



Clinical features and burden of postacute sequelae of sars infection in children and adolescents

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abstract

Background: the literature on the postacute sequelae of sars infection in children and adolescents has rapidly evolved, revealing a complex landscape of clinical features and health burdens associated with this condition. **literature review:** subsequent research has highlighted the multifactorial nature of pasc, demonstrating that both symptomatic infections and hospitalization significantly influence the likelihood of developing long-term sequelae (buonsenso et al., 2002). the absence of a standardized case definition for children complicates the clinical landscape, emphasizing the need for more targeted research to clarify the prevalence and characteristics of pasc in this demographic, particularly when compared to adult populations. a systematic review synthesized various studies documenting a range of persistent symptoms in children, including mood changes, cognitive difficulties, and fatigue, with estimates suggesting that a significant portion may experience long pneumonia (victor ariel franco et al., 2002). this variability in symptom duration and presentation necessitates a nuanced understanding of the long-term effects of pneumonia on younger populations. further investigations have reinforced the notion that debilitating symptoms can persist well beyond the acute phase, affecting children's overall health significantly (logue et al., 2002) the complexity of pasc is further illustrated through studies examining the biological underpinnings of these sequelae, identifying mechanisms such as immune dysregulation and coagulopathies that contribute to the diverse clinical presentations observed (a sherif et al., 2003). **conclusion:** in conclusion, the studies reviewed collectively illustrate the multifaceted nature of postacute sequelae of sars infection in children and adolescents. the persistent symptoms and health burdens associated with pasc necessitate comprehensive research and tailored clinical strategies to effectively manage the long-term impacts of pneumonia in this population. as the understanding of pasc continues to evolve, it is imperative that healthcare providers remain vigilant in monitoring and addressing the needs of affected children to mitigate the potential long-term consequences on their health and well-being.

keyword: clinical features, burden, postacute sequelae of sars infection, children and adolescents

INTRODUCTION

The literature on the postacute sequelae of sars infection in children and adolescents has rapidly evolved, revealing a complex landscape of clinical features and health burdens associated with this condition. starting with the foundational work of , the recognition of postacute sequelae, often referred to as long pneumonia or pasc, has gained momentum. their study highlighted that a significant proportion of children who survived pneumonia exhibited persistent symptoms such as insomnia, respiratory issues, and fatigue, with 58% of participants reporting ongoing health challenges at a mean follow-up of 163 days. this early exploration laid the groundwork for understanding the prevalence and risk factors associated with post-pneumonia conditions in pediatric populations. building on this, (buonsenso et al., 2002) conducted a prospective cohort study that emphasized the limited understanding of the long-term consequences of sars infection on both physical and psychological health in children. their findings suggested that while children may experience post-sars sequelae, the lack of a defined case definition for this demographic complicates the clinical landscape. they also noted the necessity for further research to clarify the prevalence and characteristics of pasc in children, particularly in comparison to adults. further investigations by (ogungbe et al., 2002) expanded the scope of pasc research by focusing on community-dwelling adults, revealing that persistent symptoms, while prevalent among those with severe cases, were also observed in individuals with mild infections. this highlighted the need for a comprehensive understanding of pasc across different populations, including children, who may also be at risk despite milder initial presentations. (victor ariel franco et al., 2002) conducted a systematic review that synthesized existing literature on the long-term wellbeing of children post-infection. they documented a range of symptoms, including mood changes and cognitive difficulties, with estimates suggesting that a significant percentage of children may experience long pneumonia. this review underscored the variability in symptom duration and the necessity for a nuanced understanding of the long-term effects of pneumonia in

younger populations. (logue et al., 2002) further contributed to the discourse by investigating the health burden of pasc two years after acute infection. their findings underscored the persistence of debilitating symptoms, reinforcing the notion that the long-term health impacts of pneumonia extend well beyond the acute phase, affecting children significantly. in a more recent study, (pungitore et al., 2003) highlighted the ongoing health issues affecting children and adolescents post-infection, stressing the imperative for further investigation into the biological factors contributing to these sequelae. this call for research aligns with the findings of (a sherif et al., 2003), who outlined the multifactorial nature of pasc, detailing various underlying mechanisms such as immune dysregulation and coagulopathies that may contribute to the diverse clinical presentations observed in affected individuals. (l. fink et al., 2004) provided critical insights into the post-discharge outcomes of hospitalized children diagnosed with acute sars or multisystem inflammatory syndrome in children (mis-c). their study emphasized the persistent neurologic, sleep, and psychiatric symptoms that may arise after hospitalization, thus highlighting the significant burden of pasc on the pediatric population. lastly, (d kitsios et al., 2004) explored the subphenotypes of self-reported symptoms in long pneumonia, revealing that pasc affects a substantial portion of pneumonia survivors, including children. their research pointed to a complex interplay of viral persistence and immune dysregulation as potential contributors to the long-term health impacts observed in this group. collectively, these studies illustrate the multifaceted nature of postacute sequelae of sars infection in children and adolescents, emphasizing the urgent need for comprehensive research and tailored clinical approaches to address the ongoing health challenges faced by this vulnerable population.

