ΑΝΑΣΚΟΠΗΣΗ

Ψυχολογικό στρες και δυσλειτουργική αναπνοή στα παιδιά

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ΠΕΡΙΛΗΨΗ

Εισαγωγή: Η Δυσλειτουργική Αναπνοή (ΔΑ) αποτελεί μία παθολογική οντότητα που περιγράφει τις αποκλίσεις από τα φυσιολογικά πρότυπα της αναπνοής. Συναντάται τόσο σε ενήλικες όσο και σε παιδιά. Το άρθρο αφορά παιδιά που επισκέπτονται το παιδοπνευμονολογικό ιατρείο χωρίς προηγούμενη διάγνωση. Η διάγνωση βασίζεται στο ιστορικό και σε ψυχομετρικά εργαλεία, όπως ερωτηματολόγια. Η σπιρομέτρηση και η πληθυσμογραφία βοηθούν στη διάγνωση της δυσλειτουργικής αναπνοής. Τα παιδιά αυτά συχνά εμφανίζουν αυξημένο άγχος, επηρεάζοντας την ποιότητα ζωής τους και των οικογενειών τους.

Σκοπός: Η παρούσα συστηματική ανασκόπηση είχε ως στόχο να συνοψίσει τα διαθέσιμα επιστημονικά δεδομένα σχετικά με τη ΔΑ στα παιδιά.

Υλικό και Μέθοδος: Η σχετική βιβλιογραφία αναζητήθηκε στη βάση δεδομένων PubMed. Χρησιμοποιήθηκε το διεθνώς αναγνωρισμένο πρότυπο RRISMA (Preferred Reviews and Meta- Analyses), δίνοντας τις παρακάτω λέξεις κλειδιά: dysfunctional breathing, psychological stress in children και dysfunctional breathing and stress in children. Μόνο εννέα μελέτες πληρούσαν τα κριτήρια και συμπεριλήφθηκαν στη συστηματική αυτή ανασκόπηση.

Αποτελέσματα: Στην αρχική αναζήτηση αναγνωρίστηκαν συνολικά 1016 άρθρα. Στη συνέχεια αποκλείστηκαν από τον τίτλο 968 άρθρα. Τα υπόλοιπα 48 υποβλήθηκαν σε περαιτέρω επεξεργασία. Από αυτά, τα 39 αποκλείστηκαν μετά από προσεκτική μελέτη των περιλήψεων. Εννέα μελέτες συμπεριλήφθηκαν στη συστηματική ανασκόπηση. Σύμφωνα με τα άρθρα που περιλαμβάνονται, η ΔΑ συνυπάρχει με το παιδικό άσθμα και συχνά προκαλεί σύγχυση στην τελική διάγνωση. Όλα τα άρθρα συμφωνούν στην ύπαρξη διαφορετικών προτύπων αναπνοής, τα οποία επηρεάζουν την ψυχολογική κατάσταση των παιδιών στην καθημερινότητά τους. Τονίζεται επίσης ο σημαντικός ρόλος του σωστού ιστορικού, καθώς και η σημασία των επιπρόσθετων βοηθητικών διαγνωστικών εργαλείων στην τελική διάγνωση. Όσον αφορά τη θεραπευτική προσέγγιση, όλες οι μελέτες προτείνουν τη συμμετοχή των παιδιών σε φυσικοθεραπευτικά προγράμματα από εξειδικευμένους επαγγελματίες, τα οποία εκπαιδεύουν και βελτιώνουν τα αναπνευστικά πρότυπα. Επιπλέον, απαιτείται υποστήριξη από ψυχολόγους.

Συμπεράσματα: Είναι γεγονός ότι η ΔΑ απασχολεί την παιδιατρική ιατρική κοινότητα και έχει καταβληθεί σημαντική προσπάθεια για την κωδικοποίησή της, τόσο διαγνωστικά όσο και θεραπευτικά. Επίσης, ενώ αναφέρεται ότι πολλές φορές μπορεί να υποκρύπτεται παθολογικό υπόβαθρο στα παιδιά και ότι επηρεάζει την ψυχολογία τους, δεν υπάρχει επαρκής αριθμός ερευνών που να επιβεβαιώνει αυτές τις υποθέσεις. Απαιτούνται περαιτέρω καλά σχεδιασμένες μελέτες σε παγκόσμιο επίπεδο για να διευκρινιστεί αυτό το σύνθετο ζήτημα.

Λέξεις Κλειδιά: Δυσλειτουργική αναπνοή, stress στα παιδιά, δυσλειτουργική αναπνοή και stress στα παιδιά.

