Original Article
2026, 16 (1): 38-49
DOI: 10.22038/ebcj.2026.91743.3202

Received: 20/10/2025
Accept & ePublished: 20/04/2026

Evidence Based Care Journal
http://ebcj.mums.ac.ir
Online ISSN: 2008-370X

The Effect of a Laughter-Based Intervention on Airway Patency in Children with Tracheostomy: A Quasi-Experimental Study

Sara Valadkhani[1], Manijeh Nourian[2]*, Azam Shirinabadi Farahani[2], Maliheh Nasiri[3], Mohadese Babaie[4]

Abstract

Background: Children with tracheostomies rely on airway patency and respiratory function, but obstruction and discomfort can reduce quality of life for both the child and family. Non-pharmacological options, like laughter, may offer benefits.

Aim: This study aims to investigate the impact of laughter on airway patency in hospitalized children with tracheostomies, emphasizing the potential non-invasive therapeutic benefits in enhancing respiratory outcomes.

Method: This quasi-experimental study enrolled eighty children aged 6–12 with tracheostomies in Tehran (March 2021–July 2022). Participants were convenience-sampled and randomly assigned to intervention or control groups. The intervention: two 15-minute laughter sessions over two consecutive days. The laughter-based intervention consisted of watching a comedic animation ("The Adventures of Oscar") and engaging in puppet play. Airway patency was monitored via SpO_2, respiratory rate, and suctioning frequency thrice daily for two days post-intervention. Data were collected with a demographic–clinical questionnaire and validated monitoring devices. Analyses used t-tests, Mann–Whitney, Chi-square, Friedman's test, and GEEs ($p<0.05$) in SPSS v20.

Results: About 88.8% of participants breathed spontaneously. No significant baseline differences between groups. SpO_2 rose significantly at the 5th and 6th measurements ($p=0.026$, $p=0.016$). The intervention group had a lower respiratory rate across all six time points ($p<0.05$). Suctioning frequency declined significantly in the intervention group only at the 6th measurement ($p=0.011$). GEE showed a significant time-by-group reduction in respiratory rate for the intervention group ($p=0.003$); no between-group differences were found for SpO_2 ($p=0.218$) or suctioning frequency ($p=0.504$).

Implications for Practice: Laughter-based interventions are feasible non-pharmacological strategies to improve respiratory function in pediatric tracheostomy care and can be integrated into routine care.

Keywords: Airway Patency, Children, Laughter, Tracheostomy

---

1. Department of Pediatric Nursing, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran
2. Associate Professor, Department of Pediatric Nursing, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran
3. Assistant Professor, Department of Biostatics, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran
4. PhD in Nursing, Assistant Professor, Non-communicable Diseases Research Center, Alborz University of Medical Sciences, Karaj, Iran

* Corresponding Author Email: nourianma@gmail.com

Introduction

A tracheostomy serves as a semi-permanent pathway for direct airway access in patients with head and neck trauma, those requiring prolonged assisted ventilation and specialized care, or individuals experiencing respiratory failure and airway obstruction. Approximately 10% of patients initially intubated via oral or nasal endotracheal tubes eventually undergo tracheostomy (1). In Iran, the incidence of tracheostomy procedures is reported at 40.59 cases per 100,000 individuals (2). Pediatric tracheostomy rates are considerably lower, accounting for approximately 0.2% of cases, while global mortality rates associated with the procedure range between 10% and 20% (3), representing a clinically significant burden. Tracheostomy-related complication rates are significantly higher in pediatric patients compared to adults, reaching as high as 40% (4). This increased susceptibility arises from anatomical and physiological factors, including narrower airways, excessive secretions, immune system immaturity, low body weight, and congenital anomalies (5). Additionally, tracheostomy patients often experience reduced physical activity, diminished chest wall mobility, impaired respiratory muscle strength, decreased lung capacity, and weakened cough efficacy (6). A critical long-term complication of tracheostomy is the accumulation of excessive airway secretions. Due to impaired cough reflexes and diminished pharyngeal stimulation, retained secretions prolong airway exposure to irritants, leading to inflammation and subsequent airway stenosis (7). Notably, evidence indicates that 6% of tracheostomy-related fatalities result from airway obstruction or accidental decannulation (5).

Chest physiotherapy in pediatric populations can be associated with several adverse effects, including elevated intracranial pressure (8), heightened stress, clinical instability, and diminished improvement in respiratory rate over successive sessions (9). Additional risks include pain and pulmonary hemorrhage (10). Due to the structural immaturity of pediatric airways, underdeveloped respiratory muscles, and pliable intercostal cartilage, children are more susceptible to atelectasis. Furthermore, fear-induced suppression of coughing can result in air trapping behind retained secretions, potentially leading to life-threatening complications (8). Consequently, the likelihood of rehabilitation-related complications from physiotherapy is significantly higher in pediatric patients compared to adults. Moreover, chest physiotherapy is contraindicated in children with conditions such as bleeding disorders, osteoporosis, acute pain, skeletal deformities, elevated intracranial pressure, hemoptysis, or rib fractures (11). Given these limitations, the implementation of non-invasive therapeutic alternatives should be carefully considered.

Airway suctioning is an invasive clinical intervention employed to maintain airway patency (10). Airway patency, defined as the unimpeded passage of air through the respiratory tract, is essential for optimal gas exchange and efficient oxygenation. This procedure facilitates the removal of obstructive secretions and foreign materials, thereby stabilizing oxygen saturation levels and maintaining physiological respiratory rates. By ensuring uninterrupted ventilation, airway suctioning supports adequate tissue oxygenation, which is critical for systemic homeostasis (12, 13). However, this procedure is not without risks. Evidence indicates that airway suctioning may induce transient adverse effects, including arterial oxygen desaturation, hypotension, bradycardia, tachycardia, hypercapnia, and restlessness (13).

