Breathing Pattern Management Through Mental Imagery as Mental Health Rehabilitation After Dyspnea: A Narrative Review

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Abstract- Dyspnea or air hunger is distressed breathing that is associated with mental awareness. Dyspnea in chronic respiratory often display anxiety or depressive symptoms. These emotional states cause a decline in the individual's quality of life and functional status. This category contributes to 1) the degree of disability related to dyspnea, and 2) the degree of impairment in lung function. :In this study, we need to answer the question Can mindfulness improve the condition of shortness of breath? Both mindfulness and shortness of breath are .subjective sensations, but shortness of breath is multidimensional and multidisciplinary in nature In this study, we conducted a scoping narrative review using three main online databases Google Scholar, PubMed, and Scopus on three main topics: respiratory system, mental imagery, and self- management (rehabilitation). We searched for observational studies and a limited number of systematic reviews and meta-analyses published up to 1968 to 2024. The specific keywords were dyspnea, oxygen, pulmonary rehabilitation, intensive care, and self-management. Dyspnea and mental imagery are the natural occurrence in most people's daily lives. Mental imagery as a cognitive ability is the motivational amplifier for promoting activities, potentially in representative outstanding emotional practices. This review emphasizes on managing the emotional distress caused by dyspnea by imagery in the brain through three different themes: 1) Attention and bodily sensations in the dyspnea, 2) Episodic memory and cognitive load in dyspnea, and 3) Managing dyspnea with mental imagery for health psychology process.

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Introduction

The rhythm of breathing creates the rhythm of life. When individuals focus attention or carry out a difficult task, their breathing changes. In this situation which respiratory parameters change?

Can these parameters be used as indicators in cognition load?

1. Respiratory system

Breathing is a multifaceted process that must rely on the coordinated action of the respiratory muscles and the control center in the brain. Therefore, in response to changes in blood gases, this system must adapt by modifying its breathing patterns to help meet the body's metabolic needs.

Pulmonary gas exchange

The pulmonary gas exchange is measured by a continuous procedure include: a) ventilation, b) diffusion, and c) perfusion.

a. Ventilation (V) discusses to the current of air into and out of the alveolar.
b. Pulmonary diffusion refers to physical diffusion through the pulmonary blood includes: gas barrier and subsequent chemical reactions between O_2 and hemoglobin (Hb), and also for

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CO_2 alteration to bicarbonate (1).

c. Alveolar gas exchange is passive transport but ventilation and perfusion processes require energy expenditure, and in many common cardiopulmonary diseases, either or both may be compromised (2). In disease condition, the pulmonary uptake of O_2 is decreased and tissues will not be able to sustain metabolic rate, and in this condition the body finds a way for compensation. Otherwise, the problem can be severe and death will ensue (3).

The output of the above three physiological processes is the tidal volume (TV), which as a critical parameter permits for appropriate ventilation. By breathing, oxygen from the surrounding atmosphere enters the lungs, then it must diffuse across the alveolar-capillary border to influence the arterial blood. At the same time, after the process of cellular metabolism, carbon dioxide is continuously made, and therefore it is vital to eliminate carbon dioxide, and prevents accumulation in the body. The lungs are responsible for delivering a capable TV as maintaining adequate ventilation factor. Respiratory problems due to hypoxia can lead to increased shortness of breath, physiological arousal, and panic with anxiety and fear in a vicious cycle. Air hunger as a primordial sensation, alerts us to a failure homeostatic need for maintaining gas exchange. Anxiety, frustration, and fear evoked by air hunger motivate behavioral actions to address the failure. The unpleasantness and emotional consequences of air hunger make it the most debilitating component of clinical dyspnea, a symptom associated with respiratory, cardiovascular, and metabolic diseases. In most clinical populations studied, air hunger is the predominant form of dyspnea (colloquially, shortness of breath). Most experimental subjects can reliably quantify air hunger using rating scales, that is, there is a consistent relationship between stimulus and rating.

Shortness of breath or breathlessness (Dyspnea)

This problem is often defined as a strong tightening in the chest, air hunger, difficulty breathing, breathlessness, or a feeling of suffocation. Air hunger in the primordial sensation signals an urgent homeostatic demand for maintaining gas exchange. Anxiety, frustration, and fear of air hunger are the motivations for behavioral measures to correct respiratory failure. The unpleasantness and emotional concerns of air hunger can make it the most debilitating constituent of clinical dyspnea, a symptom linked to respiratory, cardiovascular, and metabolic diseases. In the most clinical populations studied, air hunger is the main form of dyspnea (colloquially, shortness of breath). It should be noted that shortness of breath is not a single feeling and there are at least three distinct feelings, including air hunger, work/effort, and chest tightness. Therefore, dyspnea similar pain has at least two separate dimensions sensory and affective (4). The modern neuroimaging of the neural structures in pain is similar to dyspnea and thus neurophysiology and psycho physical studies can help to comprehend pain like dyspnea. These studies have shown that dyspnea stimulates the insular cortex and limbic formations to cause anxiety and fear (4). Stress and anxiety are important factors for breathing harder. In this situation, it's natural we get anxious and beginning to panic. This makes a cycle between short of breath, fear, and anxiety. This sequence is known as the dyspnea cycle. It's common among people with chronic lung disease. In 2022, the World Health Organization (WHO) included chronic dyspnea in the International Classification of Diseases (ICD-11) as a status can last more than 8 weeks. Therefore, symptom management (alleviation) is necessary alongside treatment with a focus on disease modification (5).

