

# Impact Of Breast Feeding Versus Formula Feeding On Surgical Wound Healing In Infants During The First Three Months Of Age

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## Abstract

Breast milk has antimicrobial and healing properties that actually can help the wound healing. Surgical infants are at a much higher risk for malnutrition as a result of increased metabolic demands from surgery, nutrient losses, and sepsis. Many methods of feeding are used postoperatively for infants; oral feeding (breast or formula milk), enteral, or parenteral feeding. Aim of this work was to assess the effect of breast-feeding versus formula feeding on surgical wound healing in infant during the first three months. Methods and materials: Comparative descriptive research design was used to carry out this study. It comprised 100 infants aged less than 3 months, they were divided into two equal groups as the following: Group 1: received breast milk feeding, Group 2: received formula milk feeding. Tools were developed by the researcher, after that the researcher fulfill assessment sheet and took anthropometric measurements for each infant then the photographs were taken by the researcher on the 7th postoperative day and reassessed for second time on the 14th day. Results: Out of the included breast-fed infants, 78 % were boys, while 22% were girls. Also in the formula-fed infants, the males were 64%, while the females were 36 %. As a general statistically significant difference was found between anthropometric measurements. The majority (58%) of artificially fed infants' wounds were inflamed, while less than one third (30%) of breast-fed infants' wounds were inflamed during the 7th day. on the other hand 38% of artificially fed infants' wounds were inflamed, while only 8% of breast-fed infants' wounds were inflamed during the 14th day. Conclusion, breast-fed infants have rapid sound healing, less wound inflammation, higher anthropometric measurements, receiving more number of daily feeding, fewer disturbances in urinary tract and gastrointestinal tract and had normal laboratory results than artificially fed infants.

**Keywords:** Breast-feeding, formula feeding, wound healing, pre and postoperative infant feeding.

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## **1. Introduction**

Breast-feeding remains the optimal method for nutritional support of the healthy infant. In addition to fostering bonding between the mother and her child, breast milk provides optimal nutrient content to support growth and provides immunoactive substrates [19,16].

At birth, the infant has substantial nutritional demands because of the high metabolic rate and the rapid growth and development. Surgical infants are at a much higher risk for malnutrition as a result of increased metabolic demands from surgery, nutrient losses, and sepsis. Many methods of feeding are used postoperatively for infants; oral feeding (breast or formula milk), enteral, or parenteral feeding [18].

Wound healing progresses through four phases: hemostasis, inflammation, proliferation, and remodeling. Nutrition plays a significant part in wound healing since it enables optimal healing to occur. Proper nutrition enhances the body's ability to regain its balance [3].

Wound infections can cause illness, anxiety, increase patient discomfort and can lead to death. It is estimated that surgical wound infections result in an increased length of hospital stay by about 7-10 days [6].

Nurses who care for children with wounds should develop an understanding of wound care in order to expedite wound healing, prevent infection, promote accurate communication both written and verbally, provide patient comfort, and prevent the development of institution-acquired wounds [11].

Breast milk has antimicrobial and healing properties that actually can help the wound healing. The importance of breast-feeding must be identified to nurses and parents. Mothers should be encouraged to maintain breast-feeding during the postoperative period if oral feeding is allowed, in order to promote wound healing.

## **2. MATERIALS AND METHODS**

### **a. AIM OF THE STUDY**

The aims of this study were to assess the impact of breast feeding versus formula feeding on surgical wound healing in infants during the first three months of age.

### **b. HYPOTHESIS**

Infants who will receive breast milk are experiencing rapid wound healing more than those who will receive formula milk.

### **c. Research design:-**

Comparative descriptive research design was used to carry out this study to fit the nature of the problem under investigation.

### **Setting:-**

The study was conducted in the Pediatric Surgical Unit at Assiut Pediatric University Hospital.

**Subjects:**

- The study subjects were including 100 neonates and infants who were selected according to criteria. They were divided randomly into two equal groups, each group included 50 patients: Group one received breast milk feeding and group two received formula milk feeding.