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REVIEW

Psychological stress and Dysfunctional Breathing in children

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ABSTRACT

Background: Dysfunctional Breathing (DB) is a pathological entity which describes the deviations in the normal biomechanical patterns of breathing. It is recognized in both adults and children. The article focuses on children visiting the pediatric pulmonology clinic without a prior diagnosis. Diagnosis is based on medical history and psychometric tools, such as questionnaires. Spirometry and plethysmography aid in identifying dysfunctional breathing. These children often experience increased anxiety, affecting both their quality of life and that of their families.

Aim: The present systematic review aimed to summarize the available scientific evidence in DB in children.

Methodology: The relevant literature was searched in the PubMed database. The internationally recognized PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were used, with the following

keywords: dysfunctional breathing, psychological stress in children, and dysfunctional breathing and stress in children. Only nine studies met the inclusion criteria and were included in this systematic review.
Results: A total of 1,016 articles were initially identified. Subsequently, 968 articles were excluded based on their titles. The remaining 48 were further evaluated. Of these, 39 were excluded after a careful review of their abstracts. Nine studies were included in the systematic review. According to the included articles, DB coexists with childhood asthma and often confuses the final diagnosis. All articles agree on the existence of different patterns in breathing which affects the psychological state of children in their daily routine. The important role of the correct history is also emphasized as well as the importance of additional auxiliary diagnostic tools in the final diagnosis. Regarding the therapeutic approach, all studies recommend the participation of children in physiotherapy programs by specialists, which train breathing patterns and improve them. In addition, support from psychologists is needed.
Conclusions: It is a fact that DB concerns the pediatric medical community and a significant effort has been made to codify it, both diagnostically and therapeutically. Also, while it is mentioned that many times it can hide a pathological background in children and that it affects their psyche by adding more stress, there is not a significant amount of research that focuses only on the stress caused by dysfunctional breathing in children. Further well-designed worldwide studies are necessary to clarify this complex issue.

Keywords: Dysfunctional breathing, psychological stress in children, dysfunctional breathing and stress in children.

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BACKGROUND

The term dysfunctional breathing describes a set of breathing disorders in patients with a chronic change in their breathing pattern resulting in dyspnea. Many of these breathing patterns are likely to be a normal response to an underlying disease. Many different terms have been used in the literature to describe this particular syndrome. Behavioral or psychogenic breathing in dysfunctional breathing is defined as a chronic or recurrent change in breathing pattern that cannot be attributed to a specific medical diagnosis. Patients present with respiratory manifestations, while overt anxiety, reported headache and fatigue may coexist. It usually presents with dyspnea and hyperventilation.[1]

Dysfunctional breathing has been characterized as a respiratory disorder, ultimately leading to unstable breathing patterns, without obvious anatomical abnormalities or physiological alterations. It seems to be associated with emotional disorders and states of stress, anger and depression. Symptoms can be numerous and impossible to attribute to physical causes and greatly affect health-related quality of life.[2-6]

Many patterns of dysfunctional breathing patterns are described in the literature and a review of symptoms and physiology allows classification into the following suggested categories: Hyperventilation Syndrome and its subcategories. It is the most common form of dysfunctional breathing that has been described and has been the subject of extensive research. Periodic deep sighing: This type of dysfunctional breathing is characterized from frequent sighing and irregular breathing patterns, sometimes overlapping with hyperventilation. Predominant chest breathing: Chest breathing

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or upper breathing occurs when the upper chest is mainly used with a simultaneous lack of lateral expansion. Violent abdominal exhalation: Observed irregular and large contraction of the abdominal muscles. And last type of hypo functional breathing described in the international bibliography, is the irregular thoraco-abdominal breathing. In extreme cases it is characterized as a paradoxical breathing.

In Table (1), the most severe types of synergistic breathing and the most common diseases presenting common symptoms are shown. It is not possible to accurately determine the prevalence of dysfunctional breathing. Recently, the diagnosis of dysfunctional is based on the exclusion of organic pathology. More data is available for 'Hyperventilation Syndrome (HVS), the prevalence of which reaches 6-10% of general population.[7] It is the most recognized type of dysfunction breathing and was described about 70 years ago.[8] Appears to be increasing at 29% in patients with asthma.[7]

The diagnosis of dysfunctional breathing is primarily based on a good medical history by an experienced clinician. An interview with an experienced clinical psychologist as well as a physical therapist would add more information in some cases.[9] The criteria, which differentiate psychogenic functional respiratory symptoms from organic ones, do not include their manifestation during the night. Symptoms may appear suddenly even at rest.