Hypoxia

Hypoxia is different from hypoxemia and anoxemia. Hypoxia is insufficient oxygen delivery, while hypoxemia and anoxemia are certain conditions with low or zero arterial oxygen.

Oxygen delivery

The bases for oxygen homeostasis accurate via the development of a complex physiological foundation for O2 transfer to tissue. This process involves O2 entering the respiratory system, transporting it to erythrocytes, and reaching the heart. Homeostasis regulation by chemoreceptor cells stabilizes ventilator and cardiovascular rates. The vasoconstriction response in hypoxic pulmonary arteries and veins occurs rapidly with an intrinsic response in the smooth muscle cells of the pulmonary vasculature via inhibition of K channels and then depolarization of voltage dependent Ca2 channels, with increased the cytosolic calcium level and constriction of myocyte in these smooth muscle cells (6). In the hypoxic conditions, the reactive oxygen species decreases, thereby it can inhibit the K^+ channel (7). Thus, it allows the organism to face the potential source of O2 degradation. ATP in healthy cells is an essential parameter for maintaining cellular homeostasis. ATP-dependent ion pumping systems, such as Na/K ATPase consume 20-80% of resting cell metabolism. Ionic and osmotic stability in normal cell needs to production and maintenance of ATP, so cell death occurs when ATP production fails. The failure of ATP level effects on the ion-motive ATPase causes to membrane depolarization, with unrestrained Ca2+ influx through voltage-dependent Ca2+ channels, and following stimulation of calcium-dependent phospholipases and protease. The outcome of these proceedings are cell swelling, hydrolysis of the main cellular mechanisms, and finally to cell necrosis (8).

Cellular adaptation to Hypoxia (Na/K-ATPase)

Cellular adaptation to hypoxia is taken 1) by elevation of efficiency in energy-producing ways, principally with the increased anaerobic glycolysis activity, and 2) by declining in energy-consuming processes. It seems that the hypoxia-induced cell death can be owing to the extent of electrical activity with the significance of the ATPase ionic pumps (Na/K-ATPase) against other ATP-consuming processes. This ion pumping shows up to 80% of ATP consumption is in the neurons while in skeletal muscle cells is only 20%. Therefore, in the case of severe O2 restriction, excitable cells cannot respond to the ion transport systems' energy demands, which can lead to cell death (9). This suppression of the metabolic response in a healthy heart is accompanied by a decrease in myocardial oxygen delivery, which leads to a reduction in contractile activity and O2 consumption, a phenomenon known as myocardial hibernation (10,11). In lung, disruption of the enzyme Na/K-ATPase during acute respiratory distress syndrome (ARDS) not only prevents pulmonary edema but also exacerbates its formation (12). This ionic pump is able to transport Na+ and K+ ions from the alveolus cell membrane, for maintaining homeostasis of the ionic gradient. Hypoxia inhibits the activity of Na-K-ATPase by reducing the number of active Na^+ pump molecules in the plasma membrane, which damages the clearance of lung fluid. Down regulation of this enzyme by hypoxia needs the generation of mitochondrial reactive oxygen species (ROS) and the a-subunit phosphorylation of the Na/K-ATPase by protein kinase Cζ (PKCζ), and increasing of the intracellular $Ca2^+$ from the endoplasm reticulum (ER) (13). Gusarova et al in 2011 reported that hypoxia causes the alveolar epithelial dysfunction by the influx of $Ca2^+$ through $Ca2^+$ release-activated $Ca2^+$ (CRAC) channels is a main connection between mitochondrial ROS for leading to Na/K-ATPase down-regulation (14). The alveolar epithelium's inability for preventing and resolving pulmonary edema is the main factor of morbidity and mortality in the acute lung injury (ALI). By damaging the alveolar epithelial barrier, the cascading process of physical, chemical, and immune functions in the lung occurs. The Pulmonary edema (PE) or pulmonary congestion is the accumulation of liquid in the lung tissue and air spaces which leads to damage of the gas exchange. Pulmonary edema can happen in pathological conditions that are directly or indirectly related to alveolar hypoxia. Chronic hypoxia offers different findings like acute respiratory distress. Acute Respiratory Distress Syndrome (ARDS) is a serious threat to a person's breathing, behavior, and mental health and can occur through sepsis, pneumonia, corona virus (COVID-19), and other conditions. Lung injury in ARDS can progress and worsen rapidly in a matter of hours to days. There is a delicate balance between the ventilatory system and the central nervous system, and this respiratory failure can lead to a host of neurological and neuropsychiatric problems that are consequences of hypoxia and hypercapnia.