**Criteria of the study Subjects:**

**Inclusion Criteria :**

Both sexes, full term infant up to one month of age.

Postoperative for 3 days.

**Exclusion Criteria :**

Infants with medical problems (diabetics and heart diseases) were excluded from the study subject.

**Tools:-**

Three tools were used in this study.

**Tool one:** Assessment sheet for infant:

It was developed by the researcher after reviewing of literature and consists of two parts:

**Part one:** Demographic and clinical data about infant and his/her parents such as gestational age, birth weight, postnatal age, sex, community type, birth order, social level, parents' education, parents' consanguinity, and working of mother and history of pregnancy and Labor.

**Part two:** Child's food consumption pattern (preoperative and postoperative): such as, number of feeds / day, type of milk (artificial or breast milk), and route of feeding.

**Tool two:** Nutritional Assessment sheet: It included 4 parts:

**Part one:** Anthropometric measurements sheet was used on the 3<sup>rd</sup>, 7<sup>th</sup>, and 14<sup>th</sup> post operative days to assess infants' growth parameters as weight, height, as well as head, and chest circumferences.

**Part two:** Physical assessment of the infants: it included assessment of face (flushed, pale, or moon face), eyes (bright, unclear sclera, or unclear conjunctiva), mouth, {gums (bleeding, stomatitis, or bad odor) and tongue (dry or ulcers)}, vital signs {pulse (tachycardia, bradycardia, or irregular), respiration (tachypnea, bradypnea, deep, irregular, or mouth breathing), and body temperature (hypothermia or hyperthermia)}, gastrointestinal tract (appetite, vomiting, constipation or diarrhea), and urinary system (polyurea, oligurea, haematuria, or pain in urination). Physical assessment was done by the researcher.

**Part three:** Daily dietary intake chart:

The twenty-four hours recall method was used from the third postoperative day until discharge and the type of milk, number, and method of feeding /day were taken and were reassessed during follow up at 7<sup>th</sup> and 14<sup>th</sup> postoperative days.

**Part four:** Laboratory investigation:

It included the total serum protein, hemoglobin, and hematocrite, red blood count, white blood count, potassium, sodium, blood urea and blood glucose and these were taken from the infant hospital record.

**Tool three:** Observation sheet which included surgical wound healing criteria; sound healing, wound inflammation or redness, wound discharge, gapping of wound, burst abdomen, or incisional hernia. Wound's photographs were taken.

#### **Data collection:**

- Tools were developed by the researcher after reviewing of literature. Then the contents of the assessment sheet of wound healing were given to a panel of five pediatric surgeons and pediatric nurses with more than five years experience to determine the content validity.
- Permission was obtained from the director of Pediatric Surgery Unit
- After obtaining the official permission, mothers were interviewed individually by using the developed questionnaire sheet.
- The data were collected by the investigator herself. The study objectives were explained to mothers and an informed consent was obtained to collect the desired data. When interviewing the mothers, the investigator started by introducing herself explaining the purpose of the study.

#### **Pilot study:**

- A pilot study was carried out on 10 infants who were fulfilling the criteria of the study to evaluate the content of the questionnaire and assessment sheet and to estimate the time needed for answering the questions. The pilot study was excluded from the study sample.

