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Effect of Early Weaning on Infant Development

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Abstract: Objective: Compare the developmental status in Programmed and Non Programmed Early and Late Weaning among Infants in Menoufia Governorate. **Background:** Optimal infant feeding practices rank among the most effective interventions to improve child health. Breast-feeding is the most natural and safe way to feed an infant, Adequate nutrition during infancy is essential to ensure the growth, health and development of children to their full potential. Weaning means introduction of complementary foods to the diet of the infant. It is a critical nutritional stage in an infant's life and the optimal age for this has been much debated. **Methods:** Prospective observational study in clinics of Menoufia university hospital.150 healthy infants had normal development till the age of four months according to Baroda Development Screening Test For Infants were classified to 3 groups, group I 50 infants, started weaning early after 4 months of age on a recommended weaning program from Pediatric Department, Faculty Of Medicine Menoufia University, group II 50 infants started weaning early after 4 months of age according to family knowledge, group III 50 infants with late weaning after 6 months of age (exclusive breast fed till the age of 6 months) according to family knowledge, then three groups were compared regarding the developmental status according to Baroda Development Screening Test For Infants and Developmental Quotients were calculated for all infants. **Results**: there was no significant difference between three groups regarding demographic data. Regarding the motor and mental developmental scores using Baroda Development Screening Test, group I recorded the highest development scores among the three groups and that were of significant difference from the group II (p-value <0.001) and from group III (p-value <0.001) And also group II recorded higher scores than group III which were of significant difference (p-value <0.05). Regarding Developmental Quotients group I recorded the highest percentage of the developmental quotient (DQ) which was significantly different from group II (P-value<0.001) and group III (p-value<0.001). Group II recorded higher percentage of the developmental quotient (DQ) than group III and was of significant difference (p-value<0.05). **Conclusion:** Developmental milestones of the studied infants who started weaning early after the age of four months, according to recommended nutritional program from Pediatric Department, Faculty of Medicine, Menoufia University or according to family knowledge were better than that of infants who started weaning late after the age of six months.

[Aya A Abouhegazy, Ali M El Shafie, Dalia Mounir Allahony and Zein A Omar. **Effect of Early Weaning on Infant Development.** *J Am Sci* 2019;15(7):12-22]. ISSN 1545-1003 (print); ISSN 2375-7264 (online). http://www.jofamericanscience.org. 2. doi:10.7537/marsjas150719.02.

Key words: weaning infants, development, scores.

1. Introduction:

Exclusive breast feeding is defined as consumption of human milk with no supplementation of any type (no water, no juice, no foods, and no non human milk) except for vitamins, minerals and medications. (1).

Weaning means introduction of complementary foods to the diet of the infant. It is a critical nutritional stage in an infant's life and the optimal age for this has been much debated (2).

Much of the debate has centered on the so-called "weaning dilemma" in developing countries: the choice between the known protective effect of exclusive breast feeding against infectious morbidity and the theoretical insufficiency of breast milk alone to satisfy the energy and micronutrients needs of the infants beyond 4 months (3).

Fewtrell et al found that; babies exclusively breastfed for six months are at a higher risk of developing anemia which has been linked to adverse mental, motor and psychosocial problem. (4).

Weaning should be started after the age of 4 months and weaning food should be rich in calories, proteins, vitamin D and zinc. There is a gap between the intake and the requirements of calories, proteins, vitamin D and zinc at the age of 4 months (5).

Introduction of recommended nutritional program from Pediatric Department, Faculty of Medicine, Menoufia University after the age of four months is associated with better weigh gain and Normal body mass index than other group, also there is less prevalence of disease such as respiratory tract infection, GE and Allergic diseases (6).

2. Subject and methods:

Our study was done as a prospective observational study during the period from September 2015 to march 2017, that enrolled 150 healthy infants aged four and six months and their mothers who were randomly selected from the clinics of Menoufia university hospitals, The sample at the start was 171 then became 150 because of non compliance of 21 mothers.

Studied infants had been chosen according to

Inclusion criteria:-

Full term infants with average birth weight.

Normal development till the age of four months according to Baroda developmental score (7)

Healthy breastfed infants with early weaning i.e.: given

additional or solid food after 4 months of age and healthy breastfed infants with late weaning i.e.: exclusively breastfed up to 6 month.

Exclusion criteria:-

Preterm infants and infants of LBW.

Artificially fed infants.

Infants with chronic diseases (Congenial or acquired).

