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Editorial Board Member of *World Journal of Orthopedics*, Byron Chalidis, MD, PhD, Assistant Professor, The First Orthopaedic Department, Aristotle University of Thessaloniki, Thessaloniki 57010, Greece.  
byronchalidis@gmail.com

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## Investigating clubfoot in Saudi Arabia: Prevalence, factors, and future directions

Chun-Han Cheng, Wen-Rui Hao, Tzu-Hung Cheng

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**Chun-Han Cheng**, Department of Medical Education, Linkou Chang Gung Memorial Hospital, Taoyuan 33305, Taiwan

**Wen-Rui Hao**, Division of Cardiology, Department of Internal Medicine, Shuang Ho Hospital, Ministry of Health and Welfare, Taipei Medical University, New Taipei 23561, Taiwan

**Wen-Rui Hao**, Division of Cardiology, Department of Internal Medicine, School of Medicine, College of Medicine, Taipei Medical University, Taipei 11002, Taiwan

**Tzu-Hung Cheng**, Department of Biochemistry, School of Medicine, College of Medicine, China Medical University, Taichung 404328, Taiwan

**Co-corresponding authors:** Wen-Rui Hao and Tzu-Hung Cheng.

**Corresponding author:** Tzu-Hung Cheng, PhD, Professor, Department of Biochemistry, School of Medicine, College of Medicine, China Medical University, No. 91 Xueshi Road, North District, Taichung 404328, Taiwan. [thcheng@mail.cmu.edu.tw](mailto:thcheng@mail.cmu.edu.tw)

### Abstract

This editorial discusses the significant findings and implications of the study conducted by Alomran *et al.* This retrospective study, soon to be published, provides valuable insights into the epidemiology of and risk factors associated with clubfoot in a specific Saudi population. By highlighting the study's key outcomes and discussing its broader implications for public health and clinical practices, this editorial aims to underscore the importance of continued research and targeted interventions in addressing congenital deformities such as clubfoot.

**Key Words:** Clubfoot prevalence; Saudi Arabia; Congenital deformities; Retrospective study; Orthopedic epidemiology

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**Core Tip:** This editorial highlights the critical findings from the study conducted by Alomran *et al.*, which examined the prevalence of and factors associated with clubfoot in the eastern province of Saudi Arabia. The study's retrospective analysis provides valuable epidemiological data and identifies key risk factors, offering insights for health-care providers and policy-makers. By addressing the significance of these findings, this editorial underscores the need for targeted interventions and continued research to improve the management and prevention of congenital deformities such as clubfoot.

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## INTRODUCTION

Clubfoot, medically known as congenital talipes equinovarus, is a prevalent congenital deformity characterized by the inward and downward twisting of the foot; it strongly affects mobility and quality of life[1]. In a recent hospital-based retrospective study, Alomran *et al*[1] extensively analyzed the prevalence of and factors associated with clubfoot in the eastern province of Saudi Arabia[1]. Their research provides crucial insights into the epidemiology and determinants of this condition within a specific regional context. Their results revealed a notable occurrence of clubfoot within the region, underscoring the public health burden of this congenital deformity[1]. This analysis informs health-care providers and policymakers regarding the effective allocation of resources to develop targeted interventions for early diagnosis and treatment. Understanding the prevalence of clubfoot is crucial in ensuring timely access to specialized care and improving long-term outcomes for affected individuals. Moreover, insights from other studies highlight the complexity of clubfoot management and its influence on patient outcomes. Gelfer *et al*[2] emphasized the high rate of relapse among patients with idiopathic clubfoot and the adverse effects of this condition on clinical and quality-of-life outcomes. Similarly, genetic studies by Charng *et al*[3] and Huang *et al*[4] have highlighted the genetic basis of clubfoot, suggesting potential avenues for personalized treatment. National register data from Sweden[5] and local experiences from pediatric tertiary centers in Abha, Saudi Arabia[6], have provided additional perspectives on treatment strategies and outcomes, highlighting regional variation and the importance of tailored health care. By integrating findings from the aforementioned studies, this editorial enhances the understanding of the multifaceted nature of clubfoot, from epidemiology and genetic predisposition to clinical management and public health implications. Such insights are pivotal in shaping comprehensive strategies aimed at improving outcomes and quality of life for individuals affected by clubfoot in Saudi Arabia and beyond.

