

Barriers to Utilization of Metered Dose Inhaler (MDI) Therapy of Inhaled Corticosteroid (ICS) and Bronchodilator in Pediatric Asthma Management: A Cross-sectional Study in Gandaki Province of Nepal

Dr. Deepak Raj Paudel^{1*}; Dr. Ram Hari Chapagain²; Dr. Anil Kumar Shrestha³; Dr. Dipak Kumar Gupta⁴

Dr. Amrita Ghimire⁵; Dr. Dinesh Kumar Lamsal⁶; Gita Devi Ghimire⁷

¹Senior Consultant Pediatrician at GP Koirala National Centre for Respiratory Diseases, Tanahun, Gandaki, Nepal
(During Period of doing Research Study)

²Chief Consultant Pediatrician, Kanti Children's Hospital, Kathmandu, Nepal/Associate Professor, Department of Pediatrics, National Academy of Medical Sciences(NAMS), Kathmandu, Nepal

³Senior Consultant Pediatrician, Kanti Children's Hospital, Kathmandu, Nepal/Assistant Professor, Department of Pediatrics, National Academy of Medical Sciences(NAMS), Kathmandu, Nepal

⁴Professor, Pediatric Department, JMCTH, Janakpur, TU, Nepal

⁵Associate Professor, Department of Pediatrics, Pokhara Academy of Health Sciences(PAHS), Pokhara, Nepal

⁶Professor, HOD at Emergency Department, Civil Service Hospital, Minbhawan, Kathmandu, Nepal

⁷Assistant Professor, Pokhara Nursing Campus, TU, Nepal

Correspondence Author:- Dr. Deepak Raj Paudel^{1*}

Email Address: deepak79727@gmail.com

Mobile Phone: +977.9813299320

Day-Time Phone: +977.9813299320

Evening-Time Phone: +977.9813299320

Address:- Shuklagandaki Municipality 10, Khairenitar, Tanahun, Gandaki, 33912, Nepal

Website: <https://www.deepakrp.com.np/>

Abstract:-

➤ Introduction:

Effective pediatric asthma management relies on the proper utilization of Metered Dose Inhalers (MDIs), yet multiple barriers can hinder this. This study aims to identify and assess the key barriers to MDI utilization in pediatric asthma management in both urban and rural settings of Gandaki Province, Nepal.

➤ Methods:

A cross-sectional study was conducted with 171 pediatric asthma patients. Data were collected through structured questionnaires, examining educational, economic, healthcare infrastructure, cultural, social, and technical barriers. The association between residence (urban vs. rural) and these barriers was analyzed using Chi-square tests.

➤ Results:

The study sample consisted of 53% children aged 1-5 years, 64.9% males, and 59.6% from urban areas. Educational barriers were prevalent, with 27.5% of participants lacking knowledge of MDI use and 28.1%

having no formal education on childhood asthma and MDIs. Economic barriers, particularly limited health insurance coverage (28.1%) and high costs of inhalers (24.0%), were prominent in both settings. Rural areas faced greater challenges with healthcare infrastructure, including lack of availability of MDIs (22.8%), long distances to healthcare facilities (18.7%), and limited access to specialized care (18.7%). Cultural factors, such as preference for traditional medicine (16.4%), were also more significant in rural areas. Chi-square analysis revealed significant differences between urban and rural areas for several barriers, including inadequate knowledge of MDI use ($p=0.024$), difficulty affording regular usage ($p=0.038$), lack of availability of MDIs ($p=0.001$), long distances to healthcare ($p=0.0006$), and preference for traditional medicine ($p=0.009$).

➤ Conclusions:

Rural populations face more pronounced barriers to MDI utilization, particularly regarding healthcare access and cultural preferences. Tailored interventions addressing both economic and infrastructural issues in rural areas, along with educational programs in both

urban and rural settings, are necessary to improve pediatric asthma management.

Keywords:- Pediatric Asthma, Barriers, Rural Healthcare, Urban Healthcare, Healthcare Infrastructure, Cultural Factors, Economic Barriers.

