Effect of Prone versus Lateral Position on Respiratory Status among Children with Lower Respiratory Tract Infections

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Abstract

Introduction*:* Lower respiratory tract infection is considered one of the major public health problems in many developing countries among under five children. The correct positioning will help to reduce the breathing difficulty to some extent. **Aim*:*** The study aims to evaluate the effect of prone versus lateral position on respiratory status among children with lower respiratory tract infections. **Subjects and method: Design:** A quasi-experimental research design was utilized in this study. **Setting:** the study was conducted in Pediatric Intensive Care Unit at Sohag University Hospital**. Subjects**: A non-probability purposive sampling technique was adopted to select 100 children with lower respiratory tract infections from the previous setting who were assigned into two groups, with 50 children in each group. Prone position was given to group 1 and lateral position was given to group 2. **Tools:** Tool (1) Children assessment sheet and Tool (2) Children respiratory status assessment sheet. **Results***:* The result of the study revealed that in group-1 and group-2, the significance of the difference between the mean pre-observation and post-observation respiratory status score was statistically and was found to be highly significant at 0.05 level. The result shows that the respiratory status had no significant association with their variables. The values of heart rate, respiratory rate, and oxygen saturation improved significantly among children in the prone position than in the lateral positions after the intervention. **Conclusion:** The current study results concluded that prone and lateral positions were effective in improving the respiratory status of children under five years old with lower respiratory tract infections. The study findings also depicted that the prone position was more effective than the lateral position. **Recommendations**: Prone position is recommended and could be used in the routine care of children with lower respiratory tract infections as a simple and applicable strategy to improve the respiratory status.

Keywords: Children with lower respiratory tract infections, Prone and lateral positions, Respiratory status

Introduction:

Respiratory infections are the leading cause of morbidity and mortality throughout the world, particularly in developing countries. It contributes to about 20% of mortality and one-fourth to one-third of morbidity in under five children. A wide variety of problems affect the lower respiratory system. Although acute infection of the lower respiratory tract may be diagnosed in children of all ages, they tend to occur most frequently in young children who have not yet developed resistance to infectious diseases. Respiratory problems are responsible for a large proportion of pediatric admissions and outpatient attendance **(Cristina, 2019).**

Lower respiratory tract infection is a broad terminology which includes acute bronchitis, pneumonia, acute exacerbations of chronic obstructive pulmonary disease/chronic bronchitis, and acute exacerbation of bronchiectasis. Lower respiratory tract infections are one of the common clinical problems in community and hospital settings. Management of community-acquired pneumonia may pose challenges because of diagnostic difficulty in differentiating infections caused by typical and atypical microorganisms and rising rates of antimicrobial resistance. Beta-lactam antibiotics, macrolides, and fluoroquinolones are routinely prescribed medicines for the management of lower respiratory tract infection. Macrolides are time-tested and effective agents for the treatment of lower respiratory tract infection. Clarithromycin, a macrolide, offers several benefits in the

management of lower respiratory tract infection (**Ferwerda et al., 2019)**.

Positioning children in good body alignment and changing body position is essential for children with lower respiratory tract infections to improve oxygenation and reduce the need for supplemental oxygen (**Babaei et al., 2019**). It is considered basic nursing care and includes keeping the child in supine, prone, side lying, and head up tilted positions (**Soniya, 2019**). Despite the association between positioning and vital functions of children, controversies still exist about the best position **(Torabian et al., 2019).**

Changing positions is extremely common during daily life including the nighttime sleep of normal humans. Investigating the effect of body position has always been a field of great interest for respiratory physiologists and physicians as well. As an example, Milic-Emili described the distribution of ventilation in humans in different positions **(Milic-Emili et al., 2016).**

Prone position improves ventilation-perfusion mismatching, lung compliance, re-expansion of gravity-induced atelectasis, the drain of secretions from the trachea and bronchus, and lower levels of apnea (**Salih et al., 2020**). In addition, it reduces heat loss and metabolic rate, improves child sleeping, reduces gastroesophageal reflux and gastric emptying is optimized **(Babuyehet al., 2018**). While the lateral position is beneficial for children's comfort and development of fine motor skills. The lateral position increases gastric emptying whereas the left lateral position reduces gastric reflux (**North Devon Healthcare, 2018**).

