Association of the Type, Amount and Frequency of Milk Feeding with Anthropometric Growth Indicators in Infants

Rida Khan[1], Fatima Farooq[2], Afifa Tanweer[1], Amina Chughtai[3]*

[1]Department of Nutrition Sciences, School of Health Sciences, University of Management and Technology, Lahore, Pakistan.
[2]University Institute of Diet and Nutritional Sciences, The University of Lahore, Lahore, Pakistan.
[3]Department of Food Science and Human Nutrition, University of Veterinary and Animal Sciences, Lahore, Pakistan.

Abstract. Infant feeding practices during early days of life are considered crucial as they may have an impact on growth and development later in life. A cross-sectional study was conducted on 150 infants aged 0-4 months, in Lahore, Pakistan to find out the association between milk feeding practices and anthropometric growth indices. Data was collected through interviewer administered questionnaire for 24-hour dietary recall and WHO growth charts for anthropometric assessment. The average breastfeeding time for normal weight for length infants was significantly (p=0.014) higher (9.850±3.907) than wasted infants. Infants with normal length for age were breastfeed for significantly (p=0.009) longer time (9.768±3.993) as compared to stunted infants (8.000±3.045). Normal weight for age infants had significantly (p=0.015) shorter breastfeeding interval (83.767±37.228) as compared to underweight infants (103.750±25.527). Infant milk feeding practices was found to be linked to the nutritional status. Breastfed infants had better growth outcomes as compared to non-breastfed. Promotion of breastfeeding practices may warrant good nutritional status in infants and thus can be regarded as one of the strategies for tackling the short term and long-term burden of malnutrition.

Key words: Breastfeeding, Stunting, Wasting, underweight, Growth Indicators, Z-Score.

Introduction

The growth patterns of healthy infants during the first few months of life and the standards for their assessment have been important subjects of research among dieticians and pediatric health professionals, (1). Milk feeding practices including early initiation, type of milk fed, amount, frequency and duration of each feed along with hygiene conditions can influence an infant's health. World Health Organization (WHO) guidelines recommend the promotion of breastfeeding because of its nutritional composition, and physical, social, emotional and economic benefits.

Globally 44% of infants initiate breastfeeding within the first hour after birth and 40% of all infants under 6 months of age are exclusively breastfed, (2).

The percentage of infants under 6 months of age being exclusively breastfed in South Asian countries is 43.1% in Afghanistan, 55.3% in Bangladesh, 54.9% in India, 65.2% in Nepal, 82% in Sri Lanka (3). Contrary to the recommendation that children under age of 6 months be exclusively breastfed, only 48% of the infants in Pakistan under age of 6 months fall in this category, (4).

The initial 6 months are considered as the first window of opportunity and critical period for the growth of an infant. The period is designated golden if an infant receives nourishment required for optimum growth and development where as those infants who get inappropriate feed go through a critical period. Higher rates of growth increments for breast fed infants are seen in the early stages of extra-uterine life than in formula fed infants. A visible improvement in

the growth indices was seen in low birth weight pre-term infants with breast feeding, (5). Infant feeding practices determine the overall health and strongly influence the growth and development. Inappropriate feeding practices leading to acute malnutrition, include lack of exclusive breast feeding in first 6 months of age and subsequent bottle feeding, (6). This research study was intended to determine the rates of breast feeding as well as to compare the growth pattern of breastfed and formula fed infants.

Material and methods

A cross sectional study on breastfeeding practices was undertaken in Punjab province, Pakistan. Data was collected from mother-child pairs attending regular vaccination visits in primary health care centers of two private sector hospitals centrally located in Lahore, the provincial capital of Punjab, Pakistan. The hospitals were selected based on convenience sampling. A sample of 150 mother-child pair was considered to be enough to support inferential statistics used in the analysis at 95% confidence interval. Primary data was collected by a trained researcher visiting the vaccination centers of both hospitals. Mothers who were accompanied with infants less than and equal to 4 months of age in general healthy state and those who gave a verbal consent to participate were selected. Principles mentioned in the Declaration of Helsinki were followed. The study did not include any invasive data so IRB approval was not required. Also it was conducted independent of any institute so ethical approval was not sought. However, the rights of anonymity, confidentiality and consent of study participants were fulfilled.