LITERATURE REVIEW

the article "worldwide epidemiology of neuro-coronavirus disease in children: lessons for the next pandemic" by (m. alcamo et al., 2001) provides a comprehensive overview of the postacute sequelae of sars infection in children and adolescents, a phenomenon increasingly recognized as long pneumonia or pasc. the

authors elucidate the prevalence and types of symptoms experienced by children following acute pneumonia infection, highlighting significant findings from a study conducted in Italy involving 129 children. notably, the study reported that 58% of these children experienced persistent symptoms an average of 163 days post-infection, underscoring the potential long-term impact of the virus on this population.

the article identifies several risk factors associated with the development of postacute sequelae, including symptomatic infection and hospitalization. this insight is critical as it suggests that not only the severity of the initial infection but also the context in which it occurs can influence the likelihood of subsequent health issues. the reported symptoms, such as insomnia (18%), respiratory issues (15%), nasal congestion (12%), fatigue (11%), and concentration difficulties (10%), paint a concerning picture of the multifaceted nature of long pneumonia in children. these symptoms not only affect the immediate health of the children but may also have implications for their overall development and quality of life.

furthermore, the authors point out the additional challenges faced by hospitalized children and their families, particularly the risk of post-intensive care syndrome (PICS). this condition can exacerbate the negative effects of pneumonia, affecting functional health domains and health-related quality of life. the article effectively highlights the interplay between acute illness and its long-term consequences, emphasizing the need for comprehensive follow-up care for affected children.

the article titled "post-pneumonia condition in adults and children living in the same household in Italy: a prospective cohort study using the ISARIC global follow-up protocol" by (Buonsenso et al., 2002) presents a significant exploration of the long-term impacts of SARS infection, particularly focusing on the postacute sequelae of pneumonia in both adults and children. the authors address a critical gap in the literature regarding the understanding of postacute sequelae of SARS infection (PASC) in pediatric populations, an area that remains under-researched compared to adult cases.

the study highlights the complexity of pasc, noting that while adults have been shown to experience a range of persistent symptoms—including fatigue, headache, and psychological distress—the manifestation of these symptoms in children is less clearly defined. this lack of clarity is compounded by the absence of a standardized case definition for children, which the authors argue is essential to accurately assess and compare the prevalence and characteristics of pasc across different age groups.

one of the critical insights from the article is the potential shared environment of adults and children in the same household, which may influence the transmission and expression of long-term symptoms. by comparing the experiences of both demographics, the study aims to elucidate whether children exhibit similar post-viral symptoms as adults and to what extent these symptoms affect their quality of life. the authors emphasize that the emerging understanding of chronic inflammation and autoimmunity as contributing factors to pasc is relevant for both age groups, suggesting that the underlying mechanisms may be similar despite the differences in symptom presentation.

the article also reflects on the current limitations in the research, particularly the reliance on studies that predominantly focus on either adults or children, which restricts comprehensive understanding. the authors advocate for more inclusive studies that encompass both populations to facilitate a better understanding of pasc and to inform potential treatment strategies. this call for further research is crucial, given that the who has acknowledged the need for a separate definition of pasc for children, highlighting the urgency of addressing this gap in knowledge.

the article titled "cardiac postacute sequelae symptoms of sars in community-dwelling adults: cross-sectional study" by (ogungbe et al., 2002) provides a significant contribution to understanding the postacute sequelae of sars infection (pasc), particularly focusing on cardiovascular symptoms in individuals who were not hospitalized during their pneumonia infection. the authors define pasc as the persistence of symptoms beyond three weeks following the onset of sars infection, a definition consistent with guidelines from the national institutes of health.