Some studies consider COPD is a suitable model of investigation for cognitive injuries with chronic hypoxia due to lung disease (15).

Respiration & cognition

The nasal cavity is the main airway for respiration that connects to the central nervous system (CNS) through rhythmic neural activity. Pulmonary ventilation is often defined as the process of respiration, which can, unfortunately, behave the most annoying form in the air hunger (16). In the low tidal volume dyspnea must not be relieved by the respiratory tract, because air hunger is not caused by increased work of respiration (17). Air hunger is stimulated by an increase in the predicted medulla cortical respiration (output drive), which is decreased via increasing the tidal volume of the lungs, which is sensed by the vague pulmonary receptors. Thus, inflammation and collapse in the lung units stimulate the afferent nerves in the lungs, causing extra movement and dyspnea (18). Belli and Fischer (2024) suggested that the ability to encode visual-spatial data systematically fluctuates throughout breathing. They studied whether breathing-related interception signals affect visual-spatial attention placement or not? The results of their study showed that inhalation and exhalation have separate effects: Inhalation shifts attention into the right visual field while exhalation shifts it into the (19).

Hypoxia & cognition

Duration and degree of hypoxia has a direct effect on the severity of cognitive impairment. Acute and chronic hypoxia can similarly impair several cognitive domains such as attention, learning/memory, rapidity of movement, and executive performance. Recovery occurs after acute hypoxia, but in chronic hypoxia, its complications can threaten the patient's dementia, which may be due to its molecular processes. The compensatory responses in processes of cardiopulmonary, glycolysis, oxidative stress, a high level of calcium and adenine, mitochondrial disturbance, inflammation and excitotoxicity are all cascading of molecular-compensatory mechanisms for cognitive deficiency after acute hypoxia (20). The short report of Faull et al, in 2017 by Bayesian framework reported that the primary perception into potential mechanisms of perceptual modulation of breathlessness. In this context, the brain integrates previous expectations with sensory information to create a feeling of shortness of breath. Behavioral modulators can potentially change this communication and affect further perceptual distributions. They showed that anxiety sensitivity levels are associated with changes in the perception of shortness of breath in healthy volunteers, which may change the background and sensory enhancement to create more perceptual diversity. Thus, paying attention to bodily sensation (ASI) may decrease the strength of this system in healthy people, and increase talent misinterpretation of breathlessness. They suggested that the larger cohorts needs for the investigation to address the connection between anxiety sensitivity, interception accuracy/confidence, and breathlessness (21). Attention to bodily sensation can be an experience of health anxiety in all individuals. It can form by the mind scanning of bodily sensations for signs of ill health, and then induces the worrying about bodily sensations. Mind scans are applicable to mental images of all bodily sensations.

Attention is a significant part of the cognitive process, and it is ability for selecting appropriate stimuli. This cognitive ability is very significant for essential functions in our daily lives. To some extent, it is normal to be aware of the body's emotions and changes and to pay attention to possible health problems. Dyspnea is a very strong and influential factor in causing anxiety, and in spite of all neurophysiology and psychoneurosis studies, perception of it's as individual attention to bodily sensation has long been neglected (22).

The interaction between awareness and cognition in the bodily sensations and its interception abilities can increase the defense potential against shortness of breath. There is evidence that anxious people increase their interception sensitivity, which may be associated with decreased interception accuracy (Figure 1).