#### **Field of the work**

- The field work was carried out through a period of 12 months from January 2009 to January 2010.
- The time taken for filling each sheet ranged from 30 – 50 minutes that is depending upon the response of the mother.
- The collected data was done daily. Then the mother was asked about demographic and clinical data of the infant and his parents.
- Then the mother was asked about child's food consumption pattern (preoperative and postoperative).
- Anthropometric measurements of studied infants of both groups were recorded
- For comparing the anthropometric data (weight, length, head, and chest circumference) the infants in both studied groups were classified according to Egyptian growth charts from birth – 36 months into three percentiles groups.
- All the two groups were subjected to complete physical examination by the researcher observation and asking mother during the third day from child's operation and reassessment during follow up at 7<sup>th</sup> and 14<sup>th</sup> days of operation with special attention to: assessment of face, eyes, mouth, vital signs, gastrointestinal tract, and urinary system.
- The daily dietary intake was assessed on the third postoperative day if the child starts milk feeding, but if not this case was excluded. The type of milk, average numbers, and method of feeding / day was taken. These data were collected by asking the mother, while average of intake was taken after discharge during follow up at 7<sup>th</sup> and 14<sup>th</sup> postoperative days.
- Observation sheet was developed to assess the wound healing process using surgical wound healing criteria (sound healing, presence of wound inflammation or redness, presence of wound discharge, gapping of the wound, burst abdomen, and incisional hernia). The previous observations and photographs were taken by the researcher on 7<sup>th</sup> postoperative day and reassessed for second time on 14<sup>th</sup> day.

**Data analysis:**

Collected data were revised and coded for computerized data entry. Data were then verified prior to statistical analysis. Statistical methods were applied including descriptive statistics as; (frequency, percentage, mean, and standard deviation), Z-test and Chi-square ( $\chi^2$ ) were used. P-values were considered as statistically significant when less than 0.05.

**Ethical considerations:**

Consent was taken from every mother; data were collected through interviewing the mothers individually, reassured that the information obtained will be confidentially, and used only for the purpose of the study.

**Limitations of the study:**

Shortage in number of full term gestation and milk feeding newborns (breast-fed and artificial feed newborns) postoperative at Neonate Intensive Care Unit (NICU) was found.

**3. Results**

**Part one:**

**A. Socio-demographic data and history for infant and his mother.**

**Table (1):**

Distribution of breast-fed and artificially fed infants' data according to their gestational age, birth weight, postnatal age, sex, community type, and birth order.

<u>Items</u>	<b>Breast-fed</b>		<b>Artificially</b>	
	<b>No.</b>	<b>%</b>	<b>No.</b>	<b>%</b>
<b><u>Gestational Age:</u></b>				
< 41 weeks	18	36	22	44
41 – weeks	22	44	24	48
> 42 weeks	10	20	4	8
<b>Total:</b>	50	100	50	100
<b><u>Birth Weight:</u></b>				
3.400 kg –	20	40	8	16
3.700 kg –	18	36	14	28
> 4 kg	12	24	28	56
<b>Total:</b>	50	100	50	100