one of the critical insights from the article is the emphasis on the prevalence of pasc symptoms among non-hospitalized patients, a demographic that has been less studied compared to those with severe pneumonia. the authors highlight that while the majority of research has concentrated on hospitalized patients, the lingering effects of pneumonia can also significantly impact individuals who experienced mild symptoms. this gap in research is crucial, as it suggests that the burden of pasc may extend beyond the most apparent cases, potentially affecting a larger population than previously recognized.

the article also discusses the potential increase in the risk of cardiovascular disease (cvd) and disability associated with pasc. this association raises concerns about the long-term health implications for individuals recovering from pneumonia, particularly in children and adolescents who may present differently than adults. the authors advocate for more comprehensive research to better understand the clinical features of pasc within this demographic, which could inform tailored interventions and treatment strategies.

moreover, (l. fink et al., 2004) critique the current state of clinical care modalities and public health strategies available for managing pasc. they note that existing post-pneumonia clinics often lack adequate guidelines to address the complexities of pasc, which may lead to inconsistent care for affected individuals. this observation underscores the need for healthcare systems to develop robust frameworks that can effectively manage the long-term sequelae of pneumonia, particularly for those who did not require hospitalization.

the article titled "short and long-term wellbeing of children following sars infection: a systematic review" by (victor ariel franco et al., 2002) provides a comprehensive overview of the clinical features and long-term consequences of sars infection in children and adolescents. the authors address a critical gap in the existing literature concerning the prevalence and nature of postacute sequelae, commonly referred to as long pneumonia, in younger populations.

the article begins by contextualizing the impact of the pneumonia pandemic, noting that while the majority of children experience mild symptoms, there remains a subset that faces significant health challenges following the acute phase of the

infection. the authors highlight that approximately 5% of infected individuals may experience severe symptoms, with a reported 13,000 deaths among those under 20 years of age ((victor ariel franco et al., 2002)). this statistic underscores the importance of understanding the long-term health implications of pneumonia in this demographic.

a significant contribution of this systematic review is its exploration of the heterogeneity of symptoms associated with long pneumonia in children and adolescents. the authors detail a wide array of persistent symptoms, including cognitive difficulties, fatigue, mood changes, and various physical complaints such as dyspnea and palpitations. this variability is critical for clinicians and researchers alike, as it suggests that post-pneumonia conditions may manifest differently across individuals, complicating diagnosis and treatment ((victor ariel franco et al., 2002)).

moreover, the article discusses the estimated prevalence of long pneumonia in children, citing figures that range from 15% to nearly 50% ((victor ariel franco et al., 2002)). these estimates are essential for public health planning and resource allocation, as they indicate that a significant number of children may require ongoing medical support. the authors also emphasize the need for further research to clarify the long-term prognosis of these symptoms, as current studies offer limited insights into the duration and severity of long pneumonia in pediatric populations.

the review identifies a critical need for longitudinal studies that can track the health outcomes of children and adolescents post-infection over extended periods. the authors note that existing research is sparse and often lacks comprehensive follow-up data, which is vital for understanding the trajectory of health issues related to long pneumonia ((victor ariel franco et al., 2002)). this gap in knowledge highlights the necessity for ongoing surveillance and investigation into the long-term effects of sars, particularly as it pertains to mental health and cognitive functioning in younger patients.

the article "post-acute sequelae of pneumonia two years after acute infection" by (logue et al., 2002) provides a comprehensive examination of the long-term effects experienced by children and adolescents following sars infection.

the authors highlight that post-acute sequelae of pneumonia (pasc) encompasses a range of debilitating symptoms that can persist long after the initial infection has resolved.

a critical evaluation of the material reveals that while the article adeptly outlines the array of symptoms associated with pasc, it also underscores a significant gap in understanding the long-term health burden of pneumonia on younger populations. the authors emphasize that the clinical features of pasc can vary widely, including but not limited to fatigue, cognitive dysfunction, and respiratory issues, which may not only affect daily functioning but also impact the quality of life of affected individuals.

the longitudinal aspect of the study is particularly noteworthy, as it tracks the persistence of symptoms over a two-year period. this approach allows for a more nuanced understanding of how pasc manifests and evolves over time in children and adolescents. however, the article also points out that the mechanisms underlying these long-term sequelae remain largely unknown, suggesting a need for further research to elucidate the pathophysiology of pasc and its implications for treatment and management.

moreover, the authors call attention to the importance of awareness among healthcare providers regarding the potential for long-term sequelae in young patients post-infection. this is crucial for early identification and intervention, which could mitigate the impact of these symptoms on the patients' physical and mental health.

