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## Research Article

# Infant and Young Child Complementary Feeding in Saudi Arabia: Timely Introduction, Frequency and Diversity

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## Abstract

**Background and Objective:** Appropriate feeding practice reduces the risk of undernutrition, sickness and mortality rates among infants and young children less than 24 months of age. The objective of this study was to assess the timely introduction, frequency and diversity of complementary feedings given to infants 0-24 months of age in Saudi Arabia. To achieve this objective, there is a need to compute and assess the introduction of complementary feedings, minimum dietary diversity (MDD), minimum meal frequency (MMF) and the minimum acceptable diet (MAD) indicators. **Materials and Methods:** A descriptive cross-sectional study of 1,700 infant mothers' ages 19-49 years with infants 0-24 months of age was conducted in Saudi Arabia. Multistage random sampling was used, five regions were selected (Northern, Southern, Middle, Eastern and Western) and from each region 33 primary health care centers were selected from both urban (80%) and rural (20%) sites. From each center, 9-16 respondents were randomly selected. Structured interviewer administered questionnaire was used. **Results:** The results revealed that in Saudi Arabia, the mean number of the food group consumed is amounted to 3.85 times, which is below the threshold for MDD. The top four food groups consumed were dairy products (95%), grains (83%), flesh foods (65%) and vitamin-A-rich fruits and vegetables (53%). The least consumed food groups were other fruits and vegetables, eggs and legumes and nuts. The majority (83%) of infants were introduced to complementary feeding under six months of age, while, merely 13% of infants were optimally introduced to complementary feedings. One in three Saudi infants ages 6-23 months did not consume from four food groups or more and is at risk of undernutrition, including micronutrient deficiencies. Nearly 42% of children ages 6-23 months were not being fed the minimum number of meals per day during this critical period of growth and development. The prevalence of the MAD was merely 35%, indicating that 65% of the Saudi's infants and children were deprived from being fed frequently throughout the day and their meals weren't nutrient-dense or coming from diversified food groups. Early introduction, less frequent and diversified infants' complementary feedings were the major determinants of optimal complementary feeding practices in KSA. **Conclusion:** The present study estimates the infant and child complementary feeding indicators, according to World Health Organization (WHO) standardized methodology and a gap existing between the prevailing and recommended levels, thus the formulation and implementation of infant and young child feeding strategy is highly recommended, so as to enhance the appropriateness of complementary feedings practices in Saudi Arabia.

**Key words:** Complementary feeding, minimum dietary diversity, minimum meal frequency, Saudi Arabia, the minimum acceptable diets

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**Data Availability:** All relevant data are within the paper and its supporting information files.

## **INTRODUCTION**

Infant and young child feeding practices directly influence the nutritional status of children under 24 months of age and, eventually, impact child survival. Improving infant and young child feeding practices in children 0-23 months of age is therefore critical to improve nutrition, health and development of children<sup>1</sup>.

Breast-milk represents an important source of energy and nutrients in children (6-23 months of age). It can provide half or more of a child's energy needs between the age of six months and up to the end of the first year and one-third of energy needs between the first and second year of the child's life. Moreover, breast-milk is also a critical source of energy and nutrients during childhood illness and decreases mortality among malnourished children<sup>2</sup>.

Few children receive nutritionally adequate and safe complementary foods; in many countries, less than one-fourth of infants (6-23 months of age) meet the criteria of dietary diversity and feeding frequency that are appropriate for their age<sup>2</sup>.

As per the recommendation of World Health Organization/Pan American Health Organization (WHO/PAHO) (2003), breastfed children (6-23 months of age) should receive animal-source foods and vitamin-A-rich fruits and vegetable daily<sup>1,3-4</sup>. Therefore, for breastfed infants, four food groups (grain- or tuber-based staple, animal-source food, vitamin-A-rich fruit or vegetable) were recommended and to be the minimum acceptable number of food groups. On the other hand, non-breastfed children should be fed meals 4-5 times/day, with one to two snacks, as anticipated. Meal frequency is considered a proxy for energy intake from foods other than breast milk. Thus, for non-breastfed children, feeding frequency indicators include both milk feeds and solid or semi-solid feeds<sup>1,4</sup>.

Inadequate quantities and quality of complementary foods, inappropriate child feeding practices and high incidence of infections have an unfavorable effect on health and growth in children in the first two years of age. Even with optimum breastfeeding, children will become stunted if they do not obtain both sufficient dietary diversity and meal frequency after the first six months of age<sup>1,5-6</sup>. The timely introduction; quality; quantity and appropriateness of complementary food are essential to ensure children adequate growth and mental development<sup>6</sup>.

Many studies have shown that dietary diversity score (DDS) is positively linked to overall dietary quality and micronutrient intake of young children and can be used as a proxy indicator for household food security and in the long run, for childhood stunting<sup>7,8</sup>.

