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Please see Corrigendum

Quality of life in asthmatic patients: Pre- and post-COVID-19

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REVIEW ARTICLE

Abstract

Chronic respiratory diseases impact patients' social, psychological, and physical well-being. Before COVID-19, asthma management focused on preventing lung damage and treating flare-ups. Despite more treatments, many patients struggle with medication adherence and experience isolation. The pandemic shifted asthma management toward preventive measures across the world. Practices such as wearing masks universally, improved hygiene, and more use of telemedicine were adopted globally. These helped to minimize hospital burden, with drop in asthma patients, proving that adhering to preventive practices can successfully treat long-term respiratory diseases. However, the pandemic also exacerbated the mental well-being of asthmatic patients, causing a decrease in their quality of life because of increased stress, anxiety, and loneliness. This formed a vicious cycle in which worsening physical and mental health worsened asthma management. Consequently, there is a requirement for a more patient-centered, multidisciplinary care approach for tackling social, mental, and physical health requirements. Disparities in healthcare continued, especially in rural and disadvantaged communities. Telemedicine and digital health technology, adopted so quickly during the pandemic, allowed for the continuity of care, increased medication compliance, and fewer hospital visits. This article delves into asthma care before and after the COVID-19 pandemic, demonstrating the multifaceted impact of the crisis. It highlights the significance of individualized treatment and prevention as well as the value of incorporating mental healthcare in asthma management. In the future, new models of asthma care could leverage learnings from the pandemic, integrating telemedicine with improved preventive measures to enhance patient outcomes, equity, and access. The pandemic has triggered innovations in the treatment of asthma, such as the creation of digital tools for individualized care and novel biologic treatments. These advances need to be incorporated into the existing management practices to improve asthma control globally.

Keywords: asthma, quality of life (QoL), COVID-19, physical health, mental health

Introduction

Asthma is a persistent respiratory disorder, with approximately 300 million patients globally. It is characterized by inflammation of the airways and increased sensitivity, leading to clinical manifestations, such as cough, tightness of the chest, wheezing, and shortness of breath (Porsbjerg *et al.*, 2023; Terry *et al.*, 2021). Asthma demands constant care. This involves timely administration of prescribed drugs, evading stimuli, and periodic visits to physician (Furtado *et al.*, 2019; Kharaba *et al.*, 2022). Asthmatic patients typically have a poorer quality of life (QoL). Most have difficulty performing physical exercise and social interactions, resulting in

psychological distress (Ghozali, 2024; Zhang *et al.*, 2023). Most asthmatic patients have a reduced QoL in spite of enhanced management options prescribed by the Global Initiative for Asthma (GINA). This is due to physical constraints, psychological issues, and barriers to accessing healthcare services (Mulvey *et al.*, 2021; Rajvanshi *et al.*, 2024; Reddel *et al.*, 2022).

From late 2019, the COVID-19 pandemic drastically changed daily life and healthcare systems (Filip *et al.*, 2022). Initially, there were fears that asthmatic patients would have poorer outcomes from COVID-19 because of underlying respiratory disease. This resulted in a review of asthma management approaches (Burrows and Ellis, 2022; Linton *et al.*, 2023; Shi *et al.*, 2022). Yet, in contrast to these anxieties, a few patients reported that their asthma was more effectively controlled. Interventions, such as wearing masks, enhanced hygiene measures, and reduced exposure to respiratory viruses, were responsible for this development (Greenhalgh *et al.*, 2024; Jefferson *et al.*, 2023; Polivka *et al.*, 2022). Studies in top-tier journals documented these unforeseen advantages and their possible impact on future treatment.

The pandemic hastened the use of telemedicine in line with GINA's guidelines. This facilitated digital surveillance, intelligent inhalers, and remote prescriptions (van Boven *et al.*, 2024). Moreover, COVID-19 and flu vaccination drives offered extra protection for asthmatic patients from respiratory complications (Cates and Rowe, 2013; Jaffee *et al.*, 2024).

Some of the changes were advantageous to patients, while others revealed vulnerabilities. Increased feelings of isolation, declining mental health, and disruptions in routine care compromised the existing psychiatric problems. These findings underscore the importance of an integrated approach to asthma care that includes both mental and physical health assistance (Brandt *et al.*, 2022). Accurately understanding what changed in treatment and QoL of asthmatic patients amidst the pandemic can help enhance the quality of care (Benfante and Scichilone, 2020; Isasi *et al.*, 2021). Utilizing evidence-based techniques and the lessons gained from COVID-19, medical systems could refine QoL for asthmatic patients and strengthen resilience against future medical emergencies (Isasi *et al.*, 2021).