The evaluation methods recommended by the international literature refer to special questionnaires, as well as specialized methods that are widely used for the diagnosis of dysfunctional breathing.

Nijmegen Questionnaire (Table 2) it is the most common method of diagnosing dysfunctional breathing. This questionnaire, developed by a team in the Netherlands, includes 16 questions about symptoms. Of these, seven are related to respiratory symptoms, four to hyperventilation and five to central nervous system symptoms involving hypocapnia and 'central tetany'. In validation, the Nijmegen questionnaire was shown to have a sensitivity of 91% and a specificity of 95%. A score >23 is commonly used as the HVS threshold. SEBO Questionnaire (Self Evaluation of Breathing Questionnaire). Functional residual capacity is an indicator of dysfunctional breathing. The questionnaire describes two factors that of 'lack of air' and 'restriction of breathing'. The MARM method (Manual Assessment of Respiratory Maticm). This is tool for assessing irregular breathing rhythm. In this method the user wears a series of belts on the chest and the changes in the dimensions of the chest and abdomen are measured. From the literature it appears that the use of all these methods, in combination with each other, can

achieve the maximum result in the diagnosis of dysfunctional breathing.

Management of the patient with dysfunctional breathing must be individualized and based on techniques to restore respiratory function. Physiotherapy breathing techniques may also relieve symptoms. In the acute situation, there is usually no possibility of intervention. The Papworth and Buteyko methods are the most well-known techniques used internationally and seem to be effective in relieving the symptoms of dysfunctional breathing. Hypnotherapy and Yoga suggested also.[10-14]

METHODOLOGY

This systematic review included nine (9) studies written in English. Searches where conducted via Pub Med until June 2022 using each of the following one keyword and search terms i.e., 'dysfunctional breathing', in combination with each one of the following two terms i.e., 'psychological stress in children', 'stress in children'. According to the PRISMA guidelines, a total of 1,016 articles were identified from the database. Of these, 948 were excluded based on their titles. After screening the titles and removing non-relevant articles, and reviews, 48 publications remained. Thirty-eight of these were excluded due to the following reasons: studies on asthma (n=4); studies concerning lung function and airway dysfunction (n=4); studies refer to sleep breathing disorder (n=4); studies concerning respiratory exercises to improve pathological respiratory patterns (n=3); studies on breathing patterns (n=2); studies dealing with distress syndrome (n=2); studies with neonatal (n=2); studies unavailable in full text (n=2); studies non-concern children (n=1); and studies unavailable in English (n=1). Studies that could not be categorized (n=11). Finally, only 9 studies were included in the present review (shown in Fig.1)

RESULTS

A total number of nine (9) studies were included in the review. The characteristics of the studies with regard to dysfunctional breathing in children, which refer mainly to diagnosis and treatment, are summarized in table 3.

Connett et al.[15] investigated the correlation of dysfunctional breathing in asthma in adults' vs. children. In this review they were mainly recognized three diagnostic considerations: Breathing pattern disorders; in reference to children and young people, girls more often affected and more common in those with psychological co-morbidity. Involving adults presented across all asthma types and age groups. Women more often affected and those with more severe asthma and/or poor control and/or psychological comorbidity. Relatively the exercise inducible laryngeal obstruction they mention that the exercise indused

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breathlessness poorly responsive to asthma treatment in children. Adolescents of either sex but more commonly girls who are elite athletes or 'A' grade students. The same was described in young adults as in adolescents. Concerning the inducible laryngeal obstruction, cases similar to that seen in adults have been described and occurring in increasingly younger age groups and is more common in women.

The most important thing according to the article is the need to be differentiated the symptoms relating to dysfunctional breathing from symptoms due to other causes such undiagnosed respiratory, cardiac or metabolic diseases associated with breathlessness, a lack of physical fitness, panic disorders and anxiety. In conclusion, the review concluded that the diagnosis and treatment of dysfunctional breathing has mostly evolved through observational experience and a realization about the importance of this problem in all age groups. The increasing emergence of this clinical problem is impacting on asthma morbidity and in particular during adolescence and early adult life.

Weinberger et al.[16] aimed to determine the different clinical patterns for dysfunctional breathing in children and adolescents. This review referred to different clinical entities related to the dysfunction of the respiratory system in children and adolescents that have both common characteristics and differences between them. Indicatively it refers to vocal cord dysfunction (VCD), in exercise-indused laryngomalacia (EIL), in hyperventilation and habit cough.

