

Improving Elderly Functional Capacity and Quality of Life through Breather Trainer: A Narrative Review

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Abstract

Background: The growing elderly population faces challenges in maintaining functional capacity and quality of life. Respiratory dysfunctions are prevalent, reducing independence and increasing healthcare burdens.

Aim of Study: To explore the effects of the Breather Trainer, a respiratory muscle training device, on enhancing diaphragmatic mobility, functional capacity, and health-related quality of life in older adults.

Material and Methods: This narrative review synthesizes findings from previous studies and trials that evaluated the use of the Breather Trainer in elderly populations, examining its impact on pulmonary function tests, emotional well-being, and quality of life metrics.

Results: Consistent use of the Breather Trainer significantly improves maximal inspiratory pressure, peak expiratory flow, and respiratory endurance. Improvements were noted in socio-family quality of life, while mental and physical domains showed marginal gains. The device's low cost and ease of home use make it suitable for long-term implementation in elderly care.

Conclusion: Breather Trainers offer a promising, non-invasive approach to enhance the health and independence of older adults. Their integration into elderly rehabilitation programs is recommended. Further research should explore IoT-integrated training solutions for scalable impact.

Key Words: Elderly – Functional Capacity – Quality of Life – Breather Trainer – Respiratory Muscle Training.

Introduction

ENHANCING the quality of life for the elderly is a significant public health challenge due to increased life expectancy and low birth rates, resulting in a rising elderly population. This demographic shift raises concerns about longevity and quality of life, as functional impairments may lead to greater dependence on families and health systems [1]. Care for the elderly requires substantial financial resources and affects national economies. Therefore, improving the quality of life and functional capacity of the elderly has become an urgent research focus. Enhancing functional capacity means increasing the ability to perform activities of daily living (ADL), instrumental activities of daily living (IADL), and related cognitive tasks. Quality of life is influenced by culture, personal expectations, and standards. Various instruments have been devised to assess the elderly's quality of life, helping researchers identify areas to enhance their independence and overall well-being [2].

Background on elderly functional capacity:

The global adult population, especially the elderly, is projected to rise significantly, with those over 60 increasing from 900 million in 2015 to 2 billion by 2050. Over 80% of these seniors reside in low- and middle-income countries. This demographic shift presents critical challenges as older individuals often face higher rates of chronic diseases and functional limitations, impacting their quality of life (QoL) [3]. Functional capacity involves the physical abilities required for daily tasks, underpinned by physiological capacity. Even with physical limitations, one can maintain functional efficiency through adaptive task per-

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formance. Health-related quality of life (HRQoL) encompasses health perceptions, life expectancy, comorbidities, chronic disease severity, activities of daily living (ADL), and the influence of mental health and social relationships on overall QoL. As physical and mental capacities decline with age, elderly individuals risk losing functional capacity and consequently their HRQoL [2,4].

Importance of quality of life in the elderly:

As age advances, respiratory mechanics, efficiency, and functional residual capacity decline due to changes in the respiratory system. Anxiety and depression also affect the quality of life in the elderly, leading to exacerbated breathing issues and reduced physical activity, creating a negative cycle [2]. Key age-related risk factors include aging, gender, and geography. Enhancing functional capacity positively impacts quality of life; various exercises have shown to significantly improve physical functioning over 12 years. Notably, consistency with once a week exercises led to greater improvement than exercising three times a week [5].

Breathing ability significantly impacts the well-being and quality of life (QoL) of the elderly. Despite the increasing elderly population, no specific breathing program exists for them. The Breather Trainer, a simple and effective device, was evaluated for its impact on respiratory motion [6]. A population-based quasi-experiment validated its benefits, showing improvements in maximal inspiratory pressure, Peak Expiratory Flow, Maximal Expiratory Pressure, and overall Sr-QoL scores in both intervention and control groups, with significant effects noted [7].

Material and Methods

A narrative review approach synthesizing data from clinical trials, cohort studies, and expert commentary on the impact of Breather Trainers on lung function and quality of life in elderly individuals.

This study has begun from October 2022 – March 2024.

