Effect of Abdominal Massage on Feeding Intolerance and Weight of Preterm Neonates

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Abstract

Feeding intolerance (FI) is one of the most common problems that occur among preterm which increase morbidity and mortality rate among them. **Aim**: To evaluate the effect of abdominal massage on feeding intolerance and weight of preterm neonates**. Design**: quasi experimental design. **Setting:** The study was conducted at Elgameyaa Elshreya Neonatal Intensive Care Unit at Shebin EL Kom city and Elgameyaa Elshreya Neonatal Intensive Care Unit at Ashmoon city /Menoufia Governorate. **Sample**: A purposive sample of 61preterm neonates were selected and randomly assigned into two groups, massage group include thirty three preterm and control groups include twenty-eight preterm neonate. **Tool,** one tool was used for data collection; it includes three parts, Part 1:Structured questionnaire was developed to collect characteristics and medical data of the preterm infants, Part 2: Feeding-intolerance criteria in the preterm infants, Part 3: Chart for daily weight of preterm neonate. **Results:** There was a highly statistically significant difference in the mean score of feeding intolerance between the 1st and 5th days, abdominal circumference was(28.49±2.39 and 26.65±2.422), frequency of defecation was (0.515±0.71 and 2.61±0.83), frequency of vomiting (0.636±0.89and 0.06±0.35) and GVR(7.09±3.33 and 0.24±1.39) in the massage group, respectively. Also, the mean preterm infant weight in the massage was (1602.88±388.8 and 1640.06±393.96) on the 1st and 5th day respectively, with a highly statistically significant difference. **conclusion:** The abdominal massage had a positive influence on feeding tolerance indicators such as frequency of defecation, vomiting, abdominal distention, abdominal circumference, and GRV. **The study recommended:** Utilizing abdominal massage as a nursing care routine in enterally fed preterm neonates.

Keywords: Abdominal Massage, Feeding Intolerance, Preterm Neonate.

Introduction

Preterm birth is one of the leading causes of neonatal mortality. Premature birth complications kill one million of the 15 million premature infants each year. Preterm birth accounts for 5-9% of all births in developing countries and 12.8-15% of births in the United States **(World Health Organization (WHO), 2019).**

The neonatal period, which is regarded as the most vulnerable stage, is usually accompanied by several physiological adaptations to extrauterine life. Low birth weight is one of the most serious complications of prematurity and the leading cause of hospitalization in the neonatal intensive care unit (NICU). Low-birth-weight babies (2000-2500 g) have four times the risk of morbidity and mortality as normal-weight babies **(Tshotetsi et al., 2019).**

Nutritional problems are considered one of the most obvious problems during this period. Because of the functional immaturity of the gastrointestinal (GI) tract, preterm neonates are more likely to have feeding difficulties. The incomplete development of the gastrointestinal system in preterm infants increases gastric emptying time, decreases bowel movements, and eventually leads to symptoms such as constipation, abdominal distention, and increased gastric residual volume (GRV). A high GRV raises the risk of gastrointestinal complications **(Valizadehet al., 2014).**

It is difficult to promote the preterm neonate's nutritional needs. Feed intolerance (FI) can result from the combination of gastrointestinal immaturity and high nutritional needs, which can lead to malnutrition, stunted growth, and necrotizing enterocolitis **(Soltani et al., 2020).** Feeding intolerance is one of the most common causes of preterm infant weight loss. At 34 weeks of gestation, it is most common in premature infants. Feeding intolerance is defined as preterm infants with a gastric residual volume greater than (50%) of

the previous feeding volume, recurrent vomiting, regurgitation, and abdominal distension. Due to feeding intolerance, the delay in achieving enteral feeding results in extended parenteral feeding, which increases the risk of nosocomial infections and prolonged hospitalization **(Yuan et al., 2019).**

It is essential to find an efficient treatment for food intolerance and to enable preterm infants diagnosed with food intolerance to achieve total enteral feeding as promptly as possible. Feeding intolerance interventions should support or resolve the problems associated with inadequate gastrointestinal tract maturation, such as motility and digestion problems **(Fanaro, 2013).**