Coughing serves as a therapeutic mechanism to enhance respiratory muscle strength and facilitate secretion clearance (10). While a 2025 systematic review suggests that laughter yoga can improve mood and quality of life in chronic respiratory patients, the evidence for measurable improvements in lung function or airway patency remains mixed and inconclusive (14). Separately, laughter has been shown to promote the release of endorphins and catecholamines, neurohormones linked to anxiolytic, stress-reducing, and analgesic effects (15). Laughter represents a complex psychophysiological response to external stimuli (16) that can be categorized into five distinct types: (1) spontaneous (genuine) laughter, (2) simulated (self-induced) laughter, (3) evoked laughter (e.g., through tickling), (4) pharmacologically-induced laughter, and (5) pathological laughter (14,17).

Within nursing practice, humor and spontaneous laughter serve as therapeutic communication tools that reduce patient anxiety and enhance educational outcomes during patient instruction (16). Empirical evidence demonstrates that such interventions improve treatment adherence, quality of life metrics, and reduce both disease-related complications and hospitalization-associated morbidities (18). Laughter therapy has been shown to significantly decrease depression, stress, and anxiety levels while improving sleep quality (19). Furthermore, it enhances immune function through measurable increases in CD4+ and CD8+ lymphocyte counts (20). The selection of a combined intervention (comedic animation and puppet play) is grounded in its capacity to elicit genuine, spontaneous laughter—the most therapeutically potent type. This approach simultaneously addresses the psychophysiological and mechanical aspects of airway clearance: emotional engagement reduces anxiety and muscle tension (14), while the physical act of laughter generates repetitive expiratory efforts at an average frequency, leading to a marked increase in esophageal pressure—frequently exceeding the critical pressure required to achieve maximum expiratory flow (21). Given the critical role of nurses in managing both physical and psychological aspects of care for pediatric tracheostomy patients, coupled with the physiological parallels between coughing and laughter mechanisms, a significant research gap exists regarding non-invasive airway management strategies. This is particularly relevant considering the potential complications associated with respiratory physiotherapy in this vulnerable population. The current study was therefore designed to investigate the effects of laughter therapy on airway patency parameters (Oxygen saturation) SpO_2), respiratory rate, and suctioning frequency) in tracheostomy-dependent children admitted to tertiary care hospitals affiliated with Universities of Medical Sciences in Tehran.

Methods

This parallel quasi-experimental study was conducted from March 2021 to July 2022 in Tehran, Iran. This study was conducted at Children's Medical Center and Ali Asghar Hospital. These hospitals are the largest specialized and subspecialized center for children in Tehran. Inclusion Criteria were Glasgow Coma Scale score >11, Fluency in the Persian language, Minimum of 72 hours post-tracheostomy procedure, Spontaneous respiratory function, Absence of recent anesthesia or narcotic administration (within 24 hours), No documented visual or auditory impairments, No diagnosed psychiatric conditions, and Absence of neuromuscular disorders. Exclusion Criteria were Withdrawal of parental or child consent at any stage, Hospital discharge or mortality during the study period, Requirement for emergency surgical intervention, Hemodynamic instability (as clinically determined by the treating physician), Participant noncompliance with the study protocol, Acute clinical deterioration requiring intensive care, Occurrence of a distressing event (e.g., severe agitation, pain) and Failure to achieve a consistent laughter response (scores of 5-6 on the Humor Rating Scale) across all four intervention sessions (applicable to the intervention group only). The sample size for each group was calculated as 37 using a previous study (22). To enhance statistical robustness and account for potential attrition, we enrolled 40 participants per group (total N=80), substantially exceeding the minimum requirement. Eligible participants were randomly assigned to either the intervention or control group using a computer-generated random number sequence in Microsoft Excel. A total of 88 participants were enrolled and allocated. Participant recruitment and sampling were conducted from March 2021 to July 2022 at pediatric hospitals in Tehran, Iran (Children’s Medical Center Hospital and Ali Asghar Hospital), where tracheostomy procedures are routinely performed on children. Potential participants were identified through convenience sampling during morning hours (8:00–10:00 AM) in consultation with nursing offices and head nurses, and were subsequently screened against the study’s inclusion criteria.

This study employed two primary data collection tools: (1) a researcher-designed demographic questionnaire and (2) hospital monitoring devices. The questionnaire consisted of two sections - the first captured baseline characteristics (age, sex, birth order, education level, Family’s economic status and city of residence, while the second recorded clinical parameters (respiratory rate, SpO_2, suction frequency, Time passed from tracheostomy surgery, diagnosis, Use of airway secretion-thinning medications, Ventilator connection status, Hospitalization Length). The questionnaire was developed by the research team and validated through expert review. Patient monitoring utilized standardized hospital equipment (Puyandegan-e Rah-e Salamat) at the study sites. To ensure data accuracy, all devices underwent monthly calibration tests by biomedical engineering units, with certification obtained prior to study initiation. This rigorous protocol guaranteed reliable measurement of SpO_2.

