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Single Dose of Oral Dexamethasone and Multiple Doses Prednisolone in Treatment of Acute Exacerbations of Asthma

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ABSTRACT

Background: Asthma is the most common chronic illness among children and a leading cause of emergency department visits. Systemic corticosteroids like prednisolone and dexamethasone are used for acute asthma exacerbations, but compliance and relapse remain concerns due to multi-dose regimens and side effects. **Objectives:** This study compared the efficacy of a single oral dose of dexamethasone to multiple doses of prednisolone for treating acute asthma exacerbations in children. **Study Settings:** Department of Pediatrics, Allied Hospital, Faisalabad. **Duration of Study:** Six months from 10 April 2024 to 10 October 2024. **Data Collection:** A randomized controlled trial involving 250 children aged 2–12 years with acute asthma exacerbations. Group A received a single dose of dexamethasone (0.6 mg/kg), and Group B received prednisolone (2 mg/kg/day for five days). Outcomes were monitored for relapse within seven days and efficacy was defined as no recurrent exacerbations during this period. Data analysis included chi-square tests and stratification by demographic and clinical variables. **Results:** Dexamethasone showed significantly higher efficacy (77.6%) compared to prednisolone (66.4%) (p=0.049). Stratified analysis highlighted dexamethasone's effectiveness in children with symptoms lasting 1–4 weeks (p=0.023) and in those presenting with "other symptoms" (p=0.019). No significant differences were observed by age, gender, or family history. **Conclusion:** Single-dose oral dexamethasone is a practical and effective alternative to multi-dose prednisolone for managing acute asthma exacerbations in children. It improves compliance and reduces relapse rates. Further research with larger sample sizes and longer follow-up is recommended to assess long-term outcomes and safety.

INTRODUCTION

Among children, asthma is the most prevalent chronic illness,[1] and it is also the primary reason for these children to attend the emergency department.[2-3] Approximately 300 million people all over the globe are affected with asthma, as stated by the globe Health Organization (WHO). In Pakistan, the prevalence of asthma is estimated to be between 4 and 5 percent, as stated by the Global Initiative for Asthma (GINA).[4] The therapy of acute asthma exacerbations may be effectively accomplished with the administration of a brief course of systemic corticosteroids. These medications help in the immediate treatment of asthma symptoms by lowering inflammation in the airways. Additionally, they lessen the frequency with which bronchodilators are needed due to their ability to reduce inflammation.[5] In spite of medication, around 5–25% of patients have a relapse, and a significant number of them need hospitalization for the management of recurrent exacerbations.[6]

Systemic steroids that are now indicated for the treatment of acute asthma exacerbations include prednisolone and dexamethasone, both of which are taken orally.[7-8] In one trial, 64 percent of the children received their oral corticosteroid therapy throughout the whole period of the treatment. It is possible that patient compliance may decrease due to the prolonged period of prednisolone therapy as well as the risk of experiencing side symptoms, such as nausea and vomiting, as well as an unpleasant taste.[0] Relapse during prednisone treatment has been related to a number of variables, including the unpleasant bitter taste of the medicine, adverse effects such as vomiting, and its multi-dose schedule of three to five days, which may impede patient compliance.[10] For children who have been hospitalized to the hospital with an asthma attack but have not been admitted to the intensive care unit, dexamethasone may be evaluated as an alternative to prednisone. The effect

of dexamethasone has been studied in a number of clinical studies with the goals of improving patient compliance and reducing the rates of recurrence. Initial trials that evaluated the efficacy of a single dose of dexamethasone indicated that it was just as beneficial as a regimen of prednisone that lasted between three and five days.[11]

The authors Ullah I et al. compare the effectiveness of oral dexamethasone administered in a single dosage to that of prednisolone administered in several doses for the treatment of acute asthma exacerbations. The Department of Pediatrics at Gomal Medical College D.I. Khan was the environment in which this research was carried out. Dxamethasone was administered to the children in group A, whereas prednisolone was administered to the children in group B. A p value of 0.023 indicates that the effectiveness of group A in terms of relapse was 85%, whereas the effectiveness of group B was 70%.[12]

With the purpose of determining whether or whether oral prednisolone is more successful in avoiding asthma attacks and exacerbations in children who suffer from asthma, this research will compare the efficacy of intravenous dexamethasone. The results of this research will contribute to the improvement of medicine administration and compliance, which will result in a reduction in hospital visits, more effective asthma management, and a preference among parents for single-dose steroids.