Massage has become increasingly common in neonatal intensive care units in recent years. Abdominal massage has been shown in studies to be therapeutic, safe, non-invasive, and non-pharmacological nursing care; it has the potential to reduce gastric residual volume; its focus is on stimulating parasympathetic activity, which has a positive effect on the digestive system by enhancing intestinal peristalsis movement, decreasing abdominal distension, limiting the frequency of vomiting, and improving gastric motility **(Lu et al., 2020; Zhu & Gong, 2021).**

Tactile stimulation is used in abdominal massage to stimulate muscles and organ systems. It stimulates the vagus nerve, which increases the working capacity of the intestinal peristaltic, resulting in faster gastric emptying and a more easily satisfied baby. Furthermore, massage therapy improves blood circulation and metabolic rate **(Lestari et al., 2021).** Abdominal massage increased alertness after feeding and feeding tolerance indicators such as vomiting, abdominal distention, abdominal circumference, and GRV, while decreasing vomiting and increasing defecation frequency **(Hendy et al., 2022).**

The nursing interventions for feeding intolerance are usually based on the prevention and monitoring of symptoms **(Carter, 2012)**. A non-pharmacological neonatal nursing intervention like kangaroo care and massage therapy for neonates is recommended and preferable because it is easier to implement, painless, and has no side effects **(Hockenberry & Wilson, 2021).**

Significant of the study:

Preterm infants usually have feeding difficulties due to immaturity of the gastrointestinal tract ,now massage therapy has been found to increase gastric motility in infants, as well as reduce stress hormone levels and colic, regulate sleep, increase infant motor development and coordination, and support weight gain, in addition to reducing jaundice levels **(Moghadam et al., 2022; Mrljak et al., 2022).**

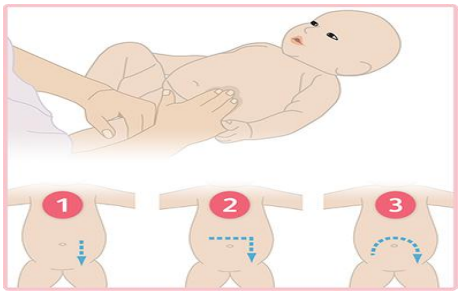
Nonpharmacological interventions such as abdominal massage have the potential to reduce preterm neonatal gastric residual volume, frequency of vomiting, abdominal distension, frequency of defecation, and weight gain. It is considered to be an effective method for preventing, reducing, or eliminating feeding intolerance in preterm neonates, The abdominal massage for premature infants with a gestational age of (28-34) weeks significantly prevent the symptoms of feeding intolerance **(Mohamed & Ahmed, 2018).** This study was conducted to assess the effect of abdominal massage on feeding intolerance and weight of preterm neonate.

Operational definitions:

Feeding intolerance: occurs when a preterm infant is unable to ingest and digest food safely, as evidenced by increased gastric residual volume more than 50% of the food amount giving in the previous meal, presence of vomiting, abdominal distension, and constipation (Moore & Wilson, 2011).

Abdominal massage: (I Love U technique) This technique was applied clockwise over the intestines on the abdominal wall by tracing the letter "I" down the infant's left costal margin. Then trace an inverted "L" across her abdomen, along the base of her ribs, from right to left and down. Then, from the infant's right side, trace an inverted "U" stroke over and around the umbilical, then under the left side **(Tekgündüz et al., 2014).**

Figure1: I Love U abdominal massage technique



Note by: Vimala McClure(2017) Infant Massage: A Handbook for Loving Parents. retrieved from https://www.johnsonsbaby.com.

Aim

The aim of the study was: To evaluate the effect of Abdominal Massage on Feeding Intolerance and Weight of Preterm Neonates.

Research hypotheses:

- Preterm neonates who received abdominal massage had better feeding tolerance than those who did not.
- Preterm neonates who receive abdominal massage gain more weight than those who do not.

Methods

Design:

Quasi experimental design used to accomplish this study.