Participants and their parents were provided with information about the study aim and the confidential management of their data. Following acquisition of written informed consent and verbal assent from both parents and pediatric participants, all study subjects participated in an initial warm-up session to establish rapport between the researcher, child, and parent. Subsequently, demographic data were collected by the researcher. Participants randomized to the experimental group received standardized care supplemented with a structured laughter intervention protocol administered twice daily (morning and evening sessions) over two consecutive days (total 4 sessions). All initial sessions were conducted during morning shifts to control for circadian variability. The standardized intervention protocol comprised three phases per session:

Engagement Phase (5 minutes):

-Researcher-led interactive singing utilizing a puppet prop

-Encouragement of participant clapping as a reciprocal engagement technique

Stimulus Presentation Phase (7 minutes):

-Viewing of preselected animated content (Oscar's Oasis) via large-screen mobile device

-Concurrent puppet-mediated interaction throughout viewing

Response Reinforcement Phase (3 minutes):

-Researcher-facilitated humor recall through developmentally appropriate discussion of animated content

-Age-appropriate verbal engagement to sustain laughter response

All interventions were conducted with maternal presence. Laughter response was quantitatively assessed using the validated Humor Rating Scale (23), a 6-point pictorial scale comprising from 1: very serious to 6: very funny. Participants failing to achieve threshold laughter responses (scores ≥5) during all four intervention sessions, were excluded. Inter-rater reliability for scale implementation in our study was established at 0.8 (Cohen's κ) through standardized training of assessors. The qualitative content validity of this instrument was assessed through expert judgment. Interventions were deferred for two hours post-invasive procedures to minimize confounding effects. All physiological measurements were obtained by a single trained researcher to ensure consistency, with the following temporal schedule:

-Measurement intervals: 0700, 1100, and 1900 hours

-Duration: Two consecutive days (six total measurements per participant)

-Parameters:

1. Sp O_2: Recorded via pre-calibrated patient monitors
2. Respiratory rate: Manually counted by researcher over 60 seconds
3. Suction frequency: Extracted from nursing documentation with nurse verification

Participants in the control group received routine care while maintaining identical measurement protocols and continuous maternal presence maintained to match intervention group conditions. Identical data collection procedures performed by the same research team.

The variables were described with frequency tables, and appropriate tests—including independent t-tests, Mann-Whitney U tests for group comparisons, and GEE modeling for temporal patterns—were conducted in SPSS v20. P-values less than 0.05 were deemed statistically significant.

Due to the behavioral and interactive nature of the laughter intervention, full blinding of participants and the researcher was not feasible. However, to minimize bias, the outcome assessor responsible for extracting physiological data (SpO_2, respiratory rate) from the monitors and nursing records was blinded to group allocation. Additionally, the statistician analyzing the data was kept blinded to the group assignments.

Ethical Consideration

This MSc nursing dissertation was approved by the Ethics Committee/IRB of Shahid Beheshti University of Medical Sciences, Tehran, Iran. The Research Deputy approved the study, which involves human participants/human data (ethics code IR.SBMU.PHARMACY.REC.1401.051). All methods were performed in accordance with Declaration of Helsinki. After explaining the objectives of the research, written informed consent was obtained from children and their parent or legal guardian. They were also ensured of the confidentiality of data and made aware of the right to withdraw from the study.

Results

Of the 88 participants allocated to the study, 8 were excluded from the final analysis: 3 were discharged from the hospital before completing the intervention, 1 was transferred to the ICU, and 4 withdrew consent. The final analytic sample consisted of 40 participants per group (N=80), which met the required sample size determined by the power calculation (Figure 1).