I. INTRODUCTION

Asthma is a common chronic respiratory disease that affects children globally.¹ Characterized by airway inflammation, hyperreactivity, and reversible airflow obstruction, asthma presents a significant health burden, especially in low- and middle-income countries (LMICs).² Nepal, an LMIC, reports a substantial prevalence of asthma in its pediatric population, with a study noting that 12.7% of children experience symptoms of bronchial asthma.³ Inhaled corticosteroid (ICS) and bronchodilator, delivered via metered-dose inhalers (MDIs), are considered the cornerstone of asthma management.¹ Despite their effectiveness, many children in Nepal do not benefit from these therapies due to various barriers.⁴ The underutilization of MDIs contributes to poor asthma control, frequent exacerbations, and increased healthcare costs.¹

In Nepal, where healthcare infrastructure is still developing, understanding the specific barriers to MDI utilization in pediatric asthma management is crucial for improving outcomes.^{5,6,7} This study focuses on Gandaki Province, where access to healthcare facilities and specialized asthma care remains a challenge for many families. In particular, GP Koirala National Centre for Respiratory Diseases and Hospital, a leading institution in respiratory care, serves as the setting for this study.

While previous research has identified economic, educational, and healthcare access challenges in asthma management globally, few studies have examined these issues within the Nepalese context.^{4,6,7,8} This study aims to fill this gap by exploring the barriers to the utilization of MDI therapy in children with asthma in Gandaki Province. The findings are expected to guide healthcare policymakers in developing interventions that improve asthma management and MDI adherence in pediatric patients.

II. METHODS

➤ Study Design and Setting

This cross-sectional study was conducted from April 16, 2023, to November 2023 at GP Koirala National Centre for Respiratory Diseases and Hospital in Tanahun, Gandaki Province, Nepal. This facility is a key healthcare provider in the region, offering specialized services for respiratory conditions, including pediatric asthma.

➤ Study Population

The study included pediatric patients aged 1 to 14 years diagnosed with asthma, along with their legal guardians. Participants were selected through convenience sampling from the pediatric department of the hospital from both

outpatient and emergency. Patients with comorbid respiratory conditions other than asthma were excluded.

➤ Sample Size Determination

The sample size was calculated based on a 12.7% prevalence of pediatric asthma,³ a 95% confidence interval, and a 5% margin of error, resulting in a required sample of 171 participants. The formula for calculating sample size in population studies is:

$$n = \frac{Z^2 \cdot p \cdot (1 - p)}{d^2}$$

Where:

- n is the required sample size.
- Z is the Z-value corresponding to the desired confidence level (for 95% confidence, $Z = 1.96$).
- p is the estimated prevalence (12.7%, or 0.127 in decimal form).
- d is the margin of error (5%, or 0.05 in decimal form).

➤ Data Collection Instruments

Two structured questionnaires were developed to gather information on demographic variables and barriers to MDI utilization from legal guardian. The first questionnaire focused on demographic details, including age, gender and residence. The second questionnaire explored economic, educational, healthcare infrastructure, cultural and social; and technical barriers to MDI use.

➤ Demographic Information Questionnaire

This section collected the following data:

- Age of the child
- Gender
- Residence (urban/rural)

➤ Barriers to MDI Utilization Questionnaire

This section was divided into five categories: economic, educational, healthcare infrastructure, cultural and social; and technical barriers. Respondents rated each barrier using multiple-choice questions.

➤ Data Analysis

Data were analyzed by using SPSS version 23. Barriers were categorized and ranked according to their frequency in the population. The association between residence (urban vs. rural) and each category of barriers to Metered Dose Inhaler (MDI) utilization, was determined by using Chi-square test. The p -value < 0.05 is significant association.

➤ Ethical Considerations

Ethical approval for the study was obtained from the Institutional Review Committee (IRC) of GP Koirala National Centre for Respiratory Diseases and Hospital, Tanahun, Gandaki, Nepal on 2023/04/15 (reference number 172).

III. RESULTS

➤ Demographic Profile of Participants

The demographic table provides an overview of the participants in the study. Out of a total sample size of 171 children, the majority (53%) belong to the 1-5 years age

group, followed by 32% in the 6-10 years group, and 15% in the 11-14 years group. Regarding gender distribution, 64.9% of the participants are male, and 35.1% are female. In terms of residence, 59.6% of the children come from urban areas, while 40.4% reside in rural areas.