Setting:

The research was carried out at the Elgameyaa Elshreya Neonatal Intensive Care Unit in Shebin EL Kom city and the Elgameyaa Elshreya Neonatal Intensive Care Unit in Ashmoon, Menoufia Governorate.

Sample:

A purposive sample of 61 preterm infants who met the following criteria, were selected and randomly assigned to two groups, the intervention group included thirty three preterm neonates (massage group), and the twenty-eight (control group) preterm neonates who had their usual routine of care. *The inclusion criteria were*: preterm neonates who were being fed by nasogastric tube; gestational age from 30 to 37 weeks; and birth weight of more than or equal to 1500 g. *The exclusion criteria were*: if they had any contraindication to abdominal massage, intestinal obstruction, major congenital malformations congenital heart disease, GIT anomalies, ventilatory support, necrotizing enterocolitis, sepsis, or any abdominal surgery, they were excluded

Tool of data collection: one tool was used for data collection; it includes three part

Part 1: Structured questionnaire was developed by the researchers to collect characteristics and medical data of the preterm infants before the intervention.it include question about, Gender, Apgar score in 1&5 minute, birth weight, weight at the start of the study, type of feeding milk, gestational age.

Part 2: Feeding-intolerance criteria in the preterm infants: it was adopted from (Tekgündüz etal, 2014) to assess preterm infant feeding tolerance : it include Indicators of feeding tolerance, such as the frequency of defecation per day, abdominal distention per day, frequency of vomiting per day, abdominal circumference and gastric residual volume (GRV).

Part 3: Chart for daily weight of preterm neonate.

Validity:

For validity assurance which the tool measures what it is expected to measure. It was determined by a panel of experts in the field of pediatric nursing & pediatrician, including two professor of pediatric nursing, one professors of pediatrics. The modifications were done to ascertain their relevance and completeness.

Reliability:

The reliability of this instrument was done to determine the extent to which items in the questionnaire were related to each other by Cronbachs co-efficiency alpha for the questionnaire, it was (a = 0.95) which indicates that the instrument was high reliable to meet the objectives of the study.

Ethical consideration:

The primary permission was obtained from the scientific research ethics committee of the Faculty of Nursing Menoufia University .As well, an official permission was taken from the administrative personnel in the recommended

setting to collect the data. Also each parent of preterm baby was informed about the purpose of the study and its importance. The researchers emphasized that participation in the study was voluntary, and that anonymity and confidentiality

Procedure:

- A formal letter was directed from the dean of the Faculty of Nursing , Menoufia University to Elgameyaa Elshreya Neonatal Intensive Care Units at Shebin EL Kom and Ashmoon city explaining the purpose of the study and data collection method.
- Data collection for this study was conducted for a period of 4 months extending from Jaunary 2022 to April 2022.
- The researcher introduced herself to the nurses in the selected unites, explained the purpose of the study and methods of data collection.

Assessment phase:

For massage group:

- Relevant medical history was gathered from the preterm infants' medical records and their mothers.
- After placing the nasogastric tube
- The GRV measurement was then made (the gastric residual volume measurement was taken before each feeding administration). A gastric residual volume measurement was made by aspirating with a 5 ml syringe before each feeding, GRV measurement should be done slowly).
- Abdominal circumference and palpitation of distention, assess weight, frequency of vomiting, and frequency of defecation. were measured.
- The recorded measurements were documented daily on the" follow-up sheet." for five day.
- The abdominal massage was done for 15 minutes, one hour before feeding, two times per day for a 5-day.

Implementation Phase

Technique of Abdominal Massage

- The researchers perform abdominal massage, have certificates in massage therapy after an online training course in massage therapy, and are guided by audiovisual material.
- The technique of massage was performed in the presence of a neonatal nurse and neonatologist.
- Using the recommended moisturizing lotion (Baby Lotion, pH 5.5), it was used for massage application.
- The abdominal massage was applied in a clockwise direction over the abdominal wall.