They concluded that the differing clinical patterns for dysfunctional breathing need to be distinguished from asthma and other organic respiratory diseases. They also emphasize that the correct diagnosis permits specific treatment. Treatment includes inhaled ipratropium to prevent exercise-indused VCD, speech therapy or hypnosis for spontaneously occurring VCD and suggestion therapy or hypnosis for the habit cough disorder.

Hepworth et al.[17] tried to assess the impact of breathing retraining on asthma symptoms and dysfunctional breathing (DB) in children. Participants attended outpatient physiotherapy appointments and received individually tailored interventions, particularly Buteyko breathing techniques. The primary outcome was the change in the Asthma Control Test (ACT) score or change in childhood ACT (CACT) score from first to final appointment. The ACT and CACT are validated in children more than or equal to 12 years and children aged 4 to 11. The secondary outcome measure was the change in Nijmegen Questionnaire (NQ) score from first to the final appointment (score range, 0-64) with a score of more than or equal to 23 indicating

DB symptoms. The mean ACT score improved by 4.4 (p<0.0001), the mean CACT score improved by 4.9 (p<0.0001), and the NQ score change improved by – 9.3 points (p<0.0001).

The authors pointed out that the breathing retraining was the main intervention for improving DB. They evaluated the impact of Buteyko breathing techniques, in combination with other physiotherapy interventions on decreasing asthma symptoms and decreasing DB in children. A total of 169 children with asthma or suspected asthma participated in this study; aged 2 to 18 years who were referred to the physiotherapy clinic between December 2015 and January 2017, in addition to suspected DB were included. They analyzed differences in ACT (93%), CACT (82%), and NQ (67%) scores at the first and final physiotherapy appointment. The mean number of physiotherapy sessions attended was 6 (range, 2-20) with 2 to 4 weeks between each appointment. Improvements in DB symptoms (NQ score ≥ -1) were noted in 100 of 11 (88%) participants, 3 of 114 (3%) stayed the same, and 11 of 114 (10%) had o deterioration in score change (≥+1). 91% of participants had an observed DB pattern on the first appointment and 16% on the final appointment (p<0.0001). It appeared from the results of the study that physiotherapy improved the scores of the tools used and the need for an individualized therapeutic approach was emphasized.

Pedersen et al.[18] investigated the exercise-indused respiratory symptoms (EIS) in childhood and they compared the diagnosis proposed by the primary care physician with the final diagnosis from the outpatient clinic. This was an observational study of respiratory outpatients aged 0-16 years nested in the Swiss Pediatric Airway Cohort (SPAC). They included 1065 children who had their first outpatient visit after June 1, 2017. 214 (20%) had EIS as the main reason for referral. They included data from five clinics. On average, children were 12 years old (SD: 3, age range 2-17 years) and 115 (54%) were male. The most common referral diagnosis was asthma in 126 (59%); 12 (6%) were suspected to have DB, and 74 (35%) were referred with EIS of unknown etiology. Eighty-nine (43%) had at least one follow-up visit. The average time between baseline and last visit was 3.7 months (range 0.4-16.8).

Final diagnosis from the outpatient clinic letter included asthma (n= 115, 54%); extrathoracic DB (N= 23, 16%), insufficient fitness level (n=10,5%), chronic cough (n= 6,3%), and other (pleural effusion n=1, unknown etiology n=2). The referral diagnosis often differed from the final diagnosis. Of the 126 referred for suspected asthma, 37 (29%) got another diagnosis at the outpatient clinic. In most (10 0f 12) children referred for suspected DB, the diagnosis was confirmed at the outpatient clinic. Of the 76

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children with unknown diagnosis at referral, only 24 (32%) were diagnosed with asthma, the majority (n=41) were diagnosed with DB.

The diagnostic tests most often performed at the first outpatient clinic visit were spirometry in 208 (97%), body plethysmography in 171 (80%), and FeNO in 199 (93%). Before referral, 65% of all children were on inhaled asthma therapy. This multicentre study of children referred for EIS found that in almost half of the children the diagnosis was revised at the clinic. The authors comment that the relative frequency of final diagnoses and the set of diagnostic tests performed differed between clinics reflecting the lack of guidelines and highlighting the importance of specialist evaluations.

Peiffer et al.[19] tried to compare different diagnostic tools and subtypes of dysfunctional breathing in children with unexplained exertional dyspnea. The main objective of this study was to assess whether Nijmegen questionnaire and hyperventilation provocation test (HVPT) were able to differentiate inappropriate hyperventilation from other DB subtypes in children with unexplained exertional dyspnea, and normal spirometry and echocardiography. The results were compared between a subgroup with inappropriate hyperventilation (increased VE/VCO2 slope during a cardiopulmonary exercise test (CPET) and an age and sex matched subgroup of 25 children with DB without hyperventilation (median age, 13.5 years; 36 girls). Anxiety was evaluated using State-Trait Anxiety Inventory for children questionnaire.