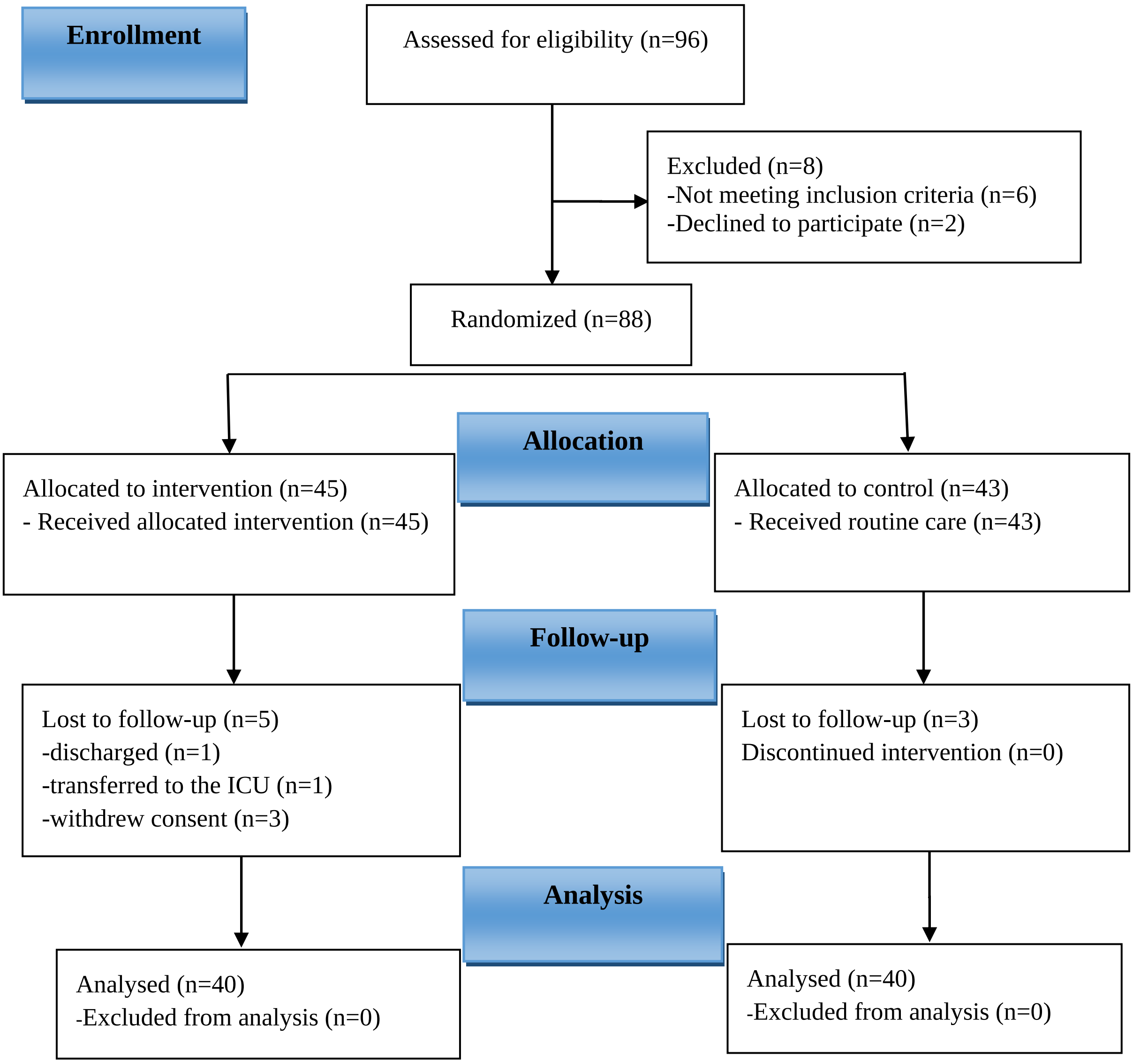

Figure 1. Flowchart of the effect of laughter on airway patency in hospitalized children with tracheostomies

The mean age of participants in the intervention and control groups was 7.65±1.33 and 7.10 ±1.37 years, respectively, with no statistically significant difference observed between the two groups (t=1.81, p=0.073). The majority of participants were male (63.8%). Most children were at the preschool education level (62.5%) and were second-born (38.8%). The demographic and clinical characteristics of both groups are shown in Table 1, with no statistically significant differences observed between them.

Results showed that the SpO_2 in the intervention group increased significantly compared to the control group during the fifth (p=0.026) and sixth (p=0.016) measurements. Additionally, the respiratory rate was significantly lower in the intervention group across all six measurements periods (p<0.05). The number of suctioning procedures required during the sixth measurement (p=0.011) was significantly lower in the intervention group (Table 2).

Table 3 presents the results of a Generalized Estimating Equations (GEE) analysis comparing respiratory outcomes between two groups over time. The intervention group demonstrated a statistically significant reduction in respiratory rate compared to the control group (p=0.003), with a significant interaction effect over time (p=0.008). Although SpO_2 showed a significant group-by-time interaction (p=0.045), indicating different trends between groups, the overall group effect was not significant (p=0.218); suctioning frequency showed no significant differences in either effect.

Table 1. Between-Group Comparison of Demographic and Clinical Characteristics in Children with Tracheostomy

Variables	Groups		P-value
	Intervention N (%)	Control N (%)	
Sex			
Female	17 (42.5)	12 (30)	0.241*
Male	23 (57.5)	28 (70)	
Education level			
Preschool	21 (52.5)	29 (72.5)	
1-3 primary level	16 (40)	9 (22.5)	0.183*
4-6 primary level	3 (7.5)	2 (5)	
Birth order			
First	11 (27.5)	12 (30)	
Second	14 (35)	17 (42.5)	0. 811 *
Third	11 (27.5)	8 (20)	
Forth	4 (10)	3 (7.5)	
Family Economic Status			
Low	31 (77.5)	29 (72.5)	0.162*
Middle	9 (22.5)	11 (27.5)	
City of Residence			
Tehran (Capital)	8 (20)	8 (20)	1*
Other cities	32 (80)	32 (80)	
Diagnosis			
Respiratory	29 (72.5)	31 (77.5)	
Neurology	7 (17.5)	5 (12.5)	
Cardiovascular	2 (5)	2 (5)	
Hematologic & Metabolic	2 (5)	1 (2.5)	0.782**
Musculoskeletal	–	1 (2.5)	
Second	3 (7.5)	4 (10)	
Third	3 (7.5)	3 (7.5)	
Forth	5 (12.5)	2 (5)	
More than 4	29 (72.5)	31 (77.5)	
Use of airway secretion-thinning			
medications	15 (37.5)	7 (17.5)	
1-2 hours	24 (60)	31 (77.50	0.132***
More than 2 hours	1 (2.5)	2 (5)	
None			
Time passed from Tracheostomy			
Surgery	2 (5)	1 (2.5)	
1 week	2 (5)	4 (10)	0.501***
2 weeks	6 (15)	8 (20)	
3 weeks	30 (75)	27 (67.5)	
More than 3 weeks			
Mechanical Ventilation			
Yes	4 (10)	5 (12.5)	0.724*
No	36 (90)	35 (87.5)	

*Chi-Square, **Fisher exact test, ***Mann-Whitney test

Table 2. Between-Group Comparison of SpO_2, Respiratory Rate, and Suctioning Frequency in Children with Tracheostomy across Six Measurement Time Points