***The following strokes with moderate pressure were applied to the areas of the preterm infants' abdomen*:**

1. Position the neonate supine with the head elevated 30°-45°.
2. Apply moisturizing lotion and move your pinkie finger's edge across your baby's abdomen like a paddle.
3. Stroke downward with one hand, then the other, in a paddlewheel motion, beginning at the base of the rib cage.
4. Massage the abdomen in a circular, clockwise motion with your fingertips.
5. Do the "I Love you" stroke (I on the left side, L a cross-section of the abdomen along the base of her ribs from her right side to her left and down, and U on the right).(right side up and around the umbilicus, and down the left side)
6. Walk around the umbilicus or move fingers around it clockwise.
7. Hold the knees and feet together and gently press the knees up toward the abdomen, Rotate the baby's hips to the right a few times.
8. Place the hand on the abdomen (above the umbilicus) horizontally and rock your hand from side to side a few times (if the cord is not completely healed, avoid massaging the tummy).

Evaluation phase

Using a daily follow-up sheet to assess feeding intolerance (GVR, abdominal circumference, frequency of vomiting, defecation, abdominal distention, and weight), (during the 5 days of massage therapy.

For Control Group

- Collecting data in the control group received feedings like the neonates in the massage group.
- Data were collected in the same way by assessment of feeding intolerance for five days.
- The control group received the usual daily nursing care for preterm infants without any complementary interventions for feeding intolerance.

Data analysis

Data were collected, tabulated, and statistically analyzed using (SPSS) version 22 (SPSS, Inc, Chicago, Illinois, USA). Quantitative data were presented in the form of mean, standard deviation (SD), and qualitative data were presented in the form numbers and percentages. The Shapiro-Wilk normality test was used to determine whether the data was normally distributed. Independent t-test was used for comparing the mean of massage and control groups. While, Chi-Squared ($\chi 2$) was used for qualitative variables. The significance level was set at $p \leq 0.05$.

Result:

Table 1: Shows the characteristics and medical data of the two studied groups of preterm neonates. As illustrated in the table, The mean gestational age per week of the preterm neonates in the study and control groups were (30.55±2.7 and 29.32±6.09) respectively. The means of preterm neonate weight per gram in the study and control groups were (1518.48±455.2 and 1789.28±470.28) respectively. Also, 57.6% of the preterm neonates in the study group were on oxygen therapy. 51.5% and 53.3% of the preterm neonates in the study and control groups were fed formula, respectively. The statistically significant difference found between the study and control groups was in Apgar score at 5 minutes and birth weight.

Figure 2: Represent distribution of gender for massage and control groups**.** As indicated in the figure, 54.50% of the massage group were male , whereases 52.60% of the control group were female.

Table 2: Shows the comparison of means measurements of parameters related to feeding intolerance between the control and massage groups on the 1st and 5th days. As indicated in the table, there was a highly statistically significant difference in the mean score of feeding intolerance on the 1st and 5th days, abdominal circumference (28.49±2.39 and 26.65±2.422) frequency of defecation (0.515±0.71 and 2.61±0.83), frequency of vomiting (0.636± 0.89 and 0.06±0.35) and GVR (7.09±3.33 and 0.24± 1.39) in the massage group, respectively. Meanwhile, there is no significant difference in the control group between the first day and last day of mean feeding intolerance parameters except for abdominal circumference.

Table 3shows the comparison of mean weight between the control and massage groups on the 1st and 5th days. As illustrated in the table, the mean weight in the massage and control groups on the 1st and 5th days was (1602.88±388.8 and 1640.06±393.96) (1806.68±488.8 and 1821.14± 486.9) respectively, and there was a highly statistically significant difference in the mean score of the weight of both massage and control groups.

Table 4 shows the mean changes in feeding intolerance between the control and massage groups. As indicated in the table, there was a highly statistically significant difference in the mean change of abdominal circumference, frequency of defecation, and GVR between the massage and control groups.

