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Gastric Residual Volume Assessment among Preterm Neonates at Neonatal Intensive Care Units

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Abstract

Background: The ability of preterm to tolerate and efficiently digest enteral nutrition is crucial for their growth and development.So, monitoring residual volume (GRV) is important factor to assess feeding tolerance **Aim of the study:** assessing the gastric residual volume before enteral feeding among preterm neonates at neonatal intensive care units. **Design**: A descriptive design was utilized for conducting this study. **Settings**: This study was carried out at the neonatal intensive care unit in Mostafa Hassan Hospital affiliated to Fayoum University and Fayoum General Hospital affiliated to Ministry of Health. **Sample**: A Purposive sample of 60 preterm neonates who met the inclusion criteria at Neonatal Intensive Care Units in the previous mention settings. **Tools**: Two tools were used to collect study data, a simple questionnaire sheet and gastric residual volume record sheet **Results**: the mean birth weight and gestational age of the studied neonates was 1370±520 and 32.0±2.33, moreover, The majority of the studied neonates were diagnosed with low birth weight. The mean amount of formula given was 19.52±12.43 while while the mean gastric residual volume was 2.23±0.98. More than half of the neonates had normal gastric residual levels, while the remaining exhibited mild to severe increases in residual volume. **Conclusion**: while more than half of preterm neonates in this study maintained normal gastric residual volumes, the presence of mild to severe increases in about one half of them warrants careful monitoring and individualized feeding plans. **Recommendation**: Adjust feeding strategies based on GRV levels, ensuring neonates with mild to moderate increases receive modified feeding schedules. Further researches are needed to incorporate positions as one of reducing gastric residuals modality in daily practice after feeding of preterm neonates.

Keywords: *Gastric residual volume, Neonatal intensive care unit, Preterm neonates & feeding.*

Introduction:

Preterm neonates who born before 37 weeks of gestation, face significant challenges in adapting to extrauterine life including the development of their gastrointestinal system.So, the ability of these infants to tolerate and efficiently digest enteral nutrition is crucial for their growth and development. One important factor influencing feeding tolerance in preterm neonates is gastric residual volume (GRV) which refers to the amount of milk remaining in the stomach after a feeding **(Gidi et al., 2020).**

Monitoring GRV in preterm neonates is a common practice in neonatal intensive care units (NICUs) to assess feeding tolerance and prevent complications such as aspiration and abdominal distension **(Ahmed Mahmoud et al., 2021).**

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Several factors can influence GRV in preterm neonates, including gestational age, birth weight, feeding volume, feeding method (continuous or intermittent), and underlying medical conditions.So, understanding the factors associated with GRV can help healthcare providers optimize feeding strategies and improve outcomes for preterm infants **(Williams et al., 2023).**

In the neonatal intensive care unit (NICU), it is customary to routinely perform gastric residual (GR) aspiration and evaluation prior to every feeding in critically ill infants. Meanwhile, aspiration and evaluation of GRs is thought to accomplish three tasks, confirm correct orogastric/nasogastric (OG/NG) tube placement, monitor whether the previous feeding remains in the stomach, and prevent aspiration of gastric contents which may contribute to ventilator associated pneumonia (VAP) **(Khatony & Batol , 2019):**

the nurse is a key factor in helping the premature neonates to thrive and survive by increasing their survival and growth possibilities and preventing the development of external complications which increase the chances of vulnerability (**Algameel et al., 2020)**

Operational Definition of Gastric Residual Volume (GRV):

Gastric residual volume (GRV) refers to the volume of undigested formula or breast milk remaining in the stomach before the next scheduled feeding. It is measured by aspirating stomach contents via a nasogastric tube. GRV is used as an indicator of feeding tolerance and gastrointestinal function in preterm neonates. Excessive GRV may indicate delayed gastric emptying, feeding intolerance, or gastrointestinal dysfunction, necessitating adjustments in feeding protocols.

Significance of the study:

Worldwide, of the 130 million neonates born every year, 15 million (11.1%) neonates are born preterm. Moreover, prematurity is still a major cause of neonatal and infant mortality and morbidity and a significant contributor to long-term adverse health outcomes **(Khasawneh et al., 2020)**.

Preterm neonates are at high risk of feeding intolerance due to their immature gastrointestinal system, which can lead to complications such as necrotizing enterocolitis (NEC) and delayed growth **(Patel et al., 2022).** Monitoring gastric residual volume (GRV) is commonly practiced in neonatal intensive care units (NICUs) to assess feeding tolerance and guide nutritional interventions **(Parker et al., 2023).**

This study is significant as it aims to assess the gastric residual volume before enteral feeding among preterm neonates at neonatal intensive care units.