Asthma and Quality of Life Prior to COVID-19

Physical health

Prior to the COVID-19 pandemic, asthmatic patients experienced considerable physical health problems because of poor asthma control, respiratory infections, and recurrent flare-ups caused by external allergens. These occurrences highlighted the pressing necessity for improved treatment approaches to asthma, as flare-ups interrupted day-to-day functioning and worsened long-term ailments.

Environmental triggers and respiratory infections

Usual allergens, such as mold, dust mites, and pollen, often cause asthma, particularly during the allergy season (Castillo *et al.*, 2017). Air contaminants, such as ozone, nitrogen dioxide (NO_2), and particulate matter are able to cause considerable aggravation of asthma, making it crucial to utilize good environmental control measures to treat asthma (Lee *et al.*, 2021). When respiratory infections, especially viral infections, such as influenza, respiratory syncytial virus (RSV), and human rhinovirus (HRV), worsen, patients tend to need medical intervention for conditions such as coughing, wheezing, and shortness of breath (Sharma *et al.*, 2022).

Recurrent exacerbations and decline in long-term lung functions

Recurrent asthma attacks may be followed by progressive reduction in lung function, particularly in patients with poorly controlled asthma. This reduction is commonly associated with chronic inflammation and remodeling of the airway structure. Hence, effective control measures must be implemented to avoid such attacks and subsequent loss of lung function. In order to reduce exacerbations and the long-term risks associated with the condition, optimal asthma care through improved medication adherence and avoidance of environmental and viral triggers must be achieved (Menzies-Gow *et al.*, 2021).

Physical activity limitations and exercise-induced bronchoconstriction (EIB)

Patients were once frequently advised to avoid exercise, as it was believed that this lifestyle could trigger or exacerbate wheezing and shortness of breath associated with asthma. However, with the advent of modern treatments, such as bronchodilators and inhaled corticosteroids, asthma management now focuses on symptom control, allowing patients to maintain active lifestyles. For those with well-managed asthma, regular exercise is not only safe but also encouraged, as it enhances the overall health and improves asthma control (Panagiotou *et al.*, 2020). Nevertheless, even light physical activity can occasionally lead to EIB, where the airways temporarily narrow during or shortly after exercise. This condition can affect both individuals with and without asthma, often resulting in symptoms such as coughing, chest tightness, wheezing, and difficulty breathing. Exercise-induced dehydration of the surfaces of the airways triggers EIB because of the release of inflammatory mediators, which can obstruct the airways. Environmental factors, such as dry and cool

air, airborne irritants, and other factors, also play a role in this condition (Aggarwal *et al.*, 2018).

Barriers to physical activity in asthmatic children

Asthmatic children encounter various obstacles that hinder their ability to engage in physical activities. These challenges include parents' worries about exercise-induced asthma (EIA), hesitance to use medication, and limited access to safe places for recreation. Furthermore, inadequate asthma management in schools limits students' chances for active recreation, which is crucial for their social and physical development (Kornblit *et al.*, 2018). As a result, many children lead sedentary lifestyles, which can lead to deconditioning, marked by decreased exercise capacity and lower endurance. Additionally, a lack of physical activity can affect child's social development, as they may miss out on opportunities to play and interact with their peers (de Lima *et al.*, 2023; Walker and Reznik, 2014).

Medication adherence and its impact on physical health

Many asthmatic patients depend on short-acting beta agonists (SABAs), or quick-relief inhalers, which often point to an over-reliance on these medications and indicate that long-term management is lacking. This high usage of SABAs, along with poor adherence to inhaled corticosteroids (ICS)—the main treatment for controlling inflammation—underscores ongoing difficulties in asthma care and in preventing flare-ups. The most recent asthma care guidelines recommend using ICS/long-acting beta-agonist (LABA) combinations to reduce dependence on SABAs and enhance the overall asthma management (Walker and Reznik, 2014).

Consequences of poor asthma management

Severe or chronic asthmatic patients are confronted with significant challenges. In Saudi Arabia, for instance, approximately 64% of patients with uncontrolled asthma suffer from exacerbations that necessitate immediate medical intervention (Al-Shamrani *et al.*, 2019). Most of these severe attacks lead to hospitalization or admission to critical care units. An effective asthma treatment plan may prevent such emergencies by providing long-term symptom control and regular medication adherence.