Table 1 Shows the Distribution of Demographic Variables

Demographic Variable	Category	Frequency (n)	Percentage (%)
Total Sample Size		171	100%
Age Group	1-5 years	91	53%
	6-10 years	55	32%
	11-14 years	25	15%
Gender	Male	111	64.9%
	Female	60	35.1%
Residence	Urban	102	59.6%
	Rural	69	40.4%

➤ Barriers to MDI Utilization

• Educational Barriers

A significant portion of the population (25.7%-28.1%) lacks awareness about childhood asthma and proper MDI use, with rural areas showing slightly higher rates of formal education and misconceptions about MDI dependency compared to urban areas.

Table 2 Educational Barriers to MDI Utilization

Barrier	Urban (n=102)	Rural (n=69)	Total (n=171)	Percentage (%)
Lack of Awareness about Childhood Asthma	28	16	44	25.7%
Inadequate Knowledge of MDI Use	35	12	47	27.5%
No Formal Education/Training on Childhood Asthma and MDI	30	18	48	28.1%
Misconceptions about MDI Dependency	20	15	35	20.5%

• Economic Barriers

High cost, limited insurance coverage, and difficulty in affording regular use of MDIs affect a significant proportion of the population, with 28.1% of families reporting limited health insurance coverage and 24.0% indicating a high cost of inhalers.

Table 3 Economic Barriers to MDI Utilization

Barrier	Urban (n=102)	Rural (n=69)	Total (n=171)	Percentage (%)
High Cost of Inhalers	22	19	41	24.0%
Limited Health Insurance Coverage	28	20	48	28.1%
Difficulty in Affording Regular Usage	15	20	35	20.5%

• Healthcare Infrastructure Barriers

Rural areas face a greater challenge in accessing MDIs (22.8%) and specialized care (18.7%), with long distances to healthcare facilities reported by 18.7% of participants, especially in rural settings.

Table 4 Healthcare Infrastructure Barriers to MDI Utilization

Barrier	Urban (n=102)	Rural (n=69)	Total (n=171)	Percentage (%)
Lack of Availability of MDIs	14	25	39	22.8%
Long Distance to Healthcare Facilities	10	22	32	18.7%
Limited Access to Specialized Care	12	20	32	18.7%

• Cultural and Social Barriers

There is a notable reliance on traditional medicine (16.4%) and social stigma related to inhaler use (14.6%), with both rural and urban populations affected similarly.

Table 5 Cultural and Social Barriers to MDI Utilization

Barrier	Urban (n=102)	Rural (n=69)	Total (n=171)	Percentage (%)
Stigma Associated with Inhaler Use	13	12	25	14.6%
Preference for Traditional Medicine	10	18	28	16.4%
Belief in Temporary Nature of Asthma	12	16	28	16.4%
Fear of Medication Dependency	11	10	21	12.3%

- *Technical Barriers*

Issues such as difficulty in proper inhaler technique (8.8%) and lack of access to spacers or aids (7.6%) were less frequently reported but are still significant, especially in rural areas.

Table 6 Technical Barriers to MDI Utilization

Barrier	Urban (n=102)	Rural (n=69)	Total (n=171)	Percentage (%)
Difficulty in Proper Inhaler Technique	6	9	15	8.8%
No Access to Spacers or Other Aids	5	8	13	7.6%
Confusion with Multiple Medications	7	5	12	7.0%

- *Top 5 Barriers Identified in Urban and Rural Regions*

Urban areas struggle mostly with high costs and lack of knowledge about MDIs. Rural areas face problems with

accessing MDIs, long travel distances to healthcare, and cultural preferences for traditional medicine. Different strategies are needed to address these issues in each setting.

Table 7 Top 5 Barriers Identified in Urban and Rural Regions

Rank	Urban Barriers (n=102)	Rural Barriers (n=69)
1	High cost of inhalers	Lack of availability of MDI in local pharmacies
2	Limited health insurance coverage	Long distance to healthcare facilities
3	Inadequate knowledge of MDI use	Difficulty in affording regular MDI usage
4	Lack of awareness about childhood asthma	No formal education/training on childhood asthma and MDI
5	Misconceptions about MDI dependency	Preference for traditional medicine

- *The Association between Residence (Urban vs. Rural) and each Category of Barriers to Metered Dose Inhaler (MDI) Utilization*

The Chi-square test shows significant differences between urban and rural groups in several barriers. Rural areas are more affected by inadequate knowledge of MDI use, difficulty affording regular usage, lack of availability of

MDIs, long distances to healthcare, limited access to specialized care, and a preference for traditional medicine. Other barriers, such as lack of awareness about childhood asthma, misconceptions, stigma, and technical challenges, do not show significant differences between urban and rural areas. These results highlight that rural populations face greater infrastructure and economic challenges in MDI utilization.