Optimal breastfeeding recommends that when the child is about six months, breastmilk should be supplemented with appropriate solid, semi-solid and soft foods, which are sufficiently calorie-dense and containing enough key nutrients for the child's needs. Early supplementation of the complementary feeding ceases exclusive breastfeeding and puts the infant at heightened risk of diarrhea, infection, malnutrition and death; while late supplementation puts the baby at risk of malnutrition, growth faltering and some essential nutrients deficiencies<sup>9</sup>.

The WHO and UNICEF Global Strategy for Infant and Young Child Feeding recommended on what, when and how children should be fed during the period 6-24 months of age. It recommends that at the age of six months, solid, semi-solid and soft will be introduced. Breastfed children age 6-8 months need to eat at least 2 meals per day while those ages 9-23 months must eat a minimum of three meals per day. On the other hand, non-breastfed children ages 6-23 months should consume a minimum of four meals a day. Moreover, children must be provided with a diverse diet from at least four food groups out of the specified seven food groups<sup>10</sup>. The objective of this study was to assess the timely introduction, frequency and diversity of complementary feeding among infants in Saudi Arabia.

## **MATERIALS AND METHODS**

Multistage random sampling was used, from Saudi Arabia, five regions were selected (Northern, Southern, Middle, Eastern and Western) and from each region 33 primary health care centers were selected from both urban (80%) and rural (20%) sites. From each center, 9-16 respondents were randomly selected. A structured interviewer-administered questionnaire was used. Collected data include socio-demographic characteristics of household heads, mothers and their children; infant and young child feeding practices.

To assess the timely introduction of complementary feeding, MDD, MMF and MAD among infant and young children ages 0-24 months in Saudi Arabia, WHO definitions and standardized calculation methods were used to compute the prevalence of these four Infants and Young Child Feeding (IYCF) indicators.

### **Introduction of the complementary feeding**

**Complementary Feeding (CF):** CF (Introduction of solid, semi-solid and soft foods) is defined as the proportion of infants (6-8 months of age) who received complementary feeding. Complementary feeding calculated using the following equation<sup>4</sup>:

$$CF = \frac{\text{Infant 6-8 months of age who received any complementary food during the previous day}}{\text{Infant of age 6-8 months}} \quad (1)$$

The respondents were queried about whether the infant received any food, other than the breastmilk, in the previous day or not. Responses to consumption of complementary feeding and infant age questions were used to screen the infants who received complementary feeding from those who didn't in the age domain of 6-8 months and then after, complementary feeding indicator was calculated.

**Minimum dietary diversity (MDD):** MDD is defined as a proportion of the children 6-23 months of age who received food from four or more food groups. It is computed using the following equation<sup>4</sup>:

$$MDD = \frac{\text{Children 6-23 month of age who received items from } \geq 4 \text{ food groups during the previous day}}{\text{Children 6-23 month of age}} \quad (2)$$

There are 17 sub-food groups which are recommended by the WHO. These sub-food groups were further aggregated into seven food groups.

Each respondent was requested to describe everything the child ate during the previous day or at night from the time the child woke up until going to sleep the next day. As the respondent mentioned the food, the data collector underlined the corresponding sub-food group to which the food item belongs. Then after, the main seven food groups were generated. These seven food groups include (1) Grains, roots and tubers, (2) Legumes and nuts, (3) Dairy products (milk, yogurt, cheese), (4) Flesh foods (meat, fish, poultry and liver/organ meats), (5) Eggs, (6) Vitamin-A-rich fruits and vegetables and (7) Other fruits and vegetables. The indicator was further disaggregated to the following age groups: (1) 6-11 months ( $\geq 183$  and  $< 365$  days), (2) 12-17 months ( $\geq 365$  and  $< 548$  days) and (3) 18-23 months ( $\geq 548$  and  $< 730$  days).

**Minimum meal frequency (MMF):** The proportion of breastfed and non-breastfed children (6-23 months of age) who received solid, semi-solid, or soft foods (also including milk feeds for non-breastfed children) the minimum number of times or more is computed using the following equation<sup>4</sup>:

$$MMF = \frac{\text{Breast children 6-23 months of age who received semi-solid or soft foods the minimum number of time or more during the previous day}}{\text{Breast children 6-23 months of age}} \quad (3)$$

and

$$MMF = \frac{\text{Non-breast children 6-23 months of age who received solid, semi-solid or soft food or milk feeds the minimum number of times or more during the previous day}}{\text{Breastfed children 6-23 months of age}} \quad (4)$$

Respondents were asked whether the child breastfed the previous day. The response to this question was used to screen breastfed from non-breastfed children. The age-question responses were used to screen the required age for each category. Moreover, reactions to the number of times the child consumed solid, semi-solid and soft was used to select the children who satisfy the indicator requirements ( $\geq 2$  and 3 times). The number of times liquid consumed such as infant formula, milk and yogurt, as well as the number of times children consumed solid, semi-solid and soft food were further used for estimating the value of the indicator. This indicator is intended as a proxy for energy intake from foods other than breast milk.

