

Study of Efficacy of 3% Hypertonic Saline Nebulisation in Hospitalised Children with Bronchiolitis in Age Group of 2 Months – 24 Months

Anushri Chourasia¹, Kunal Kumar², Ashok Kumar³, Atul Anand⁴, Jishan Alam Siddiqui⁵, Pawan Kumar Meena⁶, Anu Priya⁷

^{1,2,4,5,6,7}Junior Resident (Academic), Department of Pediatrics, Darbhanga Medical College & Hospital, Laheriasarai, Darbhanga, Bihar- 846003, India

³Professor & H.O.D, Department of Pediatrics, Darbhanga Medical College & Hospital, Laheriasarai, Darbhanga, Bihar- 846 003, India

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Corresponding Author: Dr. Ashok Kumar

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Abstract:

Background: Bronchiolitis is a common cause of hospitalization in infants under two years, typically caused by RSV. Management is largely supportive. Recent attention has turned to 3% hypertonic saline nebulisation, which may enhance mucociliary clearance and reduce symptoms.

Aim: To assess the clinical effectiveness of 3% hypertonic saline nebulisation versus standard care in hospitalized children aged 2–24 months with bronchiolitis, focusing on symptom resolution and hospital stay duration.

Materials and Methods: A prospective, randomized controlled trial was conducted at DMCH, Laheriasarai, involving 200 children randomized into two groups: one receiving 3% hypertonic saline nebulisation and the other standard supportive care. Data on clinical parameters, symptom resolution, adverse events, and length of hospital stay were collected and analyzed.

Observations: Children treated with hypertonic saline had significantly faster resolution of cough (59% in 4–5 days) and wheeze (92% in 1–2 days), and shorter hospital stays (88% discharged within 1–3 days), compared to controls. No adverse effects were reported.

Conclusion: Nebulised 3% hypertonic saline appears to be a safe and effective adjunct therapy in managing bronchiolitis, resulting in faster symptom relief and reduced hospital stay. Further multicentric studies may help solidify its role in routine care.

Keywords: Bronchiolitis, Hypertonic saline, Nebulisation, Infants, Hospital stay.

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Introduction

Bronchiolitis is a leading cause of hospitalization in infants and young children worldwide, particularly affecting those under two years of age. It is most commonly caused by the respiratory syncytial virus (RSV), although other viruses such as adenovirus, influenza, and parainfluenza may also contribute. The disease is characterized by acute inflammation, edema, and necrosis of the epithelial cells lining the small airways, leading to increased mucus production, bronchiolar obstruction, and impaired gas exchange. [1,2]

The clinical presentation of bronchiolitis includes rhinorrhea, cough, wheezing, tachypnea, and respiratory distress. Management of bronchiolitis remains largely supportive, as no antiviral therapies have proven effective for routine use, and bronchodilators and corticosteroids have limited or inconsistent benefits. Oxygen supplementation, hydration, and careful monitoring form the cornerstone of current treatment protocols. [3] In recent years,

the use of nebulised hypertonic saline (3%) has garnered attention as a therapeutic modality aimed at reducing airway edema and enhancing mucociliary clearance. The proposed mechanism involves the osmotic effect of hypertonic saline, which draws water into the airway lumen, thereby thinning the mucus and facilitating its removal. This intervention is considered to have a favorable safety profile and is cost-effective, particularly in resource-limited settings. [4]

Several clinical studies and systematic reviews have suggested that 3% hypertonic saline nebulisation may reduce the severity of symptoms and shorten the duration of hospital stay in children with acute bronchiolitis. However, data from different geographical regions and healthcare settings remain variable, and more evidence is needed to establish its efficacy in routine clinical practice. [5-8] This study aims to evaluate the clinical effectiveness of 3% hypertonic saline nebulisation com-

pared to normal saline in hospitalized children aged 2 to 24 months diagnosed with acute bronchiolitis, with a focus on improvement in clinical severity and reduction in hospital stay.

Materials and Methods

Study Design and Setting: This study was structured as a prospective, randomized controlled trial conducted in the Department of Pediatrics at DMCH, Laheriasarai, aimed at evaluating the effectiveness of 3% hypertonic saline nebulization in hospitalized children with a diagnosis of bronchiolitis. The study was performed over a specific period, adhering to standardized protocols for both data collection and patient care. Approval for the study was granted by the Institutional Ethics Committee, and informed consent was obtained from parents or legal guardians prior to enrolling the participants.

Sample Size Calculation: The sample size for the present study was calculated based on the expected prevalence of Bronchiolitis, which is most prevalent in children aged 2 months – 24 months in previous studies.

Using the formula for sample size calculation in observational studies:

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

Where:

n is the required sample size

Z is the Z-score which indicates the desired confidence level (1.96 for 95% confidence interval)

P represents the expected prevalence of Bronchiolitis, which is commonly seen in children aged 2 months – 24 months (based on literature or pilot study, e.g., 15%)

d = Margin of error (assumed to be 5% or 0.05)

Thus, a minimum of 195 infants is required for adequate statistical power. The final sample size is adjusted to approximately 200 infants.

Study Population: The study included children aged 2 months to 24 months who were hospitalized with clinically diagnosed bronchiolitis. Diagnosis was based on clinical symptoms such as wheezing, cough, nasal congestion, respiratory distress, and chest hyperinflation on examination.

Inclusion Criteria:

- Aged between 2 months – 24 months.
- First episode of wheezing.
- Respiratory distress assessment instrument score >4.

➤ Child considered to be tachypneic based on World Health Organization guidelines:

- Respiratory rate ≥ 60 per minute in age less than 2 months.
- Respiratory rate ≥ 50 per minute in age 2 months to 12 months.
- Respiratory rate ≥ 40 per minute in age > 1 year.

Exclusion Criteria:

- Children with a history of similar episodes of respiratory distress.
- Presence of chronic cardiovascular and respiratory illness.
- History of prolonged respiratory distress in newborn period.
- Immunodeficiency.

