



# International Journal of Advanced Community Medicine

E-ISSN: 2616-3594  
P-ISSN: 2616-3586  
[www.comedjournal.com](http://www.comedjournal.com)  
IJACM 2023; 6(1): 07-13  
Received: 05-10-2022  
Accepted: 12-11-2022

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## Effect of weaning age on nutritional status of breastfed infants in a rural area in Gharbia Governorate

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DOI: <https://doi.org/10.33545/comed.2023.v6.i1a.250>

### Abstract

**Background:** Breast feeding provide protection against gastro- enteritis and respiratory infection in the first year of breast-feeding results in less respiratory infection and lower blood pressure at age 7- 8 years. The appropriate age for starting complementary feeding is determined by the nutritional adequacy of exclusive breast-feeding at different ages. The aim of this study is to improve health of infant by studying the effect of weaning age on nutritional status of infants in Tanta district- Gharbia governorate.

**Methods:** This cohort study carried out on 200 infants and their mothers who attend the family health center for routine infant care visits. The mothers were subjected to a designed questionnaire including sociodemographic data as infant sex, age, education and occupation of the mother and the father, number of infants in the family, income and mode of delivery. The infants were subjected to a complete clinical examination for assessment of nutritional status through anthropometric measures and assessment of age of development of setting, standing, and walking during the period of study which was one year.

**Results:** Mean value showed statistically significant difference between three groups regarding sitting age, crawling age, standing age, weight at 4 months of age weight at 6 months of age Regarding walking age Mean value showed statistically significant difference between the two groups, Infants who started weaning at age of 4-6 months show better growth and development and less occurrence of infectious diseases, gastroenteritis, pneumonia, rickets and allergic manifestation than those at age before 4 or after 6 months. Weaning according to recommended nutritional program had better weight, length, head circumference and better hemoglobin concentration.

**Conclusions:** Starting weaning at 4-6 months of age looks better compared to earlier or delayed weaning. This could be attributed to: Higher rates of timely achievement of developmental milestones and better gaining of weight, length and head circumference. Less frequencies of infections and illnesses. Higher average of hemoglobin concentration

**Keywords:** Weaning age, nutritional status, breastfed infants, rural, Gharbia Governorate

### Introduction

Breast feeding provides protection against gastro- enteritis and respiratory infection in the first year of breast-feeding results in less respiratory infection and lower blood pressure at age 7- 8 years.

Weaning practices have significant implications for infant health, notably in relation to normal development, mineral balance and the development of obesity [2].

Exclusive Breast milk feeding is considered optimum nutrition for the first 4 months of life because of the infant's physical immaturity until this age, particularly with regard to gastrointestinal, renal and immune function and neuromuscular coordination. The introduction of solid food before 4 months of age has been associated with an increased risk of respiratory illness and eczema [3-5]. Exclusive breast feeding was defined as the infant receives breast milk alone (no other liquids or solids) [6].

The appropriate age for starting complementary feeding is determined by the nutritional adequacy of exclusive breast-feeding at different ages, by potential health benefits (or hazards) related to continued exclusive breast-feeding, including effects on development of motor, cognitive and social functions and by the impact of early feeding on risk of diseases in later life, particularly obesity, cardiovascular disease and diabetes mellitus [7].

The introduction of solid feeding with gradual replacement of breast milk by the solid food is the process known as weaning. Complementary feeding is the provision of any nutrient containing foods or liquids other than breast milk and includes both solid food and infant formula [5].

The World Health Organization (WHO) recommended in 2001 that exclusive breastfeeding should continue until 6 months of age to protect infants from morbidity and mortality that is associated with gastroenteritis [8-11].

During the weaning period, underfeeding is one of the common causes of failure to gain weight. The quantity, type and choice of food items may not be ideal for the adequate growth of the child. This encompasses infrequent feeding, use of expensive commercial foods given in diluted form and improper food preparation [12]. The main goal of the study is the improvement of the infant health through proper weaning. Study the effect of weaning age on growth & development and nutritional status of infants in Tanta district- Gharbia Governorate.

### Patients and Methods

This cohort study was carried out on the healthy exclusively breast-fed full-term infants less than or equal to 2 months who attending for vaccination and their mothers or care givers.