The minimum number of meals is two times for breastfed infants of age 6-8 months, three times for breastfed children of age 9-23 months and four times for non-breastfed children of age 6-23 months.

**Minimum acceptable diet (MAD):** MAD is defined as the proportion of children 6-23 months of age who receive a MAD excluding breast milk<sup>4</sup>.

$$MAD = \frac{\text{Breastfed children 6-23 months of age who had at least the minimum dietary diversity and the minimum meal frequency during the previous day}}{\text{Breastfed children 6-23 months of age}} \quad (5)$$

and

$$MAD = \frac{\text{Non-breastfed children 6-23 months of age who received at least 2 milk feedings and had at least the minimum dietary diversity not including milk feeds and the minimum meal frequency during the previous day}}{\text{Non breastfed 6-23 month of age}} \quad (6)$$

The age question was used to screen the data for the age domains required. The question about breastfeeding was used to select breastfed from the non-breastfed children. Questions about liquids and food consumed used to calculate the seven food groups for the breastfed children and six food groups for the non-breastfed, as the dairy product food group was

excluded from the non-breastfed children to avoid double-accounting of the food items. Moreover, there were questions about the frequency of feeding solid, semi-solid and soft food during the previous day.

To compute this indicator, three groups of the children were identified. The first group includes breastfed children in the age domain 6-23 months ( $\geq 183$  days and  $< 730$  days) who consumed four food groups out of the seven groups and twice or more frequency of the solid, semi-solid, or soft foods during the previous day.

The second group includes breastfed children ages 9-23 months ( $\geq 274$  days and  $< 730$  days) who consumed four groups or more from the seven groups with a frequency of consuming solid, semi-solid and soft food three times or more during the previous day.

The third group included non-breastfed children ages 6-23 months ( $\geq 183$  days and  $< 730$  days) and consumed at least two milk feedings and four groups out of the six food groups. The number of times they consumed infant formula, milk, yogurt and solid, semi-solid, or soft food must amount to four times or more.

The total number of the three groups were summed up and then divided by the children in the age domain 6-23 months ( $\geq 183$  days and  $< 730$  days).

## RESULTS

Table 1 shows the percentage of infants who consumed different types of liquids adapted from the WHO standard questionnaire for assessing IYCF practices. Out of those liquids, number of times consuming milk, yogurt was also presented.

Table 2 shows the different types of food consumed, which were first aggregated into approximately 17 sub-food groups. These 17 sub-food groups were further aggregated into seven food groups. The percent of consumption of these food groups in each of the five selected regions, as well as in Saudi Arabia, is also presented in Table 2.

The respondents were probed to report the number of the times the infant consumed liquids and complementary feeds during the past 24 h. The number of times infants consumed liquids (infant formula, milk, yogurt) and complementary feeds relative to different infants age groups were also presented in Table 2. It is worth mentioning that for the number of times greater than four times per day were aggregated into one group ( $\geq 4$ ).

All of these results were used for the computation of the introduction of complementary feeding; MDD; MMF and the MAD indicators (Table 3). The timing of the supplementation of breastmilk with complementary feeds as well as the disaggregation of the MDD, according to different age groups, are presented in Table 3.

Percent of food consumption from the seven food groups for both breast and non-breast infants in different age groups is presented in Table 4. The disaggregation of the infants into four age groups ( $< 6$  months, 6-8 months, 6-23 months and 9-23 months) were purposely prepared to fit within requirements of the complementary feeding indicators.

## DISCUSSION

### Infants consumption patterns

**Liquids consumption:** After six months of age, it becomes increasingly difficult for breastfed infants to meet their nutrient needs from human milk alone. Furthermore, most infants are developmentally ready for other foods at about six months<sup>11</sup>.

The infants' percent of consumption of the different types of liquid varies significantly. Nearly the majority of the infants consumed water, whether they were younger or older than six months of age. Approximately two-thirds of the infants drank milk such as tinned, powder, or fresh animal milk (69%) and 65% consumed infant formula. More than half of the infants consumed juice and juice drinks; and yogurt (Table 1).

Table 1: Percent Infants' liquid consumption in the previous day

	Riyadh		Jazan		Damam		Hail		Jeddah		KSA	
	F.	%	F.	%	F.	%	F.	%	F.	%	F.	%
Plain water	478	96	275	92	273	91	288	96	253	84	1567	92
Infant formula	388	78	179	60	197	66	185	62	152	51	1101	65
Milk (tinned, powder or fresh animal milk)	449	90	184	61	229	76	142	47	164	55	1168	69
Juice or Juice drinks	313	63	168	56	149	50	182	61	143	48	955	56
Clear Broth	124	25	43	14	61	20	81	27	50	17	359	21
Yogurt	279	56	192	64	165	55	191	64	141	47	968	57
Thin Porridge	56	11	41	14	20	7	37	12	27	9	181	11
Other liquid such as dates water and honey	176	35	49	16	53	18	79	26	52	17	409	24
Any other liquid	38	8	20	7	29	10	49	16	22	7	158	9