Even with access to effective drugs, most patients continue to have exacerbations because they do not adhere to their medication regimens. Adherence ranges from 63% to 76%, and several studies report that most patients still suffer from recurrent exacerbations and a fast decline in lung functioning because of inappropriate use of medication (Vähätalo *et al.*, 2021). Asthma was a significant health problem prior to the pandemic, with both acute exacerbations and chronic restrictions. Acute exacerbations caused by infections, allergens, or air pollution tend to necessitate hospitalization or urgent treatment. Inflammation of the airways, impaired lung function, and persistent asthma symptoms have a detrimental effect on daily life and general well-being (Kostakou *et al.*, 2019).

Resolving adherence problems is a key to enhancing asthma control and avoiding chronic respiratory morbidity (Papi *et al.*, 2020).

Mental health challenges prior to COVID-19

The psychological impact of asthma was important but frequently underestimated before the COVID-19 pandemic. The unpredictable and chronic nature of asthma may increase anxiety and unhappiness in patients. Furthermore, psychological distress has increased in the era of COVID-19 (de Boer *et al.*, 2021).

Anxiety, depression, and hypervigilance

Asthmatic patients, especially those whose symptoms are not controlled considerably, always fear having severe attacks at any moment, whether in public or even during sleep. This constant fear might cause hypervigilance, whereby the patients are very sensitive to their symptoms, the environment around them, and their routine activities in order to prevent possible initiators (Mohamed *et al.*, 2022). In extreme instances, the psychological weight of sorrow and worry exacerbate this state of hypervigilance, establishing a vicious cycle of emotional pain.

Most patients with severe asthma also often present depressive symptoms: approximately 26% present with manifestations of depression, and 13% experience both anxiety and depression. The disorder is characterized by many acute exacerbations, poor control of asthma, and physical disability that is at times entirely debilitating, for instance, during attacks of dyspnea and dysfunctional breathing. These problems are associated with emotional distress and decreased QoL. The physical and emotional discomfort frequently results in hopelessness and dissatisfaction, making it critical to include psychological care in asthma management plans (Stubbs *et al.*, 2022).

Impact on Autonomy and Control

Eassey *et al.* (2019) also carried out research that demonstrated how the prevalence of severe asthma badly erodes the autonomy of patients. Recurrent hospitalizations and serious attacks tend to make patients feel that they have lost control of their lives. One patient remembered feeling powerless after receiving medical assistance during an acute attack, saying that she had 'to give away all your power'. Another patient spoke of feeling very helpless and fearful during bad asthma attacks, which took away from her the sense of autonomy and self-control (Eassey *et al.*, 2019). This psychic burden underscores the necessity for more effective care planning that safeguards patient

autonomy as well as mental well-being while they experience an asthma attack.

Stress of managing asthma

This has many obligations, which in turn makes the illness mentally challenging. Patients often fail to avoid environmental triggers, handle symptoms of recurrent exacerbations, and comply with treatment regimens. All these interfere with the daily routines, jobs, and academic performance, thus causing mental stress. Effective management of asthma requires patient-centered approaches that include education, tailored therapies, and supportive communication to empower people and minimize the overall psychological burden of asthma on QoL (Zhang *et al.*, 2023).

Mental health challenges in children and adolescents

Asthmatic children and teenagers are usually plagued with severe mental illness. The illness may constrain their capacity to study like their fellow students at school, thus producing feelings of mental distress. Many of them are ashamed or embarrassed by the fact that they have asthma or need a management strategy. Such difficulties exacerbate the psychological effects of asthma, as they disrupt the social and developmental interests of children (Sharrad *et al.*, 2024).

In addition, parents of asthmatic children often have higher stress levels because they worry about the safety of their child and their own capacity to cope with stress. This suggests that interventions should work on the psychological impacts of asthma and practical management skills, highlighting the emotional load that asthma places on both children and families (Kemble *et al.*, 2024).

Interplay between mental health and asthma outcomes

A strong relationship exists between mental health and asthma outcomes, with stress and anxiety playing a role that may exacerbate the asthma manifestations. The emotional issues complicate not only compliance with the treatment regimen but also effective disease control. This causes patients to find it challenging to adhere to the treatment plans, resulting in compromised asthma control and increased susceptibility to exacerbations (Caulfield, 2021).

Prior to the pandemic, most mental disorders were usually overlooked in asthmatic patients. As a result, patients rarely received thorough psychological treatment from their medical professionals (Sheha *et al.*, 2021).

