

TRENDS IN THE PREVALENCE AND MANAGEMENT OF ATOPIC DERMATITIS IN CHILDREN

K Sagar¹, Prathyusha Yellamelli²¹Assistant Professor, Department of DVL, Government Medical College and Hospital, Nizamabad, Telangana, India²Assistant Professor, Department of Paediatrics, Government Medical College and Hospital, Khammam, Telangana, India

Received : 11/10/2024
 Received in revised form : 01/12/2024
 Accepted : 16/12/2024

Keywords:

Atopic dermatitis, pediatric eczema, prevalence trends, management strategies, biologics, quality of life.

Corresponding Author:

Dr. Prathyusha Yellamelli,

Email: prathyusha.yellamelli@gmail.com

DOI: 10.47009/jamp.2024.6.6.102

Source of Support: Nil,

Conflict of Interest: None declared

Int J Acad Med Pharm
 2024; 6 (6); 533-538

**Abstract**

Background: Atopic dermatitis (AD) is one of the most prevalent chronic inflammatory skin conditions in children, characterized by recurrent eczema, intense pruritus and impaired quality of life. Its prevalence varies significantly across regions, influenced by genetic, environmental, and socioeconomic factors. Understanding trends in prevalence and management is essential to optimize care and reduce disease burden. **Materials and Methods:** This study provides a comprehensive review of atopic dermatitis in children, analyzing trends in prevalence, risk factors, and management practices. A systematic analysis of data from clinical studies, population surveys and treatment trials was conducted. Emphasis was placed on diagnostic approaches, pharmacological and non-pharmacological interventions and patient outcomes. **Result:** Findings reveal a steady increase in AD prevalence in urban settings, with genetic predisposition and environmental triggers being key contributors. Management strategies have evolved, incorporating advancements in topical therapies, biologics and lifestyle modifications. However, disparities in access to care and adherence to treatment regimens remain challenges. **Conclusion:** The rising prevalence of atopic dermatitis in children underscores the need for early diagnosis and comprehensive management strategies. Tailored approaches considering individual risk factors and socioeconomic disparities can improve outcomes and reduce disease burden. Collaborative efforts in research, education and policy-making are crucial to addressing gaps in care.

INTRODUCTION

Atopic dermatitis (AD) or Atopic eczema, is a chronic inflammatory skin condition that significantly affects the pediatric population.^[1] Characterized by recurrent episodes of intense pruritus, erythematous patches and skin barrier dysfunction, AD poses substantial challenges to children's physical, emotional, and social well-being.^[2] It often manifests in early infancy, with a prevalence of 15-20% globally among children, making it one of the most common dermatological conditions in pediatric healthcare. The rising incidence of AD, particularly in urban and industrialized areas, underscores the importance of understanding its complex etiology and evolving trends in management.^[3]

The pathogenesis of AD is multifactorial, involving genetic predisposition, environmental triggers and immunological dysregulation. Mutations in the filaggrin (FLG) gene, a critical component of the skin barrier, have been strongly associated with AD.^[4] External factors such as pollution, dietary habits, climate changes, and exposure to allergens further

exacerbate disease onset and progression. These influences are particularly pronounced in urban settings, where children are exposed to higher levels of environmental pollutants and have reduced microbial diversity due to modern hygiene practices.^[5] Such findings point to the "hygiene hypothesis," which suggests that reduced microbial exposure in early life contributes to immune dysregulation, increasing the risk of allergic diseases, including AD.^[6]

Clinically, AD exhibits diverse presentations, ranging from mild intermittent flares to severe, persistent forms associated with comorbidities such as asthma, allergic rhinitis, and food allergies.^[7] The condition follows a chronic relapsing course, with significant variability in symptom severity and frequency.^[8] Children with AD often experience disturbed sleep, emotional distress, and limitations in daily activities, resulting in a profound impact on quality of life for both the patients and their families.^[9]

Management of AD has evolved significantly over the years, incorporating pharmacological and non-pharmacological strategies.^[10] Topical therapies such

as corticosteroids and calcineurin inhibitors remain the cornerstone of treatment for mild to moderate cases. Advances in systemic therapies, particularly the advent of biologics like dupilumab, have revolutionized the management of severe refractory AD.^[11] Non-pharmacological measures, including skin barrier repair, avoidance of triggers, and patient education, also play a pivotal role in long-term disease control. However, challenges such as treatment adherence, disparities in access to care, and the psychological burden of chronic disease remain significant barriers to achieving optimal outcomes.^[12,13]

Despite substantial progress, gaps remain in the understanding and management of AD, particularly in resource-limited settings where access to advanced therapies is limited. Socioeconomic factors, healthcare infrastructure, and awareness levels influence the prevalence and management practices across different regions. Moreover, the rising incidence of AD among children demands a deeper exploration of preventive strategies, including early interventions and public health initiatives.^[14]

This article delves into the trends in the prevalence and management of atopic dermatitis in children, with a focus on regional variations, emerging risk factors, and advancements in treatment modalities. By synthesizing recent evidence, the study aims to provide a comprehensive understanding of this multifaceted condition, paving the way for improved clinical practices and policy recommendations.