Primary data was collected by direct interview with mothers using interviewer administered questionnaires. Mothers were interviewed for the retrospective information regarding birth order of the infant, gestational age (weeks), delivery method (spontaneous vaginal delivery SVD or lower segment caesarean section LSCS), birth weight (Kilograms), breast-feeding practices, colostrum feeding, past medical and surgical history of infants, allopathic, alternative and complementary medicines given to infants since birth till

date. Dietary assessment of infants was performed using 24-hour dietary recall. This information and the interview with mother were utilized to determine type of milk feeding (exclusive breastfeeding [BF], almost exclusive BF, partial BF or formula feeding), amount, frequency and timings of feeding. Vaccination cards issued by National Expanded Programme on Immunization, Pakistan were sought to check compliance with vaccinations (OPV 1-2-3, Hepatitis B, BCG, Rota 1-2, PCV 10 1-2-3, Penta 1-2-3, IPV). Secondary data including name, gender and date of birth of infants was collected from vaccination cards. Anthropometric measurements of the infants including weight (recorded accurate to 0.1 kilograms), supine length (accurate to 0.1 cm), head and chest circumference (centimeter) were recorded using digital infant weighing scale, length board and measuring tapes respectively.

Crude anthropometric data was processed by plotting it on the WHO Z- score growth charts appropriate for age and gender of infants, (7). Statistical analysis was performed by using IBM SPSS Statistics 21, Version 21.0. Data of continuous and categorical variables was described as Mean ± Standard Deviation (SD) and frequency and percentages respectively. Inferential statistics including Chi-square test, Odd's ratio and T test were used. Statistical testing was performed at 95% confidence interval with $p < 0.05$ taken as significant.

Results

Socio Demographic and Anthropometric Characteristics of Study Population

A total of 150 mother-infant pairs were included in the study. Gender distribution of the sample revealed that the sample was almost equally divided among male and female infants with 82 (54.7%) males and 68 (45.3%) females. Mean (±SD) gestational age of all the infants was 37.82±2.17 weeks and ranged between 28-41 weeks. Mean birth weight (±SD) of the infants was 2.92±0.47 Kg. More than half 77(51.3%) of the infants were delivered through LSCS and the other 73(48.7%) were delivered through SVD. Majority of

the under-study infants 58(38.7%) were 1st in the birth order, whereas least no. of infants was 6th, 3 (2%), in birth order in the family.

Mean (±SD) current weight (Kg), supine length (cm), Head and chest circumference (cm) of the infants was 4.80±1.45, 54.80±6.06, 37.23±2.86, 38.34±3.85, respectively. (Table 1)

Dietary Intake Analysis of Study Sample

Out of 150 total infants 68(45.3%) had been given colostrum (first secretion of breast milk). Out of 150 infants 131(87.3%) were given breastfeed whereas 19(12.7%) were not given breastfeed at all. Regarding exclusivity of breastfeeding, 47.3% mothers reported exclusive breastfeeding for 1st six months, 36.7% partial breastfeed, 3.3% almost exclusive breast feeding while 12.7% reported the use of formula milk since birth. Out of total 150 infants 76(50.7%) were not given formula milk and 74(49.3%) were given formula

milk. The mean (±SD) breastfeed frequency of 131 infants who were breastfed was 8.31±2.40 times per day. Mean (±SD) breastfeed duration was for 9.39±3.92 minutes at one time. Mean time interval between two breastfeeds was 87.33±35.40 minutes. The mean (±SD) formula milk frequency per day was 3.88±2.16 times. The mean (±SD) amount of formula milk given at one time was 2.22±0.94 ounce. (Table 2)

Z-score Values and Infant Growth Indicators

To categorize the infants according to the growth indicators suggested by WHO, (8), indices for underweight, stunting and wasting (weight for age, length for age and weight for length) were plotted on Z-score growth charts for appropriate age (charts for < 2years) and gender. The interpretation of growth indices was done according to WHO guidelines, (7).