Aim of the study:

This study aims to assess the gastric residual volume before enteral feeding among preterm neonates at neonatal intensive care units**.**

Research questions:

- What is the amount of gastric residual volume before enteral feeding among preterm neonates?

Sample and Methods:

Design:

A descriptive design was utilized for conducting this study.

Setting:

This study was carried out at the neonatal intensive care unit in Mostafa Hassan Hospital affiliated to Fayoum University and Fayoum General Hospital affiliated to Ministry of Health. Neonatal intensive care units in the previous mentioned settings were consisted of 56 incubators (19 in Mustafa Hassan Pediatric Hospital & 37 in Fayoum General Hospital) and equipped with highly specialized apparatuses for the care of neonates who are preterm and critically ill or neonates have any other conditions requiring special care.

Sampling:

A purposive sample was obtained and including available preterm neonates (60 preterm neonates) from both genders, and admitted to the neonatology department at the previously mentioned settings

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during the study period with the following inclusion criteria namely; Preterm neonates fed using a nasogastric tube, gestational age ranged from 28 – 36 weeks, mean Apgar score at birth higher than 6 score at the 5th minute, birth weight of 800g and more, and stable physiological status (heart rate, respiratory rate and Oxygen saturation), and exclusion criteria namely; preterm neonates who have congenital anomalies, digestive problems and neonates under mechanical ventilation.

The researchers depended on the following equation to calculate the sample size: Sample size Equation: at 95% confidence, error 0.05. (Thompson, 2012).

$$n = \frac{N \times p(1-p)}{\left[\left[N-1\times\left(d^2 \div z^2\right)\right]+ p(1-p)\right]}$$

n=Sample size

N= Total society size.

d= Error percentage= (0.05).

P= percentage of availability of the character and objectivity (Probability) = (50%).

z= the corresponding standard class of significance (Confidence level) 95%= (1.96).

Tools of data collection:

Two tools were utilized to collect data for this study:-

Tool I: Simple questionnaire sheet:

It was established by the researchers to gather the required information based on the available related studies and references and it included three parts: -

Part I: Characteristics of preterm neonates namely; current age, gestational age, gender, birth weight and current birth weight.

Part II: Medical data of preterm neonates namely; type of delivery, Apgar score, diagnosis, and length of hospital stay.

Part III: mother's medical data including chronic disease as diabetes, heart diseases, kidney diseases, hypertension), previous abortion, previous preterm, and previous C.S.

Tool II: Gastric residual volume record sheet:

It was adapted from **Hussein, (2012)** which will be utilized to measure the quantity of GRV left in the stomach before giving formula feeding. It included three items which are amount of formula, color, and amount of gastric residual volume.

Scoring System

Step 1: Calculation Gastric Residual Volume (GRV) Percentage

GRV Percentage = (Measured GRV / Last feed volume) × 100

Step 2: Assigning a Score Based on GRV Percentage

GRV Percentage	Score	Level
0-10%	**0**	Normal
11-20%	**1**	Mild increase
21-30%	**2**	Moderate increase
31-50%	**3**	Significant increase
>50%	**4**	Severe

Content Validity:

The content validity of the tools was done by a panel of 5 experts in the field of nursing for its comprehensiveness, accuracy, clarity, relevance and applicability. Suggestions were given and modifications were done.

Reliability:

Reliability of the tool was tested to determine the extent to which the questionnaire items are related to each other. The Cronbach's alpha model, which is a model of internal consistency, was used in the analysis. Reliability factor for tool (II) Gastric residual volume record sheet was (0.878). Statistical equation of Cronbach's alpha reliability coefficient normally ranges between 0 and 1. Higher values of Cronbach's alpha (more than 0.7) denote acceptable reliability.

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Pilot study:

A Pilot study was carried out with 10% (6 preterm neonates) of the total sample size to test the applicability, clarity and efficiency of the tools and time consumed to fill the study tools based on the results of the pilot study the necessary modification done . preterm infants who shared in the pilot study not included in the sample.

Field work:

This research was carried out for data collection over six months period from the beginning of January (2023) to the end of June (2023). The researcher collected data in two days per week from 8 a.m. to 2 p.m.,

The time needed for taking sociodemographic and medical data of preterm neonate from preterm neonate sheet was about 10 minutes.