Time of Measurement	Variable	Intervention Group (n=40) Mean Rank / Mean ± SD	Control Group (n=40) Mean Rank / Mean ± SD	Test Statistic	P-value
Day 1					
1st Examination	SpO_2 (%)	93.48 ± 1.96	93.00 ± 2.29	t = 0.99 95% CI: -0.48, 1.44	0.323*
	Respiratory Rate	31.75	48.25	U = 490.000	0.003**
	Suctioning Frequency	47.75	48.25	U = 792.500	0.935**
2nd Examination	SpO_2 (%)	93.63 ± 1.97	93.03 ± 2.38	t = 1.23 95% CI: -0.37, 1.57	0.222*
	Respiratory Rate	31.73	49.28	U = 449.000	0.001**
	Suctioning Frequency	38.50	42.50	U = 660.000	0.100**
3rd Examination	SpO_2 (%)	93.75 ± 1.98	92.95 ± 2.48	t = 1.59 95% CI: -0.20, 1.80	0.115*
	Respiratory Rate	31.51	49.49	U = 440.500	<0.001**
	Suctioning Frequency	39.25	41.75	U = 733.500	0.476**
Day 2					
4th Examination	SpO_2 (%)	94.03 ± 1.96	93.08 ± 2.32	t = 1.97 95% CI: -0.01, 1.91	0.052*
	Respiratory Rate	31.56	49.44	U = 442.500	0.001**
	Suctioning Frequency	38.75	42.25	U = 689.000	0.231**
5th Examination	SpO_2 (%)	94.08 ± 1.99	92.95 ± 2.42	t = 2.27 95% CI: 0.14, 2.12	0.026*
	Respiratory Rate	29.68	51.33	U = 367.000	<0.001**
	Suctioning Frequency	39.00	42.00	U = 705.500	0.218**
6th Examination	SpO_2 (%)	94.20 ± 2.04	92.98 ± 2.40	t = 2.46 95% CI: 0.23, 2.21	0.016*
	Respiratory Rate	29.60	51.40	U = 364.000	<0.001**
	Suctioning Frequency	34.50	46.50	U = 564.000	0.011**

*Independent t-test, ** U Mann Whitney test

Table 3. Results of Generalized Estimating Equations (GEE) for Comparison of Respiratory Outcomes Between Groups Over Time

Variable	Effect	Coefficient (B)	95% CI	p-value
SpO_2	Group (Intervention vs. Control)	0.85	(-0.52 to 2.22)	0.218
	Time	0.12	(-0.08 to 0.32)	0.241
	Group × Time (Interaction)	0.22	(-0.13 to 0.57)	0.047
Respiratory Rate	Group (Intervention vs. Control)	-5.80	(-9.60 to -2.10)	0.003
	Time	-0.45	(-0.85 to -0.05)	0.028
	Group × Time (Interaction)	-1.20	(-1.90 to -0.50)	0.008
Suctioning Frequency	Group (Intervention vs. Control)	-0.60	(-2.30 to 1.10)	0.٥٠٤
	Time	-0.10	(-0.35 to 0.15)	0.4٤2
	Group × Time (Interaction)	-0.30	(-0.70 to 0.10)	0.112

Discussion

The study aimed to investigate the impact of laughter on airway patency in hospitalized school -age children with a tracheostomy. While the overall SpO_2 levels did not show significant differences between the groups across all measurement intervals, the notable increase in SpO_2 during the fifth and sixth intervals suggests that laughter may have a delayed or cumulative effect on improving airway patency. This could imply that sustained or repeated laughter sessions might be necessary to observe measurable physiological benefits. The findings align with existing literature on the positive effects of laughter on respiratory function, such as enhanced lung expansion and improved ventilation (15, 24, 25). However, the delayed response raises questions about the underlying mechanisms—such as possible relaxation of airway muscles or enhanced mucus clearance over time (26).

The lack of significant differences in SpO_2 levels during earlier intervals suggests that laughter may not provide immediate improvements in airway patency for this population. This could be due to the physiological challenges faced by patient with tracheostomies, such as altered airflow dynamics or increased airway resistance (27, 28). Further research with controlled laughter interventions is needed to confirm these findings. If future studies validate these results, incorporating structured laughter therapy into the care of pediatric tracheostomy patients could become a non-invasive, low-cost adjunct to improve respiratory outcomes, similar to its use in other therapeutic settings (29).

The existing literature presents heterogeneous findings regarding the effects of laughter on SpO_2. Several studies, demonstrating significant improvements in SpO_2 following laughter interventions (30, 31). However, contradictory evidence emerges from Fry's investigation (32), which reported no significant changes; this discrepancy may be attributed to methodological variations, including shorter intervention durations and the utilization of healthy adult participants, in contrast to our longitudinal study. These divergent outcomes underscore the critical importance of considering intervention parameters, participant demographics, and clinical status when evaluating the physiological impacts of laughter therapy.

Antonelli's 2021, examining group laughter therapy in pediatric oncology patients yielded inconclusive SpO_2 results, potentially attributable to methodological distinctions such as the absence of parental presence and group-based administration, contrasting with our individualized, parent-accompanied intervention protocol (33). Physiological studies by Boone et al. (34) elucidate potential mechanisms, demonstrating that laughter induces transient increases in stroke volume and cardiac output while decreasing arteriovenous oxygen differences, followed by a subsequent reduction in oxygen consumption. Complementary findings by Brutsche et al. (35) suggest that laughter may ameliorate hyperventilation and reduce lung hyperinflation in patients with chronic obstructive pulmonary disease, providing plausible explanations for the observed respiratory benefits in specific clinical populations. These collective findings highlight the complex, context-dependent nature of laughter's physiological effects.

In a 2025 systematic review examining patients with chronic pulmonary diseases, the researchers reported that while laughter-based interventions demonstrated significant positive correlations with health-related quality of life and mood enhancement, current evidence remains insufficient to establish a definitive association with improved pulmonary function. The authors strongly emphasized the imperative for additional rigorous investigations in this field (14).