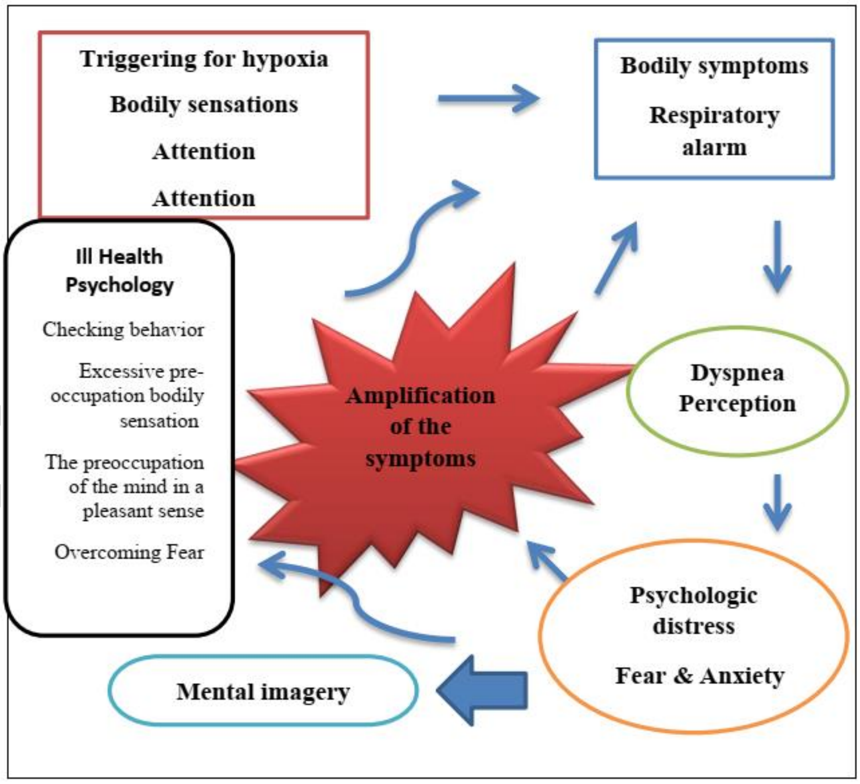

Figure 1. The communication of Attention and bodily sensations in the breathlessness process

In this figure we showed that the amplification of fear by experiencing bodily sensation (breathlessness) reaches to mental imagery, and finally to the formation of excessive anxiety (defective cycle) in the brain. Attention retraining is an important step in overcoming (23). Attention to bodily sensations can decrease the strength of this system in healthy persons and increases the susceptibility to misinterpretation of breathlessness. Therefore, reduction of a person's focus on their emotions can be free individual from attention, and focus on other activities and experiences (22).

Mental imagery

Mental imagery is a cognitive ability that enables people to simulate sensory experiences without external stimuli. Mental imagery is widely interpreted as a cognitive simulation procedure by which we can represent perceptual information in our mind in the lack of suitable sensory input (23). Mental imagery allows us to practice imminent activities in advance, and as a result, realize their potential to be pleasant and rewarding. Mental imagery is a vital component of the prospective brain as an effectual network that allows to individual to predict and manage for the future. In fact, mental imagery can facilitate and enhance the sequence of planned behaviors due to its special role in showing significant emotional experiences. Mental imagery increases the motivation and engagement of planning pleasant and rewarding activities, and can be a motivational amplifier (24).

Mental imagery & health psychology perspectives

Mental imagery refers to the simulation or reconstruction of perceptual experience in various sensory modalities. Therefore, there is a strong relationship between mental image and emotion. This relation is credited to physical and behavioral responses to images. Mental imagery interventions in health behaviors recognize situations in which they may be most effective and point to how to optimize imaging interventions in the future (25). Cognition is usually a major part of the mind. The cognitive framework is based principally on sensation and perception consisting of structures and processes of knowledge including thinking, attention, imagery, and learning/memory. Our cognitive pattern is presented by visual and verbal images of our perceptions, attitudes, and beliefs. Therefore, persons who have the wrong modeling of the pattern of cognition in their minds will have problems in life. Cognition pattern is an individual response in our minds like anyone's fingerprint, and thus manipulation of information in this pattern can be the main base in clinical psychotherapy (26).

Mental imagery and Psycho neuroscience perspective

In this view, mental imagery is consistently involved in the propagation of some emotion regulation patterns. The mind-brain system is the most complex and challenging subject from the scientific, philosophical, and psychological perspectives. The neural network functions in neurophysiology permit a theoretic deepening of spontaneous and unconscious connection of mind and brain. Although the initial stages of modern neuroscience knowledge have been considered by a cognitive psychology method, neuroimaging method permits a deeper and more detailed investigation. Today, neuroimaging studies show that the overlap between different areas of the brain is based on the type of image perceived. Episodic and long-term memories can actually affect this process. For example, an occipital lobe injury can make it difficult for a person to create images, particularly when they need to remember past memories. One of the interesting features of mental imagery is its positive effect on memory performance when a person's training stimuli are compared based on whether they are trained in mental imagery (27).

Mental imagery & Psycho neuro endocrinology perspective

These responses are the relationship between neurophysiology, endocrine system (hormone functions), and psychology. The main output of this combination is the mind's psychology/psychiatry and body neurophysiology/endocrinology with immunology which all is necessary for health psychology. The basis of human personality-behavioral structure in lifespan is derived from this cooperation; it can induce managing Biological-Psychological-Social in individual. Floridou *et al*., 2022 suggested that individual differences in sex, age, and background experience in a related activity are associated to varying degrees with different features of mental imagery (28).