Gavage feeding was used a well-placed nasogastric tube. During the gavage feeding, the gavage syringe was held 30 cm above the preterm neonate's head and the prescribed amount of milk was given in supine position with the head slightly up.

Assessment of gastric residual volume was done after two hours before the feeding by using tool (2) and gastric residual volume record sheet and it took 5 minutes.

Ethical consideration:

An approval was obtained from a scientific research ethics committee of the faculty of nursing at Helwan University and an oral consent was obtained from the parents individually before starting the study. The aim and objectives of the study was clarified to the parents whom preterm included in the study by the researcher. Participants were assured that anonymity and confidentiality would guarantee. Parents were informed that they are allowed to choose to participate or withdraw from the study at any time. Ethics, culture, values were respected.

Statistical Analysis:

The collected data was organized, categorized, tabulated, entered and analyzed by using SPSS (statistical package for social science), software program version 26. Statistical significance and association were assessed using the arithmetic mean, standard deviation (SD), chi-square (X^2) and p-value to detect the relation between variables of the standard. Statistical significance was considered at (P-value <0.05).

Results:

Table (1): Distribution of the studied preterm according to their personal characteristics (n = 60).

Items	No	%
Gender		
Male	31	51.7
Female	29	48.3
Male to Female ratio	1.97 : 1.03	
Birth weight		
800: < 1000g	16	26.7
1000: <1500g	23	38.3
≥ 1500g	21	35.0
Mean and SD	1370±520	
Gestational age		

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28: < 31 weeks	15	25.0
31: <33weeks	21	35.0
33: 36 weeks	24	40.0
Mean and SD	32.0±2.33	

Table (1) reveals that the mean birth weight and gestational age of the studied neonates were 1370±520 grams and 32.0±2.33 weeks, respectively, while the male-to-female ratio was 1.97:1.03.

Table (2): Frequency distribution of preterm neonates' medical data (n = 60).

Items	No	%
Diagnosis		
Low Birth Weight	39	65.0
LBW & Respiratory Distress Syndrome	7	11.7
LBW & Poor sucking	3	5.0
LBW & Sepsis	5	8.3
LBW & jaundice	2	3.3
Infant of diabetic mother	4	6.7
5th minute APGAR score at birth	7.53±0.724	
Type of feeding		
Formula	41	68.3
Both breast and formula	19	31.7
Length of hospital stay		
1 day	8	13.3
>1:3 days	9	15.1
>3:5 days	20	33.3
>5:7 days	8	13.3
>7 days	15	25.0

Table (2) shows that more than two-thirds of the studied neonates were diagnosed with low birth weight (LBW), and their primary type of feeding was formula (65% and 68.3%, respectively). Regarding the length of hospital stay, one-third of them remained hospitalized for approximately more than 3 to 5 days.

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Table (3): Frequency distribution of Personal characteristics and medical data of preterm neonates' mothers (n= 60).

Items	No	%
Type of pregnancy		
Single	43	71.7
Twins	17	28.3
Use of medication during pregnancy		
Yes	35	58.3
No	25	41.7
Complications during pregnancy		
Non	26	43.3
Antenatal hemorrhage	11	18.4
Placenta Previa	12	20.0
Pregnancy toxemia	2	3.3
Polyhydramnios	9	15.0
Chronic disease		
Non	34	56.7
Diabetics	18	30.0
Hypertension	6	10.0
Both	2	3.3
Type of delivery		
Vaginal	7	11.7
Cesarean section	53	88.3
Complications during delivery		
Premature rupture of membrane	30	50.0
Bleeding before labor	19	31.7
Bleeding during labor	11	18.3

Table (3) shows that more than two-thirds (71.7%) of the studied preterm neonates' mothers had a single pregnancy. Additionally, more than half (58.3%) used medication during pregnancy, while less than half (43.3%) had no complications during pregnancy. Furthermore, more than half (56.7%) had no chronic disease.

Table (4) Distribution of the studied preterm neonates according to means of measured parameters (n = 60).

Items	N	%
Amount of formula given	19.52±12.43	
Amount of Gastric residual Volume	2.23±0.98	
Color		
No residual volume	8	13.3
White	16	26.7
White & brown	0	0.0
White & yellow	14	23.3
Gastric juice	22	36.7

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Table (4) reveals that the mean amount of formula given and the mean gastric residual volume (GRV) among the studied neonates were 19.52±12.43 ml and 2.23±0.98 ml, respectively. Moreover, in more than one-third (36.7%) of the neonates, the color of their GRV was gastric juice.