Overview of breather trainers:

Breather trainers facilitate breathing exercises in various positions, from sitting to exercise training, proving beneficial in pulmonary medicine and overall health by enhancing lung function, emotional well-being, and resilience against environmental stressors. Low-cost breathing trainers for home use have emerged but are often overlooked by physical therapists. Research indicates that breathing muscle training devices may be less effective due to prolonged muscle tension from an

elastic restraint during breathing exercises. Many seniors can effectively use these trainers, improving thoracic mobility [8,9]. The different trainers promote strict oral-nasal breathing coordination, strengthen breathing muscles, and enhance thoracic cage mobility and rib cage compliance. Various training methods using different breathing trainers have been applied both passively and actively, successfully engaging a diverse range of participants. Clinical practice has incorporated breather trainers for years, aiding not just pulmonary medicine but also general health improvement. Despite their proven utility and low cost, physical therapists have largely neglected them in contrast to their usage in pulmonary medicine. Outcomes from breathing muscle training devices have shown reduced effectiveness due to the same muscle tension mentioned earlier [10]. Breather trainers can be easily utilized by seniors, and their design has proven enjoyable, even in group settings. They have demonstrated positive engagement with mobility training exercises, offering benefits even to very old or frail individuals who may not be able to participate in traditional movement activities [11].

Mechanisms of action:

Breathing involves inhaling oxygen and exhaling carbon dioxide automatically, essential from birth to death. Lung function significantly impacts overall health and energy in daily activities, making breathing training vital for physical well-being. Respiratory dysfunction alters lung volume and can lead to mental issues such as depression, attention deficits, and cognitive decline [12]. To address chronic respiratory problems, training respiratory muscles is crucial, and using a breather trainer is an effective method. Ideal for the elderly, these trainers are compact, cost-effective, and offer adjustable resistance. For better accessibility, instructions for breathing exercises should accompany the product. Health caregivers and trainers play a key role in promoting respiratory health and correct usage. Techniques like tubal and balloon breathing can also be implemented with a breather trainer [4].

The efficacy of respiratory rehabilitation for pulmonary functions is well established, but the underlying mechanisms remain unclear. Using a breather trainer during training can be assessed through force traces, providing insights into the relationship between participants and the device [13]. Key biomechanical changes include enhanced coactivity of respiratory muscles and reduced diagonal movements when using the breather trainer. These modifications clarify how lung capacity improves and breathing stabilizes throughout the respiratory cycle. The breather trainer's adaptable

properties enable its development for diverse motor functions. Increasing resistance or refining control algorithms could tailor the trainer for various clinical applications [13,14].

Results

Summarizes evidence showing improvements in respiratory muscle strength, pulmonary function (PEFR, MIP), and HRQoL—especially in the socio-family domain. Also discusses engagement and adherence in both supervised and unsupervised settings.

Respiratory muscle training:

Breathing trainers are widely used for respiratory muscle training (RMT), especially for patients with chronic obstructive pulmonary disease (COPD) or other chronic respiratory conditions. These portable, low-cost tools allow users to perform exercises suited to their capacity. Proper initial instructions are crucial for effective use, focusing on muscle groups and staff involvement to enhance treatment outcomes [15,16].

After starting treatment, vulnerability due to consent refusals, forgetfulness, reluctance to train, and improper appliance use may occur. Effectiveness can drop below the threshold after 2–3 months, even following initial success. This decline is especially notable in mild/moderate patients who lack motivation for change due to their disconnect from the disease [17]. Reminding them of training benefits, promoting self-rewarding mechanisms, and fostering peer competitions can aid in restoring motivation. If complaints arise, it's vital to assess whether the training level remains challenging. Breather trainers should never be the sole rehabilitation method; optimal results require integration with additional components [18].

Improvement of lung function:

Breather Trainer is designed for respiratory exercise, featuring three resistive nozzles (1.5 L/min, 3 L/min, and 6 L/min), a 150cm connective tube, and a mouthpiece. It allows elderly individuals to train easily without an instructor, choosing the duration (30 mins daily) and frequency (3+ times a week) [19]. After six weeks of training, pulmonary function tests showed significant improvements: VC/SC increased by 0.94, PEFR improved by 4.94, and inspiratory capacity rose by 0.395. Although FEV1 showed no significant change, expiratory reserve capacity increased by 0.363, while FEV1/VC decreased slightly. No adverse events occurred, and compliance was high, indicating enhanced pulmonary function in elderly participants [4].