Pediatric nurses have a crucial role in improving the quality of care of children with lower respiratory tract infections and providing them with comfort measures to improve respiratory rate, heart rate, and oxygen saturation. Positioning children in a good body alignment and changing body position regularly are essential components that have priority in nursing care for children with lower respiratory tract infections (**Babaei et al., 2019**). Furthermore, it has been proposed that body positioning is an easy, practical, and effective nursing intervention as compared with other invasive measures (**Salih et al., 2020**). Hence, this study was carried out to evaluate the effect of prone and lateral positions on respiratory status among children with lower respiratory tract infections.

Significance of the study:

The greatest problem for developing countries is the mortality from acute respiratory tract infection in children less than five years of age. In developing countries, 30% of all patients' consultations and 25% of all pediatric admission are of acute respiratory infection. About 5-7 episodes per child per year in urban areas and 3-5 episodes in rural areas are suffering from lower respiratory tract infection (**Thamer, 2018**). The WHO estimates that in 2019 lower respiratory tract infection tragically caused 13 million children to die each year, and 4.3 million children die from acute respiratory infection, mostly pneumonia, every year in developing countries **(World Health Organization, 2019**).

Aim of the study:

The study was aim to evaluate the effect of prone versus lateral position on respiratory status among children with lower respiratory tract infections through:

- Assessing the respiratory status among under-five children with lower respiratory tract infection.
- Determining the effect of prone and lateral position on the respiratory status of under-five children with lower respiratory tract infection.
- Comparing the effect of prone and lateral position on the respiratory status of under-five children with lower respiratory tract infection.

Research Hypotheses:

H1: There will be a significant difference between the pre-test and post-test respiratory status scores of under-five children with lower respiratory tract infection in prone and lateral positions.

H2: There will be a significant difference between a post-test respiratory status score of under-five children with lower

respiratory tract infection in the lateral and prone position.

H3: Children with lower respiratory tract infection who are positioned in a prone position will exhibit stable respiratory status than those positioned in a lateral position.

Subjects & Method:

Research design:

A comparative quasi-experimental design was utilized to achieve the aim of this study.

Setting: The current study was conducted at Pediatric Intensive Care Unit at Sohag University Hospital. This setting was selected due to the high prevalence of children in the selected setting, and also it serves the biggest region of the population.

Sample:

It included 100 children with lower respiratory tract infections from the previous setting who were assigned into two groups, with 50 children in each group. Prone position was given to group 1 and lateral position was given to group 2. The randomization achieved by asking each child to pick cards with numbers one and two were given to the participants. Children selecting number one were placed in the prone position group, while those selecting two were placed in the lateral position group.

Sampling Technique:

A non-probability purposive sampling technique was adopted to select

Variables:

Independent Variable:

Prone positioning and lateral positioning

Dependent Variable:

Respiratory status

Sample calculation:

The sample size of 100 children with lower respiratory tract infections was calculated using the following formula:

$$n > \frac{Z2\ P(1-P)}{d2}$$

Where n = sample size Z = statistic for a level of confidence = 95% Z = 1,96 P = Estimated proportion = 0.053 d = desire margin of error = 0.05 The samples were selected from the population by simple random sampling technique .

Inclusion criteria:

1. Their age ranged from 1 to 5 years old.
2. Their mothers agree to participate in the study.

Exclusion criteria:

1. Refuse to participate in the study.
2. History of other chronic diseases (e.g. heart disease)
3. Children having any condition that prevents them from being positioned in the lateral or prone position

Tools for Data Collection:

Tool (1) Children assessment sheet:

This tool was developed by the researchers after reviewing recent and relevant literature to assess children's personal, medical history, and cardiorespiratory parameters (**Harika et al., 2015 Torabian et al. 2019).** This tool included three parts:

Part 1: Personal data of the children: age, gender, and birth order.