Exclusion criteria were infants with major illness either congenital or acquired. Infants admitted to Neonatal intensive care unit 2 weeks before inclusion or during the study. Infant with chronic diseases or syndromes and metabolic disorders.

The study was carried after approval from the ethical committee of Tanta Faculty of Medicine, Egypt. Oral and written informed consent was obtained from mothers or caregivers of participants in the study groups.

The mothers were informed to call or come to the family health center if there is any illness. The mothers were subjected to a designed questionnaire including sociodemographic data as age, education and occupation of the mother, occupation of the father, and number of children in the family. The infants were subjected to a complete clinical examination for assessment of nutritional status through full clinical history, full clinical examination including anthropometric measures and necessary investigations was done when necessary. During routine infant's care visits at 4, 6, 9 and 12 months the mother asked about developmental milestones of infants [13].

The Questionnaire sheet consisted of 3 parts: Part (1) consisted of: Sociodemographic data, Mothers' knowledge as regard infant weaning (Concept of weaning, Weaning age, Weaning technique). Part (2) consisted of: Studied infants (Type of labor, Need for incubator and reason for incubation, Present or past medical problem). Part (3) consisted of: Growth and developmental assessment: This was included the results of medical and laboratory finding at the ages of 4, 6, 9, 12 months.

### Clinical examination

General health status, general examination and local examination for chest, heart and abdomen.

### Anthropometric measures

Weight, Length and Head circumference were taken at age of 4, 6, 9, 12 months. [15].

### Investigations: Hemoglobin measurement

At the age of 6 and 12 months. Anemia was considered to be present if Hb < 11 [16].

### Stool analysis

The stool was examined by direct smear methods to detect presence of parasitic infestation at the age of 6 and 12 months. Plain X ray (chest – Limbs) when necessary, in prediction of respiratory infection or rickets respectively

**Follow up:** Anthropometric Measures, and growth velocity.

### Diagnosis of gastroenteritis

Requires presence of at least two of the following symptoms for a duration of 2 to 20 days: temperature > 38.5c, increased frequency of stools, loose stools, or vomiting. For gastroenteritis, we chose the duration 2 to 20 days to exclude insignificant illness (e.g., diarrhea for 1 day) and chronic illness (e.g., loose stool secondary to dietary changes) [18].

### Any respiratory infection classified by IMCI Program

Sever Pneumonia or very severe disease: has any one or more of the following: Not able to drink, takes < 50% of feeding, difficult to wake, stridor while calm or convulsions. Pneumonia: fast breathing (50 breaths per minute or more for 2 months up to 12 months infant). Cough or cold (No pneumonia): no signs of pneumonia or sever pneumonia.

At the end of the interview: the mothers had some papers which explain method of weaning and type of foods that will be given to their infants at each month. The mothers were asked to return back for follow up visits that scheduled at 4, 6, 9, 12 months for correction of any obstacles regarding the breast feeding or weaning practice.

### Sample size and Sample technique

The calculated minimal sample size (taking in consideration 80% power of the study, 95% confidence and 50% expected effect) was 180 infants and 20 infants was added to overcome the drop out of infants by incomplete follow up so the total sample size was 200 infants. These infants were taken from 3 randomly selected rural health care centers/units. The data was collected from about 30 infants in each center monthly. The total sample size was completed within 2 months.

### Statistical analysis of data

Statistical analysis was performed using SPSS Package 20 for Microsoft Windows. Numerical data were presented as mean and standard deviation and categorical ones as number and percentage. For categorical variables, Chi-square test and fisher exact were used for testing association whenever appropriate. Level of significance was adopted at p value ≤ 0.05. F test and post hoc test were used.

### Results

Table (1): displays weaning age of the studied infants according to parental characteristics. It shows that no significant differences were observed between infants weaned <4 months, 4-6 months or >6 months regarding father and mother occupation (P=0.653) and (P=0.446) respectively. It displays also that father and mother education were not significantly associated with weaning age (P=0.722) and (P=0.749) respectively. the same was also observed regarding family income (P = 0.411). also, this table show no significant differences regarding father and mother age (P=0.882) and (P=0.698) respectively.