Social life prior to COVID-19

Before the COVID-19 pandemic, asthmatic children and adolescents encountered specific social challenges that were largely induced by the physical limitations of the condition, societal perceptions, and family dynamics. These problems made it more challenging for them to engage in life's common activities, such as sports, school functions, and athletic events—all of which are integral for their social development.

Social Isolation and Exclusion

Asthmatic children are often excluded from social activities, especially sports and vigorous playing because of their condition. The fact that they require frequent medication or the possibility of precipitating an asthma attack during sports or physical exercise outside their home results in their social isolation. This isolation is most pronounced at the places where kids spend maximum time with other kids: playgrounds and schools. The asthmatic children do not have a chance to become active; hence, the building of uncompetitive social relationships led them to loneliness and disconnection with their groups (Hughes, 2014).

Barriers to school engagement

Asthma flare-ups often meant missed school days, which, in turn, meant missed time to finish assignments. Asthma in children also makes their scholastic problems worse by making it harder for them to participate in group projects or classwork. Asthmatic children are often sidelined for group activities in gymnasium classes because of their frequent absence or physical limitations. They are not able to relate with other students in the classroom because of their inability to participate in physical activities. Exclusion brought by the cycle of omission because of social and intellectual problems is what led to the feelings of banishment (Hsu *et al.*, 2016).

Family influence on social participation

Parents are key influencers of how their children perceive social relationships as either encouraging or discouraging. Anxiety over asthma symptoms and triggers causes overly protective but well-intentioned parents to limit their children's involvement in group settings or outdoor playing games with friends. Thus, such children have fewer opportunities to bond with their peers and establish friendships.

On the other hand, families capable of controlling their children's asthma can efficiently manage manifestations and establish settings that promote increased physical activity (Shao *et al.*, 2024).

Stigma and peer relationships

Children's social lives are also affected by the stigma of having asthma. Asthmatic children often suffer from bullying or social exclusion because of their need for medication or because their asthma is visible through symptoms, such as coughing, wheezing, or the use of inhalers. Physical limitations and social stigma make for the feelings of shame and

unwillingness to speak candidly with others about their illness. Because of this, many kids feel 'different', leading to social disengagement and a reduced feeling of community with their classmates (Ahmad and Ismail, 2015).

Impact of extracurricular activities (ECAs) on student development

Extracurricular activities are essential for enhancing students' intellect and social development. These activities enhance skills, such as time management, teamwork, and leadership, thereby improving academic achievements and building relationships with students. Generally, the tendency of being involved in ECAs is associated with enhanced self-esteem, reduced behavioral problems, and increased student involvement. Conditions such as asthma, on the other hand, limit physical exercises, reducing opportunities for social interactions and personal growth. Despite these challenges, ECAs are important for the total development of students, and schools must ensure that all children participate in inclusive programs (Anjum, 2021).

Peer support and social inclusion

Despite the barriers that asthma imparts to children's lives, peer support groups help to level some of the social hurdles that asthmatic children confront. Team activities aimed at asthmatic children, such as asthma campaigns or asthma-friendly athletic events, help to reduce the stigma that often surrounds this illness and create a sense of community. With such activities, asthmatic children easily move into contact with peers having the same forms of struggles. Moreover, this encourages them to make support networks that enhance social inclusion, especially for the children who had been alone or perceived as different because of asthma (Sloand *et al.*, 2021).

Long-term social consequences

The long-term social effects of asthma, especially if it is not treated during childhood, can last well into adolescence and even later adulthood. Those who experience stigma or long-term social ostracism because of childhood asthma often continue to have difficulty in forming secure relationships or getting along in other social settings. Low self-esteem resulting from the psychological impacts of social isolation and continued physical constraints because of asthma may eventually make it more difficult for them to integrate into wider social networks (Plaza-González *et al.*, 2022).

Healthcare Accessibility

Traditional in-person asthma care

Before COVID-19, visits to the clinic were mandatory for the treatment of asthma. This ensured that all patients must have information, received spirometry testing, and have treatment alteration as well as an assessment of symptoms. At the time of clinic visits, health practitioners could advise patients about the proper use of inhalers, control of triggers**,** and compliance with medication. Although telemedicine has made life easier and far more pleasant for both patient and practitioner by means of virtual visits and remote patient-monitoring, an essential element—traditional in-person care (Persaud, 2022) is missing.