Infants who took supplementation of iron, copper, zinc, vitamin A (except obligatory administration during vaccination), vitamin D (except prophylactic dose) and vitamin E before and during the study.

All mothers were given information about our weaning program at age of four months (6), then classified into 3 groups according to their desire of feeding pattern for weaning of their infants:

Group I

It included 50 healthy infants given information about our weaning program and started weaning early after 4 months of age on a recommended weaning program from Pediatric Department, Faculty of Medicine, Menoufia University (6)

Group II

It included 50 healthy infants who started weaning early after 4 months of age according to family knowledge without interference from researcher.

Group III

It included 50 healthy infants with late weaning after 6 months of age (exclusively breastfed till the age of 6 months) according to family knowledge without interference from researcher.

Infants were subjected to the following:

Complete history taking:-

A pre-designed questionnaire applied to all mothers this questionnaire included the following items:

The first part included demographic data about: Name, Age, Sex, mother education, mother's occupation, order of birth, and number of children in family.

The second part included four questions about mother's information as regards weaning of previous children eg. Time of weaning, Time of complete breastfeeding cessation, source of mother knowledge and causes of complete weaning.

The third part about the studied infants included The type of labor, if the infants needed incubators and the reasons, any present or past problems, the infant development till the age of four months.

Developmental assessment

Assessment of the development of the infants of the studied groups at age of four months and follow up of the infants every month till the age of 18 months for the developmental milestones according to Baroda Development Screening Test For Infants Which is a screening test for the assessment of the motor-mental development of infants, was developed by selecting items from the Bayley Scales of Infant Development (7).

A routine use of Baroda test is recommended for following the development of normal children as well as for screening from the community children with possibility of developmental delay.

Baroda composed of 54 items 22 motor and 32 mental. The items were arranged sequentially according to their 97% age level, it is the age at which 97% of normal infants attain certain skill or milestone. For example the age of sitting with good coordination is 6.5 months at 50% and 9.2 months at 97% levels. It means that half (50%) of the normal children attain the skill at 6.5 months and almost all (97%) by 9.2 months and those who do not attain the skill by that age belong to the lower 3% of the normal population.

The 50 and 97% age levels of each item were plotted against its serial number and then joined to have two smooth curves –the upper representing the 50% age level and the lower representing the 97% age level.

The milestones represent the vertical line of Baroda Curve, and age by months represent the horizontal line. (figure 1)

The level of performance of the child is known by plotting the total number of items passed by the him (her) score against the chronologic age, any child below the 97 % age level is screened out for further study for developmental delay Developmental Age of the child, i.e the age at which 50 % normal children are expected to have the same score.

The intersection of the horizontal level of this score with the 50 % level curve gives the developmental age.

Developmental Quotient

If a child with chronologic age (CA) of 12 months has a score of 25, his development is delayed, as the score of this child is below 97% pass level.

From the curve, it is seen that 50% of normal children attain the score of 25 at the age of 6 months (DA) and the developmental quotient (DQ = DA/CA*100) will be 50.

At the time of revisit, the child development can be followed on the same curve.

Developmental Screening (BASED ON B.S.I.D – BARODA NORMS)

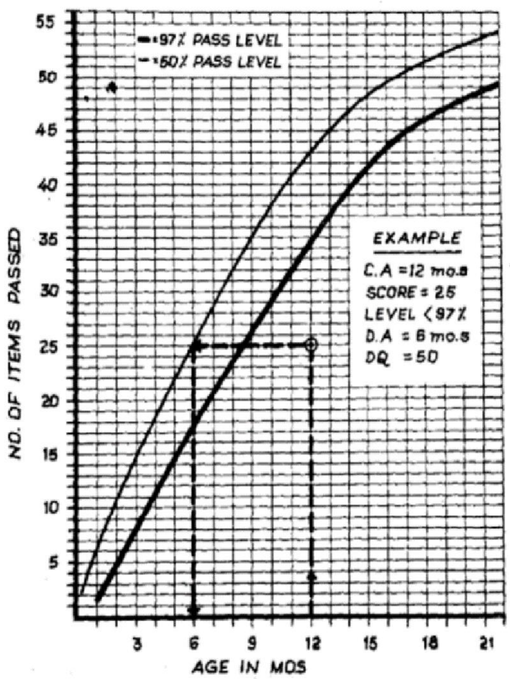

Figure (1) Baroda curve

Clinical Examination

Complete clinical examination including chest, heart, GIT, neurological examinations, head circumference**,** and assessment of appetite.