**Table 1:** Weaning age of the studied infants according to parental characteristics:

Sociodemographic characteristics	Weaning < 4m		Weaning at 4 – 6m		Weaning > 6m		X <sup>2</sup>	P value
	N	%	N	%	N	%		
<b>Father occupation</b>								
-Skilled	5	55.6	65	36.7	7	50	5.907	0.653
-Professional	1	11.1	47	26.6	3	21.4		
-Worker	2	22.2	30	16.9	3	21.4		
-Employee	0	0	27	15.3	1	7.1		
Farmer	1	11.1	8	4.5	0	0		
<b>Mother Occupation</b>								
-Worker	2	22.2	62	35	3	21.4	1.615	0.446
-House wife	7	77.8	115	65	11	78.6		
<b>Father Education</b>								
-Read & Write	0	0	1	0.6	0	0	5.324	0.722
-Elementary	0	0	3	1.7	0	0		
-Preparatory	1	11.1	11	6.2	1	7.1		
-Secondary	7	77.8	82	46.3	8	57.1		
-University	1	11.1	80	45.2	5	35.7		
<b>Mother Education</b>								
-Read & Write	0	0	5	2.8	0	0	5.083	0.749
-Elementary	0	0	6	3.4	0	0		
-Preparatory	2	22.2	19	10.7	2	14.3		
-Secondary	6	66.7	80	45.2	7	50		
-University	1	11.1	67	37.9	5	35.7		
<b>Income</b>								
-Sufficient	8	88.9	146	82.5	10	71.4	3.961	0.411
-Sufficient & increase	0	0	9	5.1	0	0		
-not sufficient	1	11.1	22	12.4	4	28.6		
<b>Father age</b>								
< 30	2	22.2	53	29.9	4	28.6	0.252	0.882
≥ 30	7	77.8	124	70.1	10	71.4		
<b>Mother age</b>								
< 30	7	77.8	131	74	9	64.3	0.719	0.698
≥ 30	2	22.2	46	26	5	35.7		

Table (2): Shows weaning age of the studied infants according to infant characteristics. It displays that no significant differences were observed between infant weaned <4 months, 4-6 months or >6 months regarding sex

distribution (P=0.917). It displays also that birth order was not significantly associated with weaning age (P=0.762). The same also observed regarding type of infant delivery (P =0.753).

**Table 2:** Weaning age of the studied infant according to infant characteristics:

Sociodemographic characteristics	Weaning < 4m		Weaning at 4 – 6m		Weaning >6m		X <sup>2</sup>	P value
	N	%	N	%	N	%		
<b>Sex</b>								
-Male	4	44.4	91	51.4	7	50	0.172	0.917
-Female	5	55.6	86	48.6	7	50		
<b>Birth order</b>								
1 <sup>st</sup>	3	33.3	48	27.1	5	35.7	3.361	0.762
2 <sup>nd</sup>	3	33.3	68	38.4	4	28.6		
3 <sup>rd</sup>	3	33.3	46	26	5	35.7		
≥4 <sup>th</sup>	0	0	12	8.5	0	0		
<b>Type of delivery</b>								
-NVD	6	66.7	101	57.1	9	64.3	0.568	0.753
-CS	3	33.3	76	42.9	5	35.7		

Table (3): displays age of physical developmental milestones according to weaning age. It reveals that nearly half (49.7%) of infants who weaned at 4-6 months sit at <6 months compared to none (0.0%) of those who either weaned at ages <4 months or >6 months. Also, all infants who weaned after the age of 6 months and two third of those

weaned before the age of 4 months sit at age >6 months. As for crawling most of infants who were weaned at 4-6 months crawled before the age of 9 months (96.6%) compared to infants weaned before 4 or after 6 months. From this table also weaning age showed no significant associated with ages of standing and walking.

**Table 3:** Age of physical developmental milestones

Weaning age	Sitting			Crawling			Standing			Walking		
	< 6	6	> 6	< 9m	9m	> 9m	< 10	10	> 10	< 12	12	> 12
<4 m												
N	0	3	6	0	2	7	0	0	9	0	0	9
(%)	.0%	33.3%	66.7%	.0%	22.2%	77.8%	.0%	.0%	100.0%	.0%	.0%	100.0%
4-6 m												
N	88	69	20	171	6	0	0	31	146	4	43	130
(%)	49.7%	39.0%	11.3%	96.6%	3.4%	.0%	.0%	17.5%	82.5%	2.3%	24.3%	73.4%
>6 m												
N	0	0	14	4	5	5	0	0	14	0	0	14
(%)	.0%	.0%	100.0%	28.6%	35.7%	.0%	.0%	.0%	100.0%	.0%	.0%	100.0%
X <sup>2</sup>	97.649			78.230			4.767			7.983		
P value	0.001*			0.001*			0.092			0.092		

Table (4) Displays Frequencies of timely achievement of physical milestones according to weaning age. It shows that the timely achievement of physical milestones was

significantly observed among infants weaned at 4-6 months of age compared to those weaned before 4 months or above 6 months.