Table 5 represents a comparison of the mean score of abdominal circumferences between the massage and control groups over the five days. As indicated in the table after the 5th day of the intervention, the abdominal circumference in the massage group was 26.65 ± 2.42cm, whereas that in the control group was 28.02 ± 2.68cm. There is a significant improvement ($p = 0.05$) in the massage group after the intervention compared to the control group.

Table 6 shows the comparison of the mean score of the frequency of defecation between the massage and control groups over the five days, As illustrated in the table after the massage therapy, the mean frequency of defecation has markedly increased in the intervention group from the first day was (0.52 ± 0 .71) to fifth day was (2.61 ± 0.83) of therapy, contrary to the control group. and there was a high statistically significant difference in the mean score of the frequency of defecation between the massage and control groups.

Table 7 represents a comparison of the mean score of the frequency of vomiting between the massage and control groups over the five days. As indicated in the table after 3rd,4th, and 5th days of the intervention, the mean frequency of vomiting in the massage group was decreased (0.24 ± 0.56) (0.12 ± 0.42) (0.06 ± 0.35) respectively, whereas that in the control group was (0.71 ± 0.94) (0.75 ± 1.04) (0.75 ± 0.97), respectively. There was a significant improvement in the massage group after the intervention compared to the control group.

Table 8 shows a comparison of the mean score of gastric residual volume between the massage and control groups over the five days. As indicated in the table, from the 2nd to the 5th day of the intervention, the mean GVR in the massage group was decreased instead of that in the control group; there was a highly statistically significant difference between the massage group after the intervention compared to the control group.

Table 9 compares the mean weight of the massage and control groups over the of five days. The mean weight of the massage group increased from the third to the fifth day of the intervention, as shown in the table (1616.61±390.09 and 1640.06±393.97). Likewise, the control group has a slight increase in mean weight from the third to the fifth day of the usual routine (1811.82±487.65 and 1821.14±486.11)

Table 1. Characteristics and medical data of massage and control groups preterm neonates

Items	Control Group (n=28)		Massage Group (n=33)		P-value
Gestational age/weeks	29.32±6.09		30.55±2.7		0.302
Birth weight (g)	1789.28±470.28		1518.48±455.2		0.026
Gender					
Female	15	53.6%	15	45.5%	0.611
Male	13	46.4%	18	54.5%	
Type of Feeding Milk					0.539
Formula	15	53.6%	17	51.5%	
Mother milk & formula	13	46.4%	16	48.5%	
Apgar score 1m	7.2±0.83		6.88±0.74		0.101
Apgar score 5m	7.96±1.14		7.3±0.8		0.012
Oxygen therapy	12	42.9%	19	57.6%	0.309

Figure 2: Distribution of gender for massage and control groups

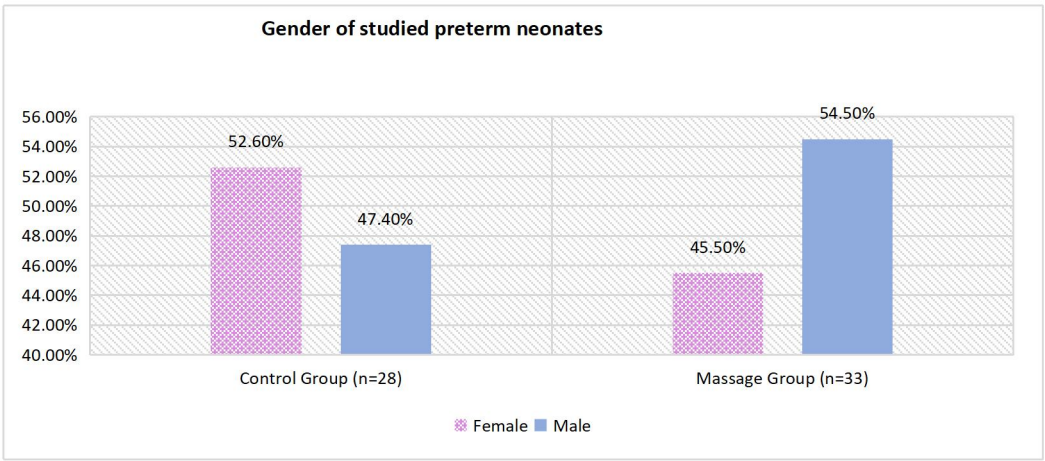


Table 2. Comparison of means measurements parameters related to feeding intolerance between massage and control groups on 1st and 5th day.