Mental imagery & Psycho neuro immunology perspective

Psycho neuro immunology responses include a person's ability to protect and help to mental health for defending against environmental stress. Responses vary, and this difference is often based on individual diversity in personality, management, self-efficacy, and social characteristics. Individual variation factors (personality) can modulate the consequence of stressors on the psychological stress (29). Many neurophysiology studies have shown that cognitive and emotional proceedings cannot effect directly on the immune function. This influence must be through two axes: HPA axis and sympathetic-adrenal medulla (SAM) axis by releasing stress neurohormones (30). Studies indicate to a significant role of Locus ceruleus as the smallest noradrenalin (NA) nucleus in midbrain (alarm system) in the response of acute stress (31), for attention, excitation and defensive responses. Thus, the release of NA in CNS can modulates autonomic, endocrine and neuroendocrine responses, through indirect projections to extensive brain and spinal cord networks, whereas LC direct projections to medial parvocellular (PVN) in hypothalamus for permitting of the HPA modulation (32,33).

The psycho neuro pharmacology responses in the nervous system are analgesic, anxiolytic, antidepressant, anticonvulsant, and sedative effects. The neuro-pharmacology studies in animal models show that there is a significant effect of essential oils (Eos) on the HPA axis, the sympathetic nervous system, and central neurotransmitter systems such as dopamine, noradrenalin, serotonin, and GABA, which can yield to quantifiable psychological effects (34). Because today aromatherapy is a natural technique for a person's mind, body, and spirit to heal. One of the most noticeable uses of clinical aromatherapy is respiratory care. Aromatherapy as a pulmonary rehabilitation can be a significant aspect of respiratory care in the chronic pulmonary problems. Aromatherapy with mental imagery can help to person for improving feelings of dyspnea and fatigue, and improving health-related quality of life (35).

Materials and Methods

The current narrative review was realized by collecting scientific studies from the main online datasets (Scopus, PubMed, and the google scholar) on three main physiologic topics. The first one was physiologic introduction of respiratory system/mental imagery.

The second topic was focused on the close relationship between mental imagery and health psychology in different perspectives.

The third and last topic was applying rehabilitation training in mental imagery to defend against feelings of shortness of breath distress. An initial set of 300 studies was identified, and after screening, 71 studies were used for this review study.

Results

Mental imagery and respiratory system

General aspect

Perception of bodily sensation is an integral part of the self-management of an individual in the internal/external environments. One of the scariest and most debilitating perceptions is shortness of breath when breathing is considered inadequate. The brain's interaction with internal sensory information can lead us to better ways of understanding and then behaving appropriately in the face of unpleasant perceptions such as dyspnea and its stress. Breathing can have important effects on brain activity and cognitive processes. Changes in breathing patterns are associated with changes in attention, arousal, and emotional states. This communication through awareness of mental health can help a person in targeted mental-applied management. Certainly, personal experience has shown that by relaxing our brain and body, we can cope better with mental, emotional, and physical stress. Many studies show that guided imagery can have a beneficial effect on mental-physical health by reducing stress and anxiety. The aim of this narrative review is introduce the role of mental imagery as a common occurrence in most people's daily lives which can be a motivational amplifier for promoting our activities. It can increase participation in planned behaviors by focusing on emotional exercises by inducing relaxation in the respiratory process in order to increase the tidal volume during shortness of breath. Findings of Balban *et al*., (2023) showed that controlled breathing techniques can be emerged as a potential tool for stress management and wellness. They characterized this breathing condition as: 1) Cyclic sigh, which emphasizes long exhalations. 2) Box breathing, which contains the inhalation interval, breath holding, and exhalation. 3) Cyclic hyperventilation with retaining, by longer inspirations and shorter expiration. The first significant finding of their study was elevation in mood, as well as reduction in physiological arousal (respiratory rate, heart rate, and heart rate variability) (36). In this process, there can be two theories; the first theory is related to the pattern of natural breathing at rest and relaxation, which includes slow and deep breathing with low numbers. The second theory is central between the neocortical slow-wave sleep (alpha waves) oscillations and their link with respiration (37). This link is resonated in the brain and modulates the person's behavior and state of consciousness (38). In humans, nasal respiration involves oscillating activity in the hippocampus, and memory recognition can rise at the peak of nasal inhalation (39). Nasal breathing, unlike mouth breathing, can progress memory recognition in the consolidation phase of memory formation. This phase of memory is a time-dependent procedure for establishing of the long term potential (LTP) phase of memory which requirement to structural and chemical changes in the nervous system (e.g., the amplification of synaptic contacts between neurons). These results suggest that nasal respiration has a direct effect on the combination of cognition activity and, episodic memories (40). These temporal effects are reduced by mouth breathing because the importance of nasal airflow is essential for cognitive tasks related to amygdala and hippocampus functions (41). There are a few studies in human and animal on limbic and para-limb effects on breathing, available evidence proposes that an increase in cognitive as well as emotional impact in two regions, particularly amygdala and anterior cingulate cortex (42). Although the neurophysiology of respiration usually focuses on the brainstem process, higher regions of the brain are also essential for the cognitive aspects of respiration. In humans, the rate of volitional respiration is controlled by the network in areas of the brain such as the prefrontal cortex, orbitofrontal, middle-caudal forehead, motor cortex, as well as in the insula, superior temporal gyrus, and amygdala. In attentive breathing, the following areas of the brain can be involved: anterior cingulum, premotor, insula, and hippocampus (41).