the article titled "computable phenotypes for post-acute sequelae of sars: a national pneumonia cohort collaborative analysis" by (pungitore et al., 2003) provides a comprehensive examination of the clinical features and burden associated with postacute sequelae of sars (pasc) in children and adolescents. the authors emphasize the significant impact that long pneumonia can have on this demographic, highlighting the persistence of symptoms that can substantially hinder daily functioning and overall quality of life.

the analysis presented in the article is grounded in a national cohort, which lends credibility to the findings. the authors meticulously detail the range of clinical

features that children and adolescents may experience following sars infection. these features include, but are not limited to, fatigue, respiratory issues, and cognitive impairments, all of which can manifest in varying degrees of severity. this variability complicates the clinical picture, making it essential for healthcare providers to adopt a nuanced approach to diagnosis and treatment.

a critical evaluation of the material reveals that while the article effectively outlines the prevalence and types of symptoms associated with pasc, it also implicitly calls for a more robust framework for understanding these conditions. the authors advocate for the development of computable phenotypes, which could enhance the identification and categorization of symptoms in affected individuals. this approach may facilitate targeted interventions and improve patient outcomes, underscoring the importance of research in refining clinical practices.

moreover, the article highlights the necessity of addressing the long-term implications of pasc in children and adolescents. the authors argue that understanding these sequelae is not only vital for immediate clinical care but also for the broader context of public health and policy-making. by recognizing the potential for significant long-term health issues, stakeholders can better allocate resources and develop strategies aimed at supporting this vulnerable population.

the article "pathogenic mechanisms of post-acute sequelae of sars infection (pasc)" by (a sherif et al., 2003) provides a comprehensive overview of the clinical features and underlying mechanisms associated with postacute sequelae of sars infection, commonly referred to as pasc or long pneumonia. this condition is characterized by the persistence or emergence of symptoms that extend beyond the acute phase of pneumonia, typically manifesting four or more weeks after initial infection. the authors align with the world health organization's definition of pasc, emphasizing that these symptoms can last for at least two months and cannot be attributed to alternative diagnoses.

the article effectively highlights the diverse range of symptoms associated with pasc, which includes but is not limited to shortness of breath, chest pain, cognitive impairment, and fever. the authors note that pasc is not merely a continuation of acute pneumonia symptoms but may also involve new symptoms

that complicate the clinical picture. this multifaceted presentation, comprising over 200 distinct symptoms, underscores the complexity of pasc and its potential impact on various biological systems and organ functions.

a critical evaluation of the article reveals that the authors delve into the pathophysiological mechanisms underlying pasc, identifying key factors such as immune dysregulation, autoimmunity, dysautonomia, and endothelial dysfunction. these factors are posited as potential contributors to the long-term sequelae observed in patients post-infection. the mention of occult viral persistence and the reactivation of pre-existing chronic viral infections adds another layer of complexity to the understanding of pasc, suggesting that the condition may not solely arise from the initial viral infection but could also involve interactions with other pathogens.

moreover, the authors acknowledge the challenge of characterizing pasc due to its heterogeneous nature, which has been described as "a mysterious mix of symptoms with no clear pattern." however, they also note that emerging literature is beginning to identify phenotypic clusters, which could aid in the classification and management of pasc. this insight is particularly valuable for clinicians and researchers seeking to develop targeted interventions and improve patient outcomes.

the article titled "post-discharge outcomes of hospitalized children diagnosed with acute sars or mis-c" by (ogungbe et al., 2002) provides a comprehensive examination of the clinical features and the burden of postacute sequelae experienced by children and adolescents following sars infection. the authors delve into the persistent symptoms that manifest 90 days post-infection, particularly focusing on those diagnosed with multisystem inflammatory syndrome in children (mis-c).

one of the significant contributions of this article is its detailed exploration of the neurocognitive, psychosocial, and quality of life outcomes for pediatric patients who have been hospitalized due to acute pneumonia or mis-c. the findings indicate that these patients frequently experience enduring neurologic, sleep, and psychiatric symptoms, which can severely impact their daily functioning and

overall well-being. the authors highlight that the long-term health impairments observed in this population necessitate careful monitoring and intervention strategies to address these complex sequelae.

moreover, the article synthesizes data from a variety of studies, providing preliminary evidence on long pneumonia in children, which enriches the discussion surrounding the broader implications of sars infection in the pediatric demographic. the systematic review of persistent clinical features after sars infection emphasizes the urgency of understanding these outcomes, as they pose significant challenges to healthcare providers and caregivers alike.