Randomization and Study Groups

Patients were randomly assigned into two groups using a computer-generated randomization technique to ensure an unbiased allocation process.

1. Intervention Group (Hypertonic Saline Group): Received 3% hypertonic saline nebulization administered every 6–8 hours for up to 5 days or until significant clinical improvement.
2. Control Group: Received supportive therapy alone.

Both groups received standard supportive care, including:

- **Oxygen therapy** (if oxygen saturation fell below 92%).
- **Intravenous or enteral hydration** based on clinical assessment.
- **Nasal suctioning** as needed for airway clearance.
- **Nutritional support** ensuring adequate caloric intake.

Intervention Protocol: The nebulization was delivered using a jet nebulizer with oxygen flow at 6–8 L/min. Each session consisted of 4 mL of the respective saline solution (3% hypertonic saline) administered over approximately 10 minutes. The treatment was continued until significant clinical improvement or a maximum of 5 days.

Data Collection and Analysis: All clinical parameters were recorded at baseline and monitored every 12 hours until discharge. Data were collected using a structured case record form, including patient demographics, medical history, clinical examination findings, and response to treatment.

Statistical Analysis: Demographic and clinical characteristics of the study population were summarized using descriptive statistics to provide a comprehensive overview. Continuous variables were compared between groups using the Student's

t-test, while categorical variables were analyzed using either the Chi-square test or Fisher's exact test, as appropriate for the data distribution and sample size. A p-value of less than 0.05 was considered statistically significant for all analyses.

Results: The study involved 200 subjects who were randomly assigned to one of two groups: the

Case group (100 subjects), which received nebulization therapy with 3% hypertonic saline, and the Control group (100 subjects), which received standard treatment. This research was conducted in the Department of Pediatrics at Darbhanga Medical College and Hospital, Laheriasarai, with a clear and systematic selection process targeting on pediatric indoor patients.

Table 1: Mean age distribution between case and control

| Groups | Mean | S.D | Minimum | Maximum |
|---------|-------|-------|---------|---------|
| Case | 13.38 | 6.34 | 2 | 24 |
| Control | 12.72 | 5.822 | 2 | 24 |

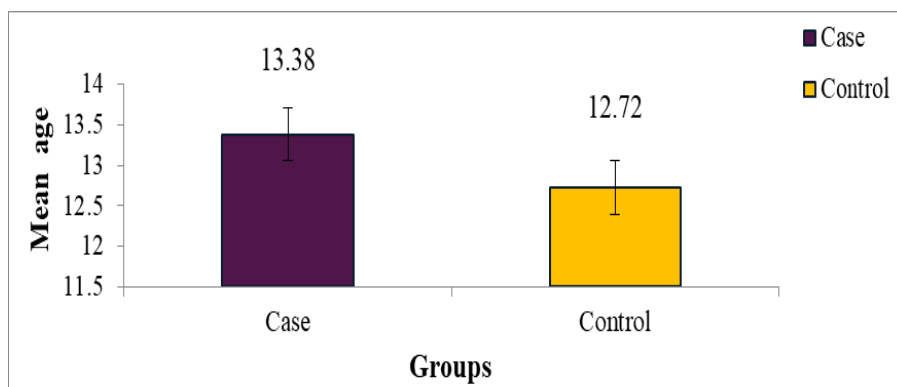


Figure 2: Mean age distribution between case and control groups

In our study, the case group had an average (Mean±SD) age of 13.38 ± 6.34 months, while the control group averaged 12.72 ± 5.822 months, with ages in both groups ranging from 2 to 24 months (Table 1 and Figure 2).

Table 2: Age-based distribution of patients across two groups

| Age (months) | Case N (%) | Control N (%) | Total patients |
|--------------|------------|---------------|----------------|
| Less than 6 | 7 (7%) | 7 (7%) | 14 |
| 6-12 | 46 (46%) | 47 (47%) | 93 |
| 13-18 | 17 (17%) | 21 (21%) | 38 |
| 19-24 | 30 (30%) | 25 (25%) | 55 |
| Total | 100 | 100 | 200 |

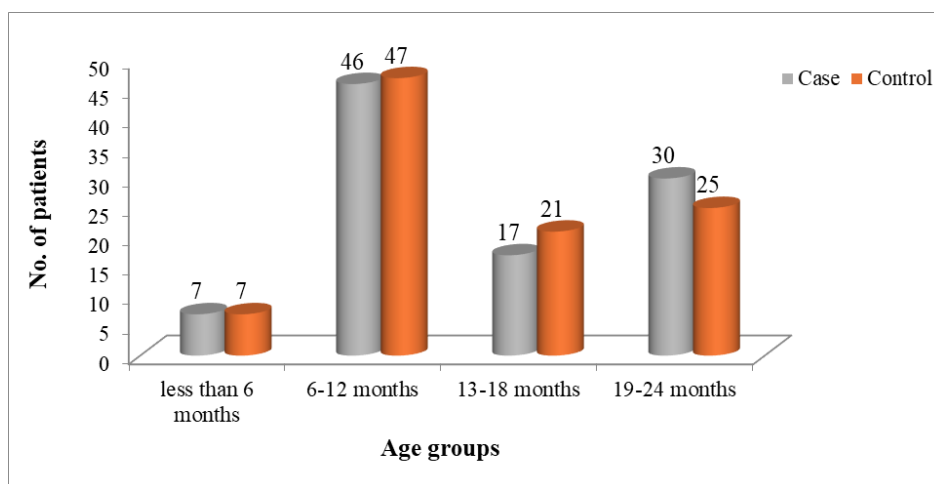


Figure 3: Age-based distribution of patients across two groups

In accordance with the age based distribution in the present study, the case group included 7 participants less than 6 months of age, 46 within the 6-12 months range, 17 aged 13-18 months, and 30 between 19-24 months. Similarly, the control group

showed a comparable distribution: 7 participants (7%) were under 6 months, 47 (47%) fell within 6-12 months, 21 (21%) were aged 13-18 months, and 25 (25%) belonged to the 19-24 months range (Table 2 and Figure 3).