The scores for the three different questionnaire (Nijmegen, SHAPE, and STAI-C) did not show significant differences between the two subgroups, children with hyperventilation and those without hyperventilation. Also, the diagnostic tests were unable to differentiate children with exercise-indused inappropriate hyperventilation from children with DB without hyperventilation. The authors concluded that this result related either to the failure of these tests to detected actual differences or to the actual absence of any relevant difference, between those subgroups.

Barker et al.[20] in this review investigated the proposed components, mechanisms, diagnosis and management of dysfunctional breathing in children. The authors mentioned that efforts have been made to classify different types of abnormal breathing in adult patients with five different patterns being identified; hyperventilation, periodic syndrome, periodic deep sighing, thoracic dominant breathing, forced abdominal expiration and thoraco-abdominal asynchrony.

According to the review in young people there is overlap between types of pattern and much variation probably depends on the

circumstances the young person is in. Forced abdominal expiration is rarely seen in pediatric DB, and commonly associated with COPD (Chronic Obstructive Pulmonary Disease). They, also, hypothesized that there is a group of conditions which are co factors. These promote vocal cord closure and the most common factors in pediatrics are extra-esophageal reflux, nasal obstruction and asthma. Then they reported that the commonest triggers in young people are exercise and emotional states, particularly anxiety where dysfunctional breathing is more common in chronic anxiety states. The psychological well-being especially with anxiety states may often be seen in DB.

In addition, the authors referred to the diagnosis of dysfunctional breathing in children, giving particular importance to the good history, the spirometry, the examination and the special questionnaires, especially the most used, Nijmegen questionnaire. They concluded that the youngest people with dysfunctional breathing will require a course of non-pharmaceutical therapy to enable them to return to normal function and therapy should be based on an individualized assessment, provided by an experienced physiotherapist, speech and language therapist or psychologist.

Newson et al.[21] studied the role of specialist voice SALT intervention in children with dysfunctional breathing, who were diagnosed in their respiratory clinic (2015-2018). A total of 18 patients were included in this intervention study. The age of the patients ranged from 11 to 16 (median: 14 years, 14 female/4 male patients). Many patients had comorbidities: 16 had asthma, 2 had tracheoesophageal fistula and esophageal atresia repair, one patient suffered from chronic regional pain syndrome, and one patient had chronic fatigue syndrome. The commonest BPD (Breathing Pattern Disorders) was indused laryngeal obstruction (ILO) in 16 patients Exercise – Indused Laryngeal Obstruction (EILO).

Referrals to SALT were made for children and young people with suspected BPDs after clinical review. The specialist voice SALT assessed the patient's BPD considering (a) type of BPD, frequency, severity, and duration; (b) triggers; (c) psychosocial concerns; (d) anxiety patterns; and (e) motivation for change and then a personalized treatment plan was drawn up. According to the results of the study, outcomes were very good: 14 of 18 patients had a good control with positive results within a few consultations. BPD or DB can severely affect quality of life in children and young people, but theirs early recognition and appropriate treatment can have a rapid positive impact.

Burman et al.[22] compared the eucapnic voluntary hyperventilation (EVH) in children

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with other traditional tests in diagnosis of dysfunctional breathing. This was a pilot study that investigated the usability of the EVH test with real time biofeedback in children of 10-16 years of age in the diagnostics of exercise-indused dyspnea. Six 10-16 year-old teenagers with history of exercise-indused dyspnea and three healthy control subjects were selected for this study (three children with diagnosed asthma and three children with diagnosed dysfunctional breathing). EVH test has been used in adults and elite athletes. On the contrary, there are not many studies reporting EVH testing in children.

In the EVH test, according to the article, the examine hyperventilates dry air consisting of 4%, 9%-5%, 1% of carbon dioxide for 6 min. The target minute ventilation (TMV) is 30 times forced expiratory volume in one-second (FEV1). A decrease of 10% or more in FEV1 after hyperventilation is interpreted as a positive reaction in adults. The researchers found only one study comparing results of results EVH and treadmill test in group of asthmatic children, without finding differences between the two tests.

The EVH test was successful and well tolerated in the 10-16-years-old children having participated in the study. EVH and bronchodilation tests were conducted on each participant. Target minute ventilation (TMV) was 30x FEV1. Spirometry was defined prior and 1,5 and 10 min after the test. According to the authors, during the tests, respiration, respiration rhythm and ratio of inspiration to test, and spirometry values (FEV1) remaining unchanged after EVH test.