Several studies of respiratory responses during emotional imagery show that the psychophysiology aspect of respiratory responses is generally, a reflection of the action tendency that exists in the context of emotion (43). Boiten *et al*., (1994) suggested three dimensions underlying respiratory responding: 1) excitement (arousal reflection) for act and amplified perceptual sensitivity, 2) In this respiratory hypersensitivity, they described the second dimension, which must leave the extreme of activation, and controlled tension by activation without pressure, and overt panic (44). The clinical perspective in this dimension must be respiratory behavior for the operation of a specific defense. This dimension has been hypothesized by Pribram *et al*., (45). In this psychophysiology perspective, Diest et al hypothesized that pCO2 drops would mostly reflect a necessary response to this condition, which can occur during imagery of both pleasant and unpleasant high arousal scripts. They investigated the significance of arousal and valence dimensions as triggers for hyperventilation responses through inspiratory/expiratory time, tidal volume, and pulse rate which were measured in a non-intrusive way. Hyperventilation is often reflected as a fight/flight reaction as a part of a defense response, which is associated with an unpleasant emotion and negative valence. Hyperventilation is usually associated with a strong affinity to high arousal. After each trial, they ranked the images for arousal, valence, and vividness. These findings showed that bodily emotions created through hyperventilation could be understood both in a positive and negative approach, and can lead to consistent variations in the psychosomatic signs (46). 3) Boiten *et al*., also described the third dimension underlying respiratory responding which reflects the metabolic appropriateness of respiration from normal ventilation to hyperventilation (44). Therefore, a mental image cannot be formed without cognition. Memory performance during inhalation is more accurate than exhalation, and its effect through nasal breathing is greater than mouth breathing, both for encoding and retrieval. Breathing through the nose, which involves the sense of smell. Olfactory decline appears to be associated with cognitive decline, including episodic memory decline, which is age- and lifestyle-dependent. Eckert *et al.,* 2025 reported that reduction of gray matter volume in cortical areas that confirmed this decline within medial temporal and orbitofrontal cortex for olfactory and episodic memory performance (47). These findings increase our understanding of olfactory and cognitive disorders that happen simultaneously (co-morbid).

From physiological responses to psychological challenge under breathing and dyspnea

Is the cognitive load directly related to respiratory behavior?

How is breathing under cognitive load?

Respiration is a multi-layered, combined, and very diverse and complex system that serves for maintaining the suitable partial pressure of O2/CO2 in the blood to accommodate metabolic and behavioral requirements. Although respiratory regulation has a stable system, with its flexibility potential it can quickly adapt to internal and external homeostatic challenges, but this system at rest has a dynamic steady state, which is associated with different types of variability and infrequently needs resetting which actually is done by sighing (48). This resetting significantly is motivated by feed-forward regulation, through the anticipating of perturbations (i.e., maladaptive in the normative values) and correcting them before they happen (49). This perspective can be having a number of implications for breathing physiological function in the evaluation of cognitive load. The first, arousal and its degree for changing respiratory function, anticipatory for this arousal degree, rate of the cognitive load, the task of this load (cognitive load manipulation), occupying working memory, and finally reduction of arousal, through physiological responses (feed-forward system), must be occurred for maintaining normal tidal volume in the corrected breathing behavior. For answering of this problem, the Vanilla baseline task can reduce anticipatory arousal (50). The second is a decline of the cognitive function in a hypoxia situation below 50 mm Hg, oxygen partial pressure (51), which is associated with the decline of memory performance (52), attention skills (53), working memory (54), and executive functions (55). On the other hand, very few studies have been operating the immediate effects of hyperoxia on cognitive function. For example, Scholey *et al*., showed that during a short period of hyper excitability, up to 5 minutes, oxygen administration can selectively increase the performance of cognitive, by raising blood oxygen, which is necessary for neural mechanisms information of the consolidation phase of memory (56).