Table 3: Distribution based on gender among case and control groups

| Sex | Case N (%) | Control N (%) | Total | P value |
|--------|------------|---------------|-------|---------|
| Male | 60 (60%) | 61 (61%) | 121 | 0.885 |
| Female | 40 (40%) | 39 (39%) | 79 | |
| Total | 100 | 100 | 200 | |

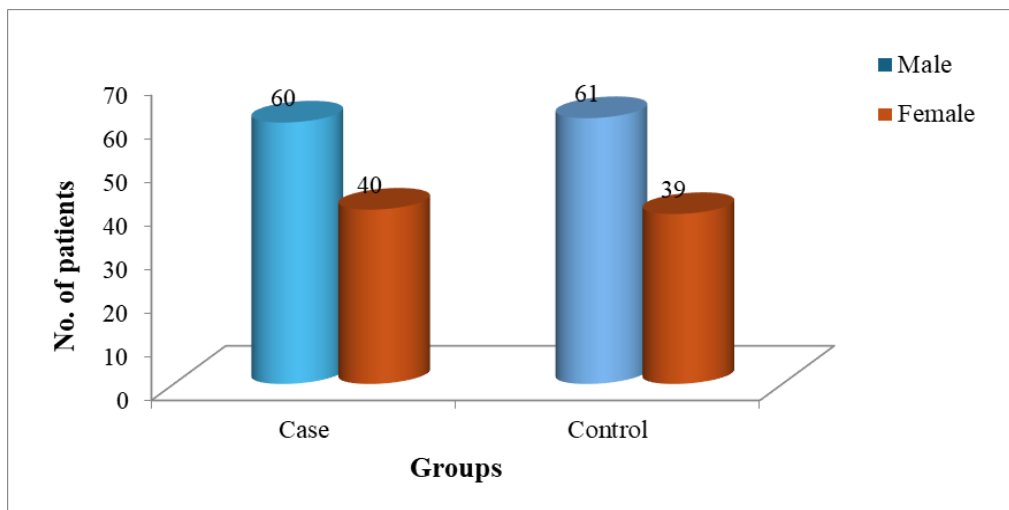


Figure 4: Gender allocation within case and control groups

Next, we studied gender distribution and found that in the case group, 60 subjects (60%) were male, while 40 subjects (40%) were female. Likewise, the control group comprised 39 (39%) females and 61 (61%) males. The gender distribution between the

two groups was nearly similar, indicating a well-balanced sample in terms of sex. Additionally, no significant difference in age distribution was observed between the two groups ($P > 0.05$). (Table 3 and Figure 4).

Table 4: Chest X-ray findings in both groups

| CXR | Case N (%) | Control N (%) | Total | P value |
|--------------------------|------------|---------------|-------|----------|
| Bilateral hyperinflation | 46 (46%) | 15 (15%) | 61 | 0.000002 |
| Normal | 54 (54%) | 85 (85%) | 139 | |
| Total | 100 | 100 | 200 | |

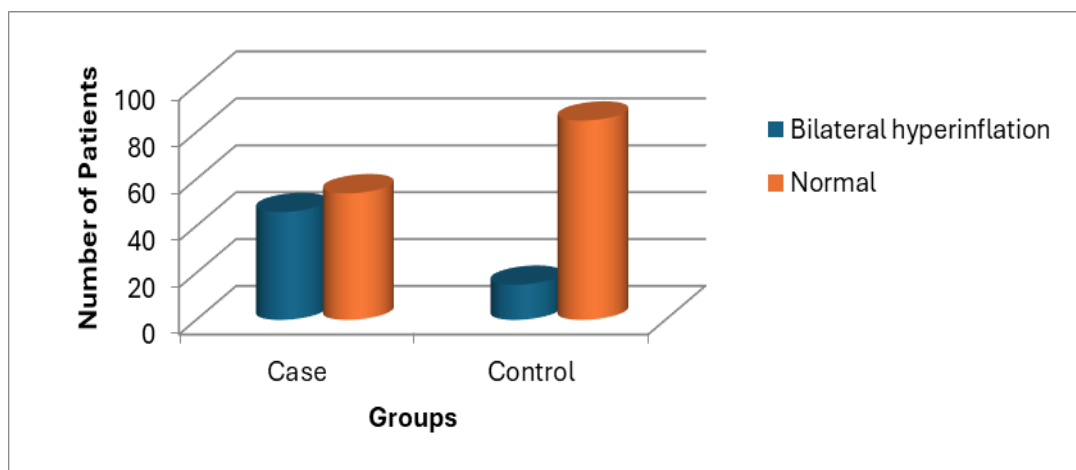


Figure 5: Chest X-ray findings in both groups

In the chest X-ray findings of our study, 46% of participants in the case group presented with bilateral hyperinflation, whereas the remaining 54% displayed normal findings. In contrast, the control group showed a significantly lower prevalence of

bilateral hyperinflation, with only 15 participants (15%) affected and 85 participants (85%) displaying normal results. Significant differences were observed in radiographic observation between the groups (Table 4 and Figure 5).