Part 2: Children's medical history; It contains items related to the medical history of children such as the family history of respiratory illness, previous history of respiratory illness, present diagnosis of the child, and duration of illness.

Part 3: Cardiorespiratory parameters of children: such as heart rate, respiratory rate, and oxygen saturation (SPO2).

Tool (2) Children respiratory status assessment sheet:

It This tool was developed by the researchers after reviewing recent and relevant literature to assess respiratory distress signs of children (**Children's Health Queensland Hospital and Health Service, 2019; Hockenberry, 2015**) such as respiratory depth,

presence of grunting, retractions, nasal flaring, chest in drawing, wheezing, and cyanosis.

Tool Validity and Reliability:

The content validity of the tools, their clarity, comprehensiveness, appropriateness, and relevance were reviewed by five expert professors; three experts in Pediatric Nursing, and two expert physicians from the medical-thoracic department. Modifications were made according to the panel judgment. The content validity index was 96%.

The Reliability of the first tool was assessed through Cronbach's alpha test α= for tool I was 0.932, and tool II was 0.892 by Cronbach's alpha.

Method:

An official permission was obtained from the responsible authorities of the Pediatric Intensive Care Unit (NICU) at Sohag University Hospital to achieve this study after explaining its aim.

Ethical considerations:

Before beginning the study, the researchers met with the pediatric nursing directors of the selected setting to explain the aim of the study and gain their cooperation. First, the objectives of the study were explained to the children's parents and informed consent was obtained to obtain their cooperation. They were informed that participation in the study was voluntary, and they were free to withdraw from the study at any time, without giving any reason. The participants were told that their information would be kept confidential and used for research purposes only.

The pilot study

It was conducted on 10% of the studied sample (10 children with lower respiratory tract infections) of the total sample to assess the clarity and applicability of the tools and to identify any difficulties that may be faced during the actual study. In addition, the time needed to answer the tools were also estimated. To produce the final form of the tools, modifications were made. Children included in the pilot study were excluded from the study.

Fieldwork:

The researcher visited the previously selected settings two days/ a week from 9 am to 1 pm. Data were collected within six months, from the beginning of March to the end of August 2019. Approximately, 50-60 minutes were taken to complete interview tools using face-to-face interviews.

Initially, the researcher gains the children's cooperation by creating a pleasant relationship with them by engaging in brief conversations. The researchers completed the tools (Tool (1) Children assessment sheet and Tool (2) Children respiratory status assessment sheet.) were assessed for both the prone position group and lateral position group twice before the intervention, then re-assessed for the same groups post the intervention.

- ***The fieldwork was achieved through the following sequences:***

Positioning was performed by a researcher. Before the intervention, the researcher prepared the children and environment for the intervention. The demographic information questionnaire was completed before the intervention.

Children were assigned into two groups, with 50 children in each group. Prone position was given to group 1 and lateral position was given to group 2. Children have applied the prone position for two hours as well as children who applied the lateral position.

- Children in group 1 were placed in the prone position for two hours and children in group 2 were placed in the lateral position for two hours.
- Before positioning children, the researchers assessed the characteristics of the children using Tool I, part (3).
- Cardiorespiratory parameters was including, respiratory rate, heart rate, and oxygen saturation (SPO2) immediately before positioning and every 15 minutes. The average of measures was calculated after two hours.
- Respiratory rate was measured by observing the number of breaths the children took in a minute. Oxygen saturation and heart rate were continually monitored by a transcutaneous pulse oximeter.

- If the oxygen saturation in any position was less than 85%, or the children's heart rate reached above 200 or less than 100 beats per minute (b/min), or the respiratory rate increased to more than 60 cycles per minute(c/min), the children were returned to the previous position and was immediately notified to the physician. If a desaturation occurred, the value of FIO2 was increased after the physician's order.
- Respiratory status included respiratory distress signs were assessed and recorded twice, at zero minutes (base time) immediately before positioning and after two hours using Tool II.