Pulmonary function declines with age, making it harder for the elderly to exhale, which can lead to various diseases. This significant study compared different training methods to enhance lung function. After six weeks of training, improvements in all pulmonary function components were noted, especially in the prefixed group, which showed the greatest changes [20]. The Breathe Trainer exercise protocol offered several benefits: It allowed elderly individuals to train simply without a special instructor, enhanced respiratory volume immediately after testing, and provided evidence that consistent respiratory exercise over six weeks can boost lung function effectively using the trainer simulator [2].

Impact on quality of life:

The quality of life scores indicated a significant improvement in the socio-family domain with a p -value of 0.025, while physical and mental domains did not show significant changes as their p -values exceeded 0.05. The Breather Trainer enhances quality of life by increasing airflow to the lungs, aligning with research that links pulmonary function to quality of life. A noteworthy correlation was found between pulmonary volume and overall quality, particularly in the socio-family domain [21]. However, standard breathers may not yield lasting benefits for healthy users. In contrast, the Breather Trainer allows for continuous engagement with effective visual feedback, leading to sustained muscle development. Limitations include the absence of a control group, suggesting that future studies should include larger samples and an appropriate control group to assess long-term effects of breathing training [2,22].

Barriers to use:

Age is not just a number but a state of mind, signaling a rich life experience. With age, bodily changes occur and aging advances. The phrase 'Old is gold' reflects the wisdom gained over years, beneficial to society, especially with healthy lifestyle choices. However, aging brings health challenges, often exacerbated by inactivity. Common diseases in older adults include Chronic Obstructive Pulmonary Disease (COPD), Asthma, Stroke, Parkinson's disease, Alzheimer's disease, and arthritis, which impact functional capacity and quality of life if untreated [23].

Medical assistive technologies have evolved for decades, enhancing disease management, longevity, and quality of life. Simple machines perform complex calculations, while sensors monitor health statuses and process data in the cloud. Conditions like asthma and COPD are linked to aging lungs, leading to the development of various devices

aimed at preventing and diagnosing these chronic diseases [24].

Older adults utilize two DIY breathing trainer (BT) devices: One involves a straw attached to a nebulizer's mouthpiece, and the other loops a straw from a balloon back into the nebulizer. Well-being is crucial for older adults to adopt health technologies. However, they may encounter barriers like lack of knowledge, unawareness of ergonomic designs, unclear manuals, and inefficient use strategies to manage discomfort with the devices [25].

Discussion

Analyzes mechanisms of action for the Breather Trainer, the physiological and psychological benefits of regular respiratory training, and barriers to adoption. Highlights comparisons with Pilates and IMT, discusses IoT innovations, and identifies gaps in existing literature, especially in tech-supported rehab for elderly users.

Comparative analysis with other interventions:

Both Breathe Trainer (BT) and Inspiratory Muscle Training with Pilates method (IMT-PIL) significantly improved capillary blood glucose levels. Enhanced respiratory capacity from IMT-PIL and BT training led to lower blood glucose levels and reduced oxidative stress among elderly participants in a home study. These methods improved health, functional capacity, and quality of life for the elderly [6]. Creative equipment and group interventions bolstered adherence and participation. Sustaining these group habits is essential for long-term quality of life impacts. Individual equipment allowed visibility of exercise performance via devices, motivating adherence through self-checking capabilities. Participants received immediate digital feedback on performance, enhancing daily engagement and interest in weekly face-to-face sessions. While home-based interventions for the elderly have been documented, this study used innovative strategies to boost participation. Results were nuanced with inconsistencies, and further validation is suggested. A short seven-day intervention could mitigate initial boredom from longer training but may not significantly influence health outcomes [15].

Future directions in research:

Between 2020 and 2022, the Breather® breathing training device was distributed in northern and eastern India, with the first branded store established in Kolkata in August 2022, followed by locations in Hooghly and Midnapore. Large-scale awareness programs educated elderly individuals on using Breather®, leading to better familiarity.

By June 2023, these devices were accessible to seniors both at stores and online, extending availability throughout West Bengal [26]. Before the pandemic, some elderly with respiratory issues used Breather® devices with assistance, prompting curiosity among healthier seniors about its benefits. The organization aimed to explore how community engagement could improve the functional capacity and quality of life for healthy seniors, particularly those aged 65 and above without a history of respiratory medications. The research differentiated between healthy seniors and those who had previously used Breather® but stopped, examining their experience. Preliminary studies began in 2019, and ongoing community involvement was proposed for future research directions [2].