Follow up of the infants every month till the age of 18 months for Revision of the weaning regimen (Appendix 1) to ensure that the mothers followed the recommended weaning program for group I and reinforcement to the new items in the regimen and follow up the development of the infant according to Baroda developmental score **(7)**

Statistical design.

The data collected were tabulated, analyzed by SPSS (statistical package for the social Science software) statistical package version 11 on IBM compatible computer (8)

Quantitative date were expressed as mean + standard deviation (X + SD) and analyzed by applying student T-test for Comparison of the three groups of normal distributed variables.

Qualitative data were expressed as number and percentage (No & %) and analyzed by applying Chi-square test (x2). All tests were used as tests of significance at P<0.05 (8)

Mean value [X]: the sum of all observations divided by the number of observation:

Standard Deviation [SD]: It measures the degree of scatter of Individual varieties around their mean

Chi- square: the hypothesis that the row and column variables are independent, without indicating strength or direction of the relationship. Pearson chi-square and likelihood ratio chi-square.

Fisher's exact test (FE) and Yates' corrected Chi-square are computed.

Chi-square test:

For comparison between 2 groups as regards qualitative data

P-value (the level of significance)

Is the probability of obtaining a value of the test static at least as extreme as the one that was actually observed, given that the Null Hypothesis is true. The fact that p-value was based on this assumption is crucial to their correct interpretation.

P- value was interpretated as follow:-

P < 0.001 highly significant (HS).

P< 0.05 significant (S).

P> 0.05 non-significant.

3. Results:

There was no significant difference between the three groups regarding the sex of the infant, mode of delivery, birth order, mother's education mother's occupation (P-value >.05) Table (1)

at age of 4 months, there was no significant difference between the three groups in the development scores (p-value= 0.238).

From the age of 5 months to the age of 7 months, a significant difference in the development scores was noticed among three groups (p-value <0.001). Group I recorded the highest development scores among the three groups and that were of significant difference from the group II (p-value <0.001) and from group III (p-value <0.001). And also group II recorded higher scores than group III which were of significant difference (p-value <0.05). Table (2)

From the age of 8 months to the age of 18 months there was highly significant difference among the three groups (p-value<0.001). The post hock analysis revealed that group I recorded the highest scores among the three groups with significant difference from the group II (p-value<0.001) and the group III (p-value<0.001). And also group II recorded higher scores than group III which were of significant difference (p-value <0. 05). Table (3)

From the age of the 4 months to the age of 7 months, the developmental quotients were significantly different among the three groups. After doing post hock analysis for each month we found that, At the age of 4 months, group I recorded the highest percentage of the developmental quotient (DQ) which was significantly different from group II (p-value=.021) and without significant difference from group III (p-value=.496). Group III recorded higher percentage of the developmental quotient (DQ) than group II but without significant difference (p-value=.26). At the age of 5 months, group I recorded the highest percentage of the developmental quotient (DQ) which was significantly different from group II (P-value<.001) and group III (p-value<.001). Group II recorded higher percentage of the developmental quotient (DQ) than group III but without significant difference (p-value=.935). At both ages 6 months and 7 months, group I recorded the highest percentage of the developmental quotient (DQ) which was significantly different from group II (P-value<.001) and group III (p-value<.001). Group II recorded higher percentage of the developmental quotient (DQ) than group III and was of significant difference (p-value=.0016). Table (4)

From the age of the 8 months to the age of 18 months, the developmental quotients are significantly different among the three groups. After doing post hock analysis for each month we found that, from the age of the 8 months to the age of 18 months, group I recorded the highest percentage of the developmental quotient (DQ) which was significantly different from group II (P-value<0.001) and group III (p-value<0.001). Group II recorded higher percentage of the developmental quotient (DQ) than group III and was of significant difference (p-value<0.05). Table (5)

Table (1): **Comparison between studied groups regarding the demographic data of the infants.**