Table 5: Total blood count results in both groups

| Total blood count | Case N (%) | Control N (%) | Total | P value |
|-------------------|------------|---------------|-------|---------|
| Abnormal | 5 (5%) | 3 (3%) | 8 | 0.470 |
| Normal | 95 (95%) | 97 (97%) | 192 | |
| Total | 100 | 100 | 200 | |

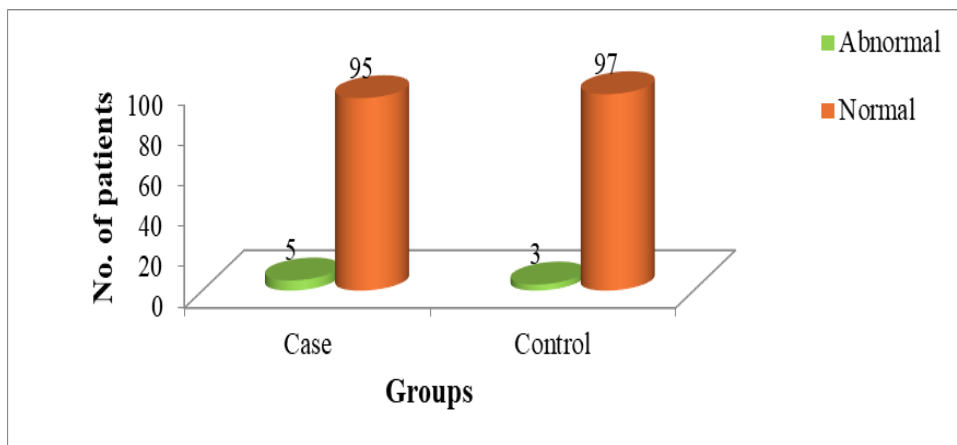


Figure 6: Total blood count results in both groups

Here, in the case group, 95 (95%) of individuals have normal total blood counts, while 5 (5%) exhibit abnormalities. Similarly, in the control group, 97 (97%) of individuals have normal total blood counts, with only 3 (3%) showing abnormalities. This indicates a very small difference in the proportion of individuals with abnormal total blood counts between the two groups (Table 5 and Figure 6).

Table 6: Humidified oxygen use between both groups

| Humidified oxygen | Case N (%) | Control N (%) | Total |
|-------------------|------------|---------------|-------|
| Yes | 100 (100%) | 100 (100%) | 200 |
| No | 0 (0%) | 0 (0%) | 0 |
| Total | 100 | 100 | 200 |

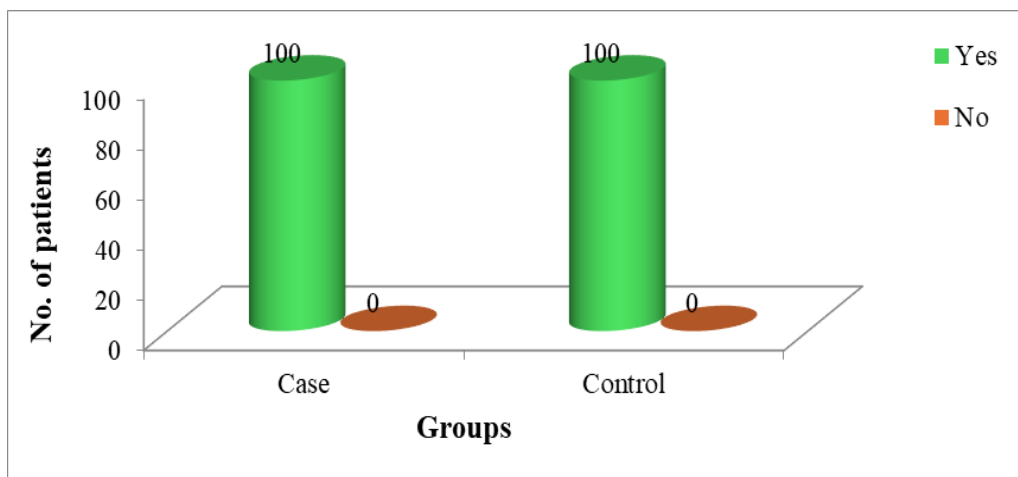


Figure 7: Humidified oxygen use between both groups

In the case group, all 100 (100%) individuals received humidified oxygen. Similarly, in the control group, all 100 individuals received humidified oxygen (see Tables 6 and 7).

Table 7: Intravenous fluid administration in case and control subjects

| Intravenous fluid | Case N (%) | Control N (%) | Total | P value |
|-------------------|------------|---------------|-------|---------|
| No | 95 (95%) | 97 (97%) | 192 | 0.470 |
| Yes | 5 (5%) | 3 (3%) | 8 | |
| Total | 100 | 100 | 200 | |

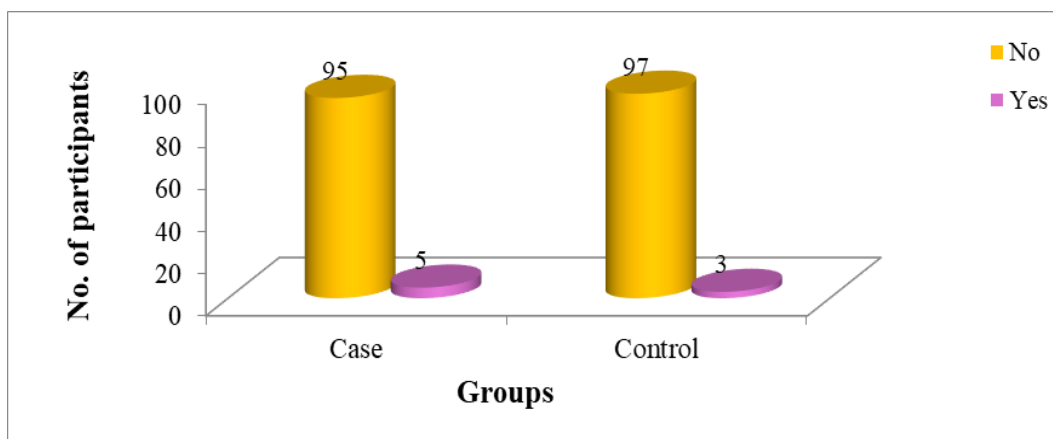


Figure 8: Intravenous fluid administration in case and control groups

In this investigation, the case group revealed that the majority of individuals, 95% (95 out of 100), did not require intravenous fluids, while a small percentage, 5% (5 out of 100), needed them. Similarly, in the control group, most individuals, 97%

(97 out of 100), did not require intravenous fluids, with only 3% (3 out of 100) needing them (Table 7 and Figure 8). These findings highlighted an insignificant difference in intravenous fluid usage between the two groups.