Barriers to accessing specialized care in rural areas

In the context of poor and rural areas, where specialist care is significantly limited because of scarce resources and clinicians, the traditional healthcare paradigm poses particular problems. Patients at such locations often have limited access to and utilization of culturally competent healthcare services that meet individual needs. These problems are further exacerbated by resource constraints and communication breakdowns between healthcare providers that lead to fragmented care and poor health outcomes for rural communities (Coombs *et al.*, 2022).

Financial and logistical challenges in routine care

The traditional healthcare paradigm poses challenges not found in other settings, especially among the impoverished and rural communities. Given the lack of resources, including physicians, there exists a severe constraint to access highly specialized care. In these areas, patients often have limited access and utilization of culturally sensitive care services that are required by them to cater their needs. Shortage in resources and poor communication between providers add to all these problems, thereby generating fragmented treatment and poor health outcomes for rural people (Zeitouni *et al.*, 2022).

Emergency room visits and healthcare costs

Those who suffer severe asthma exacerbations often find themselves in the emergency department, which significantly contributes to healthcare costs and interferes with daily life. Even with maintenance medications, a major cause of preventable exacerbations that require urgent medical attention is the inconsistent adherence to prescribed treatment plans (Kostakou *et al.*, 2019).

Underutilization of telemedicine during pre-pandemic

Telemedicine was generally an underutilized resource in the United States prior to the COVID-19 pandemic. Despite a steady increase in use, a number of obstacles

prevented widespread adoption. These included complicated rules, inconsistent reimbursement schemes, and technological limitations that hindered the widespread adoption of telemedicine. By 2018, telemedicine was implemented in 76% of the US hospitals, although its incorporation into the standard care is still lacking. The main users are in specialty fields, including radiology, psychiatry, and cardiology, and the criteria that affected access to telemedicine included hospital technology capabilities, geographic location, and the existing reimbursement systems. Because of this, not all patients had equal access to telemedicine, and its use continued to be a specialized service, rather than a routine aspect of healthcare delivery (Shaver, 2022).

Impact of limited technological infrastructure on healthcare accessibility

Inadequate technology infrastructure restricts the growth of telemedicine in healthcare, especially for underserved and rural populations. Some health systems have virtual consultations, but these are not widespread due to a lack of technology and low digital literacy. This lack of infrastructure disrupts the treatment of chronic illnesses, such as asthma, because weather, transport, and personal health emergencies tend to delay support. Hence, the digital infrastructure that needs to be improved is essential for making the most of telemedicine and ensuring consistent access to reliable technology (Anawade *et al.*, 2024).

Asthma and Quality of Life During and After COVID-19

Physical health challenges

Contribution of universal masking and hygiene practices to lower asthma attacks and respiratory infections

The COVID-19 pandemic highlighted the need for preventive measures, such as hand-washing, hand sanitizers, social distancing, and universal masking, to avoid respiratory infections and control asthma. All respiratory infections, including the 7–8-m long droplets of SARS-CoV-2, were less likely to spread when everyone wore masks. In highly polluted metropolitan areas, masks also shielded people from allergens, dust, pollen, and smoke—all of which can exacerbate asthma. This was demonstrated by the ensuing decline in asthma episodes and the overall health improvement. Research found that hospitalization of asthmatic children during the pandemic dropped by 53% because of these precautions. Most asthmatic patients became aware of medication adherence and self-management because of reduced hospital attendance. This consequently reduced the demand for emergency care because there was enhanced symptom control and therefore fewer complications (Chan *et al.*, 2021; Lai *et al.*, 2022; Maison *et al.*, 2021; Sohn *et al.*, 2022; Veys *et al.*, 2021). To ensure the continuing maintenance of health benefits for asthmatic patients, there is a priority need for public health approaches, such as GINA-initiated programs, regarding masking and maintaining cleanliness during peak seasonal allergen prevalence (Vishak Acharya *et al.*, 2021).

Impact of long COVID-19 on asthmatic patients

For asthmatic patients, long COVID-19 posed serious difficulties because symptoms, such as coughing (12%), chest pain (12%), and dyspnea (30%), persisted for up to 12 months. Because of these symptoms, there was a greater need for systemic therapies and inhaled corticosteroids as maintenance drugs. Long COVID-19 also exacerbated respiratory difficulties and tiredness problems, highlighting the necessity of individualized treatment plans and continuous observation (Laorden *et al.*, 2023).

Clinical risks for asthmatic patients during COVID-19

According to a cohort research, COVID-19 infected 1.41% of asthmatic patients, with risk of hospitalization being higher in case of older people and those with numerous comorbidities. Biologics and inhaled corticosteroids as protective therapy lessened the severity of COVID-19. However, asthmatic patients faced additional difficulties, such as increased physical fragility and psychological stress (Izquierdo JL Ac *et al.*, 2021).