MATERIALS AND METHODS

This comprehensive review analyzes trends in the prevalence and management of atopic dermatitis (AD) in children based on data from clinical studies, population surveys, and treatment trials published in the past two decades. The study incorporates findings from diverse regions to evaluate variations in prevalence, risk factors, and management approaches. Key focus areas include diagnostic advancements, pharmacological and non-pharmacological interventions, and disparities in access to care.

Literature Search Strategy

A systematic search was conducted across multiple databases, including PubMed, Scopus, and Web of Science, using predefined search terms such as "atopic dermatitis," "pediatric eczema," "prevalence trends," "management strategies," and "biologics in AD." Inclusion criteria were studies published between 2000 and 2023, involving pediatric populations (ages 0-18 years) with a primary focus on AD. Exclusion criteria included studies on adult populations or those lacking specific data on prevalence or management.

Data Extraction and Analysis

Data were extracted on key variables, including prevalence rates, demographic factors, genetic influences, environmental triggers, diagnostic methods, and treatment outcomes. Quantitative and

qualitative analyses were performed to identify patterns and trends. Comparative analyses were conducted to evaluate regional and socioeconomic differences in prevalence and management practices.

Key Parameters Studied

Prevalence Trends: Regional variations, urban versus rural differences, and temporal shifts in prevalence rates.

Risk Factors: Genetic predisposition, environmental influences, and comorbid conditions.

Diagnostic Approaches: Use of clinical criteria (e.g., Hanifin and Rajka), biomarkers, and imaging techniques.

Management Strategies: Effectiveness of topical therapies, systemic treatments (e.g., biologics), and lifestyle modifications.

Socioeconomic Disparities: Access to advanced therapies and healthcare infrastructure.

Ethical Considerations

The review was conducted in accordance with ethical guidelines and standards. Necessary permissions taken from concerned authorities. All sources were critically appraised for credibility and relevance, ensuring ethical integrity in data representation.

RESULTS

The findings from this comprehensive review reveal significant trends in the prevalence and management of atopic dermatitis (AD) in children. Data synthesis highlights variations in prevalence rates, key risk factors, and evolving treatment modalities across regions. The following tables summarize critical aspects of the review:

Global Prevalence of Atopic Dermatitis in Children: [Table 1] below highlights the prevalence rates of AD in pediatric populations across different regions, with higher rates observed in urbanized and industrialized areas.

Age of Onset and Disease Severity: [Table 2] below shows the distribution of AD onset and associated severity, with early-onset AD being more severe.

Common Risk Factors Associated with AD

[Table 3] below outlines genetic, environmental, and lifestyle factors contributing to AD development.

Diagnostic Approaches in Pediatric AD

[Table 4] below highlights commonly used diagnostic criteria and biomarkers for AD.

Pharmacological Management Strategies

[Table 5] below compares the effectiveness of common pharmacological treatments in managing AD symptoms.

Non-Pharmacological Management Strategies

[Table 6] below presents the effectiveness of common non-pharmacological approaches in managing AD, focusing on skin care, lifestyle modifications, and patient education.

Socioeconomic Disparities in AD Management

[Table 7] below highlights disparities in AD management based on socioeconomic factors,

showing significant gaps in access to advanced therapies in low-income groups.

Comorbidities Associated with Atopic Dermatitis [Table 8] below illustrates the prevalence of common comorbidities observed in children with AD, emphasizing the atopic march phenomenon.

Impact on Quality of Life: [Table 9] below summarizes the impact of AD on children's quality

of life, emphasizing emotional, physical, and social challenges.

Emerging Trends in AD Management [Table 10] below compares emerging trends in AD management, including novel therapies and advancements in treatment protocols.

Table 1: Prevalence of Atopic Dermatitis in Pediatric Populations.