Table 8 Showing the Chi-Square Test Results for the Association between Residence (Urban vs. Rural) and each Category of Barriers to Metered Dose Inhaler (MDI) Utilization

Barrier	Chi-Square Value	p-value	Interpretation
Educational Barriers			
Lack of Awareness about Childhood Asthma	0.200	0.655	No significant difference between urban and rural groups.
Inadequate Knowledge of MDI Use	5.095	0.024	Significant difference between urban and rural groups.
No Formal Education/Training on Childhood Asthma and MDI	0.091	0.763	No significant difference.
Misconceptions about MDI Dependency	0.021	0.884	No significant difference.
Economic Barriers			
High Cost of Inhalers	0.510	0.475	No significant difference.
Limited Health Insurance Coverage	0.002	0.964	No significant difference.
Difficulty in Affording Regular Usage	4.316	0.038	Significant difference.
Healthcare Infrastructure Barriers			
Lack of Availability of MDIs	10.598	0.001	Significant difference.
Long Distance to Healthcare Facilities	11.780	0.0006	Significant difference.
Limited Access to Specialized Care	6.932	0.008	Significant difference.
Cultural and Social Barriers			
Stigma Associated with Inhaler Use	0.388	0.533	No significant difference.
Preference for Traditional Medicine	6.825	0.009	Significant difference.
Belief in Temporary Nature of Asthma	3.133	0.077	No significant difference.
Fear of Medication Dependency	0.238	0.626	No significant difference.
Technical Barriers			
Difficulty in Proper Inhaler Technique	1.819	0.177	No significant difference.
No Access to Spacers or Other Aids	1.758	0.185	No significant difference.
Confusion with Multiple Medications	0.000	1.000	No significant difference.

IV. DISCUSSION

The findings of this study highlight the multifaceted barriers to the utilization of Metered Dose Inhaler (MDI) therapy in pediatric asthma management in Gandaki Province, Nepal.

Educational barriers were significant, with a substantial portion of caregivers lacking awareness about childhood asthma and the correct use of MDIs. This lack of knowledge was slightly more prevalent in rural areas. The findings underscore the urgent need for targeted educational programs that address misconceptions, such as the belief in the temporary nature of asthma and the fear of medication dependency, which contributes to suboptimal treatment adherence. Similar to findings in other low- and middle-income countries (LMICs), asthma in Nepal is often misunderstood as an acute condition rather than a chronic one, leading to inconsistent MDI use and poor asthma control.

Economic barriers played a critical role, with nearly one-quarter of participants reporting high costs of inhalers and inadequate health insurance coverage. While the urban population struggled more with financial barriers related to inhaler costs and limited health insurance, rural populations faced additional challenges, such as difficulty in affording regular MDI use. These findings highlight the need for financial policies aimed at reducing the cost burden on families. Expanding health insurance to cover asthma medications and implementing government subsidies could significantly reduce economic constraints.

Healthcare infrastructure barriers were more pronounced in rural areas, where participants reported a lack of availability of MDIs in local pharmacies and long distances to healthcare facilities. The absence of specialized asthma care and training for healthcare providers in these areas further exacerbates the issue. These findings align with global research from LMICs, where rural populations often face significant access challenges in managing chronic conditions like asthma. Improving the distribution of MDIs and incorporating asthma management into primary healthcare services are crucial steps to overcoming these barriers.

Cultural and social barriers emerged as key factors, particularly in rural settings. A preference for traditional medicine and the social stigma attached to inhaler use were common issues. Rural participants were more likely to rely on traditional remedies and believe in the temporary nature of asthma, reflecting deep-rooted cultural perceptions about health and medicine. These attitudes hinder the adoption of modern asthma treatments, underscoring the need for culturally competent healthcare interventions. Community-based educational campaigns that promote the benefits of modern asthma treatments and counter misconceptions are essential to shifting cultural attitudes and reducing stigma.

Technical barriers, while less frequently reported, were still notable. Difficulty in mastering proper inhaler technique and limited access to spacers or aids, especially in rural areas, can reduce the effectiveness of MDI therapy.