The multidimensional nature of dyspnea in the sensory-conceptual domain can result in emotional distress. The feeling of shortness of breath refers to complex afferent and efferent signals that must be integrated in the cerebral cortex for effective processing. Air hunger signaling by a rise in the medulla respiratory stimulus arrives at the cerebral cortex and is sensed by stretch receptors of the pulmonary vagus nervous system. Dyspnea with a somatosensory feature (intensity and quality) and an emotional dimension (unpleasantness) has affected cognitive and behavioral domains. Dyspnea is related to the emotional response through the limb system stimulation (57). The effect of emotional conditions on dyspnea symptom perception is a subject of respiratory disease. Dyspnea in patients with chronic lung disease is associated with symptoms of anxiety or depression. These emotional conditions influence the quality of life and may lead to worsening dyspnea. How is this relationship?

These results show a perspective of a key point of connection between dyspnea and cognitive load, which can occur through an arousal signal in the formation of episodic memory.

Episodic memory and cognitive load in dyspnea

In humans, emotion has a significant effect on the cognitive processes particularly on attention. Emotion can facilitate acquisition, consolidation, and retrieval phases of memory. Emotions can widely improve anterograde memory and are also closely related to autobiographical memory, which permits to person retrieve their life in the primary context of temporal-spatial, therefore is critical for the construction of one's identity. Emotional memory involves a change in approach or avoidance of previously unbiased stimuli as a consequence of the person's action against an unpleasant experience. Emotional memory function is interacted with cortical and sub-cortical areas of brain with partnership with amygdala and hippocampal for alterations in panic, phobias and other psychiatrist disorders (58).

Tulving (1972) for the first time separated the concept between semantic memory (knowing actual information) and episodic memory (recollecting of the past events). Episodic and semantic memories are the part of declarative memory. Episodic memory refers to the awareness recollection of an individual experience that covers information about its time and place. Therefore, episodic memory for every person has a different perspective and is unique. Episodic memory is a type of long-term memory that includes the remembrance of exact events, experiences, and its situations (location and time). Episodic and autobiographical memories have a significant role in our self-identity. The assessment of episodic memory is difficult in the laboratory, and its measurement is more difficult in clinical populations. The impairment of episodic memory function in Alzheimer's disease is the first cognitive sign (59), because episodic memory as the type of memory can allow the recollection of personal experiences include information on what, where and when it happened. Dementia in four subtypes include: Alzheimer's disease (AD), vascular dementia, Lewy body dementia, and frontotemporal dementia, which are associated with communicating damage, brain disorders (agnosia, apraxia), impaired judgement, and psychiatric disorders like depression, and anxiety (60).

Many studies show that anxiety and depression influence the emotional components; therefore, the cardiopulmonary function can easily raise the intensity of dyspnea. Pulmonary rehabilitation improves anxiety and depression, and conversely these conditions affect the rate of rehabilitation completion (61). Von Leupoldt *et al*, reported the comparison of panic attacks in the chronic obstructive pulmonary disease (COPD) and healthy subject groups. They showed that the dyspnea rating augmented linearly in two groups with an increasing the resistivity load and higher levels of depression in the COPD group between groups (62,63). Three major dimensions can be described in dyspnea: 1) the sensory-perceptual dimension, 2) emotional distress, and 3) emotional burden or symptoms. The sensory-perceptual dimension includes quality and the sensory intensity of dyspnea, i.e. "how does it feel to breathe". Emotional distress addresses the question of "how distressing breathing" by focuses on the affective unpleasant sensation or cognitive evaluative response about the potential consequence of what is perceived. Symptom impact evaluates how emotional responses of dyspnea impacts on functional ability/disability such as anxiety, fright and frustration, health status, and/or quality of life (63,64). Many qualitative studies show the severe influence of shortness of breath on daily life. Shortness of breath as an unpleasant sensation can be a stimulus for the formation of episodic memory. Persons define episodes the shortness of breath as an acute event with a sudden onset that is unpleasant and frequently reason anxiety. Episodic memory is a brain-mind (neurocognitive) system, it enables human beings to remember past. It has autobiographic nature as a long-term memory which can involves to conscious recollection of past experiences (context in terms of time, place, associated emotions, etc). In Figure 2, we showed the stages of episodic memory formation through encoding, storage, and retrieval of discrete past events. This memory is not well know, and one's sense of self is based in large part on the memory of past life experiences, episodic memory has been the subject of philosophers, psychologists and neuroscience with a sensation of self-knowlage. This sensation is primal for alerts our urgent homeostatic demand to maintain gas exchange, then air hunger is a primal sensation always accompanied by panic and anxiety. There is always a strong emotional component to dyspnea, particularly when the adaptive breathing response becomes inadequate to match the respiratory drive (65). Relieving shortness of breath, like relieving pain has an effect on the quality of life. The defense physiological mechanism against shortness of breath as pulmonary rehabilitation can help to increase the tidal volume.