**Table 4:** Frequencies of timely achievement of physical milestones according to weaning age.

Weaning age	Timely achievement of physical milestone							
	4 m.		6 m.		9 m.		12 m.	
	N	%	N	%	N	%	N	%
Weaning < 4m N=9	2	22.2	1	11.1	1	11.1	4	44.4
Weaning at 4 – 6m N=177	115	65	108	61	98	55.4	102	57.6
Weaning > 6m N=14	5	35.7	6	42.9	2	14.3	3	21.4
(P value)	(0.003*)		(0.005*)		(0.001*)		(0.022*)	

Table (5): Shows Average age of physical developmental signs among infants weaned before 4 months, 4-6 months and after 6 months of age. It displays that infant who weaned at 4-6 months of age sit at ages ranged between 4.5 and 6.5 months with an average of 5.67±0.52 which was significantly younger compared to these weaned <4 or >6 months (p =0.001). The same was also observed for crawling standing and walking.

to weaning age. They reveal that the average weight of infants who weaned at the age of 4-6 months were (6.56± 0.36), (7.98± 0.38), (9.23±0.43) and (10.49±0.42) at the ages of 4,6,9 and 12 months respectively which were higher compared to their weaned at ages <4 or >6 months (p=0.001). The same regarding the infant length and head circumference except at the age of 9 months where the average head circumference were not statistically different.

Table (5): displays anthropometric measurement according

**Table 5:** Anthropometric measurement and physical developmental signs according to weaning age

Anthropometric measurement	Weaning < 4m	Weaning at 4 – 6m	Weaning > 6m	f test	p. value	Post Hoc Tests		
						P1	P2	P3
<b>Weight(kg)</b>								
At 4m	5.8 – 6.2	6 – 7.5	5.7 – 6.2	31.869	0.001*	0.001*	0.981	0.001*
	5.94 ± 0.13	6.56 ± 0.36	5.97 ± 0.15					
At 6m	7 – 7.8	6 – 8.8	6.8 – 7.6	38.480	0.001*	0.001*	0.689	0.001*
	7.34 ± 0.30	7.98 ± 0.38	7.21 ± 0.25					
At 9m	8.4 – 8.9	8.1 – 10	8 – 8.9	31.033	0.001*	0.001*	0.506	0.001*
	8.63 ± 0.17	9.23 ± 0.43	8.44 ± 0.31					
At 12m	9 – 9.5	9.6 – 12	9 – 9.8	93.621	0.001*	0.001*	0.990	0.001*
	9.26 ± 0.17	10.49 ± 0.42	9.28 ± 0.32					
<b>Length (cm)</b>								
At 4m	58 – 60.5	59.5 – 63	58 – 60.1	70.906	0.001*	0.001*	0.647	0.001*
	59.53 ± 0.85	61.32 ± 0.75	59.25 ± 0.61					
At 6m	61.6 – 63.3	61.9 – 66	61.7 – 63.5	123.077	0.001*	0.001*	0.756	0.001*
	62.52 ± 0.56	64.61 ± 0.65	62.33 ± 0.47					
At 9m	67.4 – 69.3	65.5 – 79	66.3 – 69	25.434	0.001*	0.002*	0.366	0.001*
	68.53 ± 0.60	70.12 ± 1.39	67.76 ± 0.61					
At 12m	72.1 – 73.1	70 – 77	72.3 – 72.2	24.512	0.001*	0.001*	0.986	0.001*
	69.13 ± 10.15	73.95 ± 1.01	69.34 ± 7.82					
<b>H C(cm)</b>								
At 4m	40 – 41	40 – 42.2	40 – 40.6	22.579	0.001*	0.002*	0.489	0.001*
	40.39 ± 0.40	41.06 ± 0.60	40.11 ± 0.17					
At 6m	41 – 42.1	41 – 45	41 – 41.4	35.594	0.001*	0.001*	0.310	0.001*