Demographic data of the infants	**Groups**						**X^2**	**P value**
	I (N=50)		**II (N=50)**		**III (N=50)**			
	no	**%**	**no**	**%**	**no**	**%**		
Sex • Female • Male	25 25	50.0% 50.0%	19 31	40.0% 60.0%	20 30	40.0% 60.0%	**I vs II=1.46 II vs III=0.04* I vs III=1.01**	**I vs II= 0.227 II vs III=0.238 I vs III=0.315**
Mode of delivery • CS • Normal	40 10	80.0% 20.0%	39 11	78.0% 22.0%	40 10	80.0% 20.0%	**I vs II=0.06 II vs III=0.06 I vs III=0.00***	**I vs II=0.806 II vs III=0.806 I vs III=1.00**
Birth order • 1st • 2nd • 3rd • 4th • 5th	25 15 9 1 0	50.0% 30.0% 18.0% 2.0% 0.0%	25 13 12 0 0	70.0% 10.0% 20.0% 0.0% 0.0%	25 15 10 0 0	50.0% 30.0% 20.0% 0.0% 0.0%	**I vs II=1.57 II vs III=0.325 I vs III=1.053**	**I vs II=0.66 II vs III=0.850 I vs III=0.789**
Mother's Education • Illiterate	5	10.0%	8	16.0%	10	20.0%	**I vs II=.845 II vs III=2.34 I vs III=4.75**	**I vs II=0.838 II vs III=0.503 I vs III=0.19**
• Basic	10	20.0%	10	20.0%	15	30.0%		
• Secondary	17	34.0%	15	30.0%	10	20.0%		
• University	18	36.0%	17	34.0%	15	30.0%		
Mother's Occupation • Employee	25	50%	24	48%	26	52.%	**II vs III=2.627**	**II vs III=0.105**
• Housewife	25	50%	26	52%	24	48%	**I vs III=2.627**	**I vs III=0.105**

Significant difference means P- value <0.05 * Non-Significant difference means P-value >0.05

Table (2): comparison between studied groups regarding the motor and mental developmental scores from the age of 4 month to the age of 7 months.

Motor and Mental Development score	Groups			one way Anova test (F)	P value	Post Hoc Test
	I (N=50)	II (N=50)	III (N=50)			
	Mean±SD	Mean±SD	Mean±SD			
4 months	10.20±1.26	9.9±1.1	10.3±1.3	1.448	0.238	**I vs II** =0.4395 **I vs III** =0.9121 **II vs III** =0.2341
5 months	12.80±1.34	11.9±1.46	10.74±1.16	30.34	<0. 001	**I vs II**<0.0025 **I vs III**<0.001 **II vs III=0.**0001
6 months	15.50±1.52	13.50±1.70	12.74±1.01	49.4927	<0. 001	**I vs II** <0.001 **I vs III**<0.001 **II vs III**=0.0240
7 months	17.40±1.58	15.30±0.97	13.94±0.96	104.56	<0. 001	**I vs II**<0.001 **I vs III**<0.001 **II vs III**<0.001

Significant difference means P- value <0.05 * Non-Significant difference means P-value >0.05.

Table (3): comparison between studied groups regarding the motor and mental developmental scores from the age of 8 months to the age of 18 months.

Motor and Mental Development data	Groups			one way Anova test (F)	P value	Post Hoc Test
	I (N=50)	II (N=50)	III (N=50)			
	Mean±SD	Mean±SD	Mean±SD			
8 months	19.40±1.58	17.80±1.06	15.04±1.03	155.88	<0. 001	**I vs II**<0.001 **I vs III**<0.001 **II vs III**<0.001
9 months	22.90±1.89	18.20±1.91	18.04±1.31	128.375	<0. 001	**I vs II**<0.001 **I vs III** <0.001 **II vs III**=.626
10 months	25.50±2.09	20.70±2.12	20.44±1.49	109.827	<0. 001	**I vs II** <0.001 **I vs III**<0.001 **II vs III** =.479
11 months	29.40±2.14	23.90±1.83	22.84±1.40	187.851	<0. 001	**I vs II**<0.001 **I vs III** <0.001 **II vs III**<0.001
12 months	31.30±2.22	25.50±1.71	24.34±1.32	217.341	<0. 001	**I vs II**<0.001 **I vs III**<0.001 **II vs III**<0.001
13 to 15 months	34.60±2.73	28.80±1.62	27.24±1.13	198.427	<0. 001	**I vs II** <0.001 **I vs III**<0.001 **II vs III**<0.001
16 to 18 months	41.60±2.73	35.20±1.55	32.14±1.31	301.527	<0. 001	**I vs II** <0.001 **I vs III** <0.001 **II vs III** <0.001

Significant difference means P- value <0.05 * Non-Significant difference means P-value >0.05

Table (4): comparison between studied groups regarding the developmental quotient (DQ) of the studied infants from the age of 4 month to 7 months