Table 8: Oral feeding practices in case and control groups

| Oral feeds | Case | Control | Total | P value |
|------------|----------|----------|-------|---------|
| Yes | 96 (96%) | 98 (98%) | 194 | 0.407 |
| No | 4 (4%) | 2 (2%) | 6 | |
| Total | 100 | 100 | 200 | |

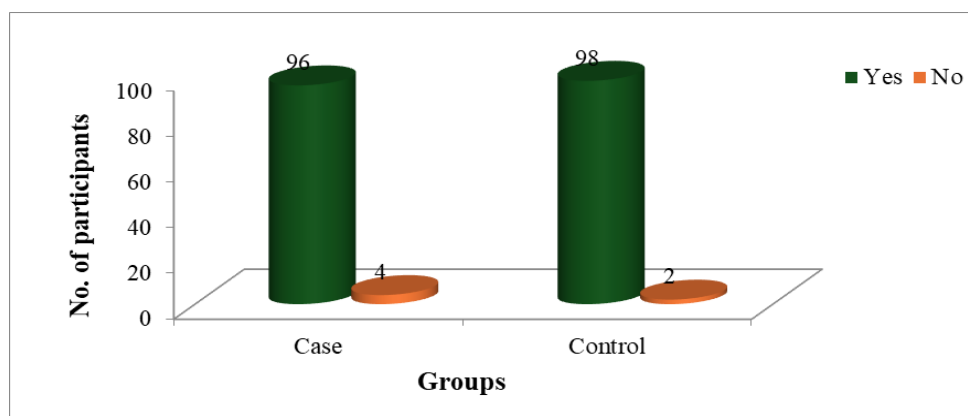


Figure 9: Oral feeding practices in case and control groups

This study also revealed that in the case group, 96 (96%) individuals were taking oral feeds, while 4 (4%) individuals were not. Similarly, in the control group, 98 (98%) individuals were on oral feeds, whereas 2 individuals were not (Table 8 and Figure 9).

Table 9: Cough resolution time in both groups

| Cough resolution time | Case N (%) | Control N (%) | Total | P value |
|-----------------------|------------|---------------|-------|---------------|
| 4-5 days | 59 (59%) | 25 (25%) | 84 | 0.00000000002 |
| 6-7 days | 41 (41%) | 75 (75%) | 116 | |
| Total | 100 | 100 | 200 | |

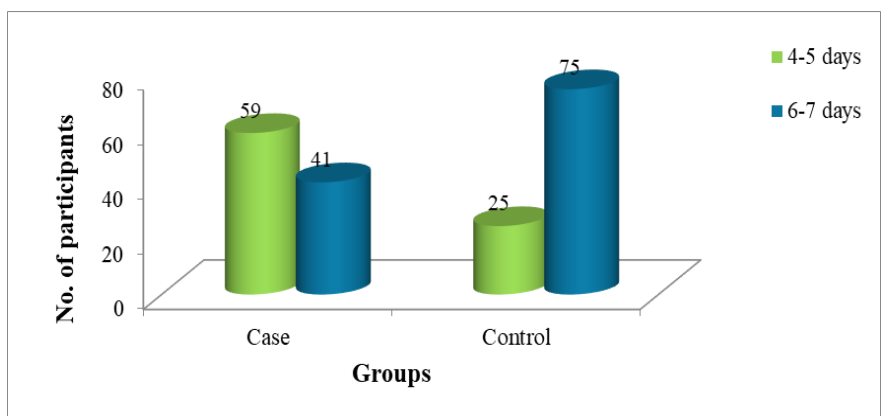


Figure 10: Cough resolution time in case and control groups

Moreover, this study demonstrated that 59 patients (59%) experienced a cough resolution time of 4–5 days, while 41 (41%) patients required a longer duration of 6–7 days for resolution. Conversely, in the control group, 25 (25%) patients showed cough

resolution within 4–5 days, whereas 75 (75%) patients experienced resolution over a longer period of 6–7 days (Table 9 and Figure 10). In this instance, the p-value was found to be statistically significant.

Table 10: Wheeze Resolution time in both groups

| Wheeze Resolution time | Case N (%) | Control N (%) | Total | P value |
|------------------------|------------|---------------|-------|----------------|
| 1-2 day | 92 (92%) | 25 (25%) | 117 | 0.000000000022 |
| 3-4 day | 8 (8%) | 73 (73%) | 81 | |
| 5-6 day | 0 (0%) | 2 (2%) | 2 | |
| Total | 100 | 100 | 200 | |

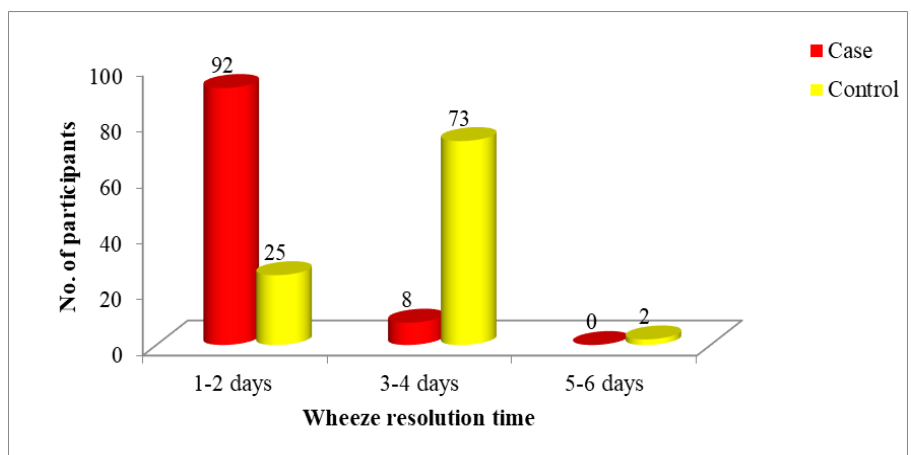


Figure 11: Wheeze resolution time in case and control groups

Furthermore, this study observed that in the case group, 92% of patients (92 individuals) experienced wheeze resolution within 1–2 days, while 8% (8 patients) required 3–4 days, and none experienced wheeze resolution within 5–6 days. In contrast, the control group showed that 25% of patients (25 individuals) resolved their wheeze within 1–2

days, 73% (73 patients) required 3–4 days, and 2% (2 patients) needed 5–6 days for resolution (Table 10 and Figure 11).