	41.51 ± 0.39	42.45 ± 0.68	41.11 ± 0.13					
At 9m	42 – 43	42.5 – 44	41.8 – 43	0.203	0.817	0.910	1.0	0.867
	42.37 ± 0.32	46.41 ± 30.29	42.36 ± 0.38					
At 12m	43 – 43.6	43.7 – 47	42.5 – 44.1	63.598	0.001*	0.001*	1.0	0.001*
	43.26 ± 0.21	45.25 ± 0.84	43.26 ± 0.42					
<b>Developmental signs</b>								
Sitting	6 – 7	4.5 – 6.5	6.5 – 7.5	54.852	0.001*	0.001*	0.026*	0.001*
	6.44 ± 0.39	5.67 ± 0.52	7.00 ± 0.20					
Crawling	8 – 9	5 – 9	8.5 – 9.5	40.133	0.001*	0.001*	0.051*	0.001*
	8.50 ± 0.35	7.81 ± 0.55	9.04 ± 0.41					
Standing	10.5 – 12	10 – 12	11 – 12	21.573	0.001*	0.003*	0.477	0.001*
	11.39 ± 0.60	10.81 ± 0.52	11.64 ± 0.31					
Walking	14 – 16	11 – 16	14 – 16	21.161	0.001*	0.001*	0.746	0.001*
	15.00 ± 0.71	13.58 ± 1.19	15.36 ± 0.63					

P1: Weaning < 4m vs. weaning at 4 – 6m, P2: Weaning < 4m vs. weaning at > 6m, P3: Weaning 4 – 6m vs. weaning at > 6m.

Table (6): displays history of illness among the studied infants. It reveals that the least frequent illness was observed among infants weaned at ages ranged between 4-6 months (31.7%) compared to those weaned at age <4 or >6 months (p=0.001).

**Table 6:** History of illness among studied infants:

history of illness Weaning age	Gastroenteritis		Pneumonia		Rickets		Allergic manifestation		X <sup>2</sup>	P value
	N	%	N	%	N	%	N	%		
Weaning < 4m N=9	4	44.4	3	33.3	0	0	1	11.1	19.701	0.001*
Weaning at 4 – 6m N=177	29	16.4	20	11.3	3	1.7	4	2.3		
Weaning > 6m N=14	4	28.6	3	21.4	2	14.3	1	7.1		

Table (7): Shows intestinal parasitic infestation among studied infants. It reveals that the highest frequencies of intestinal parasitic infestation were observed among infants weaned before 4 months (22.2% and 44.4% at the age of 6 and 12 months respectively). The table shows also that the

least frequencies were observed among infants weaned after the age of 6 months (7.1% and 14.3% at the age of 6 and 12 months respectively). Differences were statistically significant.

**Table 7:** Intestinal parasitic infestation among studied infants:

Weaning age	Parasitic infestation				X <sup>2</sup>	P value
	6 m.		12 m.			
	N	%	N	%		
Weaning < 4m N=9	2	22.2	4	44.4	8.752	0.013*
Weaning at 4 – 6m N=177	14	7.9	27	15.3		
Weaning > 6m N=14	1	7.1	2	14.3		

**Discussion**

In this study, no significant association did occur between weaning age and sociodemographic characteristics of infants and their parents on the aspects of father and mother education, occupation, income and age. This was in concordance with the finding of (Farahat *et al.*, 2012) [22] and Elshafie *et al.*, [22] who reported that parental sociodemographic characteristics have no significant role on selecting age of starting weaning. This was contrary to the findings of Tarrant *et al.*, (2010) [23] in Hong Kong who noticed a significant association between low educational status of the mothers and the practice of early weaning. This difference could be attributed to the observation that most of the low socioeconomic mothers in the Tarrant study were obliged to early postpartum return to their work. This study showed significant difference regarding physical developmental signs among infants weaned before 4 months, 4-6 months and after 6 months of age. The infant who weaned at 4-6 months of age sit at an average younger age compared to these weaned <4 or >6 months (p =0.001). The same was also observed for crawling standing and walking.