Table 2: Percent of consumption of the food groups and sub-food groups; and percent number of times consuming complementary food, infant formula, milk, and yogurt

	F.		%									
<b>1: Percent of consumption of the sub-food groups</b>												
A. Porridge, bread, rice noodles, or other foods made from grains	1248		73									
B. Pumpkin, carrots, squash, sweet potatoes that are yellow or orange inside	755		44									
C. White potatoes, white yams, cassava, or any other food made from roots	536		32									
D. Any dark green, leafy vegetables	234		14									
E. Ripe mangoes, ripe papayas, or any other local vitamin-A-rich fruits	217		13									
F. Any other fruits or vegetables	743		44									
G. Liver, Kidney, heart, or other organ meat	134		8									
H. Any meat such beef, lamp, goat, chicken or duck	616		36									
I. Eggs	490		29									
J. Fish or dried fish, shelf fish or sea food	193		11									
K. Any foods made from beans peas, lentils, nuts or seeds	368		22									
L. Cheese, yogurt, or other milk products	1185		70									
M. Any oil fats or butter or foods made with any of these	397		23									
N. Any sugary food such as chocolates, sweets, candies pastries, cakes or biscuits	837		49									
O. Condiments for flavor such as chills, spices, herbs, or fish powder	257		15									
P. Any other food	140		8									
Q. Food made with red palm oil, red palm nuts or red palm nut bulb sauce	61		4									
	Riyadh		Jazan		Damam		Hail		Jeddah		KSA	
	F. %		F. %		F. %		F. %		F. %		F. %	
<b>2: Percent consumption of the food groups</b>												
Grains and tuber	417	83	178	59	221	74	300	100	300	100	1416	83
Legumes and nuts	114	23	72	24	28	9	78	26	81	27	373	22
Dairy products	488	98	260	87	268	89	300	100	300	100	1616	95
Flesh food	251	50	131	44	118	39	300	100	300	100	1100	65
Egg	154	31	88	29	69	23	61	20	89	30	461	27
Vitamin-A-Rich fruits and vegetables	290	58	147	49	178	59	153	51	126	42	894	53
Other fruits and vegetables	246	49	125	42	109	36	102	34	97	32	679	40
	Infant formula		Milk			Yogurt			Complementary feed			
No. of times/age in months	<6	6-8	9-24	<6	6-8	9-24	<6	6-8	9-24	<6	6-8	9-24
<b>3: Percent of consumption of infant formula, milk, yogurt and other complementary feed</b>												
0	60	30	30	41	35	29	70	40	35	31	4	7
1	16	24	21	13	12	16	22	48	50	18	39	27
2	13	23	26	8	9	15	6	11	13	33	25	26
3	6	15	13	11	18	17	2	1	2	8	19	23
≥ 4	5	7	10	28	27	23	0	0	0	10	13	18
Total	368	257	1075	368	257	1075	368	257	1075	368	257	1075

Table 3: Prevalence of complementary feeding timing; minimum dietary diversity (MDD), minimum meal frequency (MMF) and minimum acceptable diet (MAD) diet Indicators in Saudi Arabia

Introduction of complementary feeding	Riyadh (100)	Hail (100)	Jeddah (99)	Damam (96)	Jazan (84)	KSA (97)
<b>Time of introducing complementary feeding</b>						
1-2 months	5	28	16	7	1	11
3-4 months	22	11	14	32	31	22
5-6 months	52	47	50	50	51	50
≥6 months	16	11	13	10	12	13
NA	6	3	7	1	5	4
<b>Minimum dietary diversity (MDD)</b>						
6-23 month	76	69	68	58	59	67
6-11 months	68	70	68	32	47	58
12-17 months	78	70	71	66	66	71
18-23 months	86	67	63	83	69	75
Minimum meal frequency (MMF)	68	51	59	53	49	58
Minimum acceptable diet (MAD)	43	31	33	28	35	35

Table 4: Percent of consumption of food groups according infants age groups for breast and non-breast-fed infants

No of food groups	<6 months		6-8 months		6-24 months		9-24 months	
	BF	NBF	BF	NBF	BF	NBF	BF	NBF
0	21	0	1	0	1	0	1	0
1	25	38	11	6	4	2	2	1
2	6	13	10	8	5	5	3	5
3	14	16	28	22	21	21	19	21
4	13	14	22	34	26	28	27	27
5	7	10	17	16	22	20	23	21
6	8	8	8	8	15	16	17	18
7	4	2	3	6	6	8	7	8
Total (frequency)	267	101	193	64	939	393	746	329