According to the length for age category, majority of the population 107(71.3%) were of normal length

Table 1. Demographic and anthropometric characteristics of Infants under study, Lahore, Pakistan.

Variables	Category	Frequency (Percentage)	Mean ± SD (Range)
Gender N=150	Male Female	82 (54.7%) 68 (45.3%)	
Gestational Age (Weeks)			37.82±2.17 (28-41)
Birth Weight (Kg)			2.92±0.47 (1.5-4.7)
Current Weight (Kg)			4.80±1.45 (2.00-9.75)
Supine Length (cm)			54.80±6.06 (42.00-78.00)
Head Circumference (cm)			37.23±2.86 (30.50-44.50)
Chest Circumference (cm)			38.34±3.85 (30.00-47.00)
Birth Order	1st 2nd 3rd 4th 5th 6th	58 (38.75%) 41 (27.3%) 26 (17.3%) 14 (9.3%) 8 (5.3%) 3 (2.0%)	
Delivery Type	SVD LSCS	73 (48.7%) 77 (51.3%)	

Table 2. Colostrum feeding, Breast feeding practices and Infants formula milk preferences among the subjects under study, Lahore, Pakistan.

Variables	Category	Frequency (Percentage)	Mean ± SD (Range)
Colostrum fed	No Yes	82 (54.7%) 68 (45.3%)	-
Diet of infant	Formula Partial Breastfeed Almost Exclusively Breastfeed Exclusively Breastfeed	19 (12.7%) 55 (36.7%) 5 (3.3%) 71 (47.3%)	-
Breastfeed being given	No Yes	19 (12.7%) 131 (87.3%)	-
Breastfeed Frequency (Per Day) N=131		-	8.31±2.40 (2.00-20.00)
Breastfeed Amount (Minutes of Feeding) N=131		-	9.39±3.92 (2.00-30.00)
Time Interval between Breastfeeds (Minutes) N=131		-	87.33±35.40 (15.00-180.00)
Formula Milk fed	No Yes	76 (50.7%) 74 (49.3%)	-
Formula Milk Frequency (Per Day) N=74		-	3.88±2.16 (1.00-8.00)
Amount of Formula Milk at single serving (Ounce) N=74		-	2.22±0.94 (1.00-5.00)

for age, 20(13.3%) infants were severely stunted, and 20(13.3%) were stunted. In weight for age category, 83(55.3%) were of normal weight, 47(31.3%) were overweight, and 16(10.7%) were under weight. According to weight for length categories, 71(47.3%) infants scored normal, 7(4.7%) were wasted, 13(8.7%) were severely wasted, 30(20%) at the risk of becoming over weight, 18(12%) were overweight, and 11(7.3%) were obese. (Table 3)

Association between the Type of Diet and Growth Indicator of Infants

Type of diet was found to be an important predictor of the nutritional status of the infants who were not exclusively breastfed for the first 6 months of life according to the guidelines presented by WHO, (9) and UNICEF, (10). Infants who were exclusively breastfed, almost exclusively breastfed and partial breastfed were found to be 1.09 times more likely to score normal weight for length as compared to the infants who were exclusively formula fed. Comparing on the length for age indicator of infant growth, it was established that odds of being normal length for age are 1.397 times higher in exclusively breastfed, almost exclusively breastfed and partial breastfed infants in comparison to formula fed infants. The odds of an infant exclusively formula fed to have a Z-score value below -1 for weight for age are almost two times compared to those who were given breast feed (OR= 1.825). Although the odds ratio suggests the magnitude of association between the type of diet and the growth indicator of infant under study, yet this particular association was not found to be statistically significant. (Table 4)

Table 3. Z score values of the infant's anthropometric measurement and the growth indicators according to the WHO standards, Lahore, Pakistan.