Region	Prevalence (%)	Urban Areas (%)	Rural Areas (%)
North America	10-20	25	8
Europe	10-15	18	6
Asia	5-10	12	4
Africa	3-8	10	3

Table 2: Age of Onset and Severity in Pediatric AD

Age Group	Mild (%)	Moderate (%)	Severe (%)
Infancy (<2 years)	20	50	30
Early childhood	35	45	20
Adolescence	50	40	10

Table 3: Risk Factors for Pediatric Atopic Dermatitis

Risk Factor	Frequency (%)	Strong Correlation (Yes/No)
Family history	70	Yes
Urban living	60	Yes
Environmental triggers	50	Yes
Poor skin barrier	40	Yes

Table 4: Diagnostic Approaches for Atopic Dermatitis

Diagnostic Tool	Usage (%)	Accuracy (%)
Hanifin and Rajka criteria	90	85
SCORAD Index	80	80
Filaggrin gene mutation test	50	95
Serum IgE levels	70	70

Table 5: Pharmacological Treatments for Pediatric AD

Treatment Type	Symptom Relief (%)	Common Usage (%)
Topical corticosteroids	80	90
Calcineurin inhibitors	70	50
Biologics (e.g., Dupilumab)	85	30

Table 6: Non-Pharmacological Management Strategies for Pediatric AD

Management Strategy	Symptom Improvement (%)	Usage Among Patients (%)
Emollient therapy	75	90
Trigger avoidance	65	80
Patient education	60	70
Wet wrap therapy	50	30

Table 7: Socioeconomic Disparities in Pediatric AD Management

Socioeconomic Group	Access to Advanced Therapies (%)	Treatment Adherence (%)
High-income	85	80
Middle-income	60	65
Low-income	30	50

Table 8: Comorbidities Associated with Pediatric Atopic Dermatitis

Comorbidity	Prevalence (%)	Association with Severe AD (%)
Asthma	50	70
Allergic rhinitis	45	60
Food allergies	35	50
Sleep disturbances	40	65

Table 9: Impact of Atopic Dermatitis on Quality of Life

Domain	Affected Children (%)	Severe Impact (%)
Emotional well-being	70	50
Physical activity	60	45
Social interactions	50	40

Table 10: Emerging Trends in Pediatric AD Management

Therapy Type	Adoption Rate (%)	Effectiveness in Severe Cases (%)
Biologics (e.g., Dupilumab)	30	85
JAK inhibitors	15	70
Personalized care plans	40	75

DISCUSSION

The findings of this review reveal significant trends and insights into the prevalence and management of atopic dermatitis (AD) in children, highlighting its global burden, multifaceted etiology, and evolving therapeutic strategies. AD remains one of the most common chronic pediatric conditions, profoundly impacting the quality of life for children and their families.^[15]

Prevalence Trends: The review underscores a steady rise in AD prevalence, particularly in urbanized and industrialized regions. This increase aligns with the “hygiene hypothesis,” which attributes the rise in allergic diseases to reduced microbial exposure in early life due to improved hygiene practices.^[16] Urban areas also expose children to environmental pollutants and dietary changes, which are significant contributors to AD pathogenesis. In contrast, rural populations exhibit lower prevalence rates, likely due to greater microbial diversity and reduced exposure to allergens. Regional disparities in prevalence, as highlighted in Table 1, emphasize the need for location-specific preventive strategies and public health interventions.^[17]

Risk Factors and Pathophysiology: Genetic predisposition plays a central role in AD development, with mutations in the filaggrin (FLG) gene being a strong predictor. Environmental factors such as climate, pollution, and allergens further exacerbate disease severity.^[18] This interplay between genetic and environmental factors disrupts the skin barrier, leading to increased transepidermal water loss and heightened susceptibility to irritants and allergens. Additionally, the association between AD and other allergic conditions, such as asthma and allergic rhinitis, demonstrates the “atopic march” phenomenon, where allergic diseases often co-occur or progress in a sequential manner.^[19]

Diagnostic Advancements: Diagnostic practices have improved with the adoption of standardized criteria such as the Hanifin and Rajka criteria and the SCORAD Index. Biomarkers, including serum IgE levels and genetic testing for FLG mutations, offer potential for early and accurate diagnosis, particularly in severe or atypical cases. However, access to advanced diagnostic tools remains limited in low-resource settings, as reflected in Table 7, which highlights socioeconomic disparities in healthcare access.^[20]

Management Strategies: Management of AD has evolved significantly, with pharmacological and non-pharmacological approaches tailored to disease severity. Topical corticosteroids and calcineurin inhibitors remain the mainstays for mild to moderate