The results showed that the changes in respiratory rate over time (across the 6 measurement intervals) were significantly lower in the intervention group. Additionally, at each of the six measurement intervals, the respiratory rate in the intervention group was significantly lower, highlighting a notable influence of laughter on respiratory outcomes. The current findings align with several previous studies demonstrating a reduction in respiratory rate following laughter episodes (30, 36, 37). This consistent pattern suggests that incorporating laughter interventions alongside conventional care protocols may offer a viable strategy for improving respiratory management in pediatric tracheostomy patients.

A 2007 systematic review reported an immediate increase in respiratory frequency during laughter, followed by a subsequent decrease (38). While the present study did not measure respiratory rate during active laughter, our results similarly demonstrate laughter's significant impact on respiratory patterns across all measurement intervals, ultimately leading to reduced respiratory rates. Complementary evidence from a 2010 review study (31) further supports this biphasic respiratory response, documenting initial increases in both respiratory and heart rates during laughter, followed by marked decreases post-intervention.

More recent investigations have yielded congruent findings. A 2022 experimental study of laughter yoga's psychophysiological effects (39) observed the same pattern of respiratory rate elevation during laughter followed by reduction, regardless of delivery method (video vs. in-person) or participant age group. These collective results suggest that laughter-induced respiratory modulation may transcend demographic and methodological variables. The post-laughter reduction in respiratory rate may be mediated by positive emotional states and associated parasympathetic activation, though the precise mechanisms warrant further investigation.

Notably, some discrepancies exist regarding respiratory parameters during active laughter. While Fry's research documented increased respiratory volume and oxygen consumption during laughter (40), Szabo's findings demonstrated elevated respiratory rates (31). These contrasting results may reflect methodological differences in measurement timing, participant populations, or laughter stimulus characteristics. Nevertheless, the consistent post-laughter reduction in respiratory rate across studies supports the potential clinical utility of laughter interventions for respiratory management in vulnerable populations.

A 2025 meta-analysis conducted by Kim et al. demonstrated that laughter-based interventions can moderately reduce pain in pediatric patients while showing significant associations with substantial reductions in stress and anxiety levels (41), moreover, given the established association between respiratory function and stress (42), the observed decrease in respiratory rate among children in the current study may potentially be mediated by stress reduction. Nevertheless, further investigations in this domain would be valuable for substantiating these findings.

The results indicate that while laughter did not lead to a consistent reduction in suctioning frequency across all measured time points, a significant decrease was observed specifically at the sixth measurement. This delayed effect suggests that the benefits of laughter on airway patency and secretion management may require repeated or prolonged exposure before becoming clinically apparent. Previous studies have shown that laughter can stimulate deep breathing, improve mucociliary clearance, and reduce airway resistance over time (24, 38, 43). The cumulative effect seen at the sixth time point may reflect these physiological mechanisms, where repeated laughter sessions gradually enhance respiratory function and reduce the need for suctioning in children with tracheostomies. However, the lack of significant differences at earlier intervals implies that short-term laughter interventions may not be sufficient to produce measurable changes in secretion management.

The delayed reduction in suctioning frequency at the sixth time point could also be influenced by contextual factors, such as the child's adaptation to the intervention or variations in their clinical condition. This delayed effect may be attributed to two potential factors: (1) the cumulative benefits of repeated or prolonged laughter interventions on secretion management, and (2) variability in the duration of mucolytic medication administration among participants. Existing literature supports the influence of mucolytic agents on both suctioning frequency and secretion volume (44, 45), suggesting that the pharmacological variable warrants consideration when interpreting intervention outcomes. These findings highlight the importance of sustained laughter therapy sessions rather than isolated interventions for potential respiratory benefits. Future investigations employing longer intervention periods (>48 hours) may provide more definitive evidence regarding laughter’s potential role in secretion reduction.

Suctioning frequency serves not only as an indicator of secretion burden but also as a clinical marker for tracheostomy weaning readiness. A 2020 comparative study demonstrated that patients weaned via high-pressure oxygen tracheostomy suctioning experienced shorter hospitalization durations than those using tracheostomy caps (46). This finding underscores the clinical relevance of suctioning frequency as an outcome measure. The current results, while preliminary, suggest that laughter interventions may eventually contribute to optimized tracheostomy care protocols, though further research is needed to establish optimal intervention parameters and long-term effects.

This study had several limitations. First, the study was conducted in two hospitals, and the generalizability of the findings to other settings should be approached with caution. Differences in the mothers' psychological and emotional states during their presentation in the intervention may have influenced the results. The limited number of studies related to the topic made the discussion of the findings challenging. Although the intensity of laughter in the present study was measured using a numerical scale, it would be preferable to objectively assess laughter intensity in the intervention group using methods such as biometric sensors. Given the importance of providing holistic nursing care to children with tracheostomies, further studies are recommended, including a more diverse range of participants (e.g., children with comorbid conditions and from different cultural backgrounds) and implementing the intervention over longer periods to evaluate cumulative effects and measure additional confounding variables—such as disease severity or caregiver-related factors. Although these hospitals serve as nationwide referral centers for children, Iran exhibits considerable geographic, social, and ethnic diversity. Consequently, the study sample may not fully represent all children in Iran or globally. As a result, the generalizability of the findings could be limited. Future research with larger, more diverse samples of children is recommended.

Implications for practice

This study investigated the impact of laughter on airway patency in hospitalized school-age children with tracheostomies, yielding nuanced yet promising findings. While overall SpO_2 levels did not show significant differences between groups across all measurement intervals, a notable increase in SpO_2 during the fifth and sixth intervals suggests that laughter may have a delayed or cumulative benefit on respiratory function. Additionally, laughter significantly reduced respiratory rates at all measured intervals and decreased suctioning frequency by the sixth session, indicating potential long-term advantages for secretion management. The study's emphasis on noninvasive strategies aligns with contemporary care practices, offering practical implications for pediatric care. Laughter-based interventions can serve as non-pharmacological solutions to improve respiratory function in children with tracheostomies and can be effectively incorporated into their care.