Variables	Z score Category	Frequency (Percentage)
Length for age	Below -3	20 (13.3%)
	Below -2	20 (13.3%)
	Below -1	75 (50.0%)
	Above 1	30 (20.0%)
	Above 2	2 (1.3%)
	Above 3	3 (2.0%)
Length for age category	Severely Stunted	20 (13.3%)
	Stunted	20 (13.3%)
	Normal	107 (71.3%)
	Very Tall	3 (2.0%)
Weight for age	Below -3	4 (2.7%)
	Below -2	16 (10.7%)
	Below -1	83 (55.3%)
	Above 1	43 (28.7%)
	Above 2	2 (1.3%)
	Above 3	2 (1.3%)
Weight for age Category	Severely Underweight	4 (2.7%)
	Underweight	16 (10.7%)
	Normal	83 (55.3%)
	Overweight	47 (31.3%)
Weight for length	Below -3	13 (8.7%)
	Below -2	7 (4.7%)
	Below -1	15 (10.0%)
	Median	56 (37.3%)
	Above 1	30 (20.0%)
	Above 2	18 (12.0%)
	Above 3	11 (7.3%)
Weight for length Category	Severely Wasted	13 (8.7%)
	Wasted	7 (4.7%)
	Normal	71 (47.3%)
	Risk of Overweight	30 (20.0%)
	Overweight	18 (12.0%)
	Obese	11 (7.3%)

Association of Type of Milk Fed and Under Nutrition in Infants

Figure 1 shows that the frequency of severely malnourished infants was higher in formula fed group compared to the infants who were consuming formula milk along with breast-milk. The number of wasted, stunted and underweight infants was lower (14.8%, 19.1%, 28.6%) in exclusively breastfed infants as compared to formula fed infants. The rate of under-nutrition (underweight, stunted, wasted) was highest in exclusively formula fed infants and was least in breastfed infants (Figure 1).

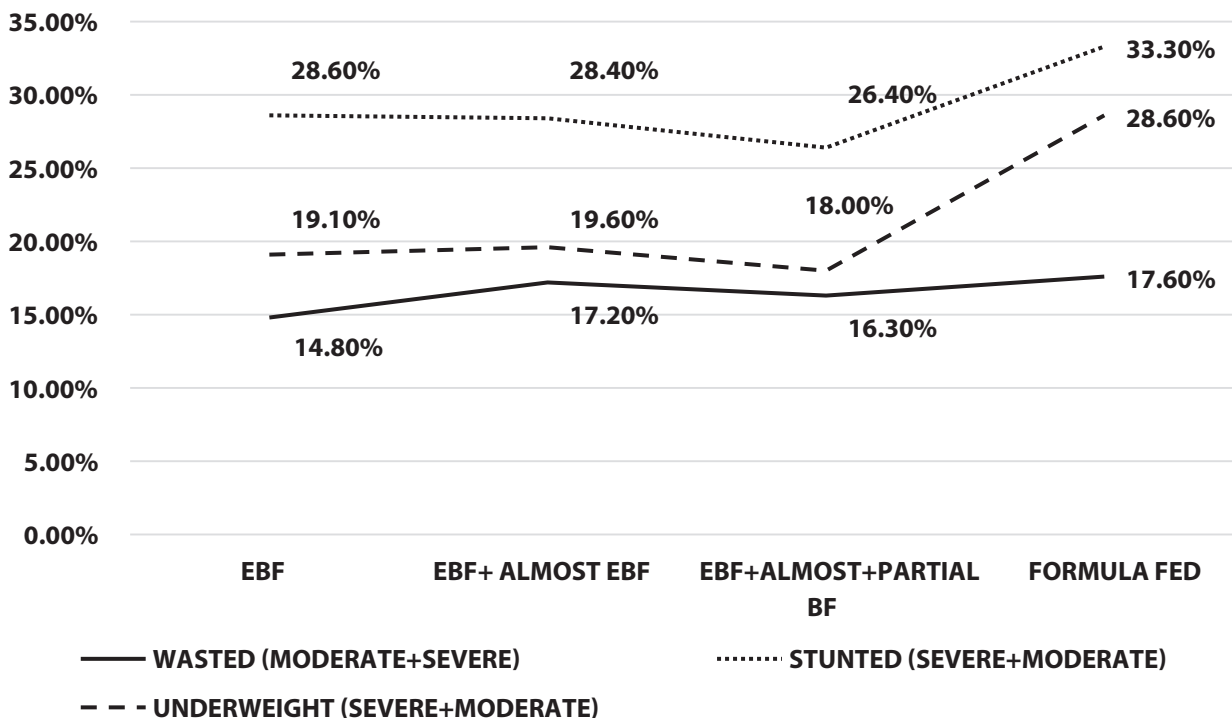*Association of Frequency, Amount and Interval between Breastfeeding with Infant Growth*