Confusion with managing multiple medications also poses a significant challenge for families. These findings highlight the importance of providing practical training and support to ensure correct MDI use.

Mortimer K, Reddel HK, Pitrez PM, et al.⁴ focus on the global unavailability and unaffordability of essential inhaled medications like ICS, advocating for an ICS–formoterol inhaler approach to reduce reliance on short-acting β_2 -agonists. Our study in Nepal similarly identifies barriers like high inhaler costs, lack of MDI knowledge, and limited healthcare access, especially in rural areas. Both studies highlight challenges in pediatric asthma management in low- and middle-income countries. Both underscore the need for cost-effective interventions and improved healthcare infrastructure to enhance asthma care, with Mortimer et al. urging global action and our study providing localized evidence for targeted interventions in LMIC settings like Nepal.

Asher et al.'s study from the Global Asthma Network Phase I examines worldwide trends in asthma symptoms among school-aged children, highlighting significant global disparities in asthma burden.⁹ Their findings emphasize regional differences in asthma prevalence and symptom severity, particularly in low- and middle-income countries (LMICs). Our study in Nepal echoes these disparities by identifying key barriers to MDI use, including economic constraints, lack of education, and poor healthcare infrastructure. While Asher et al. focus on symptom trends globally, our study delves into specific barriers affecting asthma management in pediatric patients, particularly in rural settings of Nepal.

Singh et al.'s study discusses the challenges of pediatric asthma management in low-resource settings, emphasizing issues like inadequate healthcare infrastructure, lack of awareness, and limited access to essential medications such as inhaled corticosteroids.¹⁰ These findings align closely with our study, which also highlights barriers in healthcare access, education, and economic constraints, particularly in rural areas of Nepal. Both studies point to a significant gap in the availability of MDIs and specialized care for pediatric asthma. While Singh et al. address the broader context of low-resource settings, our study focuses specifically on the Gandaki Province and MDI utilization challenges.

Kandel et al.'s study on the utilization of MDIs in pediatric asthma in Nepal highlights similar barriers to those identified in our research, such as inadequate education on proper inhaler use, high costs, and limited availability of MDIs, particularly in rural areas.¹¹ Both studies emphasize the economic and healthcare infrastructure challenges that hinder effective asthma management. However, while Kandel et al. focus on the general utilization of MDIs in pediatric asthma, our study provides a more detailed comparison between urban and rural settings in Gandaki Province, analyzing specific barriers like cultural preferences for traditional medicine and long travel distances to healthcare facilities.

Mehta et al. (2019) focused on technical challenges in MDI use in pediatric asthma, highlighting improper inhaler technique and lack of access to spacers as major issues, which aligns with our study's findings.¹² Both studies recognize these technical difficulties, particularly in rural settings. However, while Mehta et al. concentrate solely on the technical aspects, our study offers a broader view, examining additional barriers like economic, educational, and healthcare infrastructure issues that contribute to MDI underutilization in Nepal.

Shrestha et al. (2020) examined factors influencing asthma control in Nepali children, emphasizing the role of environmental triggers, medication adherence, and healthcare access.¹³ While both studies identify similar barriers, such as limited access to proper medications, our study extends these findings by focusing specifically on the underutilization of MDIs in pediatric asthma management. Additionally, our research highlights educational gaps and affordability as key barriers, providing a more comprehensive view of challenges specific to MDI use in Nepal.

Vyas et al. (2021) explored the economic impact of childhood asthma across South Asia, emphasizing the high financial burden on families due to direct and indirect healthcare costs.¹⁴ While both studies address economic challenges, our research specifically highlights the cost-related barriers to MDI utilization in pediatric asthma management in Nepal. We focus on the affordability and availability of MDIs, adding a nuanced perspective on the specific challenges of accessing effective inhaler therapy in resource-limited settings.

Tackett et al.¹⁵(2021) examine racial/ethnic disparities in pediatric asthma management, highlighting the importance of asthma knowledge, symptom assessment, and family-provider collaboration in improving asthma outcomes. Their findings emphasize how socio-cultural factors affect asthma care. Our study in Nepal similarly identifies barriers to asthma management, particularly in MDI utilization, with a focus on lack of awareness and training. While Tackett's study highlights racial/ethnic dynamics, ours focuses on resource limitations in low-income settings, but both stress the need for better education and collaboration in pediatric asthma care.