Enhanced asthma management during lockdowns

Lockdowns created a unique situation in which asthma management was enhanced. Cleaner indoor air, higher parental participation, and maintaining drug schedules improved the situation even more in case of children by having better control over symptoms. Labyad *et al.* (2024) reported that 68% of parents observed the improved conditions of their children, and no patients in controlled cases visited emergency departments. Lower exposure to outdoor allergens and pollutants was another reason for decreased exacerbation (Alaki *et al.*, 2022; Gallo *et al.*, 2020; Labyad *et al.*, 2024; Moore *et al.*, 2022; Pérez-Herrera *et al.*, 2022).

Mental health challenges

Heightened anxiety and fear of vulnerability

Asthmatic patients were more nervous during the pandemic, especially those with not well-managed conditions. Many developed 'coronaphobia', a condition marked by increased psychological suffering and social isolation because of their fear of serious COVID-19

consequences. Anxiety also affected everyday choices and mental health (Chang *et al.*, 2020; Çölkesen *et al.*, 2020; Dubey *et al.*, 2020).

Stress and anxiety due to isolation and uncertainty

Asthmatic patients felt increased stress and anxiety because of isolation and limited accessibility to medical care. Reports indicate that 61% of asthmatic patients had signs of posttraumatic stress disorder (PTSD), and 77% of them had anxiousness. Mental discomfit exacerbated the symptomatology of asthma, culminating in a vicious circle that further degraded general well-being (Chang *et al.*, 2020; Jackson *et al.*, 2023; Zhang *et al.*, 2023).

Increased vulnerability for poorly controlled asthmatic patients

During the epidemic, patients with inadequately controlled asthma had extra stress and unpredictable exacerbation. Moreover, 72% of caregivers also affirmed that they faced severe emotional pressure that often triggered a negative impact on their ability to care for asthmatics (Koujalgi and Nayak, 2022; Lai *et al.*, 2022; Perry and Margiotta, 2020; Zhang *et al.*, 2023).

Post-pandemic long-term psychological situations

Many asthmatics experienced heightened anxiety, disrupted routines, and averting healthcare facilities because of continuous fear of infection, even after easing of pandemic restrictions. More than 70% of respondents reported ongoing concern, indicating the long-term impact of the pandemic on mental health (Çölkesen *et al.*, 2020; Perry and Margiotta, 2020; Zhang *et al.*, 2023).

Role of mental health support in asthma care

During the epidemic, the need to incorporate mental health services into the treatment of asthma was underscored. Virtual therapy sessions and support groups helped in treating anxiety and gloominess in case of 77% of asthmatic patients. Improved results required holistic approaches for reducing stress, educating the patients, and support to caregivers (Davies *et al.*, 2021; de Boer *et al.*, 2021; Koujalgi and Nayak, 2022; Perry and Margiotta, 2020; Zhang *et al.*, 2023).

Social life adjustments during and after COVID-19

Dual impacts of social distancing

Asthmatic patients had mixed effects of social distancing. In children, asthma control was improved by reduced exposure to allergens and pollutants, with 32% preschoolers reporting fewer manifestations. However, telehealth consultation replaced only a small fraction of regular medical visits missed by many patients. This gap in care worsened mental health issues and hindered asthma treatment (Tyson *et al.*, 2022).

Mask-wearing: a protective but challenging measure

Masks improved the management of asthma symptoms by reducing exposure to respiratory viruses and allergens. However, several patients found it difficult to consistently stick to their masks because of discomfort from lengthy use, including skin irritation and respiratory difficulties (Polivka *et al.*, 2022; Sohn *et al.*, 2022).

Psychological and emotional strain due to social withdrawal

Increased pressure and stress**,** mainly because of pandemic-induced isolation, was experienced mainly in the younger and aged asthmatics. The feeling of isolation, loneliness, and stress became more predominant with restricted social interactions as well as changes in day-to-day life (Lai *et al.*, 2022; Serafini *et al.*, 2020).

Reduced social engagement and its long-term effects

Social interactions were restricted for asthmatic patients because of limited meetings and closure of social gatherings, causing deterioration of emotional health. Asthmatic children did not have social development similar to other normal children and felt ostracized because of lacked interaction with their peers. Elderly patients suffered loneliness because of limited mobility and vulnerability to COVID-19, which worsened their ability to engage in social activities (Chan *et al.*, 2021; Larsen *et al.*, 2022).