Forty healthy elderly individuals were selected before the COVID-19 pandemic for a study involving the Breather® device. The protocol included 4 weeks of unsupervised usage, followed by 4 weeks of monitored group sessions. Pulmonary function tests, health-related quality of life, and upper body functional capacity were measured throughout. Most outcome variables showed significant interactions between group and time, except for one. The functional capacity measures, adapted from biochemical to mechanical factors, underwent qualitative analysis based on Health, Dynamic Systems, and Epistemology models. The findings were published in noted journals [15].

Longitudinal studies:

Breathing exercises serve as an accessible treatment to enhance patients' awareness of their breathing and improve natural patterns, ultimately aiming to alleviate functional, physical, emotional, and social limitations associated with chronic respiratory diseases. This study evaluated the effects of the Breather Trainer on individuals unfamiliar with such devices. Initial assessments focused on broncho-obstruction and biofeedback components, concluding that the device positively impacted stress management, mental-emotional control, and coping with chronic conditions, including anxiety and depression [27]. Many patients lack knowledge of breathing devices and their patterns. However, even an older, less educated demographic showed improved control with the device. The study highlights the necessity for longitudinal research to better understand the long-term maintenance of patients' conditions [15].

Inspiratory muscle training enhances ribcage movement and ventilation capacity. Pilates is a holistic physical activity combining core, strength, balance, and breathing exercises, improving daily

performance. Systematic reviews show it strengthens respiratory muscles and reduces complications after stroke. A recent trial indicates that combining inspiratory muscle training with Pilates improves respiratory function in elderly women. Additionally, postural yoga may enhance weight management and positively impact respiratory mechanics [28].

Technological advancements:

To enhance the functional capability and quality of life for the elderly, new technologies have a significant impact. Rapid advancements in electronics and information technology lead to the creation of an automatic Breather trainer. This device will allow elderly users to access information on breathing exercises through the cloud and applications on various devices. The IoT-based Breather trainer aims to assist seniors with reduced functional capacity due to aging. A randomized controlled trial will explore if IoT technology can improve their functional capacity and overall quality of life. Professor Qiong Chen will assess the trainer's effects on elderly people's capabilities, quality of life, and inter-security [29].

Many types of commercial inspiration muscle trainers are commonly used without monitoring. However, their limitations become apparent in training time, intensity, and oversight. Training duration is based on the user's knowledge and experience, lacking standardization. Various inspiration muscle training devices lead to differing pressure and intensity levels, complicating support from trainers or health professionals. To address these challenges, a new IoT-based breathing training tool is being developed for elderly individuals with diminished functional capacity due to aging. This fully automatic instrument can regulate training parameters, monitor users' status, and record results in real time, ensuring consistent rehabilitation regardless of the environment. Additionally, users can access their progress and results through cloud-based applications on their devices [30].

Research on the relationship between breathing muscle training and functional capacity in the elderly is limited. Most studies have focused on various populations, such as those with chronic obstructive pulmonary disease, stroke survivors, and individuals with cardiac issues. There is little emphasis on the implementation of breath trainers and training in the elderly. Additionally, previous research has not investigated combining breathing muscle training with technology, such as Bluetooth connectivity, to log and analyze training progress or provide video guidance for effective training.

Surveys used the New Functional Mobility Scale to assess the difficulty of key actions like turning, walking, and climbing stairs, while health-related quality of life was evaluated using the Physical and Mental Component Summary [15].

Challenges and Limitations:

The demand for wellness programs for the elderly is rapidly expanding, highlighting the need for mechanisms that enhance their lives. Injury prevention and ergonomics training are becoming focal points for researchers and practitioners. A new trend is smart device-supported fitness rehabilitation. Cardio aids assessing respiratory health and breathing-based therapeutic exercise are emerging. Automatic breathing exercise robots and personal trainers are novel concepts. The Breath Trainer functions in fitness, rehabilitation, and exercise, featuring contactless sensors for motion and breathing detection, real-time feedback speakers, environmental cognition cameras, immersive projection equipment, and a touchscreen interface. It provides diverse smart training solutions for enjoyable longevity exercise without fatigue, including biofeedback breathing programs for fitness, rehabilitation, and early prevention of heart disease and mental disorders [2,31].