Feeding intolerance Criteria	Control Group		P-value*	Massage Group		P-value*
	1st day	5th day		1st day	5th day	
Abdominal circumference/ cm	27.68±2.67	28.02±2.68	0.001	28.49±2.39	26.65±2.422	0.001
Frequency of defecation/per day	1.32±0.90	1.1±0.88	0.031	0.515±0.71	2.61±0.83	0.001
Frequency of vomiting /per day	0.893±0.916	0.75±0.967	0.355	0.636±0.89	0.06±0.35	0.001
Gastric residual volume (GVR) ml	5.57±2.44	5.79±2.35	0.554	7.09±3.33	0.24±1.39	0.001

*Paired T-test was used to compare the mean difference.

Table 3. Comparison of means weight between control and massage groups on 1st and 5th day.

	Control Group		P-value*	Massage Group		P-value*
	1st day	5th day		1st day	5th day	
Weight gm	1806.68±488.8	1821.14±486.9	0.001	1602.88±388.8	1640.06±393.96	0.001

*Paired T-test was used to compare the mean difference.

Table 4: The mean changes in feeding intolerance between the control and massage group

Feeding intolerance parameters	Control Group	Massage Group	P-value*
	Change		
Abdominal circumference/ cm	-0.34±0.44	1.84±0.69	0.001
Frequency of defecation/per day	0.11±0.47	-2.09±0.98	0.001
Frequency of vomiting /per day	0.143±0.8	0.576±0.87	0.049
Gastric residual volume (GVR) ml	-0.21±1.89	6.84±3.61	0.001

*T-test was used to compare the mean differences.

Table 5: Comparison of the mean score of abdominal circumferences between the massage and control groups over the five days.

Abdominal circumference	Control Group (n=28)	Massage Group (n=33)	T.Test	P-value
before 1 day	27.68 ± 2.67	28.50 ± 2.39	-1.256	0.214
after 2nd day	28.38 ± 3.45	27.87 ± 2.37	0.689	0.494
after 3rd day	27.78 ± 2.67	27.43 ± 2.49	0.537	0.594
after 4th day	27.95 ± 2.75	27.00 ± 2.41	1.438	0.156
after 5th day	28.02 ± 2.68	26.65 ± 2.42	2.090	0.041

Table 6: Comparison of the mean score of **Frequency of defecation** between the massage and control groups over the five days

Frequency of defecation	Control Group (n=28)	Massage Group (n=33)	T.test	P-value
before 1 day	1.32±0.90	0.52 ± 0 .71	3.89	0.001
after 2nd day	1.32±0.67	1.39 ± 0.56	0.46	0.64
after 3rd day	1.39±0.88	2.06 ± 0.70	3.3	0.002
after 4th day	1.29±0.76	2.48 ± 0.83	5.82	0.001
after 5th day	1.1±0.88	2.61 ± 0.83	4.36	0.001

Table7: Comparison of the mean score of **Frequency of vomiting** between the massage and control groups over the five days

Frequency of vomiting	Control Group (n=28)	Massage Group (n=33)	T.test	P-value
before 1 day	0.89 ± 0 .92	0.64 ± 0 .90	1 .103	0.274
after 2nd day	0.86 ± 1.01	0.48 ± 0.76	1 .647	0.105
after 3rd day	0.71 ± 0.94	0.24 ± 0.56	2 .427	0.018
after 4th day	0.75 ± 1.04	0.12 ± 0.42	3 .188	0.002
after 5th day	0.75 ± 0.97	0.06 ± 0.35	3 .819	0.001

Table 8: Comparison of the mean score of Gastric Residual volume between the massage and control groups over the five days

Gastric Residual volume (GVR)	Control Group (n=28)	Massage Group (n=33)	T.test	P-value
before 1 day	6.57 ± 2.44	7.09 ± 3.33	-2.001	0.06
after 2nd day	6.75 ± 2.55	3.48± 3.15	4.394	0.001
after 3rd day	6.39± 2.01	1.79± 2.71	7.420	0.001
after 4th day	6.25± 3.07	0.67 ± 1.85	8 .742	0.001
after 5th day	5.79± 2.35	0.24 ± 1.39	11 .414	0.001

Table 9: Comparison of the mean Weight between the massage and control groups over the five days.