The average breastfeeding time for children who had normal weight for length was significantly (p=0.014) higher (mean=9.850 ± 3.970) than those who were wasted and severely wasted (mean=7.411 ± 3.410). Infants who had normal length for age were breastfed for significantly (p=0.009) longer time (mean=9.768 ± 3.993) as compared to stunted and severely stunted infants (mean=8.000 ± 3.045). Average breastfeeding time was found to be significantly different in weight for length and length for age but not in weight for age categories. Mothers of normal weight for age infants reported statistically significant (p=0.015) shorter interval between breastfeeding (mean= 83.767 ± 37.228) as compared to underweight and severely underweight infants (mean= 103.750 ± 25.527). Average time interval between two breast-feed for infants normal for weight for length (mean= 85.114 ± 32.466) and length for age (mean= 86.894 ± 34.902) was found to shorter as compared to wasted, severely wasted (mean= 90.000 ± 37.749) and stunted, severely stunted infants (mean= 90.147 ± 37.587) but this association was not significant. (Table 5)

Discussion

The current study was carried out to determine milk feeding patterns of infants (0-4 months) in Lahore, Pakistan and its association with their nutritional status (based on anthropometric indices). Early initiation of breast feeding is considered one of the basic guidelines of effective infant feeding. In our study, it was found that about 45% of mothers fed colostrum to their infants (Table 2), indicating that breastfeeding was initiated early in those infants. These findings are in line with another research from Pakistan in which 72.1% mothers reported feeding colostrum within two hours after delivery while 27.9% reported to have discarded it, (11). Colostrum is considered a complete

Table 4. Association between the type of diet (formula feed vs. exclusively breastfeed, almost exclusively breastfeed and partial breast-feed) and the growth indicator of infants, Lahore, Pakistan.

Variables		Type of Diet		Chi- Square	P value	Odds Ratio	Confidence Interval	
		Formula Feed	EBF, Almost EBF, Partial Breast feed				Lower	Upper
		F (%)	F (%)					
Weight for length category	Wasted, Severely Wasted	3 (17.6%)	14 (82.4%)	.018	.894	1.097	.284	4.234
	Normal, Risk of Overweight	17 (16.3%)	87 (83.7%)					
Length for age category	Stunted, Severely stunted	6 (33.3%)	34 (26.4%)	.388	.533	1.397	.486	4.014
	Normal	12 (66.7%)	95 (73.6%)					
Weight for age category	Underweight, Severely underweight	4 (28.6%)	16 (18.0%)	.868	.352	1.825	.508	6.561
	Normal	10 (71.4%)	73 (82.0%)					

Figure 1. Trend of under nutrition status among infants having different dietary intakes, Lahore, Pakistan August 8, 2018 to September 4, 2018.

Table 5. Association of breastfeeding frequency, amount (duration of each feed) and between feed interval with infant growth indicators, Lahore, Pakistan.

Variables	Mean ± SD		T test	P value
	Weight for length category			
	Wasted, severely wasted	**normal, risk of over weight**	**T test**	**P value**
Frequency	8.117 ± 2.288	8.206 ± 2.108	-.149	.883
Feeding time (minutes)	7.411 ± 3.410	9.850 ± 3.907	-2.630	.014
Between feed interval (minutes)	90.000 ± 37.749	85.114 ± 32.466	.499	.623
	Weight for age category			
	underweight, Severely underweight	**Normal**	**T test**	**P value**
Frequency	7.375 ± 1.586	8.328 ± 2.738	-1.870	.069
Feeding time (minutes)	8.250 ± 3.235	8.684 ± 3.511	-.479	.636
Between feed interval (minutes)	103.750 ± 25.527	83.767 ± 37.228	2.586	.015
	Length for age category			
	stunted, severely stunted	**Normal**	**T test**	**P value**
Frequency	8.117 ± 3.101	8.336 ± 2.131	-.381	.705
Feeding time (minutes)	8.000 ± 3.045	9.768 ± 3.993	-2.664	.009
Between feed interval (minutes)	90.147 ± 37.587	86.894 ± 34.902	.441	.661