The results of the study showed that all patients reported that EVH-indused breathing difficulty was similar to symptoms during exercise. Also, the minute ventilation volume of the symptomatic patients (especially patients with dysfunctional breathing disorder) remained smaller than the volume within the healthy control group. In closing it was mentioned that the real-time minute ventilation-controlled EVH test may distinguish dysfunctional breathing from asthma and it may work as a screening test for exercise-indused breathing difficulties in children.

Hengeveld et al.[23] studied the role of the exercise challenge test (ECT) to disentangle causes of childhood exertional dyspnea. They emphasized the need for specific tests in diagnosis and management of exertional dyspnea in children. Exertional dyspnea has an extensive differential diagnosis and influenced by interacting physiological and psychological factors, along with social and environmental input. Dyspnea, according to the study, may hide comorbidities in children, such as asthma, dysfunctional breathing, exercise indused laryngeal obstruction (EILO) and other diseases (anemia, gastro-

esophageal reflux), but most of the time there is no hidden underlying pathology.

They mentioned that an exercise challenge test (ECT) is a non-obstructive, real life test that provides patients, caregivers and medical professionals more insight into the predominant cause(s) of exertional dyspnea. They, also, reported that an advantage of an ECT compared to other direct and indirect tests was the possibility to identify other causes of exertional dyspnea besides EIB (exercise indused bronchoconstriction) during one test.

The researchers pointed out in their study that an ECT is a real-life test that reflects daily life symptoms and impairment, and can be used to disentangle the most prevalent causes of exertional dyspnea and can be used in children from the age of 3 to 6 years. Sensitivity of testing can be increased by simulating real-life circumstances, such as exercise modality, exercise intensity and environmental factors, in which dyspnea normally occurs.

DISCUSSIONS

Dysfunctional breathing (DB) in children presents with a notable prevalence, particularly among asthmatic populations, with reported rates ranging from 5% to 18%. It is strongly associated with poor asthma control and increased morbidity. The most common phenotypes include hyperventilation syndromes and exercise-induced laryngeal obstruction (EILO), typically triggered by physical exertion, psychological stress, anxiety, emotional distress, or social factors such as bullying.

Diagnosis most often relies on the Nijmegen Questionnaire, which, although validated for adults, lacks full psychometric validation in pediatric populations. Additionally, there is considerable heterogeneity in diagnostic criteria, complicating efforts to standardize clinical practice. DB in children is frequently associated with comorbidities, a phenomenon partially explained by the broad, umbrella-like nature of the term, which encompasses various dysfunctional respiratory patterns.

Despite attempts to classify DB, few studies have rigorously examined its psychological impact on children, especially using validated psychometric instruments. Preliminary evidence suggests that affected children exhibit elevated levels of anxiety, depressive symptoms, and somatization. Tools such as the Pediatric Symptom Checklist (PSC), but more targeted instruments and structured assessments are needed.

Therapeutic interventions, particularly specialized respiratory physiotherapy, have demonstrated encouraging results in improving symptoms and quality of life, with benefits often maintained for up to six months. However, a Cochrane systematic review emphasized the absence of

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randomized controlled trials (RCTs) assessing treatment efficacy in pediatric populations. This significant evidence gap limits the development of consensus-based clinical guidelines and hampers optimal management strategies.

To advance research and clinical care in pediatric dysfunctional breathing, the following are strongly recommended:

- Systematic application of validated psychometric instruments to assess the psychosocial burden and guide interdisciplinary care.
- Standardization of diagnostic criteria and tools, appropriately adapted for children.
- Randomized controlled trials to evaluate the effectiveness of both physiotherapeutic and psychoeducational interventions.

Statement of Ethics

An ethics statement is not applicable because this study is based exclusively on published literature.

Finding sources

There was no funding source for the realization of this study.

Conflict of Interest Statement

The author have no conflicts of interest to declare.