## ASSOCIATED RISK FACTORS

Identifying and understanding the risk factors associated with clubfoot are imperative for developing effective preventive strategies against clubfoot. In their study, Alomran *et al*[1] identified several key factors linked to this congenital deformity in the eastern province of Saudi Arabia. These factors are genetic predispositions, maternal health conditions, and environmental influences, all of which contribute significantly to the prevalence and severity of clubfoot in the aforementioned region. Additional studies have highlighted other critical risk factors. For instance, Johansson *et al*[5] emphasized the importance of considering maternal health and prenatal care in understanding the prevalence and outcomes of clubfoot. Insights from the CoCo study conducted by Gelfer *et al*[2] highlight the challenges associated with relapse in cases of idiopathic clubfoot; they emphasized the importance of early detection and comprehensive treatment protocols to mitigate long-term complications[2]. Genetic studies, such as those by Charng *et al*[3] and Huang *et al*[4], have identified specific genes and mutations associated with clubfoot, offering potential avenues for genetic screening and personalized therapeutic approaches. These insights underscore the need for tailored intervention strategies, particularly in populations in which the prevalence of clubfoot is high. The regional analysis conducted by Alomran *et al*[1] provides a foundation for future research and public health initiatives aimed at reducing the incidence of clubfoot through targeted education and health-care interventions. Through integration of their findings into broader health-care strategies, the complex interplay of genetic, environmental, and maternal factors contributing to the prevalence of clubfoot, both in Saudi Arabia and the world, can be effectively addressed. Overall, the comprehensive analysis of associated risk factors conducted by Alomran *et al*[1] considerably enhances our epidemiological understanding of clubfoot and can inform targeted efforts to improve early detection, intervention, and overall outcomes.

## CLINICAL IMPLICATIONS AND MANAGEMENT

Alomran *et al*[1] revealed a significant prevalence of clubfoot in the eastern province of Saudi Arabia: 5.3 cases per 1000 live births (42 out of 7792 births from 2015 to 2023). This finding has several critical clinical implications for managing this

congenital condition. Early detection through routine prenatal screening and postnatal examinations is essential for effectively addressing cases of clubfoot. Early identification enables timely intervention, which is crucial for minimizing the long-term complications associated with untreated clubfoot. This aligns with the findings of Gelfer *et al*[2], which emphasize the challenges of relapse and poorer clinical outcomes in idiopathic clubfoot cases. Furthermore, Alomran *et al* [1] highlighted the necessity of standardized treatment protocols and the availability of specialized care facilities. These elements are vital for ensuring optimal outcomes and reducing the burden of disability associated with clubfoot. Standardized protocols can streamline the treatment process, making it more efficient and effective, whereas specialized care facilities ensure that patients receive the best possible treatment tailored to their needs. Genetic research also contributes substantially to the management of clubfoot. The identification of genes such as *HOXD12* (homeobox D12) opens the door to personalized treatment approaches based on genetic profiles[3]. A personalized approach can lead to more targeted and effective treatment, potentially improving the prognosis of patients with clubfoot. In summary, the findings of Alomran *et al*[1] emphasize the importance of early detection, standardized treatment protocols, and specialized care facilities and the potential of personalized treatments based on genetic research. These strategies are essential for improving clinical outcomes and managing clubfoot effectively in the eastern province of Saudi Arabia and beyond.

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## PUBLIC HEALTH AND POLICY CONSIDERATIONS

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In the context of maternal health, Suarez *et al*[7] emphasized the significance of understanding medication risks during pregnancy because medication use during pregnancy can affect the development and severity of congenital conditions such as clubfoot. This underscores the necessity for comprehensive prenatal care that includes screening for both genetic predispositions and environmental factors that could affect fetal development. Alomran *et al*[1] advocated for a holistic approach in which clinical management is improved through early detection and intervention and health-care policies are aimed at enhancing access to specialized care and implementing effective preventive strategies. By integrating the literature findings into clinical practice, health-care providers can significantly enhance the quality of life of individuals with clubfoot. Also crucial are multidisciplinary collaboration and ongoing research to optimize outcomes. Recent studies, such as that conducted by Gelfer *et al*[2], have indicated that a considerable percentage of patients with idiopathic clubfoot experience relapse, which affects clinical outcomes and quality of life[2]. This finding underscores the need for continual follow-up and adaptive treatment strategies. Johansson *et al*[5] further reported the importance of early and standardized treatment protocols, which were shown to be effective in reducing relapse rates and improving long-term outcomes. From a public health perspective, the study by Alomran *et al*[1] underscores the imperative for comprehensive health-care policies addressing congenital deformities such as clubfoot. These findings advocate for enhancing access to prenatal and postnatal care to facilitate early detection and intervention, thereby aligning with global efforts to improve outcomes for affected individuals[2,5]. By integrating standardized screening protocols into national health programs, policymakers can promote the timely identification of clubfoot, which is crucial for initiating appropriate treatment and minimizing long-term complications[8]. Furthermore, raising awareness about clubfoot among health-care providers and the general public is essential for promoting early diagnosis and improving treatment outcomes[3]. This should include educating families about available treatment options and the importance of high adherence to therapy regimens, which can mitigate the risk of relapse and enhance quality of life[9]. Additionally, insights from genetic studies, such as the identification of *HOXD12* as a disease gene[3], underscore the potential for personalized treatment approaches based on genetic profiles, thereby optimizing clinical management strategies. Overall, the effective incorporation of these strategies into public health policies will not only support the well-being of individuals with clubfoot but also contribute to the broader health-care goals of reducing disability and improving quality of life. By prioritizing early intervention, raising awareness, and integrating specialized care into health-care systems, policymakers can mitigate the societal burden of clubfoot while enabling equitable access to comprehensive health-care services.