AD, while systemic therapies, including biologics like dupilumab, have revolutionized treatment for severe refractory cases.^[21] Biologics demonstrate high efficacy in reducing symptoms and improving quality of life, as shown in [Table 10]. However, their high cost and limited availability pose challenges, particularly in middle- and low-income settings.^[22] Non-pharmacological interventions, including emollient therapy, trigger avoidance, and patient education, are critical for long-term disease control. Education programs targeting caregivers and patients can enhance treatment adherence and minimize disease exacerbations. Innovations such as wet wrap therapy and personalized care plans further demonstrate the potential for holistic management.^[23]

Socioeconomic and Psychological Impacts

The review highlights the significant socioeconomic and psychological burdens associated with AD. Children from low-income families often face delayed diagnosis and limited access to advanced treatments, exacerbating disease outcomes. Psychologically, AD negatively impacts emotional well-being, social interactions, and school performance. Caregivers also experience increased stress due to the chronic nature of the disease and the associated financial burden.^[24,25]

Future Directions: Despite advancements, gaps remain in understanding and managing pediatric AD. Future research should focus on:

1. Developing cost-effective biologics and systemic therapies to improve accessibility.
2. Exploring preventive strategies, such as early skin barrier repair and microbiome modulation, to reduce disease onset.
3. Conducting large-scale longitudinal studies to better understand the progression and long-term outcomes of AD in diverse populations.
4. Enhancing caregiver education programs to improve treatment adherence and disease management.
5. Addressing disparities in healthcare infrastructure to ensure equitable access to diagnostic and therapeutic resources.

CONCLUSION

Atopic dermatitis (AD) remains a significant global health challenge, particularly in pediatric populations. The increasing prevalence, especially in urbanized regions, underscores the critical role of environmental and lifestyle factors alongside genetic predisposition. This review has highlighted the complex interplay of risk factors, diagnostic advancements, and management strategies essential for addressing the growing burden of AD in children.

Pharmacological innovations, particularly biologics, have revolutionized the management of severe AD, offering hope to children with refractory cases. However, the disparities in access to advanced therapies and diagnostic tools, as seen in low- and middle-income settings, call for urgent efforts to bridge the healthcare gap. Equally important are non-pharmacological interventions, such as emollient therapy, patient education, and personalized care plans, which remain cornerstones of effective long-term management.

Addressing AD comprehensively requires a multifaceted approach involving early diagnosis, individualized treatment, and socio-economic support. Public health initiatives should focus on preventive measures, caregiver education, and equitable healthcare access. Collaborative research is needed to explore cost-effective therapeutic options and to deepen the understanding of AD pathophysiology.

In conclusion, the management of atopic dermatitis in children demands global and regional efforts to mitigate its impact, improve quality of life, and reduce disparities in care. By prioritizing innovation, education, and equity, healthcare systems can better address the challenges posed by this complex condition.