form of nutrition and of normative importance for the infants. Despite all the emphasis on the effective breastfeeding practices, early initiation of breastfeeding is still an under recognized area. In the Pakistani community, the reason behind this could be the lack of guidance provided to new mothers by the nursing staff and the other personnel in hospital. According to the American Academy of Pediatrics, exclusive breastfeeding for the 1st six months of an infant's life is of critical importance, (12). The weaning time for the infants who are not breast feeding is relatively earlier than that of EBF, complementary feeding is initiated by the end of 4th month to compensate the increased caloric and nutrient requirement of the growing infants, (13). Contrary to that, only 47.8% of the infants of age 4 months or less in this research were EBF, which is close to the percentage of EBF rate in Pakistan (48%), (4).

Universal prevalence of stunting is 23%, underweight is 16% and wasting is 7% in under five children and Pakistan has higher burden or all these types of

malnutrition, (14). Our research suggests similar statistics for the rate of stunted (20%), underweight (16%) and wasted (7%) infants. Higher prevalence of under nutrition (stunting (48.2%), wasting (16.2%) and underweight (39.5%)) has been found in another local study conducted in Sindh province, Pakistan, (15). The prevalence of wasting among children under 5 years of age in the developing countries of South Asia like Pakistan (7.1%), Bangladesh (8.4%), Afghanistan (5.1%) and Sri Lanka (15.1%), (16), is suggestive of the fact that there is a strong need of equitable distribution of health resources. Keeping in view the results, it is evident that Pakistan is facing the burden of all types of under nutrition at the same level as the other developing countries if not less than that. A consistent and strong relationship between malnutrition among children and increased risk of deaths from diarrhea, acute respiratory distress, malaria and measles has been observed, (17). This puts Pakistan under the double burden of malnutrition and the diseases being caused by it. Results of our study suggest that breastfed infants

were more likely to score normal on weight for length, weight for age and length for age Z scores as compared to the children who were on exclusive formula feed (Table 4). A more superior approach, meta-analysis of randomized control trials, suggests the same results, infants who were formula fed had less developmental scores as compared to human milk diet, (18). Those who were having breast milk in their diet were two times more likely (OR= 1.825) to have a normal weight for their age. Human milk and formula milk are considerably different in fatty acid composition, concentration of cholesterol, monosaccharides and sugar alcohols. Therefore, it is not wise to substitute human milk with formula milk especially during the early months of life. Apart from physical and mental developmental deficit there are many reported side effects of infant formula milk including delayed gastric emptying, (19).

The research showed that growth was more rapid and accomplished sooner in infants who were breastfed for a greater duration with fewer intervals in between the feeds. Infants who consumed breast and other milks throughout their first 4 months had different weight gain patterns than infants who also consumed solid foods, (20). The average breastfeeding time for children who had normal weight for length was significantly higher than those who were wasted and severely wasted. Mothers of normal weight for age infants reported statistically significant shorter breastfeeding interval as compared to underweight and severely underweight infant (Table 5). Previous study findings show that infants who are not growing well are more likely to be weaned. It was also shown that these infants were more likely to change from being exclusively or predominantly breastfed to being partially breast-fed, (21). The potential of pro-breastfeeding policies to improve infant's nutritional status is remarkable, Infant feeding practices are influenced by many traditional and cultural factors, apart from knowledge and the difficulties of breastfeeding which mothers experience. This calls for a multipronged approach for increasing breastfeeding rates so that infants may reach their full developmental potential.