Developmental quotient	Groups			one way-Anova test (F)	P value	Post Hoc Test
	I (N=50)	II (N=50)	III (N=50)			
	Mean±SD	Mean±SD	Mean±SD			
4 months	89.75±10.56	85.00±6.49	87.75±9.00	3.636	0.0288*	**I vs II** =0.0219 **I vs III** =0.4967 **II vs III** = 0.26
5 months	89.80±8.87	80.40±9.47	79.80±7.37	21.187	<0.001	**I vs II**<0.001 **I vs III**<0.001 **II vs III** =0.935
6 months	89.50±8.28	79.83±9.10	75.17±5.50	44.127	<0.001	**I vs II** < 0.001 **I vs III**<0.001 **II vs III**=0.009
7 months	86.00±7.21	77.57±9.31	72.57±3.52	45.79	<0.001	**I vs II**<0.001 **I vs III**<0.001 **II vs III**=0.0016

Significant difference means P- value <0.05 * Non-Significant difference means P-value >0.05

Table (5): comparison between studied groups regarding the developmental quotient (DQ) of the studied infants from the age of 8months to 18 months.

Motor and Mental Development data	Groups						one way Anova test (F)	P value	Post Hoc Test
	I (N=50)		II (N=50)		III (N=50)				
	Mean	±SD	Mean	±SD	Mean	±SD			
8 months	82.75	6.15	70.12	1.79	67.63	3.31	189.64	<0.001	**I vs II**<0.001 **I vs III**<0.001 **II vs III**= 0.009
9 months	86.56	7.54	74.2	7.03	71.11	3.76	83.2613	<0.001	**I vs II**<0.001 **I vs III** <0.001 **II vs III**=0.041
10 months	86.90	7.54	74.2	7.13	71.70	4.45	82.39	<0.001	**I vs II** <0.001 **I vs III**<.001 **II vs III** =.049
11 months	92.36	6.75	74.27	1.43	71.45	5.15	262.88	<0.001	**I vs II**<0.001 **I vs III** <0.001 **II vs III**= 0.014
12 months	89.25	6.79	73.00	5.41	70.00	4.12	176.56	<0.001	**I vs II**<0.001 **I vs III**<0.001 **II vs III**=0.019
13 to 15 months	88.30	6.68	71.28	3.71	69.10	2.79	247.03	0.001	**I vs II**<0.001 **I vs III**0.001 **II vs III=0.020**
16 to 18 months	89.85	9.27	71.13	10.99	65.06	9.94	81.9	0.001	**I vs II**<0.001 **I vs III**<0.001 **II vs III=0.003**

Significant difference means P- value <0.05 * Non-Significant difference means P-value >0.05