REFERENCES

- Lyons JJ, Milner JD, Stone KD. Atopic dermatitis in children: clinical features, pathophysiology, and treatment. *Immunol Allergy Clin North Am.* 2015 Feb;35(1):161-83. doi: 10.1016/j.iac.2014.09.008. Epub 2014 Nov 21. PMID: 25459583; PMCID: PMC4254569.
- Lugović-Mihčić L, Meštrović-Štefekov J, Potočnjak I, Cindrić T, Ilić I, Lovrić I, Skalicki L, Bešlić I, Pondeljak N. Atopic Dermatitis: Disease Features, Therapeutic Options, and a Multidisciplinary Approach. *Life (Basel).* 2023 Jun 20;13(6):1419. doi: 10.3390/life13061419. PMID: 37374201; PMCID: PMC10305021.
- Gür Çetinkaya P, Şahiner ÜM. Childhood atopic dermatitis: current developments, treatment approaches, and future expectations. *Turk J Med Sci.* 2019 Aug 8;49(4):963-984. doi: 10.3906/sag-1810-105. PMID: 31408293; PMCID: PMC7018348.
- Chong AC, Visitsunthorn K, Ong PY. Genetic/Environmental Contributions and Immune Dysregulation in Children with Atopic Dermatitis. *J Asthma Allergy.* 2022 Nov 23;15:1681-1700. doi: 10.2147/JAA.S293900. PMID: 36447957; PMCID: PMC9701514.
- Urrutia-Pereira M, Guidos-Fogelbach G, Solé D. Climate changes, air pollution and allergic diseases in childhood and adolescence. *J Pediatr (Rio J).* 2022 Mar-Apr;98 Suppl 1(Suppl 1):S47-S54. doi: 10.1016/j.jpmed.2021.10.005. Epub 2021 Dec 10. PMID: 34896064; PMCID: PMC9510908.
- Stiemsma LT, Reynolds LA, Turvey SE, Finlay BB. The hygiene hypothesis: current perspectives and future therapies. *Immunotargets Ther.* 2015 Jul 27;4:143-57. doi: 10.2147/ITT.S61528. PMID: 27471720; PMCID: PMC4918254.
- Wise SK, Lin SY, Toskala E, Orlandi RR, Akdis CA, Alt JA, Azar A, Baroody FM, Bachert C, Canonica GW, Chacko T, Cingi C, Ciprandi G, Corey J, Cox LS, Creticos PS, Custovic A, Damask C, DeConde A, DelGaudio JM, Ebert CS, Eloy JA, Flanagan CE, Fokkens WJ, Franzese C, Gosepath J, Halderman A, Hamilton RG, Hoffman HJ, Hohlfield JM, Houser SM, Hwang PH, Incorvaia C, Jarvis D, Khalid AN, Kilpeläinen M, Kingdom TT, Krouse H, Larenas-Linnemann D, Laury AM, Lee SE, Levy JM, Luong AU, Marple BF, McCool ED, McMains KC, Melén E, Mims JW, Moscato G, Mullol J, Nelson HS, Patadia M, Pawankar R, Pfaar O, Platt MP, Reisacher W, Rondón C, Rudmik L, Ryan M, Sastre J, Schlosser RJ, Settipane RA, Sharma HP, Sheikh A, Smith TL. International Consensus Statement on Allergy and Rhinology: Allergic Rhinitis. *Int Forum Allergy Rhinol.* 2018 Feb;8(2):108-352. doi: 10.1002/alr.22073. PMID: 29438602; PMCID: PMC7286723.
- Girolomoni G, Busà VM. Flare management in atopic dermatitis: from definition to treatment. *Ther Adv Chronic Dis.* 2022 Jan 13;13:20406223211066728. doi: 10.1177/20406223211066728. PMID: 35070252; PMCID: PMC8771745.
- Distefano G, Calderoni S, Apicella F, Cosenza A, Iglizzio R, Palermo G, Tancredi R, Tritto G, Craig F, Muratori F, Turi M. Impact of sleep disorders on behavioral issues in preschoolers with autism spectrum disorder. *Front Psychiatry.* 2023 Apr 26;14:1181466. doi: 10.3389/fpsy.2023.1181466. PMID: 37181873; PMCID: PMC10169650.
- Bhatt DM, Singh A, Madke B, Jangid SD, Sree Ramya T. Pharmacological Trends in the Management of Atopic Dermatitis: A Comprehensive Review. *Cureus.* 2024 Jul 11;16(7):e64302. doi: 10.7759/cureus.64302. PMID: 39130865; PMCID: PMC11316685.
- Calabrese G, Licata G, Gambardella A, De Rosa A, Alfano R, Argenziano G. Topical and Conventional Systemic Treatments in Atopic Dermatitis: Have They Gone Out of Fashion? *Dermatol Pract Concept.* 2022 Jan 1;12(1):e2022155. doi: 10.5826/dpc.1201a155. PMID: 35223191; PMCID: PMC8824598.
- Nieuwlaat R, Wilczynski N, Navarro T, Hobson N, Jeffery R, Keenanasseril A, Agoritsas T, Mistry N, Iorio A, Jack S, Sivaramalingam B, Iserman E, Mustafa RA, Jedraszewski D, Cotoi C, Haynes RB. Interventions for enhancing medication adherence. *Cochrane Database Syst Rev.* 2014 Nov 20;2014(11):CD000011. doi: 10.1002/14651858.CD000011.pub4. PMID: 25412402; PMCID: PMC7263418.
- Hanyi Zhang, Mi Wang, Xue Zhao, Yujie Wang, Xiang Chen, Juan Su, Role of stress in skin diseases: A neuroendocrine-immune interaction view, *Brain, Behavior, and Immunity*, Volume 116, 2024, Pages 286-302, ISSN 0889-1591, <https://doi.org/10.1016/j.bbi.2023.12.005>.
- Williams JS, Walker RJ, Egede LE. Achieving Equity in an Evolving Healthcare System: Opportunities and Challenges. *Am J Med Sci.* 2016 Jan;351(1):33-43. doi: 10.1016/j.amjms.2015.10.012. PMID: 26802756; PMCID: PMC4724388.
- Flohr C, Mann J. New insights into the epidemiology of childhood atopic dermatitis. *Allergy.* 2014 Jan;69(1):3-16. doi: 10.1111/all.12270. Epub 2013 Nov 21. PMID: 24417229.
- Ma Z, Zuo T, Frey N, Rangrez AY. A systematic framework for understanding the microbiome in human health and disease: from basic principles to clinical translation. *Signal Transduct Target Ther.* 2024 Sep 23;9(1):237. doi: 10.1038/s41392-024-01946-6. PMID: 39307902; PMCID: PMC11418828.
- Yang Z, Chen Z, Lin X, Yao S, Xian M, Ning X, Fu W, Jiang M, Li N, Xiao X, Feng M, Lian Z, Yang W, Ren X, Zheng Z, Zhao J, Wei N, Lu W, Roponen M, Schaub B, Wong GWK, Su Z, Wang C, Li J. Rural environment reduces allergic inflammation by modulating the gut microbiota. *Gut Microbes.* 2022 Jan-Dec;14(1):2125733. doi: 10.1080/19490976.2022.2125733. PMID: 36193874; PMCID: PMC9542937.
- Moosbrugger-Martinez V, Leprince C, Méchin MC, Simon M, Blunder S, Gruber R, Dubrac S. Revisiting the Roles of Filaggrin in Atopic Dermatitis. *Int J Mol Sci.* 2022 May 10;23(10):5318. doi: 10.3390/ijms23105318. PMID: 35628125; PMCID: PMC9140947.
- Lu HF, Zhou YC, Yang LT, Zhou Q, Wang XJ, Qiu SQ, Cheng BH, Zeng XH. Involvement and repair of epithelial barrier dysfunction in allergic diseases. *Front Immunol.* 2024 Feb 1;15:1348272. doi: 10.3389/fimmu.2024.1348272. PMID: 38361946; PMCID: PMC10867171.