Soto-Martínez et al.¹⁶ (2020) discuss childhood asthma from the perspective of low- and middle-income countries (LMICs), focusing on challenges such as limited access to medications, inadequate health infrastructure, and lack of education on asthma management. Similarly, our study highlights the barriers to the utilization of MDIs in pediatric asthma management in Nepal, particularly due to poor awareness and insufficient training. Both studies stress the need for improving access to essential treatments and promoting education to enhance asthma care in LMICs, including effective inhaler use.

Lakhanpaul et al.¹⁷ (2014) provide a systematic review of barriers and facilitators to asthma management in South Asian children, emphasizing factors like socioeconomic

challenges, healthcare access, and cultural beliefs. Our study complements these findings by identifying specific barriers to MDI utilization in pediatric asthma in Nepal, including economic constraints, limited healthcare infrastructure, and educational gaps. Both studies highlight the need for targeted interventions addressing these barriers to improve asthma management in South Asian contexts.

Gupta et al.¹⁸ (2020) explore cultural perceptions of asthma in South Asia, focusing on how traditional beliefs and stigma impact asthma management. Our study similarly identifies cultural barriers in Nepal, such as preferences for traditional medicine and social stigma, which hinder effective MDI utilization. Both studies underscore the need to address cultural perceptions and integrate educational strategies into asthma management programs to improve adherence and outcomes in South Asian populations.

Khatri D, et al.¹⁹ (2020) investigate financial barriers to asthma treatment in Nepal, highlighting issues like high medication costs and limited insurance coverage. Our study aligns with these findings, showing significant economic barriers including the high cost of MDIs and inadequate health insurance. Both studies emphasize the urgent need for financial support and policy reforms to alleviate these economic challenges, ensuring better access to effective asthma treatments in Nepal.

Joshi A, et al.²⁰ (2019) focus on healthcare barriers to asthma care in rural Nepal, highlighting challenges such as limited access to healthcare facilities and lack of specialized care. Our study corroborates these findings, revealing that rural areas face significant barriers, including long distances to healthcare facilities and limited access to MDIs. Both studies underscore the need for improved healthcare infrastructure and targeted interventions in rural settings to enhance asthma management and access to care.

Tiwari D, et al.²¹(2021) examine healthcare access and its effects on asthma management in Nepal, emphasizing issues like inadequate healthcare infrastructure and limited access to medications. Our study supports these findings, highlighting similar challenges, particularly in rural areas, such as long distances to healthcare facilities and limited availability of MDIs. Both studies illustrate the critical need for improved healthcare access and infrastructure to enhance asthma management and outcomes in Nepal.

Pradhan B et al.²² (2020) focus on the economic burden of asthma in Nepal, highlighting high costs and limited insurance coverage as major financial barriers. Our study corroborates these findings, detailing economic obstacles like high inhaler costs and inadequate insurance coverage affecting both urban and rural areas. While Pradhan et al. emphasize the financial impact, our study further explores how these economic challenges interact with other barriers, including healthcare infrastructure and education, affecting overall asthma management.

Jha R, et al.²³ (2021) identify significant gaps in asthma education in Nepal, including inadequate training for healthcare providers and low awareness among patients. Our study aligns with these findings, highlighting educational barriers such as lack of awareness about childhood asthma and insufficient training for both healthcare providers and patients. While Jha et al. emphasize the need for improved educational programs, our research explores specific aspects of these barriers, including their impact on metered dose inhaler (MDI) utilization and asthma management.

Lee JH, et al.²⁴ (2020) discuss the barriers to asthma management in low-income countries, emphasizing factors like limited access to medications, lack of healthcare infrastructure, and inadequate patient education. Similarly, our study identifies key barriers to effective asthma management in Nepal, particularly focusing on the underutilization of metered dose inhalers (MDIs) due to insufficient training and awareness about childhood asthma. While both studies highlight systemic and educational obstacles, our research provides specific insights into MDI use in pediatric populations, complementing Lee et al.'s broader focus on access and infrastructure issues.

The World Bank's 2021 report highlights limited healthcare coverage and high out-of-pocket costs in Nepal.²⁵ Our study similarly identifies financial barriers to effective pediatric asthma management, particularly in MDI utilization. Both emphasize economic challenges, though the World Bank focuses broadly on healthcare, while our study is asthma-specific.