  The lateral position was performed with the children's shoulders rounded and supported, their legs were bent with a boundary against their feet and their hands were at their midline and free to move to their face (**NorthDevon Healthcare, 2018**).
- The προνε position was performed with the children's head in midline, upper limbs adducted to the side of the chest wall, lower limbs slightly flexed (30–40º) in hips and knees and the head turned to one side (**Babaei et al., 2019**).

Statistical analysis:

The data were analyzed using SPSS statistical software version 20. Continuous data were obtained before and after the intervention and expressed as mean standard deviation (SD). Categorical data were expressed using numbers and percentages. The independent t-test was used to investigate differences between the two groups, while the paired t-test was employed to investigate differences between each group before and after the intervention. Changes in cardiorespiratory parameters were analyzed using a one-way repeated-measures analysis of variance (ANOVA). The Mann-Whitney test was used for variables that did not match the parametric assumptions. The link between the two variables was investigated using the chi-square test. The chi-square test was used to assess the relationship between two variables in the case of noncontiguous data. A P value of less than 0.05 was used to determine statistical significance.

Results:

As shown in **table 1** 66% of the studied children were in the prone position group compared to 62% in the lateral position group where from 3-5 years old. Concerning gender, 54% of the studied children were boys in the prone position group compared to 60% in the lateral position group. Regarding the birth order (42% and 44%) the studied children were second in both studied groups respectively. In the intervention group, the same table pointed out that there was no significant difference between the two groups concerning their data.

Table (2) illustrates the distribution of the studied under-five children according to their medical history. It was observed from the table that (84%) of them in the prone position group compared to 80% in the lateral position group had no family history of respiratory illness, (72% and 76%) of both studied children in the prone position group and lateral position group had no previous history of respiratory illness. Concerning the Present diagnosis, it was noticed that 56% of the children had Bronchiolitis in the prone position group compared to 52% in the lateral position group. The same table portrays that 70% and 68% of the studied children in both groups respectively were hospitalized form1-4 days. There was no significant difference between the two groups concerning their medical history.

Table (3) demonstrates the mean score of cardiorespiratory parameters of the studied children in the Lateral and prone positions. It was found that at zero minutes, the mean values of heart rate were 145.8± 16.2b/min and 143.9± 10.7 in a prone position with no statistically significant difference between the two positions. After two hours, the mean values of heart rate were 141.6±17.2b/min in the lateral position and 136.1±13.2b/min in a prone position with a statistically significant difference observed between the two positions (p=0.003).

Regarding the respiratory rate, the table illustrates that the mean values of the respiratory rate at 0 minutes were 52.6±7.4 c/min in the lateral position and50.7±4.2 in the prone position with no statistically significant difference found between the two positions. After two hours, the mean values of respiratory rate were 49.8±8.5 c/min in the lateral position and decreased to 46.3±4.4 c/min in a prone position with a statistically significant difference detected between the two positions (p=0.002).

Regarding oxygen saturation, the table shows that the mean values of oxygen saturation at 0 minutes were 94.8±6.6 and 95.7±3.3 in lateral position and prone position, respectively. There was no statistically significant difference was found between the two positions. After two hours, the mean values of oxygen saturation were 94.7±6.4 in the lateral position and increased to 97.7±5.3 in a prone position with a statistically significant difference observed between the two positions ($p<0.001$).

Table 4 shows the mean score of pre-observation regarding respiratory status scores in the prone position was 12.2 ± 0.984 and 12.08 ±0.97 in the lateral position. The table also, illustrates that the mean score of post-observation regarding respiratory status in the prone position was 5.84±0.97 and 7.38±1.36 lateral position.

Table 5 reveals the Comparison between pre and post-observation respiratory status scores in the prone position (group-1) and lateral position (group-2). The independent t-test illustrates that there was a significant improvement in the respiratory status score in the prone position group than in the lateral position group with ($p < 0.001$*).

Table 6: Illustrates the distribution of under-five children according to their respiratory status score among both studied groups (prone and lateral-group), it was observed that there was no statistically significant difference found between the two positions pre-intervention as regards respiratory status score. But post-intervention, there was a statistically significant difference and improvement in the respiratory status score observed between the two positions ($p<0.001$) in the prone position group than the lateral position group.