These findings highlight differences in wheeze resolution times between the case and control groups, supported by the highly significant.

Table 11: Adverse effects observed in case groups

| Adverse effect | Case N (%) | Total |
|----------------|------------|-------|
| No | 100 (100%) | 100 |
| Yes | 0 (0%) | 0 |
| Total | 100 | 100 |

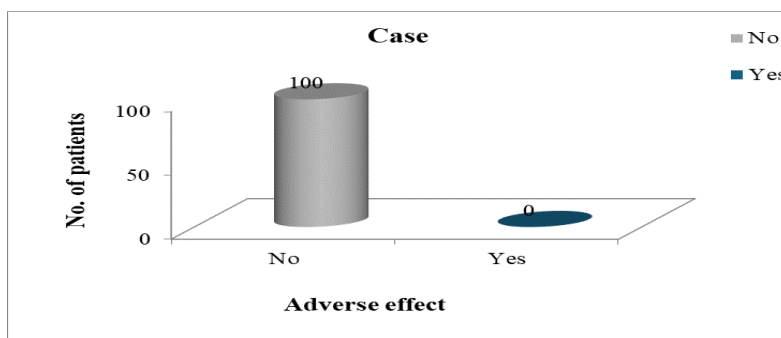


Figure 12: Adverse effects observed in case group

In the case group, none of the patients experienced adverse effects, as all 100 individuals (100%) reported no negative reactions. This demonstrates that the treatment with 0.3% saline was entirely free of adverse effects for the participants in this group (Table 11 and Figure 12).

Table 12: Hospital length of stay (LOS) in both groups

| Length of stay (LOS) | Case N (%) | Control N (%) | Total | P value |
|----------------------|------------|---------------|-------|-------------------|
| 1-3 days | 88 (88%) | 11 (11%) | 99 | 0.000000000000025 |
| 4-6 days | 10 (10%) | 87 (87%) | 97 | |
| 7-9 days | 2 (2%) | 2 (2%) | 4 | |
| Total | 100 | 100 | 200 | |

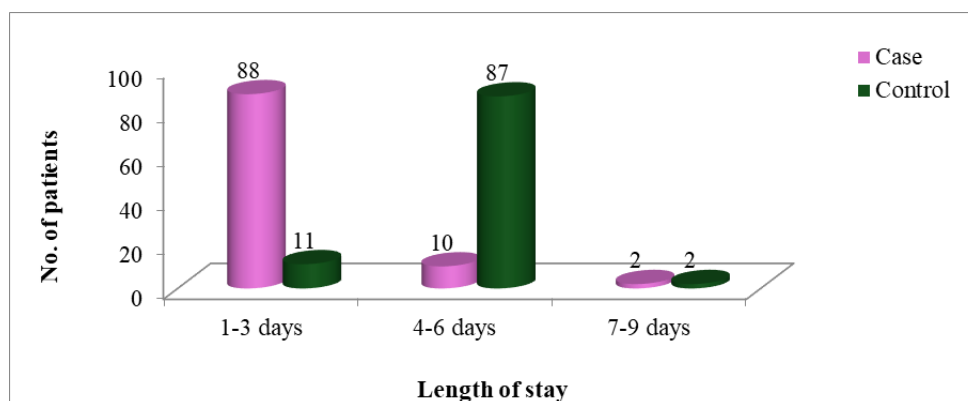


Figure 13: Hospital length of stay (LOS) in both groups

Table 12 and Figure 13, depict the hospitalization duration across both groups. In the case group, a substantial majority 88% (88 patients) had hospital stays lasting between 1 and 3 days, whereas this was observed in only 11% (11 patients) in the control group. Hospital stays lasting 4 to 6 days were observed in 10% (10 patients) of the case group,

whereas this duration was significantly more common in the control group, encompassing 87% (87 patients). For hospital stays of 7 to 9 days, both groups recorded minimal numbers, with 2% (2 patients) in each group falling into this category. A notable disparity in the LOS was observed across both groups, highlighting significant differences.

Table 13: Comparative trends in respiratory symptoms and length of stay across age groups: a case-control study.

| Case | | | | | | |
|--------------|-----------------------|----------|--------------------------|----------|----------------|----------|
| Age (months) | Cough resolution time | N (%) | Wheezing Resolution Time | N (%) | Length of stay | N (%) |
| Less than 6 | 4-5 days | 5 (5%) | 1-2 days | 7 (7%) | 1-3 days | 7 (7%) |
| | 6-7 days | 2 (2%) | | | 4-6 days | 0 |
| | | | | | 7-9 days | 0 |
| 6-12 | 4-5 days | 21 (21%) | 1-2 days | 43 (43%) | 1-3 days | 37 (37%) |
| | 6-7 days | 25 (25%) | 3-4 days | 2 (2%) | 4-6 days | 7 (7%) |
| | | | 5-6 days | 1 (1%) | 7-9 days | 2 (2%) |