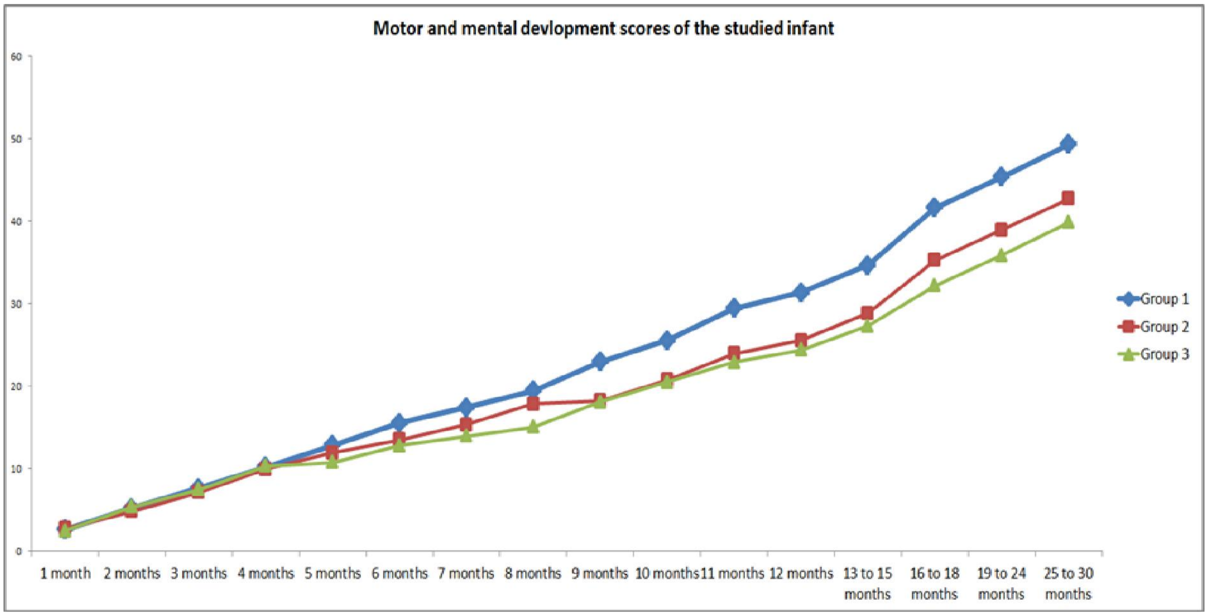

Figure (2): shows the motor and mental development scores of the studied infants.

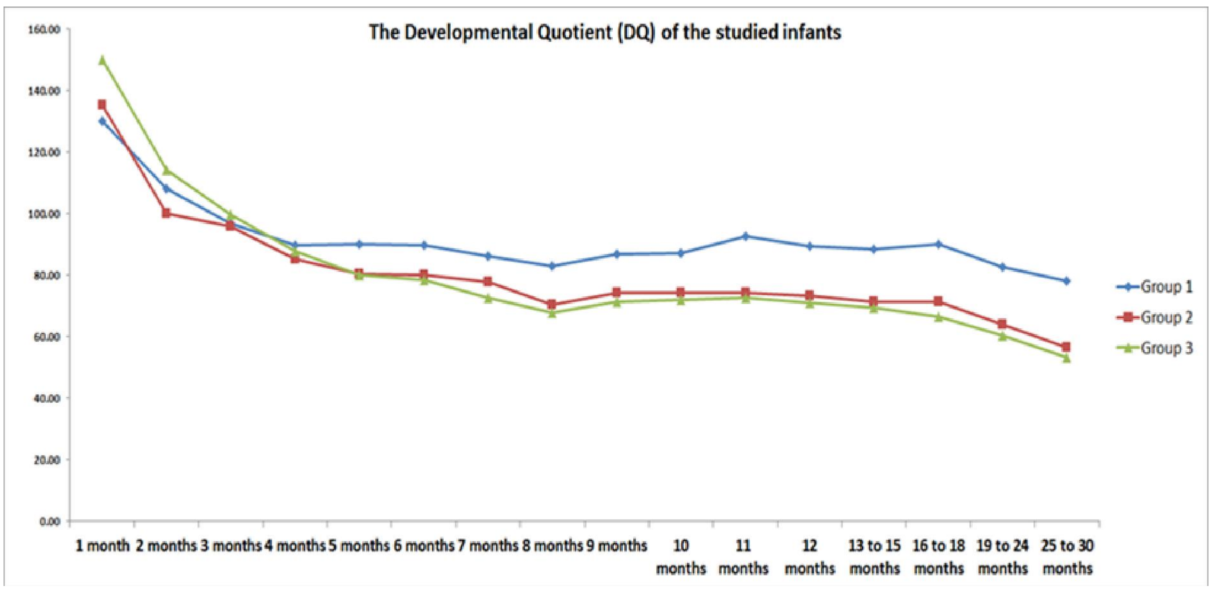

Figure (3): shows the developmental quotients (DQ) percentages of the studied infants

4. Discussion:

Complementary feeding is defined as supplementing with solid food and liquid foods in addition to breast milk or formula which begins during weaning period (9)

The 2008 European Society of Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) Committee on Nutrition concluded that exclusive or full breast-feeding for about 6 months is a desirable goal and that complementary feeding should not be introduced before 17 weeks and not later than 26 weeks (10).

WHO recommends exclusive breast feeding for the first six months of life, after which infants should receive nutritionally adequate and safe complementary foods while breast feeding is continuous up to two years of age or beyond (11).

In other hand, El Shafie et al., 2009 advised starting weaning of breast feeding infants after age of four months with introduction of recommended nutritional program from Pediatric Department, Faculty of Medicine, Menoufia University (6).

Also, the American Academy of pediatrics Evidence that Complementary Foods may be introduced between 4 to 6 months of age on basis of developmental readiness and nutritional needs as there is no significant benefit of exclusive breast feeding for 6 month (12).

Early infant nutrition is now understood to have significant short- and long-term health consequences for the individual. Nutritional interventions early in life are important in protecting the infant against infection and promoting healthy immune system development (13) and are thought to have lifetime programming effects on cardiovascular health, metabolism, bone health, immune function, and neurological development (14).