Devkota B, et al.²⁶ (2021) highlight the limited accessibility of respiratory medications in Nepal, particularly inhaled corticosteroids (ICS) and bronchodilators, due to availability and affordability issues. Our study similarly identifies barriers to metered dose inhaler (MDI) utilization in pediatric asthma management, particularly due to high costs and limited access. Both studies emphasize the need for improved availability and affordability of essential asthma medications to enhance asthma care in Nepal, especially in low-resource settings where accessibility challenges persist.

The *National Guidelines for Asthma Management* (2020) highlight challenges in adherence and access to asthma medications in Nepal.²⁷ Our study aligns with these findings, noting barriers such as cost, limited awareness, and poor MDI training in pediatric asthma care. Both stress the need for better education and access to improve asthma management.

McDonald K, et al.²⁸ (2019) emphasize the positive impact of educational interventions on asthma outcomes in low- and middle-income countries (LMICs), highlighting improved disease management and patient outcomes. Our study similarly identifies educational barriers, particularly inadequate training on MDI use and asthma management in Nepalese children. Both studies advocate for increased asthma education as a critical strategy for improving asthma control, though our research focuses specifically on pediatric populations and the unique challenges in Nepal.

V. RECOMMENDATIONS

Based on these findings, several strategies are recommended to improve MDI utilization in pediatric asthma management in Gandaki Province:

- **Education and Awareness Programs:** Initiatives should focus on raising awareness about childhood asthma and the chronic nature of the condition. Caregivers and patients need regular education on the importance of MDI therapy and proper inhaler technique, especially in rural areas where misconceptions are prevalent.
- **Financial Support and Insurance Expansion:** The government should explore policies that expand health insurance coverage to include asthma medications. Introducing subsidies or voucher programs could make MDIs more affordable, particularly for low-income families who struggle with the financial burden of asthma management.
- **Improved Healthcare Infrastructure:** Ensuring that MDIs and asthma care services are readily available in rural pharmacies and healthcare facilities is critical. Equipping primary healthcare centers with asthma management tools and training healthcare providers in asthma protocols can bridge the healthcare access gap in rural areas.
- **Cultural Competence in Healthcare Delivery:** Healthcare providers should be trained to address cultural beliefs and misconceptions about asthma and inhaler use. Community outreach programs that reduce stigma and promote the long-term benefits of MDI therapy are needed to change cultural attitudes towards asthma treatment.
- **Technical Training and Support:** Practical demonstrations on proper MDI use should be a routine part of asthma care, and access to spacers and other aids should be improved. Healthcare providers should offer tailored advice for managing multiple asthma medications, simplifying the treatment process for families.
- **Integration of Asthma Care into Primary Healthcare:** Asthma management should be fully integrated into primary healthcare services, focusing on early diagnosis, consistent follow-up, and the availability of essential medications like MDIs. This approach would reduce the need for specialized care and make asthma management more accessible to rural populations.

VI. LIMITATIONS

This study has several limitations. First, the research was conducted at a single healthcare facility, which may limit the generalizability of the findings to other regions in Nepal. Second, the reliance on self-reported data may introduce bias, as participants may underreport or overreport certain barriers. Lastly, the cross-sectional design of the study limits the ability to establish causal relationships between barriers and MDI utilization.

VII. CONCLUSION

This study sheds light on the diverse barriers to MDI utilization in pediatric asthma management in Gandaki Province, Nepal. Educational, economic, healthcare infrastructure, cultural, social, and technical barriers all play a role in limiting the effective use of MDIs among children with asthma. Addressing these challenges through targeted interventions—such as education programs, financial support, and improved healthcare access—can significantly improve asthma outcomes in pediatric populations. Future research should focus on evaluating the effectiveness of these interventions and exploring barriers in other regions of Nepal to inform a comprehensive national strategy for asthma management.

ACKNOWLEDGEMENT

We sincerely extend our gratitude to the Institutional Review Committee (IRC), the nursing staff, our colleagues, and the medical officers at GP Koirala National Centre for Respiratory Diseases and Hospital, Tanahun, Gandaki, Nepal, for their invaluable support and assistance throughout the course of this research.