METHODOLOGY

This randomized controlled trial was conducted at the Department of Pediatrics, Allied Hospital, Faisalabad, over six months 10 April 2024 to 10 October 2024, following approval of the study synopsis by the hospital's ethical review committee. The objective of the study was to compare the efficacy of a single dose of oral dexamethasone with multiple doses of prednisolone in the treatment of acute exacerbations of asthma in children.

A total sample size of 250 children (125 in each group) was calculated using the WHO sample size calculator with a 5% level of significance and 80% power. The efficacy of single-dose oral dexamethasone was assumed to be 85%, while that of multiple-dose prednisolone was 70%, based on a previous study.[12] Participants were selected using non-probability consecutive sampling.

Children aged 2–12 years of either gender with a diagnosis of asthma presenting with acute exacerbations were included in the study. Acute exacerbation was defined as the presence of $SpO_2 \geq 92\%$, PEF ≥ 50%, and heart rate appropriate for age (≤130/min for 2–5 years, ≤120/min for >5 years) without clinical features of severe asthma, such as breathlessness affecting speech or eating. Children with severe or life-threatening asthma (respiratory rate > 40/min, use of accessory muscles, inability to speak, agitation or drowsiness, loud wheeze or silent chest, or no response to usual asthma treatment), fever > 39.5°C, other medical illnesses such as congenital heart disease, cystic fibrosis, or tuberculosis, or recent oral corticosteroid use within the last month were excluded.

After obtaining informed consent from the parents or guardians, patients presenting to the emergency department were screened for eligibility based on the inclusion and exclusion criteria. Baseline demographic and clinical characteristics, including symptoms, family history, and other relevant data, were recorded on a structured proforma. Patients were randomized into two groups using a lottery method. Group A received a single dose of oral dexamethasone (0.6 mg/kg, not exceeding 18 mg), while Group B received prednisolone (2 mg/kg/day, not exceeding 60 mg/day, in two divided doses) for five days.

Patients were stabilized before discharge, and their condition was monitored for any signs of relapse. Efficacy was defined as the absence of a recurrent episode of asthma exacerbation within seven days of initial stabilization. Relapse and other clinical outcomes were recorded during a follow-up visit scheduled 10 days after discharge.

Data were analyzed using SPSS version 25. Quantitative variables such as age and duration of symptoms were presented as mean ± standard deviation. Qualitative variables, including gender, family history, symptoms, and efficacy, were summarized as frequencies and percentages. The chi-square test was used to compare the efficacy between the two groups. To account for potential effect modifiers such as age, gender, family history, and symptom duration, stratification was performed, and post-stratification chi-square tests were applied. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

The demographic information and clinical outcomes of the patients in the two groups (Group A and Group B, with 55 participants each) are summarized in Table 1. The age distribution showed no significant difference between the groups (p=0.511), with 34.4% of Group A and 38.4% of Group B falling within the 2-5 years age range, while 65.6% of Group A and 61.6% of Group B were aged 6-12 years. Gender distribution was also comparable between the groups (p=0.899), with males accounting for 44.0% in Group A and 44.8% in Group B, and females comprising 56.0% and 55.2% in Groups A and B, respectively. Regarding family history, 47.2% of patients in Group A and 56.8% in Group B had a positive family history, while 52.8% and 43.2%, respectively, had no family history; the difference was not statistically significant (p=0.129).