The aim of this study is to compare the early weaning (programmed and non-programmed) versus late weaning as regarding the effect on development of the infants in Menoufia Governorate.

There were six internationally-used tools to assess cognition and other domains in infants from 0 to 3 year (s) of age. Bayley Scales for Infant Development- II (BSID-II), British Ability Scales, Denver Developmental Materials, Stanford Binet, Ages and Stages Questionnaire, Vineland Adaptative Behavior Scales II. These tools developed in high-income countries, We looked for studies that aimed to validate these tools in low- and middle-income countries (LMICs). However, most of the studies in LMICs used these tools as the gold standard and compared the locally-developed tools with one or more of these. This comparison often happened, despite the lack of adaptation of the international tools for countries of use. Examples of such comparisons, BSID-II: Differences in cross-cultural performance have been described when comparing infants from England, Mexico, Brazil, and Taiwan.

Denver Test: Results in Brazil indicated high specificity (over 91%) but variable sensitivity ranging from 33% among mothers of four or less years of education to 73% among mothers of nine or more years of education. Similar variability was observed when comparing the responses of mothers according to income group (15).

Baroda Development Screening Test For Infants, one of the tools used in low- and middle-income countries as Developmental Screening Tools, it is a screening test for the assessment of the motor-mental development of infants, was developed by selecting items from the Bayley Scales of Infant Development, only those items which were simple and easy to administer and assess and not requiring any special training, experience or equipment were selected (7).

Baroda test is a simple, quick, cheap and precise test in comparison with Bayley Scales of Infant Development. The full scales of Bayley have a total of 230 items-67 for motor development and 163 for mental development, while that of Baroda Test are 54 items 22 motor and 32 mental. Bayley Scales of Infant Development was considered unsuitable as it requires some special equipment and set-up.

Validity of Baroda Development Screening Test For Infants, its sensitivity is 75%-93%. This variability was found because of the method used to screen. The lowest sensitivity was obtained when parent interview technique was used. As the authors had access to records of children between the ages of 0-30months on whom the Bayley Scales of Infant Development (BSID) was administered. They compared scores of items (54 items) that are included in the BDST with the overall performance of the child on the BISD, its specificity is 77.37%-94.44%. There were other tools used in low- and middle-income countries, for example Trivandrum Screening Chart (TDSC), its sensitivity is 66.7% and specificity is 78.8%(15).

This study showed that there was a non-significant difference among the three studied group as regards socio-demographic data. Table 1.

Other study was done by Zere and Mclntyre, who reported that many factors affect child growth and development status, especially in developing countries, such as educational status and knowledge about proper nutrition (16).

Abdallah et al., Illustrated that socio economic aspect influencing food consumption pattern among children under age of five year in rural area of Sudan. It was concluded that improvement of maternal education and knowledge about nutrition were helpful to maintain the children's nutritional status (17).

These results agree with Elshafie et al., who states that there was a non-significant difference between infants feeding early after 4 months (programmed and non-programmed) regarding sociodemographic data (18).

Regarding occupation of the mothers, we found that no significant difference between the three groups regarding mother's occupation (Table 1).

In contrary to El Shafie et al., who stated that prevalence of working mothers significantly higher among infants weaned after 4 months of age (programmed and non-programmed feeding) (18).

Our study showed that from the age of five months to the age of seven months there was a significant difference between the three groups in the development scores according to Baroda Development Screening Test For Infants (p-value <0.001). Group I recorded the highest development scores among the three groups and that were of significant difference from the group II (p-value <0.001) and from group III (p-value <0.001). And also group II recorded higher scores than group III which were of significant difference (p-value <0.05). Table 3.

Also. from the age of eight months to the age of 18 months there was highly significant difference among the three groups (p-value<0.001). The post hock analysis revealed that group I recorded the highest scores among the three groups with significant difference from the group II (p-value<0.001) and the group III (p-value<0.001). And also group II recorded higher scores than group III which were of significant difference (p-value <0. 05). Table 4.

In our study by calculation of the Developmental Quotient according to Baroda Development Screening Test for Infants, The results showed that Developmental Quotients were significantly different among the three groups.