Table (1): Frequency and percentage distribution of the studied under-five children regarding their personal data n =100

Children Characteristics	Group-1(Prone position) (n-50)		Group-2 (Lateral position) (n-50)		X^2	P-value
	No	%	No	%		
Age						
1-2 years	17	34.0	19	38.0	4	0.17^{NS}
3-5 years	33	66.0	31	62.0		
Gender						
Boys	23	46.0	20	40	3	$1, 18^{NS}$
Girls	27	54.0	30	60		
Birth order						
First	17	34.0	16	32.0	2	0.13^{NS}
Second	21	42.0	22	44.0		
Third	12	24.0	12	24.0		

T-test, x^2 test, NS-non-significant

Table 2: Frequency and percentage distribution of the studied under-five children regarding their medical history n =100

Children medical history	Group-1(Prone position) (n-50)		Group-2 (Lateral position) (n-50)		X^2	P-value
	No	%	No	%		
Family history of respiratory illness						
Yes					3	0.17^{NS}
No	8	16	10	20.0		
	42	84	40	80.0		
Previous history of respiratory illness						
Yes					2	$1, 18^{NS}$
No	14	28.0	12	24		
	36	72.0	38	76		
Present diagnosis						
Pneumonia	17	34.0	20	40.0	2	1.27^{NS}
Bronchitis	5	10.0	4	8.0		
Bronchiolitis	28	56.0	26	52.0		
Duration of the illness						
1-4 days	35	70.0	34	68.0	1.24	0.12^{NS}
5-8 days	15	30.0	16	32.0		

T-test, x^2 test, NS-non-significant

Table 3: Differences in Mean score of cardiorespiratory parameters among under-five children in both studied groups (prone-group-1 and lateral-group-2) n=100

Cardiorespiratory parameters	Lateral position		Prone position		F (p) between the two positions in each period	
	At 0 minute	After 2hours	At 0 minute	After 2hours	At 0 minute	After 2hours
	Mean± SD	Mean± SD	Mean± SD	Mean± SD		
Heart Rate	145.8± 16.2	141.6±17.2	143.9± 10.7	136.1±13.2	2.532 (0.113)	6.268* (0.003*)
Respiratory Rate	52.6±7.4	49.8±8.5	50.7±4.2	46.3±4.4	3.014 (0.127)	8.189* (0.002*)
O2 Saturation	94.8±6.6	94.7±6.4	95.7±3.3	97.7±5.3	2.532 (0.101*)	12.305* (<0.001*)

F: F test (ANOVA) with repeated measures
p: p-value for comparing between Lateral position and prone position in each period *: Statistically significant at $p \leq 0.05$

Table 4: Mean median, range, and standard deviation of pre and post-observation of respiratory status scores

Group	Pre observation score			
	Mean	Median	Range	SD
Group-1	12.2	12	10-13	±0.984
Group-2	12.08	12	10-13	±0.97
Post observation score				
Group-1				
Post observation	5.84	6	5-8	±0.97
Group-2				
Post observation	7.38	8	5-9	±1.36

Table 5: Comparison between pre and post-observation respiratory status scores in the prone position (group-1) and lateral position (group-2)

Group	Pre observation score			
	Mean	Mean Difference	SD Difference	Independent t' value
Group-1	12.2	0.03	0.015	0.118
group-2	12.08			
Post observation score				
Group-1	5.84	1.54	0.38	5*
Group-2	7.36			

*NS=non-significant, *= significant at p<0.05 level*

Table 6: Frequency and percentage distribution of under-five children according to their respiratory status score among both studied groups (prone-group-1 and lateral-group-2) n=100

Respiratory status score	Group-1(Prone position) (n-50)		Group-2 (Lateral position) (n-50)		X^2	P-value
	No	%	No	%		
Pre-intervention						
No distress	0	0.0	0	0.0	0.58	1.59^{NS}
Moderate distress	5	10.0	4	8.0		
Severe distress	45	90.0	46	92.0		
Post-intervention						
No distress	22	44.0	9	18.0	58.2	<0.001**
Moderate distress	28	56.0	41	82.0		
Severe distress	0	0.0	0	0.0		

*NS=non-significant, *= significant at p<0.05 level*

Discussion:

Lower respiratory tract infections are a common condition in children that produce physiological difficulties such as a low breathing rate, irregular heart rate, low level of oxygen saturation, and apnea. Proper posture is critical in the treatment of children with lower respiratory tract infections. It has a tremendous impact on their health, as well as their ventilation and tissue oxygenation. However, the best position remains debatable (**Salih et al., 2020**).