Perceptions of preventive measures post-COVID-19

The pandemic changed attitude toward preventive measures. Surveys reported that 61% of respondents with airway problems wanted to make use of mask mandatory across the flu season, and 47% intended to continue wearing masks indoors at public places. Such attitudes, which were more prevalent among women, older adults, and bronchiectasis patients, grew significantly during the pandemic to express increased awareness of preventive measures in reducing respiratory infections (Hurst *et al.*, 2022).

Healthcare Access and Innovations

Telemedicine and digital health tools

The pandemic accelerated the adoption of digital health tools and telemedicine in asthma care. Wearable sensors, smart inhalers, and remote monitoring enabled real-time symptom tracking and better adherence to medication. These technologies led to more personalized care and fewer unnecessary emergency department visits, particularly in case of high-risk patients (Cvietusa *et al.*, 2022; Davies *et al.*, 2021).

Telemedicine as a vital tool for asthma care

Telemedicine was considered as one of the significant resources for managing asthma throughout the pandemic. It proved fruitful in promoting medication adherence and monitoring of symptoms as well as education and counseling of patients. Altogether, 33 reviews were analyzed comprehensively (Almasi *et al.*, 2022).

Asthmatic patients who were more prone to respiratory illnesses were prioritized in the global COVID-19 vaccination campaign, thereby increasing another layer of protection from severe outcomes. In the 2022 Asthma and Allergy Foundation of America survey, 87% of asthmatic patients had at least one dose of the COVID-19 vaccine, while 77% of asthmatic patients received influenza vaccine during the 2021–2022 flu season. Age, gender, income, and urban/rural location are some of the factors that influenced vaccination rates.

The COVID-19 vaccine uptake differed by age and geography and was much more often associated with demographic characteristics of influenza vaccines. The pandemic placed flu shots in the limelight for asthmatic patients, as these shots could worsen symptoms and even trigger flare-ups. Despite inequalities, accession problems were not often cited as a barrier to vaccination, suggesting that education improved vaccination coverage and protection of asthmatic patients against respiratory illnesses (Jaffee *et al.*, 2024).

Hybrid care models for comprehensive management

An asthma management program should be hybrid, providing telemedicine combined with physical consultation on irregular basis. Although telemedicine improved outcomes, only 39.29% of patients could achieve adequate symptom control based on studies. Future models need to address these gaps by including personal as well as virtual treatment (Davies *et al.*, 2021; Perry and Margiotta, 2020).

Strengthening healthcare systems and public health strategies

The pandemic made it clear that there is a need for an even more robust telemedicine infrastructure, reliable drug supply chains, and annual flu shots. Preventive techniques, such as wearing masks and avoiding social gatherings, are effective and should be given prominence in public health activities (Filip *et al.*, 2022; Wee *et al.*, 2021).

Barriers to Healthcare Access

Similar to the pre-pandemic era, the adoption of telemedicine in disadvantaged areas was hindered by barriers such as poor Internet connectivity, low digital literacy, and restricted access to technology. Moreover, in addition to lack of digital infrastructure, asthma care was limited in rural and low-income areas because of scarcity of specialists and the cost of therapy. In such situations, strong digital infrastructure is necessary to strengthen the healthcare systems and to avoid troubles in providing prompt care for complex cases requiring in-person intervention. Therefore, investment in affordable healthcare, education, and technology is required to fill these gaps (Haleem *et al.*, 2021; Zeitouni *et al.*, 2022).

Education of patients, management of triggers, and preparation for critical situations are the strategies to eliminate disparities. Specialist programs and public health activities, such as annual immunization and preventive treatment, are mandatory for better long-term outcomes of asthma (Davies *et al.*, 2021; Haleem *et al.*, 2021; Hurst *et al.*, 2022; Khojasteh-Kaffash *et al.*, 2024; Wee *et al.*, 2021; Wellmann *et al.*, 2024).

Key Insights and Strategic Recommendations for Post-Pandemic Asthma Care

Long-term impact of COVID-19 on asthma care

The COVID-19 pandemic changed asthma care forever. Precautions, such as using masks, more telemedicine, and enhanced hygiene, helped to control asthma in a better way. Preventive therapy became particularly useful, as the measures taken decreased hospitalizations and exacerbations. Legislators revised telemedicine rules, enabling patients to use more healthcare providers and have easier access to biologic drugs. These advancements emphasized the need to integrate the experiences gained during the COVID-19 pandemic into long-term healthcare policy, especially for chronic respiratory diseases, such as asthma, in future public health crises (Cvietusa *et al.*, 2022).