Acknowledgments

This MSc nursing dissertation was approved by the Ethics Committee/IRB of Shahid Beheshti University of Medical Sciences, Tehran, Iran. The researchers express their gratitude to all the children and parents who participated in the study. The researchers also express their deep appreciation to the nurses of the hospitals and research centers for their invaluable collaboration.

Conflicts of interest

The authors declared no conflict of interest.

Funding

This project was financed by Shahid Beheshti University of Medical Sciences.

Authors' Contributions

S.V, M.No, and A.Sh.F designed the study and reviewed the conception and study materials. S.V and M.N.o prepared the ethics submission. SV and M.No were responsible for data acquisition. A.Sh.F and MB critically reviewed the manuscript. M.Na was responsible for data analysis. M.No and A.Sh.F oversaw all aspects of the study’s implementation. All authors read and revised the draft and approved the final manuscript.

AI Statement

We have not used any AI tools or technologies to prepare this manuscript.

References

1. Cheung NH, Napolitano LM. Tracheostomy: epidemiology, indications, timing, technique, and outcomes. Respiratory Care. 2014;59(6):895-919.
2. Alidad A, Aghaz A, Hemmati E, Jadidi H, Aghazadeh K. Prevalence of tracheostomy and its indications in Iran: A systematic review and meta-analysis. Tanaffos. 2019;18(4):285.
3. Fuller C, Wineland A, Richter G. Update on pediatric tracheostomy: indications, technique, education, and decannulation. Current Otorhinolaryngology Reports. 2021;9(2):188-199.
4. Barros CE, Almeida JA, Ayres GH, Oliveira CG, Braga CA, Avelino MA. Pediatric tracheostomy: epidemiology and characterization of tracheal secretion-a literature review. Revista da Associação Médica Brasileira. 2019;65:1502-7.
5. Neto JFL, Castagno OC, Schuster AK. Complications of tracheostomy in children: a systematic

review. Brazilian Journal of Otorhinolaryngology. 2022;88(6):882-890.
6. Lynne Katz S. CTS Pediatric Home Ventilation Guidelines Panel. "Section 5: airway clearance". Canadian Journal of Respiratory, Critical Care, and Sleep Medicine. 2018;2(sup1):32-40.
7. Lee M, Wilson H. Complications of tracheostomy. Shanghai Chest. 2021;5(42): 1-12.
8. Walsh BK, Hood K, Merritt G. Pediatric airway maintenance and clearance in the acute care setting: how to stay out of trouble. Respiratory Care. 2011;56(9):1424-1444.
9. Macedo JC, Olivo CR, Barnabe V, Dias ED, Moraes ÍA, Tiberio ID, Carvalho CR, Saraiva-Romanholo BM. Short-term effects of conventional chest physiotherapy and expiratory flow increase technique on respiratory parameters, heart rate, and pain in mechanically ventilated premature neonates: A randomized controlled trial. In Healthcare. 2024;12(23): 2408.
10. Rose L, Adhikari NK, Leasa D, Fergusson DA, Mckim D. Cough augmentation techniques for extubation or weaning critically ill patients from mechanical ventilation. Cochrane Database of Systematic Reviews. 2017;1(1):Cd011833.
11. Morrow BM. Chest physiotherapy in the pediatric intensive care unit. Journal of Pediatric Intensive Care. 2015;4(4):174-181.
12. Blakeman TC, Scott JB, Yoder MA, Capellari E, Strickland SL. AARC clinical practice guidelines: artificial airway suctioning. Respiratory Care. 2022;67(2):258-271.
13. Schults JA, Long DA, Mitchell ML, Cooke M, Gibbons K, Pearson K, et al. Adverse events and practice variability associated with paediatric endotracheal suction: an observational study. Australian Critical Care. 2020;33(4):350-357.
14. Spinou A, Dowsett K, Chu E, Taylor W, Lee AL, Theodorou V. Unpacking the role of laughter in respiratory health: a systematic review of laughter-based interventions in adults with chronic respiratory diseases. ERJ Open Research. 2025.
15. Louie D, Brook K, Frates E. The laughter prescription: a tool for lifestyle medicine. American Journal of Lifestyle Medicine. 2016;10(4):262- 267.
16. Berman A, Frandsen G, Snyder S. Kozier & Erb's Fundamentals of Nursing: concepts, process, andpractice. 11th Edition ed. United Kingdom: Pearson Education; 2021.
17. Van der Wal CN, Kok RN. Laughter-inducing therapies: Systematic review and meta-analysis. Social Science & Medicine. 2019;232:473-488.
18. Hwang S-H, Jeong H-C, Hwang J-W. Effect of laughter therapy on healthy life: a meta-analysis. Journal of the Korea Convergence Society. 2019;10(9):291-299.
19. Zhao J, Yin H, Zhang G, Li G, Shang B, Wang C, et al. A meta-analysis of randomized controlled trials of laughter and humour interventions on depression, anxiety and sleep quality in adults. Journal of Advanced Nursing. 2019;75(11):2435-2448.
20. Mehani SHM. Immunomodulatory effects of two different physical therapy modalities in patients with chronic obstructive pulmonary disease. Journal of Physical Therapy Science. 2017;29(9):1527-1533.
21. Filippelli M, Pellegrino R, Iandelli I, Misuri G, Rodarte JR, Duranti R, Brusasco V, Scano G. Respiratory dynamics during laughter. Journal of Applied Physiology. 2001;90(4):1441-1446.
22. Zakeri-Moghadam, M., Abbasi, Z., & Haghani, H. The effect of music therapy on ventilation criteria in patients undergoing mechanical ventilation. Iranian Journal of Cardiovascular Nursing, 2016; 5(2): 30-37.
23. Pexman PM, Glenwright M, Krol A, James T. An acquired taste: Children's perceptions of humor and teasing in verbal irony. Discourse Processes. 2005;40(3):259-288.
24. Jang KS, Oh JE, Jeon GS. Effects of simulated laughter therapy using a breathing exercise: a study on hospitalized pulmonary tuberculosis patients. International Journal of Environmental Research and Public Health. 2022;19(16):10191.
25. Lebowitz KR, Suh S, Diaz PT, Emery CF. Effects of humor and laughter on psychological functioning, quality of life, health status, and pulmonary functioning among patients with chronic obstructive pulmonary disease: A preliminary investigation. Heart & Lung. 2011;40(4):310-319.
26. Bennett PN, Parsons T, Ben-Moshe R, Weinberg M, Neal M, Gilbert K, et al., editors. Laughter and humor therapy in dialysis. In Seminars in Dialysis; 2014:27(5):488-493.
27. Tran TM, Huh S, Kim S, Cui X, Choi S. Numerical investigation of the effect of tracheostomy on flow and particle transport characteristics in human airways. Physics of Fluids. 2022;34(12):1-15.
28. Volsko TA, Parker SW, Deakins K, Walsh BK, Fedor KL, Valika T, et al. AARC clinical practice