The results of the current study revealed that there was no significant difference between the two groups concerning their data. There was no significant difference between the two groups concerning their medical history. From the researchers' point of view, this reflects that the baseline of personal data was similar in the two groups.

Concerning the mean score of cardiorespiratory parameters of the studied children in the lateral and prone positions, the current study results revealed that heart rate was lower in the prone position than in the lateral positions. The results of the present study are consistent with those of a previous study on children with leukemia done by **Arafa et al., (2020**) who studied Egypt's" Effect of Lateral Positions versus Prone Position on Cardiorespiratory Parameters among Preterm Neonates with Respiratory Distress Syndrome" and found that the mean heart rate in the prone position two hours was significantly lower than that in the lateral positions.

This result is similar to **Torabian et al., (2019**) who conducted a study and Compare " Effects of Supine and Prone Positions on Oxygen Saturation and Vital Signs in Premature Infants" in Iran and found that the mean heart rate of neonates in the prone position was significantly lower than that in the supine position. Similary, **Akbarian, et al., (2016)** found in their study about" The effect of position on oxygen saturation and heart rate in very low birth weight neonates " that better heart rate was in the prone position than that in the lateral positions among very low birth weight neonates which were implemented in Iran.

Regarding the respiratory rate, the present study highlighted that the mean values of respiratory rate were higher in the lateral position and decreased in a prone position with a statistically significant difference detected between the two positions. The results of the present study agreed with the study conducted by **Arafa et al., (2020)** who reported the same results and noticed that the mean respiratory rate among children was lower in the prone position after one hour than that in the lateral positions. This decrease in the respiratory rate in the prone position may be related to better diaphragmatic drawing down, resulting in larger lung expansion and thus better oxygenation, which occurs with postural change.

The results of the current study are in the same line as the results conducted by **Yinet al., (2016)** about " prone position can influence variability in respiratory rate of neonates using nasal CPAP" and found that the mean respiratory rate was higher in the prone position than in the lateral position among premature neonates exhibited more normal respiration in the prone position.

Regarding oxygen saturation, the findings of the present study revealed that the mean values of oxygen saturation increased in the prone position than in the lateral position with a statistically significant difference observed between the two positions. This finding could be explained by the fact that the diaphragm's better efficacy during contraction generates more strength and enhances ventilation, which optimizes gas exchange. Furthermore, **Salih et al., (2020**) stated that in the prone posture, the movement of the chest wall and the synchronization between the thorax and abdomen are greater, resulting in better oxygenation.

Furthermore, the current findings are consistent with the findings of **Akbarian et al., (2016**), who investigated the influence of prone, supine, and lateral positions on SaO2 in low birth weight newborns and discovered that the prone position provided greater oxygenation than the other two positions. These findings suggest that in preterm infants, prone positioning can lower the demand for a high inspiratory oxygen concentration.

Furthermore, contrary to the findings of the current investigation, **Yin et al., (2016**) found that the mean SaO2 was not substantially different across the three examined locations (i.e, supine, lateral, and semi-prone). The current study also contradicted several studies conducted by **Hough et al., (2016)** who studied " Effect of time and body position on ventilation in premature infants"**, Balali et al., (2017)** who studied**"** The effect of posture in premature infants on the arterial oxygen saturation, fraction of inspired oxygen and abdominal distension"**, and Santos et al., (2017),** who studied " Physiological and behavioral effects of preterm infant positioning in a neonatal intensive care unit " which found no significant difference between mean arterial oxygen saturation in the supine and prone positions.