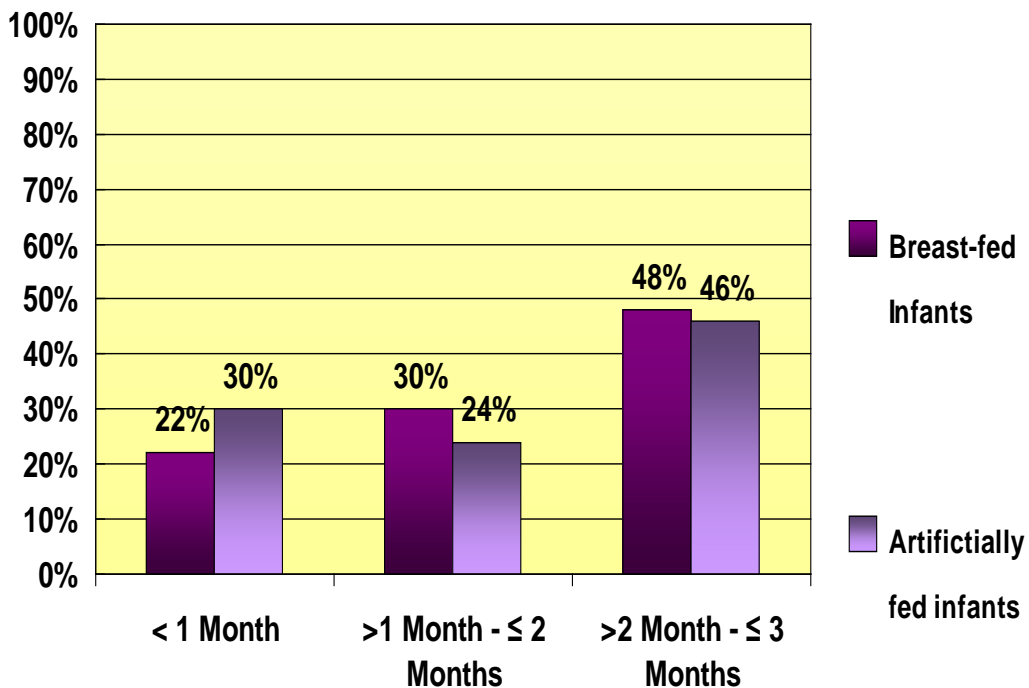
<b>Postnatal Age:</b>				
< 1 Month	11	22	15	30
>1 Month - ≤ 2 Month	15	30	12	24
>2 Month - ≤ 3 Month	24	48	23	46
<b>Total:</b>	50	100	50	100
<b>Sex:</b>				
Male	39	78	32	64
Female	11	22	18	36
<b>Total:</b>	50	100	50	100
<b>Community Type:</b>				
Urban	13	26	30	60
Rural	37	74	20	40
<b>Total</b>	50	100	50	100
<b>Birth Order:</b>				
First	24	48	34	68
Last	26	52	16	32
<b>Total</b>	50	100	50	100

**Table 1.**

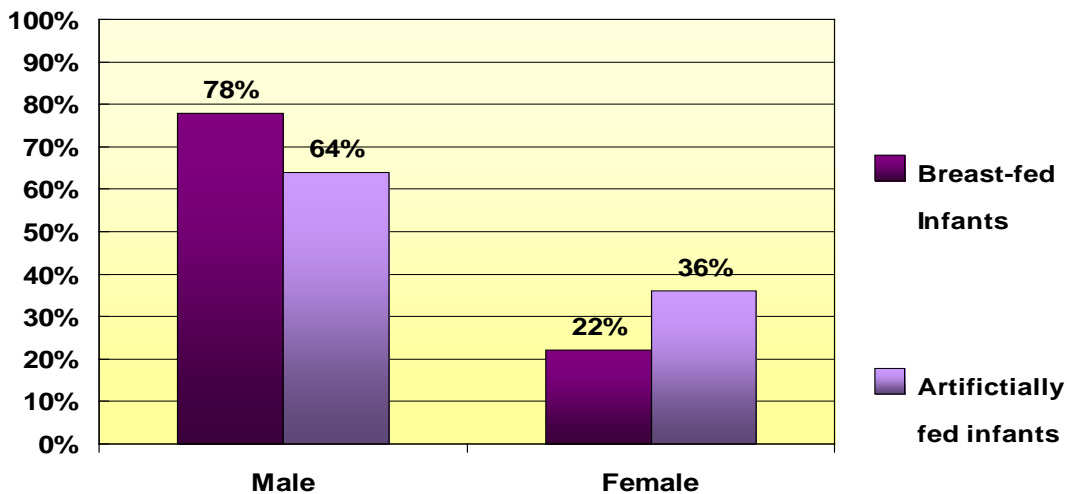
**Table (1)** Shows that about half of artificially fed infants (48%) their gestational age ranged from 41 – < 42 weeks, while less than one quadrant (8 %) of them their gestational age ranged from 42 – < 43 weeks. The majority of breast-fed infants (76 %) their birth weight ranged from 3.400 - < 3.700 kg, while 24% of them their birth weight ranged from 3.700 - 4 kg. About half of breast-fed infants (48%) their postnatal age ranged from 2 month - ≤ 3 month, while less than one quadrant (22%) of them their postnatal age was one month or less.

