and prone to use rigid defenses. These individuals may experience emotions in general as shameful and forbidden, aggressive feelings in particular. Lacking assertiveness, they find it hard to say “no” to maintain their

own psychological boundaries and often overwork to please other people. The concept of alexithymia applies well these persons. Alexithymia, presently defined (Bagby and Taylor 1997) as composing of the following salient features, i.e. of difficulty identifying feelings, of distinguishing between feelings and the bodily sensations of emotional arousal, of difficulty describing feelings to other people, and of stimulus-bound, externally oriented cognitive style, is applicable to characterize many hyperventilating persons.

The interaction of personality and somatic aspects of breathing comes true also in the twofold meaning of the “breathing space”. The space in the body one uses while breathing corresponds also symbolically to the space one takes for one’s actions and thoughts in relations to other people (Lowen 1969, Markovitz 1969). In experimental research, the strength of the ego has been found to correlate positively with low breathing frequency and large amplitude (Grossman 1983).

Rigid defences and/or deficiency of experiencing and naming affects impede experiencing emerging anxiety which would forewarn the person about impending psychic threat. An early alert could lead to psychological processing of the threatening affect, or to actions for removing the threat. Some hyperventilating persons may typically have overwhelmingly strong affects, so that both affects and hyperventilation may co-exist (Zalidis 1994). This may be the case in personality disorder patients.

However, what looks like alexithymic may also be iatrogenic, either reflecting the characteristics of the physician or the nature of the health care system. An international multicenter study exploring the presentation of psychological versus somatic symptoms of depression found that the patients more often articulated their psychological symptoms of depression (Simon 1999) in the centers offering more personal care. In our clinical experience the same is true for anxiety. Some of the patients who originally have presented in the health care with somatic symptoms exclusively are quite ready to explore their psychic problems and psychosocial stress factors when encouraged to do so.

An important aspect of the mind-body relationship of hyperventilation is its role in conditioning. As a frightening and confusing experience involving many interoceptive cues, hyperventilation easily becomes conditioned and

symptoms of hyperventilation may then be experienced without the actual hypocapnic state. Hyperventilation may thus play an important role in the establishment of panic disorder and in the reinforcement of phobias (Lum 1976, Groen 1982, Fensterheim 1994, Ley 1999, Howell 1997, Folgering 1999). Conditioning may also explain why some patients have a physiological or behavioral hyperventilatory pattern related to other organic diseases even after the original disease has resolved (Innocenti 2002).

### *Treatment model*

In contrast to the normally quite long delays after which somatizing patients are referred to psychological treatment, some of our patients entered treatment reasonably early as indicated by the median duration of hyperventilation symptoms, two and half years.

Attending to disordered breathing as the first target for intervention makes it possible for many patients, who would not otherwise accept even psychiatric/psychosomatic consultation, to get assessment and help. This is ensured, also for patients for whom the breathing school is not considered to be useful.

In our model the patient is gradually guided to understand body-mind relationships and psychological problems underlying the somatic symptoms. The stepwise nature and a rather long time span of our “treatment package” helps individual patients (and their therapist) find the treatment mode best suited to their needs. Identifying psychic problems underlying the psychosomatic symptoms to the extent needed for sound treatment recommendations is often time-consuming and requires preliminary therapeutic work without a need to commit.

The results observed in the 30 patients from the waiting list, who initially filled out two sets of self reports, suggest that the hyperventilation symptoms were already somewhat reduced as the result of the preliminary stages of intervention and were further decreased as the result of the breathing school. The general distress showed the same tendency, although less marked. Statistically significant reduction of depression symptoms was, however, seen only after the breathing school. These results are in accordance with our aim to

utilize the assessment sessions as mini-interventions. These 30 patients also served as an expediency control group for waiting list experience. A randomized control group for waiting effect was not regarded as ethical and would not have been scientifically rational since the patient selection to breathing school is a stepwise process based on individual assessment.

### *Breathing school*

In the breathing school, mastery of first-aid measures to cope with anxiety is learned along with ways to decrease anxiety by psychic work. Throughout the treatment, the acquisition of observational skills is emphasized. Being able to differentiate between various bodily sensations and reactions, and experiencing their relation to affects, relieves anxiety arising from unaccountable bodily sensations and symptoms. Learning to seek affects and thoughts preceding alterations in breathing, instead of getting more anxious about altered breathing and associated somatic symptoms, attenuates anxiety, but also paves the way to deeper self understanding. Although the theoretical basis of our treatment is mostly psychodynamic, there are many features in common with cognitive behavioral breathing therapies such as emphasizing relaxing, increasing sense of mastery in difficult situations as well as concentrating on breathing as a means to help cope with anxiety-arousing symptoms (Garssen 1992).

The group format of the treatment i.e. breathing school, has appeared to be very important. Although many are initially distrustful of other patients, the group has in the end provided support, and encouragement, and imparted a feeling of not being alone with strange symptoms. The group treatment is, of course, also economical.

### *Other applications inspired by the breathing school experience*

Psychophysics breathing therapy as part of the treatment may be used in many areas of somatic health care and rehabilitation. For instance we have adopted, with very encouraging results, principles of psychophysics breathing therapy as part of delivery preparation of mothers who are afraid of the

delivery. For depressive, middle aged women with long illness histories (including both somatizing and somatic illness) who did benefit from attending breathing school, but still needed further care, we developed a group psychotherapy in which various creative methods were also used (Lehtinen et al 2001). Further, for patients with pain as a target symptom, a group treatment consisting of 30 sessions has been initiated in which many of the principles and techniques developed in the breathing school approach have been integrated. These represent a few of several applications introduced by therapists with training in the theoretical framework and practical techniques of the breathing school as described above.

### *Conclusion*

The physiology of hyperventilation gives our breathing therapy model a solid basis in biomedicine. Hyperventilation is, however, a very complex phenomenon physiologically as well as psychologically. Thus, the way hyperventilation affects the individual patient needs to be examined in detail considering the initiating and sustaining somatic and psychic processes (Fensterheim 1994, Bass 1997, and Gardner 1996 and 2000).

Our treatment model is well suited to the general hospital outpatient setting. Because hyperventilation produces symptoms in various organ systems, patients from many specialties may benefit from this treatment which is easily accessed. An important factor is also the available somatic back up. In our hospital our treatment model has become quite well accepted by the nonpsychiatric physicians as well as by the patients themselves. Initial focus on the somatic symptoms and breathing therapy is logical, gives realistic hope, and relieves the shame many people feel regarding psychological and psychiatric treatments. Our treatment model is applicable also in primary health care and in psychiatry, modified according to the needs and available resources. Even if the short term therapy in the breathing school and the treatment at the outpatient clinic according to our model, is not enough, the experience may motivate the patient to seek further treatment according to his individual needs. Increased recognition of hyperventilation, knowledge about its pathophysiology and the possible triggering psychophysic factors

may by themselves be of considerable help to the patient even if psychosomatic breathing therapy is not available.