| | | | | | | |
|---------------------|------------------------------|--------------------|----------------------------------|------------------------------|----------------------------------|-----------------------------|
| 13-18 | 4-5days 6-7 days | 10 (10%) 7 (7%) | 1-2 days 3-4 days 5-6 days | 15(15%) 1 (1%) 1 (1%) | 1-3 days 4-6 days | 14(14%) 3 (3%) |
| 19-24 | 4-5 days 6-7 days | 23 (23%) 7 (7%) | 1-2 days 3-4 days | 27 (27%) 3 (3%) | 1-3 days | 30(30%) |
| Total | | 100 | | 100 | | 100 |
| Control | | | | | | |
| Age (months) | Cough (duration time) | N (%) | Wheezing (duration time) | N (%) | LOS (duration of time) | N (%) |
| Less than 6 | 4-5days 6-7 days | 2 (2%) 5 (5%) | 1-2 days 3-4 days | 2 (2%) 5 (5%) | 1-3 days 4-6 days 7-9 days | 1 (1%) 6 (6%) 0 (0%) |
| 6-12 | 4-5 days 6-7days | 8 (8%) 39 (39%) | 1-2 days 3-4 days 5-6 days | 8 (8%) 39 (39%) 0 (0%) | 1-3 days 4-6 days 7-9 days | 6 (6%) 40(40%) 1 (1%) |
| 13-18 | 4-5days 6-7 days | 6 (6%) 15 (15%) | 1-2 days 3-4 days 5-6 days | 6 (6%) 15 (15%) 0 (0%) | 1-3 days 4-6 days 7-9 days | 1 (1%) 19(19%) 1 (1%) |
| 19-24 | 4-5 days 6-7 days | 9 (9%) 16 (16%) | 1-2 days 3-4 days | 9 (9%) 16 (16%) | 1-3 days 4-6 days | 3 (3%) 22(22%) |
| Total | | 100 | | 100 | | 100 |

The table 13 summarizes the duration of coughing, wheezing, and LOS among hospitalized children across various age groups in both groups. Among participants under 6 months, 5% experienced cough for 4-5 days, while 2% had a cough lasting 6-7 days. The majority (7%) had wheezing for 1-2 days, and their hospital stay was limited to 1-3 days. In the 6-12 months age group, 21% had a 4-5 day cough, and 25% had a 6-7-day cough. Wheezing was most common for 1-2 days (43%), with fewer cases lasting longer.

The majority of children in this group (37%) were hospitalized for up to three days, whereas only a small percentage needed a longer stay. For children aged 13-18 months, 10% had a 4-5-day cough, while 7% had a cough for 6-7 days. Wheezing was observed in 15% of cases for 1-2 days, with very few children experiencing it for longer durations. Most children (14%) were discharged within 1-3 days, while a few required 4-6 days. The 19-24 month age group had the highest percentage of cases with a 4-5 day cough (23%) and 6-7 day cough (7%). Wheezing lasted for 1-2 days in most cases (27%), and 30% of children in this age group stayed in the hospital for 1-3 days.

While in the control group, among children less than 6 months old, 2% experienced a cough for 4-5 days, while 5% had a cough lasting 6-7 days. Wheezing lasted for 1-2 days in 2% of cases and for 3-4 days in 5% of cases. The majority of children (6%) in this group had a hospital stay of 4-6 days, while only 1% stayed for 1-3 days. Among children aged 6-12 months, 8% had a cough lasting 4-5 days, whereas 39% had longer cough duration of 6-7 days. Wheezing lasted for 1-2 days in 8% of cases and 3-4 days in 39% of cases. A significant

proportion (40%) of children in this age group was hospitalized for 4-6 days, and only 6% had a shorter stay of 1-3 days. For the 13-18 month age group, 6% had a cough for 4-5 days, and 15% had a cough for 6-7 days. Wheezing lasted for 1-2 days in 6% of cases and for 3-4 days in 15% of cases. The majority (19%) of children were hospitalized for 4-6 days, with only 1% staying for 1-3 days and 7-9 days. In the 19-24-month age group, 9% of children had a 4-5-day cough, while 16% had a cough for 6-7 days. Wheezing persisted for 1-2 days in 9% of participants and up to 3-4 in 16% of the cases. The hospitalization period was mostly 4-6 days (22%), with a smaller proportion (3%) staying for 1-3 days.

Discussion

Acute bronchiolitis is a lower respiratory tract infection frequently seen in children aged 2 to 24 months, linked to high morbidity and mortality rates between 0.5 to 1%. It is a self-limiting condition caused mainly by viral infections, such as respiratory syncytial virus, and is characterized by airway obstruction due to inflammation, edema, secretions, and muscular spasms. [6,9] Treatment typically focuses on supportive care to relieve symptoms, as no targeted antiviral therapies are currently available. Supportive measures include ensuring proper oxygenation, hydration, and alleviating respiratory difficulties. However, findings have been inconsistent across different studies, necessitating further research to establish its efficacy conclusively. [5,10] The study focused on examining the therapeutic potential of nebulized 3% hypertonic saline for respiratory distress in bronchiolitis patients. The current study revealed comparable mean ages for participants in both groups,

establishing a well-matched baseline. The mean age for the case group was 13.38 ± 6.34 months, whereas the control group recorded 12.72 ± 5.82 months.

Age distribution revealed that in the case group, 7% participants were under 6 months, 46% were aged 6-12 months, 17% fell into the 13-18 months range, and 30% were in the 19-24 months category. Similarly, the control group included 7% participants under 6 months, 47% aged 6-12 months, 21% in the 13-18 months range, and 25% in the 19-24 months category, reflecting a similar distribution. This data inferred that the age distributions in both the case and control groups are generally well-aligned, ensuring a balanced comparison for the study. The majority of participants in both groups were in the 6-12 months age range, ensuring a balanced distribution across the categories.