Weight	Control Group (n=28)	Massage Group (n=33)	T.test	P-value
before 1 day	1806.68±488.83	1602.88±388.8	-0.33	0.74
after 2nd day	1806.50±487.60	1516.91 ± 502.51	2.27	0.03
after 3rd day	1811.82±487.65	1616.61±390.09	1.74	0.09
after 4th day	1817.71±487.71	1626.45±392.18	1.70	0.10
after 5th day	1821.14±486.91	1640.06±393.97	1.61	0.11

Discussion:

Premature infants are more at risk of malnutrition, delayed development, and other health issues than full-term infants. Most premature infants are prone to gastrointestinal dysfunction and have a higher incidence of feeding intolerance, which refers to the occurrence of vomiting, abdominal distension, and high gastric residual volume, which hindered enteral nutrition establishment and the prolonged use of parenteral nutrition in premature infants **(Musial et al., 2020).** Abdominal massage can effectively relieve infants' gastrointestinal discomfort by relaxing their abdominal muscles to the greatest possible extent. Abdominal massage could not only promote premature infants' early growth and development, but it could also significantly increase their levels of gastrin and insulin, improving digestion and nutrient absorption **(Xin Jin et al., 2020).** Therefore, the aim of the study was to evaluate the effect of abdominal massage on feeding intolerance and weight of preterm neonates.

Regarding the comparison of means measurements of parameters related to feeding intolerance between the control and massage groups on the 1st and 5th days. The current study revealed that there was a highly statistically significant difference in the mean score of feeding intolerance on the 1st and 5th days, abdominal circumference, frequency of defecation, frequency of vomiting, and GRV in the massage group. Meanwhile, there is no significant difference in the control group between the first day and last day of mean feeding intolerance parameters except for abdominal circumference. These findings were consistent with Abouheiba, Moawad and Eldemery, (2022). They reported that there was a highly statistically significant difference between the control and massage groups related to all feeding intolerance measurements and for daily weight increase, as in the massage group, there was a decrease in the gastric

residual volume (GRV), a decrease in the frequency of vomiting episodes, an increase in the frequency of defecation, and a daily weight gain compared to the control group.

Furthermore, these findings were consistent with those of Seiiedi-Biarag and Mirghafour (2020), who discovered that the mean gastric residual volume and mean frequency of vomiting were significantly lower in the massage therapy group compared to the control group (P 0.00001), while the mean abdominal circumference was lower in the massage therapy group with no statistically significant difference. According to the researcher, this result could be attributed to abdominal massage being a low-cost, simple, easily accessible, feasible, and simple technique for nurses to perform, and as such positive effects were noticed in the massage group.

Concerning the comparison of mean weight between the control and massage groups on the first and fifth days, the current study revealed that there was a highly statistically significant improvement in both the massage and control groups' mean weight scores. Ghasemi et al. (2019) found that on the fifth day of the intervention, mean weight increased in the intervention group while decreasing in the control group ($p = 0.001$). This contradiction, in my opinion, was caused by the fact that the control group in this study had a successful weight management routine.

In relation to "control and massage groups mean changes" in feeding intolerance. There was a highly statistically significant difference between the massage and control groups in the mean change of abdominal circumference, frequency of defecation, and GVR. This finding was consistent with the findings of Mojaveri et al., (2020), who found that on the first and fifth days, GRV before the massage, GRV after the massage, vomiting frequency, defecation frequency, and abdominal circumference all changed significantly in the massage group ($P = 0.001$, 0.003, 0.001, 0.001, and 0.001, respectively). On the other hand, GRV, vomiting frequency, defecation frequency, and abdominal circumference did not change significantly in the controls ($P = 0.06$, 0.264, 0.421, and 0.07, respectively). This may be due to nurses performing abdominal massages correctly, as it was explained to provide comfort for infants and reduce their workload.