The WHO, in the ten steps of breastfeeding, recommends that bottle-feeding or pacifiers should be avoided, however, in Saudi Arabia about 83% of the infants were bottle-fed. Out of the total number of mothers interviewed, about 65% reported they breastfed their infants with milk formula in past 24 h. More than half of the infants were formula-fed during the first week of life. The predominance of the formula feeding among Saudi infants could be attributed to the availability of breastmilk substitutes in nearby supermarkets and pharmacies; affordability to purchase infant milk, as well as to mothers believing that they do not have sufficient milk for their children. The number of times infants consumed liquids such as infant formula; milk and yogurt, for the different age groups, showed that about 40% of the infants under six months consumed infant formula and about 70% of each of the two age groups (6-8 months and 9-24 months) consumed infant formula for a number of times ranging 1-4 times per day (Table 2). Out of the total number of children ages 6-8 months, nearly a majority (96%) of the infants consumed (1-4 times per day) complementary food. Out of those infants, about 70% drank infant formula; 65% milk, 60% yogurt (Table 2).

For the age group 9-23 months, almost 93% consumed complementary food, out of which more than two-thirds consumed infant formula, milk and yogurt for at least once a day.

**Complementary feeding:** The aggregation of the food items into seven food groups was used to compute the percentage of the infants and young children who consumed from each of these food groups at least once per day during the 24 h dietary recall, irrespective to the amount consumed.

Nearly a majority of the infants consumed dairy products (95%) and grains (83%). About two-thirds consumed flesh foods (65%). Approximately half of the infants consumed vitamin-A-rich fruits and vegetables. The percent consumption of the legumes and nuts; egg; and other fruits and vegetables

vary between 22-40% (Table 2). During the complementary feeding period, it is recommended that children should eat a frequent and diverse diet of nutrient-rich and hygienically prepared complementary foods in addition to breastmilk. Evidence has shown that a diet comprising at least four food groups per day is associated with improved growth in young children<sup>12</sup>. The mean number of the food group consumed amounts to 3.85 times, which is below the threshold for MDD. Thus, the top four groups consumed were dairy products; grains; flesh foods; and vitamin-A-rich fruits and vegetables. The least consumed food groups were other fruits and vegetables, eggs and legumes and nuts.

After the first six months of life, an infant's nutrient demands start to surpass what breastmilk alone can provide<sup>13,3</sup>. To realize these growing demands, WHO recommends that infants start consuming solid, semi-solid, or soft foods at six months of age to ratify that their nutrient intake is sufficient to meet their developing brains and bodies. These solid foods should be safe, nutritious and ideally provided in addition to breastmilk from 6-23 months of age<sup>13,12</sup>.

The time of introducing complementary food in the main five regions, as well as for Saudi Arabia as a whole, are presented in Table 3. The results displayed by 2-month age intervals revealed that about one-third of infants between one and four months of age are already consuming complementary food and 50% of the mothers introduce complementary feedings to their children between five to six months of age. At the regional level, for instance, out of the total number of the respondents from the Northern (Hail) region, around 28% introduced complementary foods during the first two months of the child's age. Eventually, this lead to the conclusion that early introduction of complementary feeding is predominant in Saudi, as nearly 83% of the infants introduced complementary feeding under six months of age, while merely 13% of the mothers optimally introduced complementary foods. Similar results were reported in the United Arab Emirates (UAE), where mixed feeding was the

norm. Many mothers introduced solid food, liquid food, or formula to their infants as early as one month. About 50% of the mothers stopped breastfeeding before their infants reached the age of three months and 40% did not even attempt to breastfeed<sup>14</sup>. The findings of the study about patterns and determinants of breastfeeding and complementary feeding practices of Emirati mothers in the UAE revealed that about 84% of the study population (593 infants) received complementary food before the age of six months<sup>15</sup>.

In Saudi Arabia, the prevalence of infants ages 6-9 months who are consuming solid, semi-solid and soft food (complementary feeding) while continuing breastfeeding is 97%. This prevalence was rated as "very good" according to WHO rating score (95-100%) for infants and young child feeding indicators. However, this high prevalence of complementary feeding was attributed to many inappropriate breastfeeding practices, as the percent of the never-breastfed infants is 8%, early introduction of complementary feeding under six months of age is 83% and early ceasing of breastfeeding under six months of age is 23%. Our findings concerning the early ceasing of breastfeeding are in the line with studies in developed countries, where a systematic review investigating the factors influencing the early introduction of complementary food found strong indications that non-breastfeeding mothers have a higher likelihood of early weaning<sup>16</sup>. Moreover, recent research-in the context of studies in Canada<sup>17</sup>, Denmark<sup>18</sup>, the United Kingdom<sup>19</sup> and the United States<sup>20</sup> has found similar results in the positive relationship between early weaning and the short duration of breastfeeding. Other researchers reported that due to change in socioeconomic status, education level and employment opportunity, Saudi women are currently becoming more educated, are undertaking employment and they are becoming less accepting of the motherhood role<sup>21</sup>.