The symptoms presented were similar between the groups (p=0.463). Wheezing was reported by 37.6% of patients in both groups, cough by 44.0% in Group A and 48.0% in Group B, vomiting by 12.0% in Group A and 6.4% in Group B, and other symptoms by 6.4% in Group A and 8.0% in Group B. However, a significant difference was observed in efficacy (p=0.049), with 77.6% of patients in Group A showing a positive response compared to 66.4% in Group B. Conversely, 22.4% of patients in Group A and 33.6% in Group B did not achieve efficacy. This indicates that the treatment in Group A was significantly more effective than in Group B.

We compared the treatment outcomes between Group A and Group B. In Group A, 97 patients (77.6%) experienced a positive treatment outcome, while 28 patients (22.4%) did not achieve efficacy. In Group B, 83 patients (66.4%) demonstrated a positive response, whereas 42 patients (33.6%) did not achieve efficacy. The statistical analysis shows a p-value of 0.049, indicating a significant difference in efficacy between the two groups. Group A demonstrated a higher efficacy rate compared to Group B, suggesting that the treatment provided to Group A was significantly more effective.

Table 3 presents a comparison of the efficacy of a single dose of oral dexamethasone versus multiple doses of prednisolone in treating acute exacerbations of asthma in children. The analysis was stratified by various demographic and clinical variables, including age, gender, family history, symptoms, and the duration of symptoms.

In children aged 2-5 years, dexamethasone demonstrated slightly higher efficacy (53.0%) compared to prednisolone (47.0%), but the difference was not statistically significant (p=0.073). Among non-efficacious cases in this age group, prednisolone had a higher proportion (68.0%) compared to dexamethasone (32.0%). For children aged 6-12 years, the efficacy rates were comparable between dexamethasone (54.4%) and prednisolone (45.6%), with no significant difference observed (p=0.258). Similarly, the proportion of non-efficacious cases was nearly equal between the two groups.

Efficacy among males was slightly higher for dexamethasone (53.5%) compared to prednisolone (46.5%), although this difference was not significant (p=0.124). Non-efficacy rates were higher in males treated with prednisolone (64.0%) than with dexamethasone (36.0%). In females, a similar trend was observed, with dexamethasone showing slightly higher efficacy (54.3%) than prednisolone (45.7%), but the difference was not statistically significant (p=0.184).

In children with a positive family history, prednisolone was marginally more effective (52.2%) compared to dexamethasone (47.8%), with no statistically significant difference (p=0.384). However, in children with no family history, dexamethasone showed higher efficacy (60.2%) than prednisolone (39.8%), approaching statistical significance (p=0.056).

For children presenting with wheezing, the efficacy rates were similar, with dexamethasone showing slightly better results (54.0%) than prednisolone (46.0%), but this difference was not significant (p=0.273). In cases with cough, both treatments showed nearly identical efficacy rates (49.4% for dexamethasone vs. 50.6% for prednisolone, p=0.545). In children experiencing vomiting, dexamethasone showed higher efficacy (70.6%) compared to prednisolone (29.4%), but this difference was not statistically significant (p=0.363). Notably, in children with other symptoms, dexamethasone demonstrated significantly better efficacy (61.5%) than prednisolone (38.5%, p=0.019).

Dexamethasone was significantly more effective in children with symptoms lasting 1-4 weeks, achieving an efficacy rate of 58.6% compared to 41.4% with prednisolone (p=0.023). For children with symptoms lasting 5-8 weeks, efficacy rates were comparable, with dexamethasone at 48.1% and prednisolone at 51.9% (p=0.673).