Also, the averages of anthropometric measures (weight, length and head circumferences) were higher in infants weaned at 4-6 months of age compared to those weaned earlier or later. It was also observed that they continued higher throughout the follow up period. (Table 9).This was in agreement with the findings of Adair *et al* (1993) [24], Simondon and Simondon (1997) [25], Padmadass *et al*, (2002) [26] and Kramer *et al.* (2003) [17] This could be explained according to Dewey and Brown (2003) [27] who reported that weaning before six months of age tend to displace breast milk which lead to infant deprivation from key nutrients beyond 1st year of life. Also, this study revealed that infants who started weaning at 4-6 months of their age were less frequently exposed to illnesses compared to those weaned at age <4 or >6 months (p=0.001). This was similar to the findings of Schoetzau *et al*, (2002) [28] who reported that infants who were exclusively breast-fed for 4 months have less atopic eczema. This was in agreement with the studies done by Popkin *et al*, (1990) [29] and Brown *et al.*, (1989) [30] and Huascar (Lima), Peru. Who reported that diarrhea and respiratory illnesses were more



frequently encountered among infant started weaning earlier.

In this study also the highest frequency of intestinal parasitic infestation was observed among infants weaned before 4 months of age compared to those weaned at 4-6 months or after 6 months. This could be attributed to early exposure to contaminated foods<sup>[18]</sup>.

In this study the average hemoglobin concentration at 6 months and 12 months in infant who started weaning at 4-6 months of age was higher compared to infants weaned <4 months or >6 months of age. This was in agreement with the finding of Farahat *et al.*, (2012)<sup>[31]</sup> who showed that the mean value of hemoglobin concentration at age of 12 months was significantly higher among infants started weaning at age of 4-6 months compared to those started weaning before or after this age. The same was also reported by Meinzen *et al.*,<sup>[32]</sup> who reported that exclusive breast feeding up to 6 months of age was associated with increased risk of anemia.

Also El Shafie *et al.*,<sup>[33]</sup> reported that infants weaned after 4 months of age with a recommended weaning program have significantly higher Hb. concentration compared to infants weaned without weaning program before 4 months or after 6 months. He attributed this to compliance with the instructions of the physicians who recommend this program. El Shafie *et al.*,<sup>[21]</sup> and Shebl *et al.*,<sup>[34]</sup> found that there was significant increase in hemoglobin level in infants weaned after 4 months than those weaned after 6 months. Contrary to this Kattelman *et al.*,<sup>[35]</sup> reported that the iron and Zinc status of infants was not influenced by timing or type of complementary foods introduced. He explained this on the basis that the infant's hemoglobin concentration during the first months of age depends primarily on their maternal stores, however hemoglobin Concentration does not depend only on iron concentration. Canadian pediatric society, 2015<sup>[36]</sup> recommend exclusive breast-feeding for at least 4 months and the introduction of iron-containing complementary foods and foods containing ascorbic acid, which enhance iron absorption, at the age of 4-6 months as by the age of 6 months iron stores of most babies have been depleted, and from 4 to 12 months after birth the infant's blood volume doubles.

American Academy of Pediatrics (AAP) recommended hemoglobin screening for all infants between the ages of 9 and 12 months and six months later. For children at high risk, screen once a year from ages two to five years. It also recommended continuing breastfeeding for at least the first year and beyond, while introducing complementary foods rich in iron beginning around six months of age. It is a major public health issue because it has important consequences including impairment of child development. The disease is preventable because the main cause of iron deficiency in this age group is lack of adequate iron intake especially between the ages of six to 12 months<sup>[37]</sup>. The Infant Feeding Recommendation (2003) insisted upon complementary feeding including all needed nutrients and vitamins essential for infants is necessary to cope with infant growth and development<sup>[38]</sup>.

### Conclusions

Starting weaning at 4-6 months of age looks better compared to earlier or delayed weaning. This could be attributed to higher rates of timely achievement of developmental milestones and better gaining of weight,

length and head circumference, less frequencies of infections and illnesses and higher average of hemoglobin concentration

### Conflict of Interest

Not available

### Financial Support

Not available

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**How to Cite This Article**

Elris ASI, Shehata WM, Atlam SAE, Alkafas EAE. Effect of weaning age on nutritional status of breastfed infants in a rural area in Gharbia Governorate. *International Journal of Advanced Community Medicine*. 2023;6(1):07-13.

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