**Minimum dietary diversity (MDD):** The results of the MDD revealed that the percent of the children ages 6-23 who consumed from four food groups or more a day (i.e., achieved MDD) amounts to 67%. Consumption of foods from at least four food groups in the past 24 h would mean that the child had a high probability of consuming at least one animal-based food and at least one fruit or vegetable that day, as well as a staple starchy food<sup>1</sup>. More than two-thirds of malnutrition-related child deaths are associated with inappropriate feeding practice during the first two years of life<sup>22</sup>.

The results indicate that one-third of Saudi's infants ages 6-23 months did not consume from four food groups or more

and is at risk of undernutrition, including micronutrient deficiencies. Moreover, disaggregated prevalence of the MDD, according to child age, showed that in Saudi Arabia 42, 29 and 25% of the infants' ages 6-11, 12-17 and 18-23 months, respectively, are at risk of undernutrition and micronutrient deficiencies (Table 2). Dietary Diversity is a key factor in all people meeting the requirements for essential nutrients. Improved feeding practices, by provision of adequately diversified food, can lead to improved intake of energy and nutrients, which leads to better nutritional status<sup>22</sup>.

In KSA, children are receiving nutritionally adequate and diversified foods, with 67% of infants ages 6-23 months of age meeting the MDD criteria. The value of MDD indicators in KSA meets the global average (29%), Middle East and North Africa (38%), South Asia (23%), East Asia and Pacific's (60%) and East and Southern Africa (19%) and only below the average of Latin America and Caribbean (73%)<sup>11</sup>. In many countries, less than one-fourth of infants aged 6-23 months meet the criteria for dietary diversity and feeding frequency<sup>23</sup>.

The reported score of MDD in KSA is similar to a study done in Sri-Lanka<sup>24</sup>. However, it is much higher than the reported national 2011 Ethiopian Demographic and Health Survey<sup>25</sup> and some other studies<sup>26-28</sup>. Furthermore, KSA's reported MDD score is higher than other scores revealed by studies done in Ghana<sup>29</sup>, East Delhi, India<sup>30</sup> and Bangladesh<sup>31</sup>. Thus, the situation of infants younger than 24 months of age being at risk of undernutrition and micronutrients deficiencies in Saudi Arabia is far better compared to many other countries.

**Minimum meal frequency (MMF):** MMF as defined by WHO<sup>1</sup> as a proportion of breastfed and non-breastfed children 6-23 months of age who receive solid, semi-solid, or soft foods (but also including milk feeds for non-breastfed children) the minimum number of times or more. According to WHO, in order to meet the MMF, breastfed children ages 6-8 and 9-23 months of age need to consume at least two and three meals or snacks a day, respectively. While non-breastfed children ages 6-23 months need to consume at least four meals or snacks a day.

The transition period from exclusive breastfeeding to the age of 24 months of age is critical window for optimal growth and development of the child. During the period of 6-24 month of the infant age, appropriate, safe, adequately nourished and frequent feeding is essential. Innocently, the food provided to a child might be high or low in some nutrients, the diversity of food might be adequate or inadequate and micronutrient content including iron could be lower than recommended<sup>32</sup>.



The results revealed that only 21% of the breastfed infants under six months of age hadn't consumed any meals or snacks per day, while 79% consumed many meals ranging 1-7 per day. On the other hand, about half of non-breastfed infants under six months of age consumed 1-2 meals or snack per day, while 40% of those consumed 3-5 meals per day.

Out of the total number of breastfed infants 6-9 months of age, 88% consumed the minimum number of meals per day while of those ages 9-24 months, 94% consumed the minimum number or more of meals or snack.

For the non-breastfed infants in the age domain of 6-24 months, one-third of the non-breastfed Saudi's infants did not consume the minimum number of meals or snacks per day.

In Saudi Arabia, the prevalence of the MMF for the children ages 6-23 months was amounts to 58%. This means that approximately 42% of children ages 6-23 months were not being fed the minimum number of meals per day during this critical period of growth and development. Infrequent meals can cause growth faltering, stunting and micronutrient deficiencies, all of which compromise brain development and can leave children's immune systems vulnerable to infections<sup>33,34</sup>. The percent of KSA infants ages 6-23 months of age who met the recommended level of MMF is similar to the global (52%) and Middle East and North Africa (55%) averages, is above the average of South Asia (47%), West and Central Africa (47%), East and Southern Africa (45%) and below the average of East Asia and Pacific (72%) and Latin America and Caribbean (78%)<sup>10</sup>. The value of this MMF is higher than those reported by WHO in Eritria (44%), Guinea (30%), India (44%), Niger (42%) and Mali (25%). It is almost equal to that of Kenya (58%), Zambia (55%) and less than from Indonesia (67%) and Morocco (62%)<sup>35</sup>.

Income and education levels as well as women's knowledge about importance of MMF are considered as important factors associated with achieving higher scores of MMF indicators in KSA.