Table (5) Number and percentage of the studied preterm neonates regarding to their level of gastric residual volume (n = 60).

Gastric residual volume level	No	%
Normal	31	51.7
Mild increase	19	31.7
Moderate increase	7	11.7
Significant increase	2	3.3
Severe	1	1.7

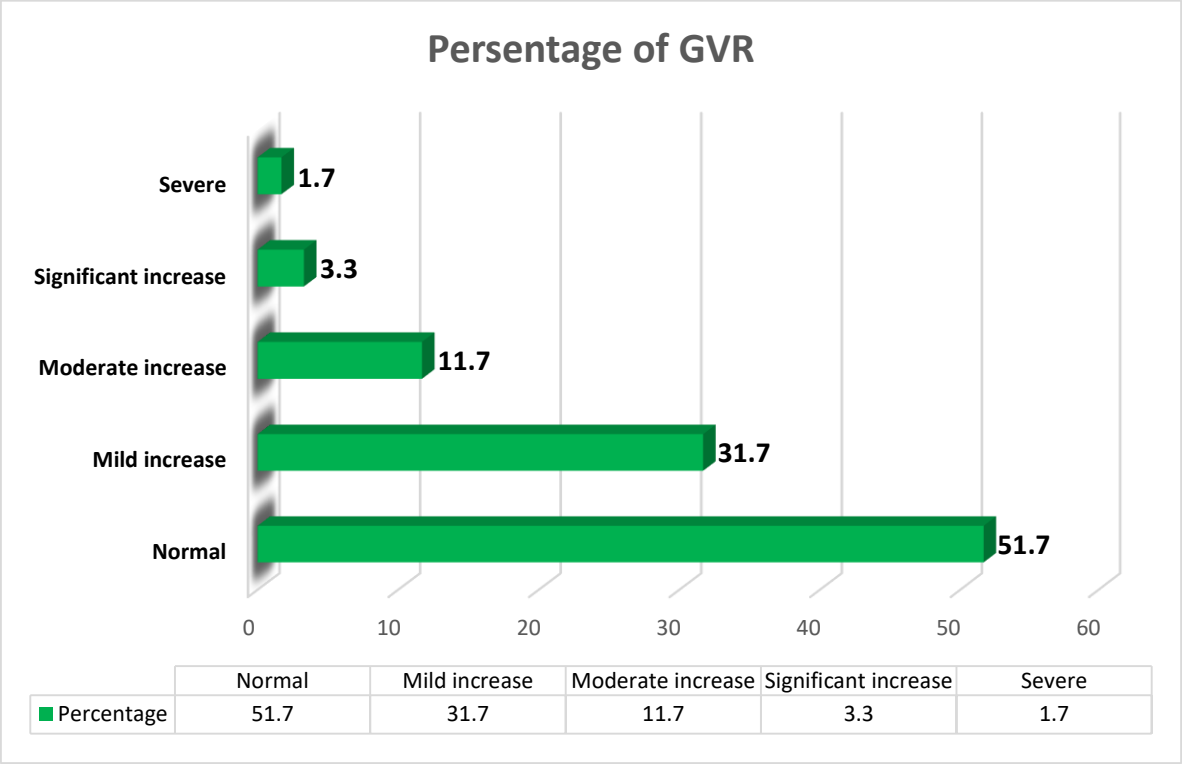

Figure (1) Percentage of the studied preterm neonates regarding to their level of gastric residual volume (n = 60).

Table (5) and figure (1) show that 51.7% of the studied preterm neonates had a normal gastric residual volume level, while 31.7%, 11.7%, 3.3%, and 1.7% had mild, moderate, significant, and severe increases in GRV levels, respectively.

Discussion:

Regarding to gender of the studied preterm, the result of the present study showed that, nearly half of them were males. This finding was supported by **Sajadi et al., (2019), w**ho studied comparison of effect of prone and right lateral positions on gastric residual volume in preterm

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newborns in Iran and indicated that, about half of the total preterm were males. But, the study results were contradicted with **Gözen et al., (2022), w**ho studied effect of different positions on gastric residuals in preterm infants initiating full enteral feeding and found that, less than two third of preterm were males.