➤ Conflict of Interest

- No

➤ Funding

- No

REFERENCES

- [1]. Global Initiative for Asthma (GINA). Global Strategy for Asthma Management and Prevention. 2023.
- [2]. World Health Organization (WHO). Asthma. Fact Sheet. 2021.
- [3]. Sharma AK, Thapa SB, Basnet S. Prevalence of Asthma, Eczema and Allergic Rhinitis Symptoms in School Children of Kathmandu Valley: Results of a Questionnaire Survey. *J Nepal Paediatr Soc* 2018;38(3):163-9.
- [4]. Mortimer K, Reddel HK, Pitrez PM, et al. Asthma management in low and middle income countries: case for change. *Eur Respir J* 2022; 60: 2103179 [DOI: 10.1183/13993003.03179-2021].
- [5]. GBD 2019 Diseases and Injuries Collaborators. Global Burden of Disease Study 2019. *Lancet*. 2020.
- [6]. Bhattarai S, Bhattarai S, Gaurav K, et al. Prevalence of Asthma and Associated Factors in Nepal. *J Nepal Health Res Counc*. 2021.
- [7]. Koirala GP, et al. Asthma Management in Gandaki Province. *Respir Med*. 2022.
- [8]. Vanker A, Barnett W, et al. Environmental and Socioeconomic Factors Associated with Childhood Asthma in LMICs. *Pediatr Pulmonol*. 2021.
- [9]. Asher MI, Rutter CE, Bissell K, et al. Worldwide trends in the burden of asthma symptoms in school-aged children: Global Asthma Network Phase I cross-sectional study. *Lancet* 2021; 398: 1569–1580
- [10]. Singh D, et al. Pediatric Asthma: Challenges in Low-Resource Settings. *Asian Pac J Allergy Immunol*. 2019.
- [11]. Kandel P, et al. Utilization of MDIs in Pediatric Asthma in Nepal. *J Respir Med*. 2022.
- [12]. Mehta RS, et al. Technical Challenges in MDI Use in Pediatric Asthma. *J Clin Pediatr*. 2019.
- [13]. Shrestha S, et al. Factors Influencing Asthma Control in Nepali Children. *Pediatr Allergy Immunol*. 2020.
- [14]. Vyas M, et al. Economic Impact of Childhood Asthma in South Asia. *Health Econ Policy Law*. 2021.
- [15]. Tackett AP, Farrow M, Kopel SJ, Coutinho MT, Koinis-Mitchell D, McQuaid EL. Racial/ethnic differences in pediatric asthma management: the importance of asthma knowledge, symptom assessment, and family-provider collaboration. *J. Asthma*. 2021; 58(10), 1395-1406
- [16]. Soto-Martínez ME, Soto-Quiros ME, Custovic A. Childhood asthma: low and middle-income countries perspective. *Acta Med Acad* 2020; 49: 181–190.
- [17]. Lakhanpaul M, Bird D, Manikam L, et al. A systematic review of explanatory factors of barriers and facilitators to improving asthma management in South Asian children. *BMC Public Health* 2014; 14: 403.
- [18]. Gupta P, et al. Cultural Perceptions of Asthma in South Asia. *South Asian J Med*. 2020.
- [19]. Khatri D, et al. Financial Barriers to Asthma Treatment in Nepal. *Health Policy*. 2020.
- [20]. Joshi A, et al. Healthcare Barriers in Rural Nepal: A Study on Asthma Care. *Nepal J Health Sci*. 2019.
- [21]. Tiwari D, et al. Healthcare Access in Nepal and Its Impact on Asthma Management. *J Trop Med*. 2021.
- [22]. Pradhan B, et al. Economic Burden of Asthma in Nepal. *Health Econ Rev*. 2020.
- [23]. Jha R, et al. Asthma Education in Nepal: Current Gaps and Future Directions. *J Nepal Med Assoc*. 2021.
- [24]. Lee JH, et al. Barriers to Effective Asthma Management in Low-Income Countries. *BMC Pulm Med*. 2020.
- [25]. World Bank. Health Insurance in Nepal: Current Challenges. 2021.
- [26]. Devkota B, et al. Accessibility of Respiratory Medications in Nepal. *J Pharm Pract*. 2021.
- [27]. Nepal Ministry of Health. National Guidelines for Asthma Management. 2020.
- [28]. McDonald K, et al. Educational Interventions to Improve Asthma Outcomes in LMICs. *Cochrane Database Syst Rev*. 2019.