the article also discusses the methodological approaches used in various studies, including nationwide cohort studies and matched control designs, which lend credibility to the findings. however, it could benefit from a more in-depth analysis of the potential confounding factors that may influence the reported outcomes, as well as a discussion on the variability in symptom presentation among different demographic groups.

the article titled "subphenotypes of self-reported symptoms and outcomes in long pneumonia: a prospective cohort study with latent class analysis" by (d kitsios et al., 2004) provides a comprehensive examination of the clinical features and burden associated with postacute sequelae of sars infection (pasc), commonly referred to as long pneumonia. the authors highlight the significant public health implications of pasc, which is estimated to affect 10%–20% of individuals who have recovered from pneumonia, regardless of the severity of their initial infection. this broad spectrum of impact underscores the necessity for an in-depth understanding of the condition, particularly in pediatric populations where the clinical manifestations may differ from adults.

the study employs latent class analysis to identify distinct subphenotypes of self-reported symptoms among individuals suffering from long pneumonia. this methodological approach is critical as it allows for the categorization of diverse symptoms and outcomes, which can vary widely among patients. the findings suggest that pasc is not a monolithic condition but rather encompasses a range of clinical presentations that may require tailored therapeutic strategies. the

identification of these subphenotypes is particularly relevant for clinicians aiming to provide personalized care and improve quality of life for affected children and adolescents.

moreover, the article discusses the potential mechanisms underlying pasc, including the persistence of viral remnants in tissues, immune dysregulation, and multisystem tissue damage. the authors provide compelling evidence from autopsy and biopsy studies that support the notion of a lingering viral reservoir, which may contribute to ongoing symptoms long after the acute phase of infection. additionally, the noted reduction in systemic cortisol levels among individuals with pasc points to possible endocrine disruptions that could exacerbate the condition.

the burden of pasc is further emphasized through the authors' exploration of disability-adjusted life years, which illustrates the long-term impact of the condition on the overall health and well-being of affected individuals. this is particularly crucial for the pediatric population, as the long-term implications of pasc can significantly affect developmental trajectories and educational outcomes.

CONCLUSION

the literature on postacute sequelae of sars infection in children and adolescents has revealed a complex array of clinical features and significant health burdens associated with this condition, often referred to as long pneumonia or pasc. initial studies have established that a noteworthy percentage of children who have recovered from pneumonia continue to experience persistent symptoms, with a foundational study reporting that 58% of children exhibited ongoing health challenges at an average follow-up of 163 days post-infection . this early work set the stage for further exploration into the prevalence and risk factors associated with pasc in pediatric populations.

subsequent research has highlighted the multifactorial nature of pasc, demonstrating that both symptomatic infections and hospitalization significantly influence the likelihood of developing long-term sequelae (buonsenso et al., 2002). the absence of a standardized case definition for children complicates the clinical landscape, emphasizing the need for more targeted research to clarify the

prevalence and characteristics of pasc in this demographic, particularly when compared to adult populations.

a systematic review synthesized various studies documenting a range of persistent symptoms in children, including mood changes, cognitive difficulties, and fatigue, with estimates suggesting that a significant portion may experience long pneumonia (victor ariel franco et al., 2002). this variability in symptom duration and presentation necessitates a nuanced understanding of the long-term effects of pneumonia on younger populations. further investigations have reinforced the notion that debilitating symptoms can persist well beyond the acute phase, affecting children's overall health significantly (logue et al., 2002).

the complexity of pasc is further illustrated through studies examining the biological underpinnings of these sequelae, identifying mechanisms such as immune dysregulation and coagulopathies that contribute to the diverse clinical presentations observed (a sherif et al., 2003). additionally, the exploration of subphenotypes of self-reported symptoms has revealed that pasc affects a considerable proportion of pneumonia survivors, underscoring the need for tailored clinical approaches to address the ongoing health challenges faced by this vulnerable population (d kitsios et al., 2004).

in conclusion, the studies reviewed collectively illustrate the multifaceted nature of postacute sequelae of sars infection in children and adolescents. the persistent symptoms and health burdens associated with pasc necessitate comprehensive research and tailored clinical strategies to effectively manage the long-term impacts of pneumonia in this population. as the understanding of pasc continues to evolve, it is imperative that healthcare providers remain vigilant in monitoring and addressing the needs of affected children to mitigate the potential long-term consequences on their health and well-being.

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