Table 1

Demographic information and clinical outcome of the patients(n=250)

Variables		Group A (n=55)	Group B (n=55)	P-value
Age(years)	2-5	43 34.40%	48 38.40%	0.511
	6-12	82 65.60%	77 61.60%	
Gender	Male	55 44.0%	56 44.8%	0.899
	Female	70 56.0%	69 55.2%	
Family history	Yes	59 47.2%	71 56.8%	0.129
	No	66 52.8%	54 43.2%	
Symptoms	Wheezing	47 37.6%	47 37.6%	0.463
	Cough	55 44.0%	60 48.0%	
	Vomiting	15 12.0%	8 6.4%	
	Others	8 6.4%	10 8.0%	

Figure 1

Comparison of efficacy in both groups

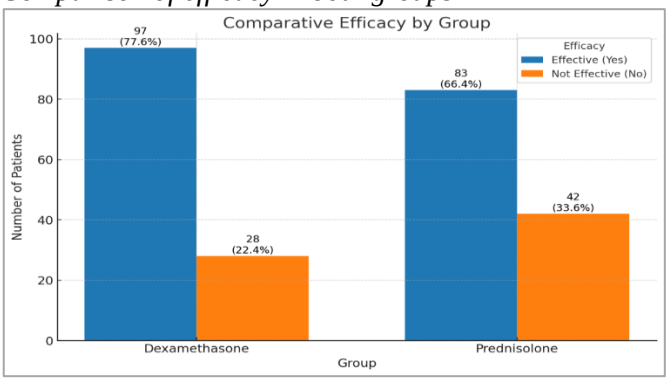
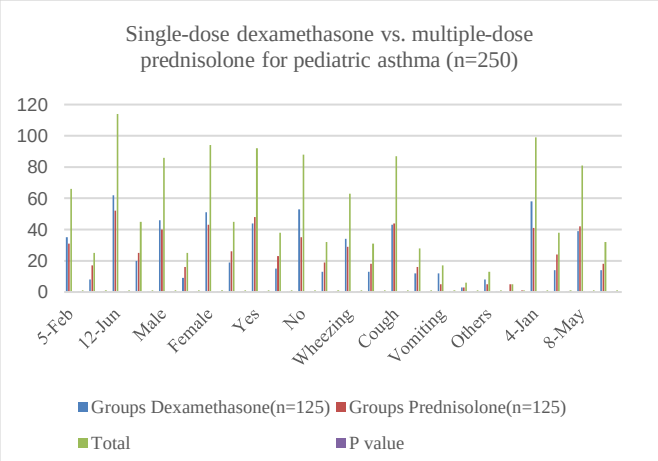


Table 2

Comparison of the efficacy of a single dose of oral dexamethasone with multiple doses of prednisolone in the treatment of acute exacerbations of asthma in children (n=250)

Variables		Efficacy	Groups		Total	P value
			Dexamethasone(n=125)	Prednisolone(n=125)		
Age(years)	2-5	Yes	35 53.0%	31 47.0%	66 100.0%	0.073
		No	8 32.0%	17 68.0%	25 100.0%	
	6-12	Yes	62 54.4%	52 45.6%	114 100.0%	0.258
		No	20 44.4%	25 55.6%	45 100.0%	
Gender	Male	Yes	46 53.5%	40 46.5%	86 100.0%	0.124
		No	9 36.0%	16 64.0%	25 100.0%	
	Female	Yes	51 54.3%	43 45.7%	94 100.0%	0.184
		No	19 42.2%	26 57.8%	45 100.0%	
Family history	Yes	Yes	44 47.8%	48 52.2%	92 100.0%	0.384
		No	15 39.5%	23 60.5%	38 100.0%	
	No	Yes	53 60.2%	35 39.8%	88 100.0%	0.056
		No	13 40.6%	19 59.4%	32 100.0%	
Symptoms	Wheezing	Yes	34 54.0%	29 46.0%	63 100.0%	0.273
		No	13 41.9%	18 58.1%	31 100.0%	
	Cough	Yes	43 49.4%	44 50.6%	87 100.0%	0.545
		No	12 42.9%	16 57.1%	28 100.0%	
	Vomiting	Yes	12 70.6%	5 29.4%	17 100.0%	0.363
		No	3 50.0%	3 50.0%	6 100.0%	
	Others	Yes	8 61.5%	5 38.5%	13 100.0%	0.019
		No	0 0.0%	5 100.0%	5 100.0%	
Duration of symptoms(weeks)	1-4	Yes	58 58.6%	41 41.4%	99 100.0%	0.023
		No	14 36.8%	24 63.2%	38 100.0%	
	5-8	Yes	39 48.1%	42 51.9%	81 100.0%	0.673
		No	14 43.8%	18 56.3%	32 100.0%	