Regarding the sex it was found that; the majority of breast-fed infants (78 %) were males and 22% of them were females compared to 64%, 36% of artificially fed infants, as for the community type it was found that; the majority of breast-fed infants (74%) living in rural areas, while 60% of artificially fed infants were from urban areas. In addition, about half of breast-fed infants (48%) was the first birth and in 52% of them, it was the last birth compared to 68%, 32% of artificially fed infants.

**Fig. (1) Distribution of Infants According to their Postnatal Age**



**Fig. (2) Distribution of Infants According to their Sex**



**Part two: A. Anthropometric measurements:**

Items	Breast-Fed	Artificially Fed	T-Test	P-Value
	Mean±SD			
<b>Weight:</b>				
Less Than Normal	3475.00 ± 450.00	2942.86 ± 677.88	1.389	0.198
3 <sup>rd</sup> To ≥50 <sup>th</sup>	4122.22 ± 747.98	3875.00 ± 633.50	1.286	0.204
50 <sup>th</sup> To ≥97 <sup>th</sup>	5257.69 ± 731.67	5000.00 ± 902.77	0.697	0.492
More Than Normal	6175.00 ± 1237.44	0 ± 0	–	–
<b>Length:</b>				
Less Than Normal	51.00 ± .00	47.00 ± 4.24	–	–
3 <sup>rd</sup> To ≥50 <sup>th</sup>	56.26 ± 3.62	55.25 ± 3.48	1.217	0.227
50 <sup>th</sup> To ≥97 <sup>th</sup>	62.93 ± 4.99	58.33 ± 2.31	1.535	0.144
More Than Normal	64.00 ± 15.56	63.00 ± 0	–	–
<b>Head Circumference.</b>				
Less Than Normal	0 ± 0	33.67 ± .58	–	–
3 <sup>rd</sup> To ≥50 <sup>th</sup>	36.05 ± 1.78	36.14 ± 2.05	0.211	0.833
50 <sup>th</sup> To ≥97 <sup>th</sup>	41.27 ± 0.79	41.00 ± 1.00	0.500	0.626
More Than Normal	0 ± 0	45.00 ± 0	–	–
<b>Chest Circumference.</b>				
Less Than Normal	0 ± 0	33.70 ± 0.52	–	–
3 <sup>rd</sup> To ≥ 50 <sup>th</sup>	34.90 ± 1.70	35.90 ± 1.94	0.074	0.888
50 <sup>th</sup> To ≥ 97 <sup>th</sup>	41.31 ± 0.82	41.08 ± 1.07	0.530	0.644
More Than Normal	0 ± 0	44.00 ± 0	–	–

**Table (2):** Anthropometric measurements between breast-fed and artificially fed infants during the third visit (14<sup>th</sup> day).

**Table (2)** Illustrate that the weight, length, head and chest circumference of the breast-fed infants showed highest in mean values of all the studied anthropometric measurements in comparison to each of weight, length, head, and chest circumference of the artificially fed infants during the third visit except in the head circumference of the artificially fed infants which showed high mean values of less than normal, 3<sup>rd</sup> to ≥50<sup>th</sup>, and more than normal of head and chest circumference measurements to breast-fed infants in the same measurements.

On the other hand, no statistical significant differences between the weight, length, head, and chest circumference to breast-fed and artificially fed infants during the second visit as regards to all anthropometric measurements.

**Part three: (Wound healing criteria)**

**a) Sound healing**

**Table (3):**

Relationship between sound healing of infants' wounds and their type of feeding (breast-feeding or artificial feeding) during 7<sup>th</sup> and 14<sup>th</sup> day

Sound healing	Feeding		Artificially fed		X <sup>2</sup>	P-Value
	Breast-fed		No.	%		
	No.	%	No.	%		
<b>7<sup>th</sup> Day:</b>						
Yes	18	36	5	10	8.131**	0.004
No	32	64	45	90		
Total	50	100	50	100		
<b>14<sup>th</sup> Day:</b>						
Yes	39	78	16	32	19.556***	0.000
No	11	22	34	68		
Total	50	100	50	100		