Conclusion

Though advocated extensively, breastfeeding rates are still one of the concerns in infant feeding practices. Breastfed infants were found to be more likely to score higher on anthropometric growth indices. Promotion of breastfeeding has a potential to impact short term as well as long term growth of infants, improving the overall health and decreasing the burden of disease and under nutrition.

References

1. Saputra DK, Carolina C, Rusli R. Duration of breastfeeding has a positive effect on infant weight gain. Universa Medicina 2016; 29(1): 21-6.
2. Organization WH. Implementation guidance: protecting, promoting and supporting breastfeeding in facilities providing maternity and newborn services: the revised baby-friendly hospital initiative. 2018.
3. UNICEF. Infant and young child feeding October 2019 [Available from: https://data.unicef.org/topic/nutrition/infant-and-young-child-feeding/.
4. Pakistan National Nutrition Survey. Aga Khan University, Ministry of National Health Services, Regulations & Coordination (Pakistan), Pakistan Medical Research Council, UK Aid Direct, United Nations Children's Fund (UNICEF); 2018.
5. Kim EJ, Lee NM, Chung S-H. A retrospective study on the effects of exclusive donor human milk feeding in a short period after birth on morbidity and growth of preterm infants during hospitalization. Medicine 2017; 96(35).
6. Prell C, Koletzko B. Breastfeeding and complementary feeding: recommendations on infant nutrition. Deutsches Ärzteblatt International 2016; 113(25): 435.
7. Organization WH. WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development: World Health Organization; 2006.
8. Organization WH. Training course on child growth assessment. Geneva: WHO 2008: p17-25.

9. Organization WH. Infant and young child feeding: model chapter for textbooks for medical students and allied health professionals: World Health Organization; 2009.

10. Unicef. Improving child nutrition. The achievable imperative for global progress. 2013. New York: UNICEF; 2016. 2018.

11. Sohail J, Khaliq A. Knowledge, attitude and practice of mothers regarding colostrum feeding to newborns in rural Pakistan: a cross-sectional study. Khyber Medical University Journal 2017; 9(4).

12. Garber MD, Schroeder AR, Flaherman V. Re: Balancing Breastfeeding Promotion. Pediatrics 2017; 140(5).

13. Organization WH. Complementary Feeding. Report of the Global Consultation, and Summary of Guiding Principles for Complementary Feeding of the Breastfed Child. WHO, Geneva, 2003. 2016.

14. Asim M, Nawaz Y. Child malnutrition in Pakistan: evidence from literature. Children 2018; 5(5): 60.

15. Khan GN, Turab A, Khan MI, et al. Prevalence and associated factors of malnutrition among children under-five years in Sindh, Pakistan: a cross-sectional study. BMC nutrition 2016; 2(1): 69.

16. Organization WH. Department of Nutrition for Health and Development. The WHO Global Database on Child Growth and Malnutrition. Geneva. 2017.

17. Walson JL, Berkley JA. The impact of malnutrition on childhood infections. Curr Opin Infect Dis 2018; 31(3): 231.

18. Wallingford JC, Barber C. A Review of Studies on the Growth of Infants Fed Infant Formula. Current Developments in Nutrition 2019; 3(9): nzz095.

19. Salvatore S, Savino F, Singendonk M, et al. Thickened infant formula: what to know. Nutrition 2018; 49: 51-6.

20. Azad MB, Vehling L, Chan D, et al. Infant feeding and weight gain: separating breast milk from breastfeeding and formula from food. Pediatrics 2018; 142(4).

21. Vail B, Prentice P, Dunger DB, Hughes IA, Acerini CL, Ong KK. Age at weaning and infant growth: primary analysis and systematic review. The Journal of pediatrics 2015; 167(2): 317-24. e1.

———
Correspondence
Afifa Tanweer
Department of Nutrition Sciences, School of Health Sciences, University of Management and Technology, Lahore, Pakistan
Postal address: Block C 2, Phase 1 Johar Town, Lahore, Punjab, 54770.
Telephone number: +92 323 4518605
E-mail Address: afifa.tanweer@umt.edu.pk