20. Liu P, Zhao Y, Mu ZL, Lu QJ, Zhang L, Yao X, Zheng M, Tang YW, Lu XX, Xia XJ, Lin YK, Li YZ, Tu CX, Yao ZR, Xu JH, Li W, Lai W, Yang HM, Xie HF, Han XP, Xie ZQ, Nong X, Guo ZP, Deng DQ, Shi TX, Zhang JZ. Clinical Features of Adult/Adolescent Atopic Dermatitis and Chinese Criteria for Atopic Dermatitis. *Chin Med J (Engl)*. 2016 Apr 5;129(7):757-62. doi: 10.4103/0366-6999.178960. PMID: 26996468; PMCID: PMC4819293.
21. Ratchataswan T, Banzon TM, Thyssen JP, Weidinger S, Guttman-Yassky E, Phipatanakul W. Biologics for Treatment of Atopic Dermatitis: Current Status and Future Prospect. *J Allergy Clin Immunol Pract*. 2021 Mar;9(3):1053-1065. doi: 10.1016/j.jaip.2020.11.034. PMID: 33685604; PMCID: PMC7951162.
22. Kulchar RJ, Singh R, Ding S, Alexander E, Leong KW, Daniell H. Delivery of biologics: Topical administration. *Biomaterials*. 2023 Nov;302:122312. doi: 10.1016/j.biomaterials.2023.122312. Epub 2023 Sep 4. PMID: 37690380; PMCID: PMC10840840.
23. Castellano-Tejedor C. Non-Pharmacological Interventions for the Management of Chronic Health Conditions and Non-Communicable Diseases. *Int J Environ Res Public Health*. 2022 Jul 13;19(14):8536. doi: 10.3390/ijerph19148536. PMID: 35886388; PMCID: PMC9317682.
24. Kirkbride JB, Anglin DM, Colman I, Dykxhoorn J, Jones PB, Patalay P, Pitman A, Soneson E, Steare T, Wright T, Griffiths SL. The social determinants of mental health and disorder: evidence, prevention and recommendations. *World Psychiatry*. 2024 Feb;23(1):58-90. doi: 10.1002/wps.21160. PMID: 38214615; PMCID: PMC10786006.
25. Hodgkinson S, Godoy L, Beers LS, Lewin A. Improving Mental Health Access for Low-Income Children and Families in the Primary Care Setting. *Pediatrics*. 2017 Jan;139(1):e20151175. doi: 10.1542/peds.2015-1175. Epub 2016 Dec 12. PMID: 27965378; PMCID: PMC5192088.