The results of the present study showed that post-intervention the mean score regarding respiratory status scores in the prone position was lower than lateral position. From the researchers' point of view, this result confirmed that the prone position was more effective than the lateral position in improving respiratory status among the studied children.

In this study, there was a significantly improving in the respiratory status score in the prone position group than in the lateral position group. From the researchers' point of view, it reflects the success of positioning application among studied children and showed that the prone position was more effective than the lateral position. This finding is supported by **Sharma et al., (2016),** who concluded that the prone position leads to an improvement in respiratory distress among neonates with respiratory status as compared to lateral positions. This finding is similar **to Nomitha et al., (2019)** at Mysore who concluded in their study about " Effect on Respiratory Status of Under Five Children with Lower Respiratory Tract Infection in Prone and Lateral Position in Selected Hospitals" and revealed that there was a significant improvement in the mean respiratory status score of under-five children with lower respiratory tract infection in prone position group when compared to the lateral position group.

The findings of the current study indicated significant improvement of under-five children according to their respiratory status score among both studied groups (prone and lateral-group) with a statistically significant difference and improvement in the respiratory status score was observed between the two positions in the prone position group than lateral position group. From the researchers' point of view, it reflects the positive effects of prone position application, which fits the needs of the studied children**.** This result might be related to the that the prone position may affect preterm neonates' respiratory mechanisms, leading to changes in gas exchange due to the decreased pressure of abdominal organs on the diaphragm letting it moves freely. The findings are matched with **Punthmatharith and Mora (2018)** who performed a study entitled Effects of positioning on respiration rate, heart rate, and oxygen saturation in infants during feeding

The findings are similar to the study conducted by **Arafa et al., (2020**) which reported that significant improvement in respiratory distress signs in the prone position than lateral position. This finding is in the same line as the study of **Babaei, et al., (2019)** who studied " Comparison of the effect of supine and prone positions on physiological parameters of preterm infants under nasal continuous positive airway pressure " and reported that prone position improves the tidal volume and the functional residual capacity, resulting in stabilization of the chest wall with more synchrony between thorax and abdomen. Also, this finding is supported by (**Thabet and Zaki 2018)** who conducted a study on "Effect of Positioning on Respiratory System Function of Preterm Neonate with Respiratory Distress Syndrome" and reported that the diaphragm acts as the main muscle when neonates breathe and that expiratory muscles are responsible for generating more strength in the prone position.

These findings were consistent with **Jarus et al., (2019)** who studied "Effects of prone and supine positions on sleep state and stress responses in infants" and showed that breathing was easier in the prone position than in the lateral position among neonates. Meanover, **Shikma**, **et al., (2019)** studied "The effect of body position on the pulmonary

function" and found the same result. **Nomitha et al., (2019)** concluded in their study about " Effect on Respiratory Status of Under Five Children with Lower Respiratory Tract Infection in Prone and Lateral Position in Selected Hospitals at Mysore " that the prone and lateral positions will help to improve the respiratory status of under-five children with lower respiratory tract infection, and prone position was more effective than lateral position.

Conclusion:

Based on the findings and hypotheses of this study, it was concluded that prone and lateral positions were effective in improving the respiratory status of children under five years old with lower respiratory tract infections. The study findings also depicted that the prone position was more effective than the lateral position. The heart rate and respiratory rate values were significantly lower in the prone position than in the lateral positions and respiratory distress syndrome was lower in the prone position compared to the right and left lateral positions. The findings of the present study revealed that there was a significant improvement in the mean respiratory status score of under-five children with lower respiratory tract infection in group 1 when compared to group 2.

Recommendations:

Based on the current study results, the following recommendations are proposed:

- The prone position is recommended and could be used in the routine care of children with lower respiratory tract infections as a simple and applicable strategy to improve the respiratory status.
- Continuous training programs should be conducted for all pediatric nurses working at the neonatal intensive care units regarding the importance and benefits of positioning among children with lower respiratory tract infections
- Repetition of the current study with a larger sample of children in different settings is required for generalizing the results.

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