**Minimum acceptable diet (MAD):** The minimum acceptable diet (MAD) refers to achieving both MMF and MDD. In Saudi Arabia, the prevalence of the MAD is merely 35%. It indicates that two-thirds of Saudi's infants and children were deprived of being frequently fed throughout the day and their meals weren't nutrient dense or coming from diversified food groups. There are far too many children being deprived of a healthy diet around the world, as only one in every six children is receiving a MAD. The situation is dire in West and Central Africa, Eastern and Southern Africa and South Asia, where only around 10% of children 6-23 months of age are fed MAD<sup>10</sup>.

Meanwhile, rates are much higher in East Asia and the Pacific, with 41% of infants and young children meeting the criteria<sup>10</sup>. KSA has shown better results, compared to the other countries; however, more efforts are required for improving the score of MAD indicators so as to improve the practice of complementary feeding in KSA.

## **CONCLUSION AND RECOMMENDATIONS**

In Saudi Arabia the mean number of the food group consumed is amounted to 3.85 times, which is below the threshold for MDD. The top four food groups consumed were dairy products; grains; flesh foods; and vitamin-A-rich fruits and vegetables. The majority of the infants were introduced to complementary feeding under six months of age, while only 13% of Saudi infants were optimally introduced to complementary feedings. One-third of Saudi infants ages 6-23 months were not achieving the MDD and are at risk of undernutrition, including micronutrient deficiencies. Nearly half of children ages 6-23 months were not being fed the minimum number of times of meals per day during this critical period for growth and development. The prevalence of the MAD was merely one-third, indicating that two-thirds of the Saudi's infants and children were deprived from being fed frequently throughout the day and their meals weren't nutrient dense or coming from diversified food groups. Early introduction, less frequent and diversified infants' complementary feedings were the major determinants to optimal complementary feeding practices in Saudi Arabia. The present study estimates the infant and child complementary feeding indicators according to WHO standardized methodology and a gap exists between the prevailing level and the recommended one, thus the formulation and implementation of the IYCF strategy is highly recommended, so as to enhance the appropriateness of complementary feeding practices in Saudi Arabia. There is insufficient data on breastfeeding in KSA, therefore making it difficult to monitor progress and develop promotional programs. The WHO does not report any breastfeeding data in KSA's profile because there are no existing national data on breastfeeding<sup>35,36</sup>.

Thus, the primary outcomes of this study are the development of four infants and young child complementary feeding indicators measured for the entire country of KSA and the each of the five selected regions. These population-level indicators of infant and young child feeding (IYCF) practices concerned with complementary feeding are at the disposal of the KSA health authorities and research community. The outcomes can be used primarily for assessment; to make

national and sub-national comparisons and to describe trends over time; to identify populations at risk, target interventions and make policy decisions about resource allocation for improving IYCF indicators in KSA.