Regarding the studied preterm birth weight, the present study revealed that, the mean weight of the studied preterm was 1370±520 g that indicates that the majority suffering from low birth weight so they need good intervention to improve nutritional state. In the same context **Halemani et al., (2023)**, who studied efficacy of body position on gastric residual in preterm infant a systematic review and meta-analysis who found the majority of the preterm weights were 1272–2683 g.

Regarding gestational age, this study revealed that, less than half of the studied preterm their gestational age between 33: 36 weeks with the mean age was 32.0±2.33 weeks. In the same context **Anwar & Refaat, (2021), w**ho studied the effect of different positions on gastric residual volume of preterm neonates at neonatal intensive care unit at Assiut university children hospital and indicated that, the mean age 32.45±2.46. On the contrary **Sajadi et al., (2019).** who studied comparison of effect of prone and right lateral positions on gastric residual volume in preterm newborns in Iran and indicated that, more than half of the total preterm their gestational age ranging between 28:30 weeks.

As regarding the medical data of preterm newborn, less than two third of the studied preterm were diagnosed with low birth weight. This finding attributed to the importance of feeding for the preterm to improve their growth and their weight. The present study result supported by **Sajadi et al., (2019),** who studied comparison of effect of prone and right lateral positions on gastric residual volume in preterm newborns in Iran who found that, more than half the preterm diagnosed with respiratory distress syndrome.

In relation to five minute Apgar score of the studied preterm, the results of the current study showed that, the mean of Apgar score was 7.53±0.724. This result goes in line with a study done by **Gözen et al., (2022),** who studied effect of different positions on gastric residuals in preterm infants initiating full enteral feeding and found that, the mean of Apgar score was 7.400±1.355 On the contrary **Sajadi et al., (2019),** who studied comparison of effect of prone and right lateral positions on gastric residual volume in preterm newborns in Iran who found that, more than two third of the preterm with 9 Apgar score.

The present study revealed that, more than two third of the studied preterm were feed with formula only (artificial milk). Which indicated that the using of formula rate among the studied sample was high due to lack of knowledge about the importance of breast milk for both the preterm and the mother so, should instruct mothers about the importance and technique of breast milk storage. On the contrary **Gözen et al., (2022).** Who studied effect of different positions on gastric residuals in preterm infants initiating full enteral feeding and found that, only about quarter were feed formula.

Regarding the studied mothers' data, the present study revealed that, more than three quarters delivered a Cesarean section which indicated that the obstetric physician do this to save the life of the preterm . In the same context this result goes in line with a study done by **Gözen et al., (2022), w**ho studied effect of different positions on gastric residuals in preterm infants initiating full enteral feeding and found

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that, more than three quarters delivered by Cesarean section.

Regarding to the mean of the amount of formula given and amout of gastric residual volume of the studied preterm were 19.52±12.43 respectively In the same context **Anwar & Refaat, (2021), w**ho studied the effect of different positions on gastric residual volume of preterm neonates at neonatal intensive care unit at Assiut university children hospital and indicated that, the mean amount of formula given and amout of gastric residual volume of the studied control group at 10 am were 18.87±7.37, 2.12±0.89 respectively.

Regarding the level of gastric residual volume of the studied preterm Showed that, about half of the studied preterm neonates, their level of gastric residual volume were normal. This result agree with **McCulloh et al., (2018),** who studied the impact of gastric residual volume on feeding intolerance in preterm infants a systematic review and found that normal GRV is a common finding among preterm infants and can tolerate enteral feeds without significant feeding intolerance

The rest of the studied preterm were mild, moderate, significant and severe increase level of GRV respectively. This supported by **Klein et al., (2020),** who studied feeding intolerance in preterm infants and the prevalence of feeding intolerance in preterm infants and noting that while many exhibit normal GRV, mild and moderate increases are common.

Conclusion

Based on the results of the present study, it can be concluded that; while more than half of preterm neonates in this study maintained normal gastric residual volumes, the presence of mild to severe increases in about one half of them warrants careful monitoring and individualized feeding plans

Recommendations

Based on the results of the present study the following recommendations are suggested:

- Adjust feeding strategies based on GRV levels, ensuring neonates with mild to moderate increases receive modified feeding schedules.
- Implement routine monitoring protocols to detect significant or severe GRV increases early and adjust interventions accordingly.
- Frequent educational training programs for NICU nurses are required to updated their knowledge and practice regarding the importance of measurment the gastric residual volume .
- Further researches are needed to incorporate positions as one of reducing gastric residuals modality in daily practice after feeding of preterm neonates.

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