Pulmonary rehabilitation can induce a significant decrease in depression and anxiety situations independent of changes in dyspnea and health-related quality of life. Pulmonary rehabilitation is suggested in chronic lung disease for improving the lung function by reducing of shortness of breath symptoms and improving quality of life (66). Aromatherapy can be a benefit pulmonary rehabilitation without every side effect. In a systematic review, Hedigan *et al.,* (2023) found that studies on inhalation aromatherapy are growing exponentially. Their study shows that inhalation aromatherapy as a beneficial treatment can be a potential intervention in the areas of treatment of patients with a high degree of stress and anxiety (67). The pleasant aroma as a sensory modality through aromatherapy can activate the nerve pathways of the odor acquisition in the memory process during shortness of breath. Now, psychotherapy is a part of the lung and cardiovascular (autonomic nervous system) rehabilitation (68).

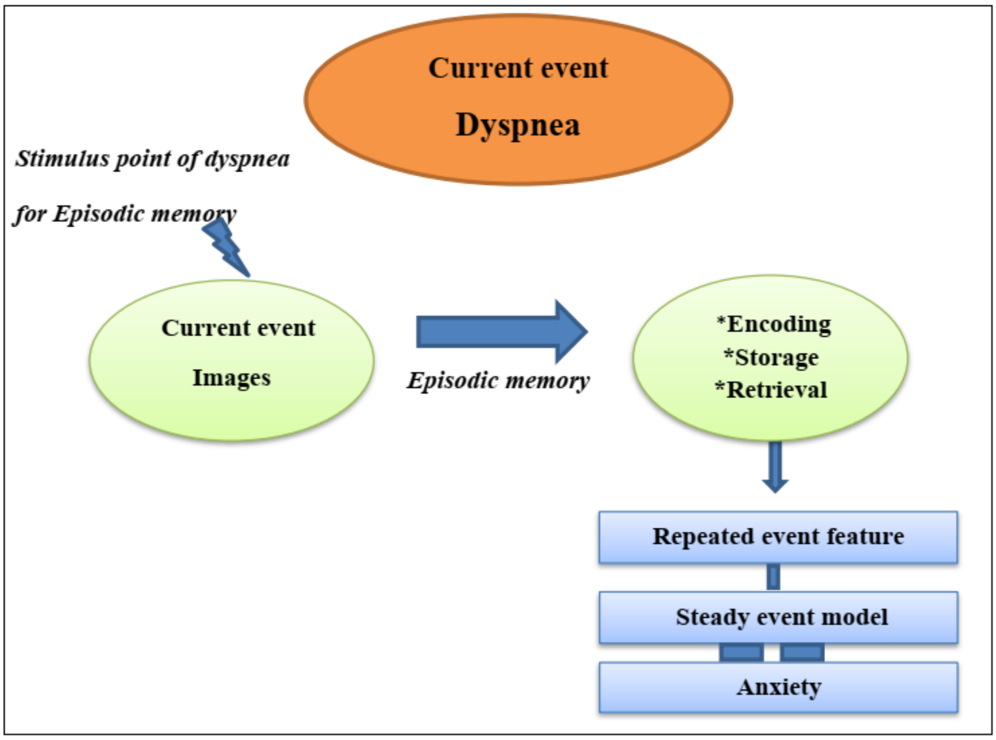

Figure 2. Encoding sensory information in milliseconds is essential for recording the processes of all emotions or stimuli (smell, sound, etc.) in the process of episodic memory formation

In recent decades, many rehabilitation methods have been developed. Mental practice (MP) is a dynamic state for evokes an imaginary representation in sensory and motor action for creating of skill in order to learn or perfect that action. Optimistically, imagery is producing a mental likeness to something you would like to have occur in real life. But under stressful conditions, these results in real life may be different, for example during shortness of breath. Therefore, mental imagery can be a rehabilitative therapy for neuropathic pain in people with spinal cord injury (68), stroke (69), anxiety and depression (70,71). Among the advantages of mental imagery as a rehabilitation method are no risk of physical injury, independence of level of motor capability, high availability/accessibility, low financial costs, and no need for equipment. Aromatherapy by mental imagery has two synergistic effects on mental health: 1) the practical management role in the recovery of episodic memory and cognitive load through pleasant aroma and 2) reduction of the panic effect and anxiety in the case of shortness of breath. Mental imagery of special senses such as sight, hearing, smell, and taste can be a good practical support for limiting mental health with the aim of creating a level of natural homeostasis in all organs.

Limitations

There are certain limitations between the recognition of a mental image and the emotions associated with it. First, our research focused on the breathing with specific aspects of mental imagery with its interaction emotional responses of dyspnea; which the potential complexity it can create limitations. Since this article takes a narrative approach, it naturally cannot have the rigor of a quantitative meta-analysis or a systematic review. Although this review does not claim to provide an explicit or comprehensive analysis, it could be useful for future more systematic research into the unpleasant emotional and cognitive aspects of mental imagery.

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