A recent study has reviewed Smart Health Research on breathing exercise techniques and health. Breath Trainer is an intelligent system providing real-time feedback on exercise performance, aimed at older adults. It also targets kinestheses, busy workers, anxious individuals, and those needing rehabilitation for cardiovascular and respiratory diseases. Before commercialization, its usability, acceptability, and effectiveness will be evaluated. This overview aims to benefit the scientific community and public health practice.

Research findings and a development blueprint of Breath Trainer may inspire other smart health systems and advance the Full Message research paradigm. This product supports older adults in fitness, rehabilitation, and health care, and is also suitable for busy workers, anxious individuals, and those recovering from academic stress impacting heart and breath.

Conclusion:

Pulmonary rehabilitation has supported patients with chronic respiratory diseases. Evidence suggests that healthy older individuals benefit from respiratory physiotherapy as well. Aging weakens inspiratory muscles, but a single exercise program can reverse this, which is significant for the growing elderly population. The review focuses on re-

cent studies, especially for nonresponsive patients. Breathing training strengthens respiratory muscles via a simple, non-invasive, low-cost method. Most studies assessed outcomes related to mood, sleep quality, strength, balance, flexibility, and range of motion.

When applied to older healthy individuals as indicated, breathing training is an effective intervention that can be used alone or alongside treatments for patients with medical comorbidities. Breathing training, aging, and body flexibility should be emphasized more frequently in health promotion programs due to their importance for quality of life in older age groups. The effectiveness of breathing exercises as a preventive method warrants further investigation. Respiratory physiotherapy includes structured programs with individual instructions. Future reviews should ensure quality assurance of these programs, similar to efforts made in music therapy and exercise programs.

This review aims to enhance awareness of respiratory physiotherapy's benefits and encourage research in the field. Currently, descriptions are limited, often focusing on asthma and cardiovascular surgery patients.

Recommendations:

The main recommendations are: Health promotion institutions, like universities and senior gyms, should provide respiratory physiotherapy for elderly prevention, and authorities should implement requirements in senior certifications reflecting the positive outcomes of these programs.

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تحسين القدرة الوظيفية ونوعية الحياة لدى كبار السن من خلال جهاز تدريب التنفس

الخلفية: تواجه الفئة المتزايدة من كبار السن تحديات فى الحفاظ على القدرة الوظيفية وجودة الحياة. تعتبر الاضطرابات التنفسية شائعة، مما يقلل من الاستقلالية ويزيد من أعباء الرعاية الصحية.

هدف الدراسة: استكشاف تأثير جهاز تدريب التنفس، وهو جهاز لتدريب عضلات التنفس، على تحسين حركة الحجاب الحاجز، والقدرة الوظيفية، وجودة الحياة المتعلقة بالصحة لدى كبار السن.

الطرق: تقوم هذه المراجعة السريرية بتجميع نتائج الدراسات والتجارب السابقة التى قيمت استخدام جهاز تدريب التنفس فى فئات كبار السن، مع فحص تأثيره على اختبارات وظائف الرئة، والرفاهية العاطفية، ومقاييس جودة الحياة.

النتائج: يؤدى الاستخدام المنتظم لجهاز تدريب التنفس إلى تحسين كبير فى أقصى ضغط شهيقى، وأقصى تدفق زفيرى، وقدرة التحمل التنفسية. لوحظت تحسينات فى جودة الحياة الاجتماعية والأسرية، بينما أظهرت المجالات العقلية والجسدية مكاسب طفيفة. تجعل تكلفة الجهاز المنخفضة وسهولة استخدامه فى المنزل مناسباً للتطبيق طويل الأمد فى رعاية كبار السن.

الخلاصة: تقدم أجهزة تدريب التنفس نهجاً واعداً وغير جراحي لتحسين صحة واستقلالية كبار السن. يوصى بدمجها فى برامج إعادة التأهيل لكبار السن. يجب أن تستكشف الأبحاث المستقبلية حلول التدريب المتكاملة مع إنترنت الأشياء لتحقيق تأثير واسع النطاق.