List of abbreviations

DB, Dysfunctional Breathing; HVS, Hyperventilation Syndrome; NQ, Nijmegen Questionnaire; SEBO Q, Self Evaluation of Breathing Questionnaire; Marm Method, Manual Assessment of respiratory Maticm; VCD, Vocal Cord Dysfunction; EIL, Exercise-Indused Laryngomalacia; ACT, Asthma Control Test; CACT, Childhood Asthma Control Test; EIS, Exercise Indused Respiratory Symptoms; SPAC, Swiss Pediatric Airway Cohort; FeNO, Fractional Exhaled Nitric Oxide; HPVT, Hyperventilation Provocation Test; CPET, Cardiopulmonary Exercise Test; VE/VCO2, Minute Ventilation/Carbon Dioxide Production; STAI-C, State-Trail Anxiety Inventory for Children Questionnaire; COPD, Chronic Obstructive Pulmonary Disease; SALT, Specialist Voice; BPD, Breathing Pattern Disorder; ILO, Indused Laryngeal Obstruction; EILO, Exercise Indused Laryngeal Obstruction; EVH, Eucapnic Voluntary Hyperventilation; TMV, Target Minute Ventilation; FEV1, Forced Expiratory Volume in one-second, ECT, Exercise Challenge Test; EIB, Exercise Indused Bronchoconstriction

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ANNEX

FIGURE 1. Flow chart of literature search. Summary of evidence search and selection according to the PRISMA flow chart.

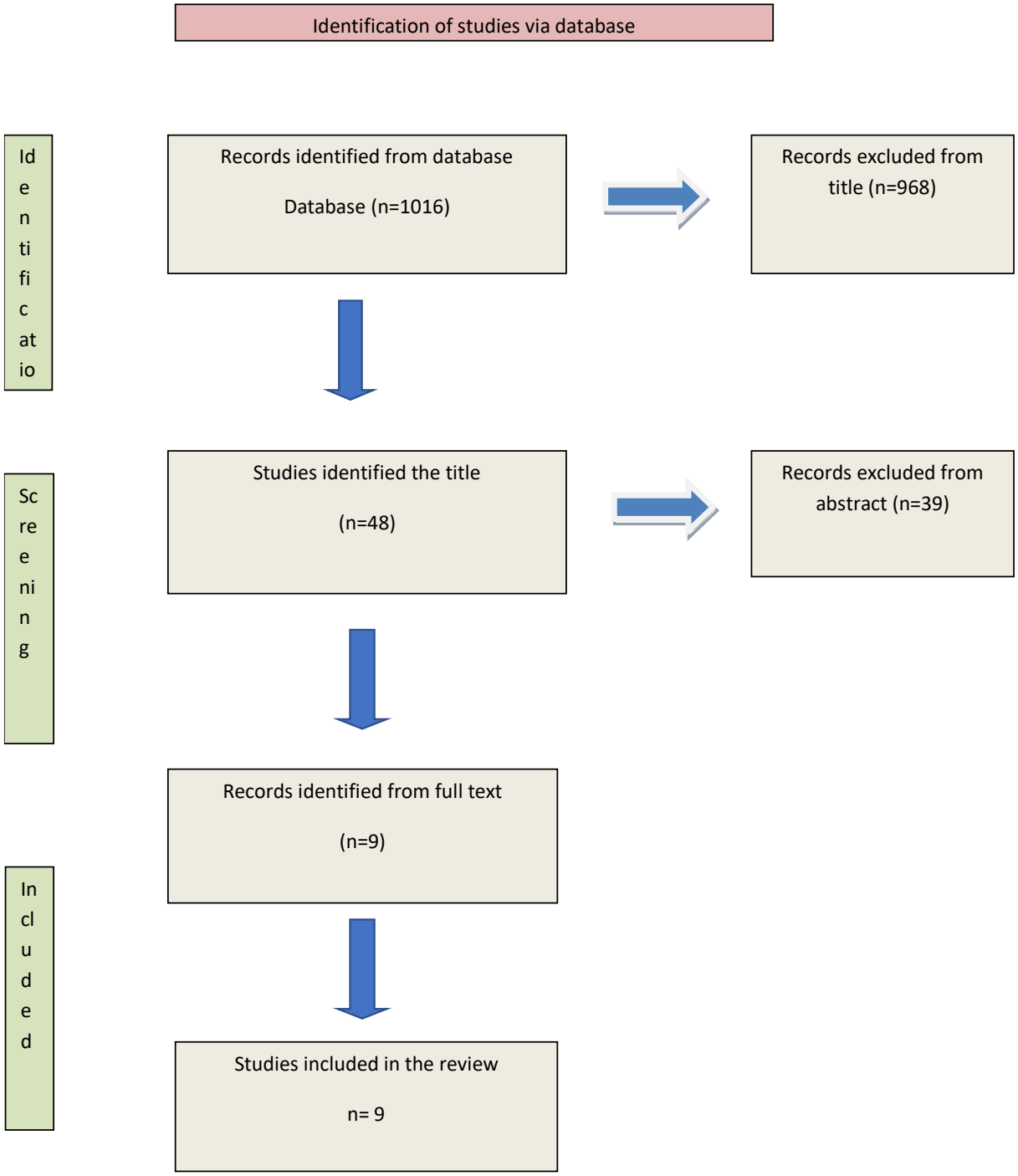

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TABLE 1: 'Breathing patterns and diseases'