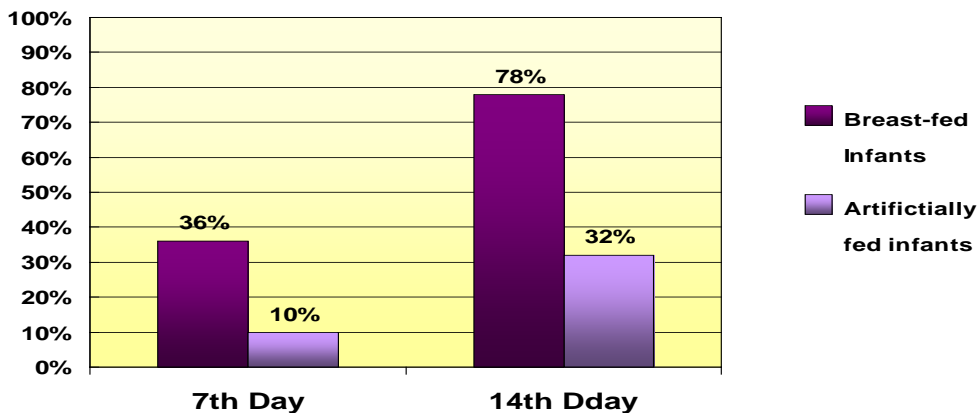


**Table 3.**

**Table (3)** Shows that high statistical significant difference ( $P < 0.004$ ) was found between occurrence of sound healing of infant's wounds and their type of feeding (breast-feeding or artificial feeding) and during the 7<sup>th</sup> day. It was found that, the percentage of occurrence of sound healing among the breast-fed infants was more than one third (36%) while the percentage of occurrence of sound healing among the artificially fed infants was 10% only.

Very high statistically significant difference ( $P < 0.0001$ ) was found between occurrence of sound healing of infants' wounds and their type of feeding (breast-feeding or artificial feeding) during the 14<sup>th</sup> day. It was found that the majority (78%) of breast-fed infants wounds' had sound healing, while less than third (32%) of artificially fed infants wounds had sound healing during the 14<sup>th</sup> day.

**Fig. (3) Distribution of Infants According to the Occurrence of Sound Wound Healing**



**b) Wound Inflammation**

**Table (4):**

Relationship between inflammation of infants' wounds and their type of feeding (breast-feeding or artificial feeding) during 7<sup>th</sup> and 14<sup>th</sup> day

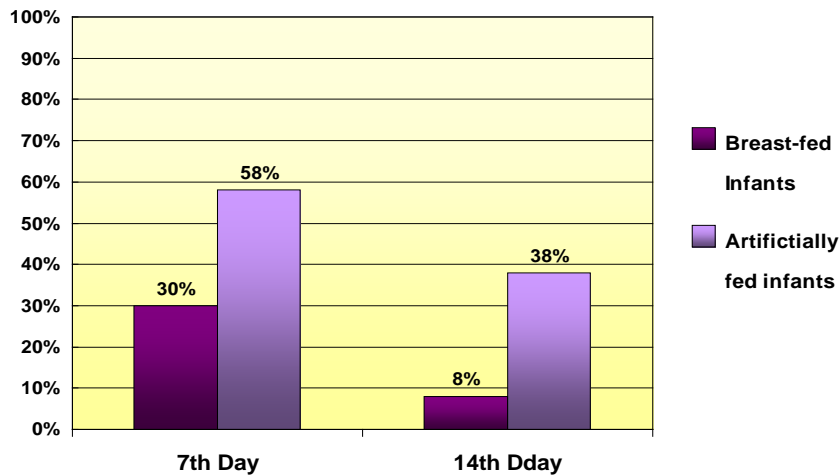
Inflammation	Feeding	Breast-Fed		Artificial fed		X <sup>2</sup>	P-Value
		No.	%	No.	%		
<b>7<sup>th</sup> Day:</b>							
<b>Yes:</b>						6.859**	0.009
Some Sutures		8	30	18	58		
All Sutures		7		11			
<b>No:</b>		35	70	21	42		
<b>Total:</b>		50	100	50	100		
<b>14<sup>th</sup> Day:</b>							
<b>Yes:</b>		4	8	19	38	11.067***	0.000
Some Sutures		1		10			
All Sutures		3		9			
<b>No:</b>		46	92	31	62		
<b>Total:</b>		50	100	50	100		