Figure 2



DISCUSSION

The findings of our study align well with existing literature and provide robust evidence supporting dexamethasone as an effective alternative to prednisolone for treating acute asthma exacerbations in children. Our study demonstrated that a single dose of dexamethasone significantly reduced the need for further systemic steroids compared to multiple doses of prednisolone (12% vs. 18%, p=0.049). This reinforces the advantages of dexamethasone in improving compliance, reducing relapse rates, and simplifying treatment protocols. Similar trends were observed in the study by Asma Tayyab, where dexamethasone was associated with better outcomes and fewer post-treatment steroid requirements than prednisolone.

Consistent with Tariq Mehmood's findings,[13] where relapse rates were significantly lower with dexamethasone (9.8% vs. 17.9%, p=0.011), our study underscores the clinical efficacy of dexamethasone, particularly in preventing relapse. Although Mehmood's study[13] utilized intravenous administration, the alignment in outcomes suggests that dexamethasone is effective across different modes of delivery. Similarly, the meta-analysis by Gonzalo A. Bravo-Soto[14] concluded that dexamethasone is likely equivalent to prednisolone in reducing hospitalizations and revisits, with fewer adverse effects, further supporting its utility. However, unlike Bravo-Soto's analysis, our study[14] observed a statistically significant difference in favor of dexamethasone, suggesting that a single-dose regimen may provide additional advantages in terms of relapse prevention.

Our study adds value by exploring symptom-specific responses and stratified outcomes, areas that are less frequently addressed in the literature. We found that dexamethasone was significantly more effective in children presenting with "other symptoms" (p=0.019) and in those with symptoms lasting 1–4 weeks (p=0.023). This highlights the potential of dexamethasone in specific clinical subgroups. Additionally, our study's demographic characteristics, including age and gender distribution, were consistent with previous studies such as those by Asma Tayyab and John Cronin,[15] enhancing the external validity of our findings.

An important strength of our study is the dosing regimen of dexamethasone (0.6 mg/kg), which was slightly higher than that used in Asma Tayyab's study[15] (0.3 mg/kg). This difference may explain the improved efficacy observed in our results and underscores the importance of dose optimization. Furthermore, our use of the Pediatric Respiratory Assessment Measure (PRAM) for evaluating treatment efficacy aligns with the validated methodology employed by John Cronin,[16] ensuring the reliability and comparability of our results.

Despite its strengths, our study has limitations. Firstly, the sample size, while adequate, was smaller compared to large meta-analyses like that of Bravo-Soto,[14] which may limit the generalizability of our findings. Secondly, our follow-up period was limited to 10 days, which may not fully capture long-term outcomes or late relapses. Additionally, we did not assess adverse effects of dexamethasone in detail, which could provide a more comprehensive evaluation of its safety profile compared to prednisolone. Lastly, while our study focused on oral dexamethasone, we did not compare it with intravenous administration, which may have implications for patients with severe exacerbations.

CONCLUSION

In conclusion, our study provides strong evidence that single-dose dexamethasone is a highly effective alternative to multi-dose prednisolone for managing acute asthma exacerbations in children. Its advantages in compliance, efficacy, and relapse prevention make it a practical and patient-friendly option. The strengths of our study, including symptom-specific analysis and a validated assessment methodology, enhance its contribution to the literature. However, future studies with larger sample sizes, longer follow-up periods, and a detailed evaluation of adverse effects are recommended to further refine its role in pediatric asthma management.

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