Breathing patterns	**Diseases**
Hyperventilation Syndrome	**Asthma- Panic Attack**
Periodic Deep Sighing	**Asthma- Panic Attack**
Predominant Chest Breathing	**Asthma-Panic Attack-Chronic Pulmonary Disease** **Heart Failure**
Violent Abdominal Exhalation	**Chronic Pulmonary Disease**
Irregular Thoracic -Abdominal Breathing	**Respiratory Failure** **Neuromuscular Diseases-Airway Obstruction**

TABLE 2: 'Nijmegen Questionnaire'

	Never	**Rarely**	**Sometimes**	**Often**	**Very Often**
	0	**1**	**2**	**3**	**4**
Chest pain	0	1	2	3	4
Feeling tense	0	1	2	3	4
Blurred vision	0	1	2	3	4
Dizzy spells	0	1	2	3	4
Feeling confused	0	1	2	3	4
Faster or deeper breathing	0	1	2	3	4
Short of breath	0	1	2	3	4
Tight feelings in chest	0	1	2	3	4
Bloated feeling in stomach	0	1	2	3	4

Tingling fingers	0	1	2	3	4
Unable to breathe deeply	0	1	2	3	4
Stiff fingers or arms	0	1	2	3	4
Tight feelings round mouth	0	1	2	3	4
Cold hands or feet	0	1	2	3	4
Palpitations	0	1	2	3	4
Feeling of anxiety	0	1	2	3	4

A score of over 23 out of 64 suggest a positive diagnosis of hyperventilation syndrome.

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TABLE 3: Studies and patients characteristics

Study/Design	Study population	Studied Groups	Conclusion	Diagnosis	Treatment
Connet et al 2018/review	Children and Adults	DB and Asthma	The need to be differentiated the symptoms relating to dysfunctional breathing from symptoms due to other causes.	Observational experience	The therapy was not studied.
Weinberger et al 2017/review	Children and Adults	VCD	Different clinical patterns for DB need to be distinguished from asthma and other organic respiratory diseases.	They only mentioned that the correct diagnosis permits specific treatment.	Inhaled ipratropium to prevent exercise-indused VCD Speech therapy or hypnosis for spontaneously occurring VCD Suggestion the-rapy or hypno-sis for the habit cough.
Hepworth et al 2019/review	Children	Asthma and DB	The breathing retraining was the main intervention for improving DB.	Special questionnaires (ACT,CACT, NQ)	Physiotherapy appointments, particularly Buteyko breathing techniques.
Pedersen et al 2020/multicentre study	Children	EIS	The referral diagnosis often differed from the final diagnosis.	Spirometry Body plethysmography FeNO	The therapy was not studied.
Peiffer et al 2022/case-control study	Children	DB in children with unexplained exertional dyspnea	Did not show significant differences between the subgroups children with hyperventilation from children with	Special Questionnaires (NQ/SHAPE/ STAI-C) HVPT	The therapy was not studied.

			DB without hyperventilation.		
Barker et al 2020/review	Children	DB	The commonest triggers in young people are exercise and emotional states, particularly anxiety where dysfunctional breathing is more common in chronic anxiety states. The psychological well-being especially with anxiety states may often be seen in DB.	Good history Spirometry Examination Special questionnaires (NQ)	Non pharmaceutical therapy Individualized assessment provided by an experienced physiotherapist Speech and language therapist Psychologist
Newson et al 2020/intervention study	Children and Young people	DB	BPD or DB can severely affect quality of life in children and young people, but theirs early recognition and appropriate treatment can have a rapid positive impact.	The diagnosis was not studied	Specialist voice SALT
Burman et al 2017/pilot study	Children	DB Exercise-indused Dyspnea	The real-time minute ventilation-controlled EVH test may distinguish dysfunctional breathing from asthma and it may work as a screening test for exercise-	EVH-test Spirometry	The therapy was not studied.

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			indused breathing difficulties in children.		
Hengeveld et al 2022/review	Children	Exertional Breathing	ECT is a real-life test that reflects daily life symptoms and impairment, and can be used to disentangle the most prevalent causes of exertional dyspnea and can be used in children from the age of 3 to 6 years.	ECT-test	The therapy was not studied.