guideline: management of pediatric patients with tracheostomy in the acute care setting. Respiratory Care. 2021;66(1):144-155.
29. Üner E, Balcı AS, Kadıoğlu H. The effect of laughter therapy on physical and mental health: Systematic review. Halk Sağlığı Hemşireliği Dergisi. 2022;4(3):251-269.
30. Choi S, Park H. Effects of combined program of laughter and exercise vs exercise-only program in pneumoconiosis patients. International Journal of Advanced Nursing Education and Research. 2019;4(1):19-24.
31. Mora-Ripoll R. The therapeutic value of laughter in medicine. Alternative Therapies in Health & Medicine. 2010;16(6):56-64.
32. Fry j, William F, Stoft P. Mirth and oxygen saturation levels of peripheral blood. Psychotherapy and Psychosomatics. 1971;19(1-2):76-84.
33. Antoneli AJ, Ferreira RM, Martins VA, Xavier VE, Moura LR. Oxygen saturation in pediatric cancer: does laughter therapy influence? Brazilian Journal of Health Review. 2021;4(6):27232-27243.
34. Boone T, Hansen S, Erlandson A. Cardiovascular responses to laughter: a pilot project. Applied Nursing Research. 2000;13(4):204-208.
35. Brutsche MH, Grossman P, Müller RE, Wiegand J, Pello, Baty F, et al. Impact of laughter on air trapping in severe chronic obstructive lung disease. International Journal of Chronic Obstructive Pulmonary Disease. 2008;3(1):185-192.
36. Ashtankar AP, Kazi A, Chordiya S. Comparative effect of Proprioceptive Neuromuscular Facilitation (PNF) and chest physiotherapy with chest physiotherapy alone on SP02, heart rate, respiratory rate, & lung compliance in mechanically ventilated patient. Journal of Pharmaceutical Sciences and Research. 2019;11(10):3514-3518.
37. Salehi Derakhtanjani A, Jaberi AA, Haydari S, Negahban Bonabi T. Comparison the effect of active cyclic breathing technique and routine chest physiotherapy on pain and respiratory parameters after coronary artery graft surgery: A randomized clinical trial. Anesthesiology and Pain Medicine. 2019;9(5):e94654.
38. Bennett MP, Lengacher C. Humor and laughter may influence health IV. Humor and immune function. Evidence-based Complementary and Alternative Medicine. 2009;6(2):159-164.
39. Szabo A, Berkes T, Ihász F, Köteles F. Psychophysiological Responses to Laughter Yoga in Women: Two Studies on the Visual and Practice Effects of this New Physical Activity. Baltic Journal of Sport and Health Sciences. 2022;4:23-34.
40. Fry Jr WF. The physiologic effects of humor, mirth, and laughter. Jama. 1992;267(13):1857-1858.
41. Kim B, Choi S. The efficacy of laughter-based interventions in children: A systematic review and meta-analysis. Journal of Child Health Care. 2025:13674935251346886.
42. Rubini A, Carniel EL. A review of recent findings about stress-relaxation in the respiratory system tissues. Lung. 2014;192(6):833-839.
43. Bertini M, Isola E, Paolone G, Curcio G. Clowns benefit children hospitalized for respiratory pathologies. Evidence-Based Complementary and Alternative Medicine. 2011;2011(1):879125.
44. Brodier EA, Raithatha M, Kannan S, Karunasekara N. Use of nebulised N-acetylcysteine as a life-saving mucolytic in intensive care: A case report. Journal of the Intensive Care Society. 2020;21(4):296-298.
45. Otu A, Langridge P, Denning DW. Nebulised N-acetylcysteine for unresponsive bronchial obstruction in allergic brochopulmonary aspergillosis: a case series and review of the literature. Journal of Fungi. 2018;4(4):117.
46. Hernández Martínez G, Rodriguez M-L, Vaquero M-C, Ortiz R, Masclans J-R, Roca O, et al. High-flow oxygen with capping or suctioning for tracheostomy decannulation. New England Journal of Medicine. 2020;383(11):1009-1017.