**Table 4.**

**Table (4)** Shows that high statistical significant difference ( $P. < 0.009$ ) was found between occurrence of inflammation of breast-fed and artificially fed infants' wounds during the 7<sup>th</sup> day. The majority (58%) of artificially fed infants' wounds were inflamed, less than one third (30%) of breast-fed infants' wounds were inflamed during the 7<sup>th</sup> day.

Very high statistical significant difference ( $P. < 0.000$ ) was found between occurrence of inflammation of wounds of breast-fed and artificially fed infants during the 14<sup>th</sup> day. About 38% of artificially fed infants' wounds were inflamed, while only 8% of breast-fed infants' wounds were inflamed during the 14<sup>th</sup> day.

**Fig. (4) Distribution of Infants According to the Occurrence of Wound Inflammation**



#### 4. Discussion

Nutrition plays a key role in the prevention and treatment of children's wounds and especially in newborns. Breast-feeding is such an amazing advantage for both a mother and child. [4].

Results of the present study were in accordance with what mentioned by [1] added that the exclusively bottle-fed infants showed fewer number of feeding and shorter duration of sucking and compared to breast-fed infants.

Based on the results of the present study, it was observed that the weight, length, head circumference, and chest circumference of the breast-fed infants showed high mean values of all the studied anthropometric measurements in comparison to each of weight, length, and head circumference of the artificially fed infants as shown in tables 5, 6, 7 and 18. The differences could be explained by the difference in infants' appetite, which was better in breast-feeding rather than in artificial feeding. The second explanation may be due to the diarrheal diseases that occur in infants who were artificial feeding more than those with breast-feeding.

Results of the present study were in agreement with those obtained by one study in Menoufia, Egypt by [7] reported that the infants who were exclusively breast-fed lost 14 percentiles of weight for age from birth to 6 months while those who were exclusively formula fed lost 18 percentiles.

Results of the present study were in agreement with those obtained by the study of [13] reported that the available data suggest that feeding infants following hospital discharge with breast milk show increasing in growth rates during infancy compared with unfortified breast milk. Breast milk feeding for 12 weeks after hospital discharge

resulted in higher rates of growth during infancy. At 12 months corrected age, weight, length and head circumference were statistically significantly greater in the intervention group.

In this study, it was observed that a statistically significant difference was found between occurrence of diarrhea and vomiting among breast-fed and artificially fed infants. In addition, the results of present study reported occurrence of infant poor appetite in the majority of artificially fed infants comparing to small percentage among breast-fed infants, also this study showed that the majority of cases of diarrhea and vomiting occurred among artificially fed infants as shown in table 14. These results could be explained by one of the following; Firstly, these finding may occur due to inappropriate preparation of artificial formula (as excessive dilution, unsterile techniques, or poor hand washing of caregiver). Secondly, the use of unsuitable type of artificial milk to infant's condition or his age by caregiver. Thirdly, may be the easy digestion of breast milk and its contained macrophages that prevent occurrence of gastrointestinal tract infection and protect the intestinal mucous membrane and helping in healing it if damaged.

The findings that were documented in the present study were in parallel with the results of [2] reported that more than half of infant death from diarrhea in Latin American were preventable by exclusive breast-feeding among infants aged 0-3 months and partial breast-feeding through the remaining period of infancy.