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## LIMITATIONS AND IMPORTANCE OF CLUBFOOT TREATMENT

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Large strides have been made in the management of clubfoot, but several limitations and challenges remain. One major issue is the variation in treatment outcomes; approximately 37% of patients with idiopathic clubfoot experience relapse, which adversely affects clinical results and quality of life[2]. This variation underscores the need for ongoing research to refine treatment strategies and elucidate the causes of relapse. Access to specialized care is another challenge. Walani *et al* [10] emphasized the global difficulties related to congenital anomalies, including clubfoot, noting that disparities in access to surgical care and follow-up treatment can lead to delayed or inadequate management. This issue highlights the necessity for more equitable distribution of resources and improved health-care infrastructure to ensure timely and effective treatment. Adherence to treatment protocols, particularly in the Ponseti method, is crucial for achieving optimal outcomes. Research indicates that noncompliance with orthotic use is a frequent problem contributing to relapse and poor outcomes[11]. Addressing adherence challenges is vital for enhancing the success of nonsurgical treatments. Despite these limitations, the importance of effective clubfoot treatment cannot be overstated. The Ponseti method remains the gold standard for initial treatment, having been demonstrated to be effective in correcting deformities and minimizing the need for surgical interventions[3,5]. However, successful outcomes depend on early diagnosis and rigorous adherence to treatment protocols. Advancements in clubfoot management are promising. Emerging research highlights the potential of personalized treatment plans based on genetic profiles to improve patient outcomes[3,4]. Additionally, innovation

regarding surgical techniques and postoperative care is expected to enhance outcomes and reduce relapse rates[12,13]. These advancements, coupled with efforts to increase access to specialized care and support adherence to treatment, will be crucial in overcoming the current challenges and achieving better outcomes for patients with clubfoot.

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## FUTURE RESEARCH DIRECTIONS

The study conducted by Alomran *et al*[1] opens avenues for advancing research in the field of congenital deformities, particularly clubfoot. Future investigations must delve deeper into the intricate interaction between genetic predisposition and environmental factors that contributes to the pathogenesis of clubfoot[3]. Insights gained from genetic studies underscore the potential for elucidating underlying genetic mechanisms that influence the development and severity of clubfoot[3,4]. Moreover, longitudinal studies are needed that comprehensively evaluate the long-term efficacy and outcomes of various treatment modalities for clubfoot[2,5]. Such studies are crucial for refining existing treatment protocols and developing more personalized management strategies that cater to the diverse clinical presentations and needs of patients with clubfoot[8]. Expanding research efforts to include large-scale epidemiological studies could further enhance our understanding of the global burden of clubfoot and facilitate implementation of targeted public health interventions[9]. Such initiatives are essential for informing health-care policies aiming to improve access to specialized care, optimize treatment outcomes, and ultimately reduce the socioeconomic impact of clubfoot on affected individuals and their families[6,7]. Overall, research in genetic, epidemiological, and treatment domains is pivotal for advancing the field of clubfoot management. By utilizing multidisciplinary research approaches and fostering international collaborations, future studies can contribute to the development of innovative therapeutic strategies and improve overall patient care and outcomes.

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## CONCLUSION

The study conducted by Alomran *et al*[1] provides crucial insights into the prevalence of and factors associated with clubfoot in the eastern province of Saudi Arabia. This editorial highlights their findings' significance and profound implications for public health and clinical practice. Understanding the prevalence of clubfoot and identifying the associated risk factors are fundamental steps in the quest to develop targeted interventions aimed at improving patient outcomes. Continued research efforts are imperative to advance the understanding of clubfoot. Future investigations should focus on exploring the genetic underpinnings of clubfoot, as highlighted by recent studies that identified *HOXD12* as a novel disease gene[3,4]. Additionally, longitudinal studies are needed to evaluate the effectiveness of various treatment modalities and to develop personalized management strategies tailored to various patient profiles[2,5]. Enhancing early detection, treatment, and prevention strategies through collaborative efforts among health-care providers, researchers, and policymakers is essential. Clubfoot's impact on affected individuals and their families can be mitigated by addressing its genetic, environmental, and clinical dimensions. Collaborative initiatives can advance the scientific knowledge and contribute to improving health outcomes and enhancing the quality of life of individuals with clubfoot worldwide.

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## FOOTNOTES

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**Country of origin:** Taiwan

**ORCID number:** Tzu-Hung Cheng 0000-0002-9155-4169.

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