In case of gender distribution, the case group presented 60% participants were males, while 40% were females. Similarly, the control group included 61% males and 39% females. The gender distribution across both groups was nearly identical, ensuring a balanced representation by sex. Mazhar et al. (2024) observed similar findings in a study of 124 patients, randomly divided between Group A (62 participants, 3% hypertonic saline) and Group B (62 participants, 0.9% normal saline). Their results indicated that Group A included 21 females (33.9%) and 41 males (66.1%), whereas Group B had 28 females (45.2%) and 34 males (54.8%). The average age in Group A was 7.0 months (± 4.61 months), compared to an average age of 5.97 months (± 4.29 months) in Group B. [11,10]

Subsequently, we observed in our investigation that the case group had a significantly higher proportion of individuals with bilateral hyperinflation (46%) compared to the control group (15%). This disparity suggested that the condition in the case group might have been associated with an increased occurrence of bilateral hyperinflation. In contrast, the control group demonstrated a majority (85%) with normal chest X-rays, indicating a lower association with bilateral hyperinflation. These findings highlight a clear difference in the prevalence of bilateral hyperinflation between the two groups.

Furthermore, the majority of individuals were observed to have normal total blood counts. In the case group, 95% of individuals had normal results, while 5% showed abnormalities. Similarly, in the control group, 97% had normal total blood counts, with only 3% having abnormal results. This indicates that abnormalities in total blood count are relatively rare in both groups, with a slightly higher percentage observed in the case group.

Additionally, all 100 participants across both groups were provided with humidified oxygen. This uniform distribution indicates that humidified

oxygen was consistently provided across both groups.

Both groups exhibit a very high proportion of individuals who did not require intravenous fluids (95% in the case group and 97% in the control group). The observed difference between the two groups was negligible, indicating that the treatment applied to the case group had little to no impact on the requirement for intravenous fluids.

Additionally, we found in our study that in the case group, 96 individuals were taking oral feeds, while 4 individuals were not. Similarly, in the control group, 98 individuals were receiving oral feeds, and only 2 were not. The data shows a high prevalence of oral feed adoption in both groups, with a slightly higher proportion in the control group. This minimal difference suggests that oral feed adoption was consistent and nearly uniform across both groups. [12]

Besides these, in the case group, 59 (59%) patients resolved their cough within 4-5 days, representing a larger proportion of the group, while 41 (41%) patients required 6-7 days for resolution. This indicates that a majority of patients in the case group experienced faster recovery times. In comparison, the control group showed a slower recovery trend, with only 25 (25%) patients resolving their cough in 4-5 days, while the majority, 75 (75%) patients, and needed 6-7 days. This data suggests that the treatment in the case group have contributed to quicker cough resolution compared to the control group. Supporting this, Wang et al. (1995) observed respiratory status improvements in similar studies, typically occurring within 2-5 days. [13,14]

Additionally, our study revealed that in the case group, 92 patients (92%) experienced wheeze resolution within 1-2 days, indicating a rapid recovery for the majority. A smaller proportion of patients took longer, with 8 patients (8%) resolving symptoms within 3-4 days and none requiring 5-6 days. In contrast, the control group showed slower recovery times, with only 25 patients (25%) resolving their wheeze within 1-2 days. The majority of control group patients, 73 individuals (73%), required 3-4 days for resolution, and 2 (2%) patients resolved their wheeze in 5-6 days. The case group showed a notably faster recovery compared to the control group. These observations align with earlier studies indicating respiratory improvement within 2-5 days, though wheezing often lasted up to a week or more in some infants. [13, 15]

Additionally, our study demonstrated that none of the subjects experienced any adverse outcome. This indicates that the treatment was well-tolerated and free from any negative reactions among the participants. Moreover, a marked variation in the period of hospital stays was noticed between both groups.

In the case group, 88% of patients had shorter stays of 1 to 3 days, as opposed to only 11% in the control group. Moderate hospital stays of 4 to 6 days were far less frequent in the case group, comprising just 10% of patients, compared to 87% in the control group. Extended stays of 7 to 9 days were rare, recorded at 2% in both groups. This observation aligns with findings from another study¹⁵, which revealed that 44 subjects in the study group were discharged within three days, whereas 36 patients from the control group experienced similar short hospital stays. Furthermore, 39 patients in the study group stayed for 3-6 days, in contrast to 22 patients in the control group. Notably, none of patients required hospitalization beyond six days, while 20 individuals from the control group had extended stays ranging from seven to eleven days. [12,15]

Subsequently, the case group data of our study indicated that younger children (less than 6 months) had shorter durations of coughing, wheezing, and hospitalization. As age increased, the prevalence of longer-duration coughs surged, although hospital stays generally remained relatively short for most cases. The majority of children across all age groups experienced wheezing for 1-2 days, and most hospitalizations lasted between 1-3 days, which suggested effective management and recovery. In contrast, the control group data revealed that as age increased, the percentage of children who experienced longer cough durations (6-7 days) increased significantly. Wheezing was more prolonged in older children, particularly in the 6-12- and 13-18-month age groups. Hospitalization trends also showed that most children required stays of 4-6 days, especially in the 6-12-month and 13-18-month groups. These findings indicated that children in older age groups experienced more prolonged symptoms and required extended hospital stays in the control.

Based on our study findings, 3% hypertonic saline nebulization demonstrates potential as an effective therapeutic option by enhancing mucociliary clearance, mitigating airway inflammation, alleviating respiratory distress, and improving airway obstruction.

Conclusions

The study concludes that the case group demonstrated superior treatment outcomes compared to the control group. Faster recovery trends were observed in cough and wheeze resolution, alongside shorter hospital stays, with no adverse effects reported. Younger children in the case group particularly benefited, showing quicker recovery times for symptoms and shorter hospitalizations. Although prolonged coughs became more prevalent with increasing age, the case group consistently achieved better outcomes compared to the control group. Conversely, the control group experienced

more pronounced symptom durations and longer hospital stays, particularly among children aged 6-12 and 13-18 months. The treatment in the case group facilitated quicker symptom resolution, improved overall patient recovery, and reduced respiratory distress, showing the effectiveness and tolerability of the 3% hypertonic saline solution.

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