These results in agreement with the result of [8] reported that the breast-feeding results in a stable enterobacterial flora with lower counts of enterobacteria than seen in bottle-fed infants.

In comparing the results of two studies in India and Canada by [5], all breast-fed infants had significantly lower incidence of diarrheal diseases and of complications such as dehydration than bottle-fed infants.

The majority of the cells in breast milk are macrophages, cells that kill bacteria, fungi and viruses. Breast-fed babies are protected, in varying degrees, from a number of illnesses, including pneumonia, botulism, bronchitis, staphylococcal infections, influenza, ear infections, and German measles [14].

Analysis of these data showed that infants who were receiving breast milk feeding showed better growth, fewer urinary tract infection, and better gastrointestinal tract function than the growth, urinary tract infection, and gastrointestinal tract function of infants who were receiving formula milk feeding and this may be related to the adequacy and suitability of nutritional components in human milk to the infants at first three months of life rather than different types of artificial milk.

In addition, these data showed that the healing process occurred rapidly and with correct manner and the wound infection occurred less in wounds of infants who were receiving breast milk feeding than that occurred in wounds of infants who were receiving formula milk feeding and this may be related to antibodies that reach naturally to infants from the mother during the breast-feeding and these antibodies are not found in artificial milk.

The present study proved that one third of cases with urinary tract infection manifestations (as: blood in urine or pain during the urination) occurred in breast-fed infants while another two third were present in artificially fed infants as shown in table 15. This disturbance may occur as a result of industrial wastes which present in the artificial milk, which are deposited in urine and cause urinary tract infection.

These results were in agreement with those obtained by [12] reported that the exclusive breastfeeding gave a significantly (about half) lower risk of urinary tract infection than formula feeding (one quadrant). A longer duration of breast-feeding gave a lower risk of infection after weaning, indicating a long-term mechanism.

These results in agreement with the result of [9] reported that the mother's milk has at least one additional component of apparent importance for protection of the urinary tract.

In this study, it was observed that the highest percentage of maximum numbers of postoperative feeds reached by breast-fed infants compared to artificially fed infants.

[17] mentioned that the feeding tolerance increased postoperatively in exclusive breast-feeding because the breast milk is easily digestible than the artificial milk in cases of newborns and infants.

In this study, it was observed that twenty percent of infants who received formula milk feeding had less than normal protein level in their blood comparing to only less than one tenth of infants who received breast milk feeding as shown in table 17. This may be explained because of the wrong habits by caregiver during the formula preparation as excessive dilution to powder milk by water due to poverty or thinking about inability of infant to tolerate concentrated milk.

The finding of the present study showed that the high and very high statistically significant difference was found between occurrence of sound healing of infants' wounds and their type of feeding (breast-feeding or artificial feeding) during the 7th and 14th postoperative days respectively. On other hands, the majority of occurrence of sound healing from total healing was found among breast-fed infants while about one third of occurrence of sound healing was found among artificial fed infants during the 7th and 14th postoperative days respectively as shown in table 18. These results could be attributed to the fact that breast milk contains enough concentrations of all nutritional elements essential for healing.

[10] mentioned that breast milk has many antibacterial and other healing properties and has been found useful as eye-drops for inflammatory eye diseases and as nose drops for asthma and hiccup. In addition, it is useful in bleeding disorders and promotes healing of wounds.

High and very high statistically significant difference was found between occurrence of inflammation of breast-fed and artificially fed infants' wounds during the 7th and 14th postoperative days respectively. The majority of total inflamed cases numbers were in the artificially fed infants' wounds, while about third from total inflamed cases number was breast-fed infants during the 7th and 14th postoperative days respectively as shown in table 20. These results could be due to including the breast milk of antibodies that enable the infant body to overcome microorganism included at the infants' wounds.

[15] mentioned that none of the important antibodies found in breast milk is found in manufactured formula milk which means that formula milk doesn't provide the baby with the added protection against infection and illness that breast milk does.

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