As regards a comparison of the mean score of abdominal circumferences between the massage and control groups over the five days. The present study revealed that after the 5th day of the intervention, there was a significant improvement in the massage group compared to the control group. This finding was in the same line with Ghasemi et al. (2019), who reported that on the fifth day of the study, the intervention group had a significant decrease in the mean abdominal circumference compared to the control group. This could be related to the fact that abdominal massage can arouse parasympathetic activity and have a positive effect on the digestive system by enhancing intestinal peristalsis, diminishing abdominal distension, and so decreasing abdominal circumference among the massage group.

In terms of comparing the mean score of frequency of defecation between the massage and control groups over five days, the current study found that after massage therapy, the mean frequency of defecation increased significantly in the intervention group from the first to the fifth day of therapy, in contrast to the control group, with a statistically significant difference. This finding was consistent with Abouheiba Moawad and Eldemery (2022). They reported that defecation frequency significantly increased from the first day to the fifth day. Conversely, no statistically significant differences were found between the means of the first and fifth days for the control group. This could be because abdominal massage increases bowel transit time and gastric motility, resulting in longer defecation times.

Regarding a comparison of the mean score of the frequency of vomiting between the massage and control groups over the five days, The present study clarified that there was a significant improvement in the massage group after the intervention compared to the control group, as after the 3rd, 4th, and 5th days of the intervention, the mean frequency of vomiting in the massage group was significantly decreased compared to the control group. This

finding was consistent with Hendy et al. (2022), who reported that the relative frequency of vomiting per day in the study group decreased with a statistically significant difference (p.05) post-intervention compared to pre-intervention. This could be related to abdominal massage, which relieved discomfort and distention, enhanced the sleep state, and consequently limited the frequency of vomiting.

Regarding the comparison of the mean score of gastric residual volume between the massage and control groups over the five days, the current study stated that from the 2nd to the 5th day of the intervention, the mean GVR in the massage group decreased compared to the control group with highly statistically significant differences, this result was congruent with Diki Ardiansyah et al. (2021), who showed a decrease in average gastric residue difference and abdominal distension in the intervention group ($p < 0.05$). Whereas in the control group, gastric residue and abdominal distension increased ($p < 0.05$).

Moreover, this finding was consistent with Momenfar et al. (2018), who "found that the gastric residual volume after the intervention varied on different days and that the mean of different days in the case group was lower than the control group." This may be due to abdominal massage alleviating gastrointestinal problems as well as improving gastric function with more defecation, so gastric residual volume decreased among the massage group.

In relation to the comparison of the mean weights of the massage and control groups over the five days. The current study showed that the mean weight of the massage group increased from the third to the fifth day of the intervention; likewise, the control group had a slight increase in mean weight from the third to the fifth day of the usual routine. This result was contradicted by Shaeri et al. (2018), who reported that weight gain during the five days was greater in the intervention group than in the control group. This result could be related to the role of nurses in the intensive care unit, who provide proper care for babies for better growth and development, so the weight increased in both the massage and control groups.

Conclusion:

In conclusion, our findings suggest that abdominal massage efficiently decreases gastric residual volume. The study also revealed that abdominal massage decreases vomiting and increases the frequency of defecation, that it had a positive influence on feeding tolerance indicators such as frequency of defecation, vomiting, abdominal distention, abdominal circumference, and GRV, and therefore it promotes weight gain in preterm infants.

Recommendation:

Based on the study finding of the current study the following recommendation can be suggested.

- Increases neonatal nurse awareness about abdominal massage
- Utilizing abdominal massage as a nursing care routine in enterally fed preterm neonates'
- Further studies are recommended to evaluate the effect of abdominal massage on duration of hospitalization in preterm infants.

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