At the age of 5 months, group I recorded the highest percentage of the developmental quotient (DQ) which was significantly different from group II (P-value<.001) and group III (p-value<.001). Group II recorded higher percentage of the developmental quotient (DQ) than group III but without significant difference (p-value=.935). At both ages 6 months and 7 months, group I recorded the highest percentage of the developmental quotient (DQ) which was significantly different from group II (P-value<.001) and group III (p-value<.001). Group II recorded higher percentage of the developmental quotient (DQ) than group III and was of significant difference (p-value=.0016).

And From the age of the 8 months to the age of 18 months, the developmental quotients were significantly different among the three groups. we found that, from the age of the 8 months to the age of 18 months, group I recorded the highest percentage of the developmental quotient (DQ) which was significantly different from group II (P-value<0.001) and group III (p-value<0.001). Group II recorded higher percentage of the developmental quotient (DQ) than group III and was of significant difference (p-value<0.05). By search, there were no studies about effect of early weaning after the age of four months on infant development. This was considered as an obstacle in our study. Our results could be explained by the presence of diet rich in iron with adequate amount in the recommended weaning program such as boiled mixed vegetables (vegetable soup) "carrots + peas + pepper" at age of five months. Carrots contain 30 milligrams of iron per 100 grams, egg yolk at age of six months, each egg contain 1 milligram of iron, Lentils at age of 7 months, contain 3.3 milligrams of iron per 100 grams, very good sources of heme iron, chicken liver, each serving (75 g) contains 9.2 milligram of iron, meat each serving of beef (75 g) contains 2.4 milligram of iron, chicken each serving (75 g) contains 0.9 milligram of iron (19).

This explanation run parallel with Kramer and Kakuma, who said that Iron deficiency during infancy increases the risk of cognitive, motor, and behavioral deficits that may last into the teens, even with iron treatment. Specific deficits that have been identified include impaired motor development at 18 months (20).

This was in agreement with El Shafie et al., who reported that infants weaned after 4 months of age with recommended weaning program was significantly higher in Hb. concentration than infants weaned without weaning program at 12 month of age (18).

Also these results agree with Meinzen et al., who reported that exclusive breast feeding up to 6 months of age was associated with increased risk of anemia (21).

El Shafie et al., and Shebl et al., found that there was significant increase in hemoglobin level in infants weaned after 4 months than those weaned after 6 months. (5) (22).

A randomized trial, performed by Kramer and Kakuma, showed that infants with exclusive breastfeeding for 6 months, compared with 3-4 months, was associated with lower mean hemoglobin (23).

Also this result is in agreement with the study done by Ali and Zuberi, who reported that late weaning is one of the most significant risk factor for developing iron deficiency anemia. It's 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 group is a lack adequate iron intake, especially between the ages of six to 12 months (24).

On the other hand these results are not in agreement with the study done by Kattelman et al., who reported that the iron and Zinc status of infants was not influenced by timing or type of complementary foods introduced (25).

Breast milk may have evolved to have low iron as a mechanism for protecting infants from infection, the introduction of iron supplements and iron-fortified foods, particularly during the first six months, reduces the efficiency of baby's iron absorption. The specialized proteins in breast milk ensure that baby gets the available iron (26).

Canadian pediatric society, 2012 and American Academy of Pediatrics, 2012 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 (27) (12). Thus at this age, dietary sources of iron become critical to keep up with this rapid rate of red blood cell synthesis (23). So this iron needs to come from complementary foods, in addition to breast milkif the mother tries to meet her infant's iron requirement on breast milk alone, the baby would have to consume between 4 and 13liters of breast milk per day, depending on baby's efficiency of iron absorption from breast milk (estimates range from 15-50%absorption). Most exclusively breastfed babies don't consume much more than 1 liter of milk per day (28).

Exclusive breast feeding provides iron requirements in the first six months in full-term babies, with good birth weight, and of mothers without iron deficiency and their body stores of this nutrient (29). However, after six months, liver iron stores become depleted and iron requirements have to be supplied by complementary foods (30) and AAP recommends hemoglobin screening for all infants between the ages of nine and 12 months and then six months later; for children at high risk, screen once a year from ages two to five years. Also recommend continuing breast feeding for at least the first year of life and beyond, while introducing complementary foods rich in iron beginning around six months of age (31).

Conclusion:

Developmental milestones of the studied infants who started weaning early after the age of four months, according to recommended nutritional program from Pediatric Department, Faculty of Medicine, Menoufia University or according to family knowledge were better than that of infants who started weaning late after the age of six months.

No Funds

No Conflict Interest

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6/25/2019