Advances in post-COVID-19 asthma treatment and management

Recent studies have greatly impacted the asthma treatment. Biologic drugs, such as mepolizumab and omalizumab, have significantly better results in severe asthmatic patients who do not respond to conventional treatment (Chapman *et al.*, 2019). The integration of wearable respiratory sensors, smart inhalers, and artificial intelligence (AI)-driven technologies also

appropriated real-time monitoring of symptoms, adherence to medication, and forecasted probability of exacerbation. All these have given rise to new standards of asthma care in the scope of precision medicine and a tailored treatment plan for every patient's needs (Himes *et al.*, 2019; Honkoop *et al.*, 2022; Margam, 2024).

Patient-centered approaches in asthma care

Patient-centered care remains critical in managing asthma effectively. The application of cultural sensitivity and community-based initiatives has managed health disparities, especially among disadvantaged communities (Basnet *et al.*, 2024; Krieger *et al.*, 2005; Ramdzan, 2022; Sircar *et al.*, 2023; Wang and Nurmagambetov, 2024). Interventions, such as school-based education campaigns and community programs to cope asthma, facilitate better control of the disease (Lyon-Callo *et al.*, 2007; Ramdzan, 2022; Schneider, 2020). Psychological impacts of asthma, including anxiety and depression, require important care models to integrate mental health services. This, therefore, calls for holistic approaches to care that takes into consideration the physical and emotional aspects of the treatment (Isaacs and Mitchell, 2024; Shafran *et al.*, 2017).

Comparative analysis across geographic regions

A glimpse at asthma care across the globe reveals glaring differences in results. Low-income and rural locations are confronted by some of the major barriers, while high-income regions have sophisticated medicines, strong telemedicine systems, and access to specialized healthcare. Such challenges involve shortages of asthma specialists, infrastructural inadequacies, and high treatment costs. Investments in healthcare systems, specialized interventions to meet cultural and geographic demands, and advanced approaches, such as mobile health units and hybrid telemedicine, are necessary to bridge the gap (Barne, 2023; Codispoti *et al.*, 2022; Haynes *et al.*, 2021; Lyon-Callo *et al.*, 2007; Nwankwo *et al.*, 2024).

Discussion and Recommendations

The pandemic brought into light the value of preventive care, high-tech therapies, and precise healthcare systems for managing asthma. Future studies should examine the effectiveness of tailored interventions for all types of patients, the sustainability of digital health tools, and the role played by environmental factors in triggering asthma. Legislators need to make telemedicine infrastructure stronger, give equal access to biologic therapies, and incorporate mental health interventions into the treatment of chronic illnesses. Cooperation between physicians, researchers, and public health officials is very important to ensure that improvement in asthma treatment means better outcomes for every patient. (Caponnetto *et al.*, 2024; Chan *et al.*, 2022; Filip *et al.*, 2022; Kaplan *et al.*, 2024; Mosnaim *et al.*, 2021; Varga, 2022).

Conclusion

The COVID-19 pandemic has had a significant impact on asthma control and offered key lessons for enhancing QoL in patients. Application of preventive practices, such as universal mask-wearing and enhanced hygiene measures, resulted in a sharp decline in respiratory illnesses and asthma exacerbations. In addition, the sudden shift to the use of digital health technologies and telemedicine ensured uninterrupted care amidst the pandemic and proved their role in enhancing access and efficacy of care for managing chronic conditions.

We now have the opportunity to personalize treatments even for the most severe and intricate cases by utilizing wearable technology, AI, and innovative biologic therapies. Yet, serious gaps in accession to healthcare exist, particularly, in case of rural as well as poor. Joint efforts are required to close these gaps and on how to beef up the healthcare system, make the latest therapy available, and promote culturally acceptable care.

The pandemic also brought to light the psychological facets of asthma and the importance of incorporating mental health services into care plans. Doing so can aid in alleviating the psychological weight imposed by chronic diseases on both patients and caregivers, thus promoting the overall well-being.

The health systems must implement the lessons learnt during COVID-19 to achieve future public health resilience. It implies promoting interdisciplinary cooperation between policymakers, researchers, and healthcare practitioners to facilitate innovation and provide equal care delivery. Through investment in holistic and patient-focused interventions, we can generate lasting asthma improvement and enhance QoL in all patients.

Data Availability Statement

The dataset used in this study can be obtained by interested parties upon request.

Conflicts of Interest

The author declared no conflict of interest.

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