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### REFERENCES

1. WHO., 2008. Indicators for Assessing Infant and Young Child Feeding Practices Part I: Definition. World Health Organization, Switzerland, ISBN: 9789241596664.
2. WHO., 2016. Infant and young child feeding. World Health Organization, Geneva, Switzerland. <http://who.int/mediacentre/factsheets/fs342/en/#>.
3. PAHO., 2003. Guiding principles for complementary feeding of the breastfed child. Pan American Health Organization, Washington DC., USA.
4. WHO., 2010. Indicators for Assessing Infant and Young Child Feeding Practices Part II: Measurement. World Health Organization, Switzerland, ISBN: 9789241599290.
5. Black, R.E., L.H. Allen, Z.A. Bhutta, L.E. Caulfield and M. de Onis *et al.*, 2008. Maternal and child undernutrition: Global and regional exposures and health consequences. *Lancet*, 371: 243-260.
6. Reinbott, A., 2016. Effectiveness of a nutrition education intervention to improve complementary feeding practices: Randomized controlled trial in Cambodia. Dissertation Submitted to the Faculty of Agriculture, Nutritional Sciences and Environmental Management Justus Liebig University Giessen for the Degree of Dr. Oec. Troph.
7. Labadarios, D., N.P. Steyn and J. Nel, 2011. How diverse is the diet of adult South Africans? *Nutr. J.*, Vol. 10, No. 1. 10.1186/1475-2891-10-33
8. Kennedy, G.L., M.R. Pedro, C. Seghieri, G. Nantel and I. Brouwer, 2007. Dietary diversity score is a useful indicator of micronutrient intake in non-breast-feeding Filipino children. *J. Nutr.*, 137: 472-477.
9. Michael, F., 1996. A guide to qualitative research for improving breastfeeding practices. Wellstart International, Washington, DC., USA. [http://pdf.usaid.gov/pdf\\_docs/PNABZ605.pdf](http://pdf.usaid.gov/pdf_docs/PNABZ605.pdf)
10. UNICEF., 2016. From the First Hour of Life: Making the Case for Improved Infant and Young Child Feeding Everywhere. UNICEF., New York, USA., ISBN: 978-92-806-4852-2.
11. WHO., 2009. Infant and Young Child Feeding: Model Chapter for Textbooks for Medical Students and Allied Health Professionals. World Health Organization, Geneva.
12. Onyango, A.W., E. Borghi, M. de Onis, M.D.C. Casanovas and C. Garza, 2014. Complementary feeding and attained linear growth among 6-23-month-old children. *Public Health Nutr.*, 17: 1975-1983.
13. WHO., 1998. Complementary Feeding of Young Children in Developing Countries: A Review of Current Scientific Knowledge. World Health Organization, Geneva.
14. Autret, M. and S. Miladi, 1979. Report on the state of food and nutrition in the United Arab Emirates. Part II. UNICEF, 1979.
15. Radwan, H., 2013. Patterns and determinants of breastfeeding and complementary feeding practices of Emirati Mothers in the United Arab Emirates. *BMC Public Health*, Vol. 13, No. 1. 10.1186/1471-2458-13-171
16. Wijndaele, K., R. Lakshman, J.R. Landsbaugh, K.K. Ong and D. Ogilvie, 2009. Determinants of early weaning and use of unmodified cow's milk in infants: A systematic review. *J. Am. Diet. Assoc.*, 109: 2017-2028.
17. Fegan, S., E. Bassett, Y. Peng and K.S. O'Connor, 2016. Adherence to complementary feeding recommendations for infants and implications for public health. *Public Health Nutr.*, 19: 638-649.
18. Kronborg, H., E. Foverskov and M. Vaeth, 2014. Predictors for early introduction of solid food among Danish mothers and infants: An observational study. *BMC Pediatr.*, Vol. 14, No. 1. 10.1186/1471-2431-14-243
19. Armstrong, J., E.C. Abraham, M. Squair, Y. Brogan and A. Merewood, 2014. Exclusive breastfeeding, complementary feeding and food choices in UK infants. *J. Hum. Lactat.*, 30: 201-208.
20. Doub, A.E., K.J. Moding and C.A. Stifter, 2015. Infant and maternal predictors of early life feeding decisions. The timing of solid food introduction. *Appetite*, 92: 261-268.
21. Tanash, H.A., 2014. Breastfeeding knowledge, practice, attitudes and influencing factors: Findings from a selected sample of breastfeeding mothers in Bemidji, Minnesota. Master's Theses, Minnesota State University, Mankato, Minnesota.
22. Solomon, D., Z. Aderaw and T.K. Tegegne, 2017. Minimum dietary diversity and associated factors among children aged 6-23 months in Addis Ababa, Ethiopia. *Int. J. Equity Health*, Vol. 16, No. 1. 10.1186/s12939-017-0680-1
23. WHO., 2016. Infant and young child feeding 2016. Fact Sheet. World Health Organization. <http://www.who.int/mediacentre/factsheets/fs342/en/>

24. Senarath, U., S.S. Godakandage, H. Jayawickrama, I. Siriwardena and M.J. Dibley, 2012. Determinants of inappropriate complementary feeding practices in young children in Sri Lanka: Secondary data analysis of demographic and health survey 2006-2007. *Mater. Child Nutr.*, 8: 60-77.
25. Aemro, M., M. Mesele, Z. Birhanu and A. Atenafu, 2013. Dietary diversity and meal frequency practices among infant and young children aged 6-23 months in Ethiopia: A secondary analysis of Ethiopian demographic and health survey 2011. *J. Nutr. Metab.*, Vol. 2013. 10.1155/2013/782931
26. Dangura, D. and S. Gebremedhin, 2017. Dietary diversity and associated factors among children 6-23 months of age in Gorche district, Southern Ethiopia: Cross-sectional study. *BMC Pediatr.*, Vol. 17, No. 1. 10.1186/s12887-016-0764-x
27. Beyene, M., A.G. Worku and M.M. Wassie, 2015. Dietary diversity, meal frequency and associated factors among infant and young children in Northwest Ethiopia: A cross-sectional study. *BMC Public Health*, Vol. 15, No. 1. 10.1186/s12889-015-2333-x
28. Mekbib, E., A. Shumey, S. Ferede and F. Haile, 2014. Magnitude and factors associated with appropriate complementary feeding among mothers having children 6-23 months-of-age in Northern Ethiopia; A community-based cross-sectional study. *J. Food Nutr. Sci.*, 2: 36-42.
29. Saaka, M., A. Larbi, S. Mutaru and I. Hoeschle-Zeledon, 2016. Magnitude and factors associated with appropriate complementary feeding among children 6-23 months in Northern Ghana. *BMC Nutr.*, Vol. No. 1. 10.1186/s40795-015-0037-3.
30. Khan, A.M., P. Kayina, P. Agrawal, A. Gupta and A.T. Kannan, 2012. A study on infant and young child feeding practices among mothers attending an urban health center in East Delhi. *Indian J. Public Health*, 56: 301-304.
31. Kabir, I., M. Khanam, K.E. Agho, S. Miharshahi, M.J. Dibley and S.K. Roy, 2012. Determinants of inappropriate complementary feeding practices in infant and young children in Bangladesh: Secondary data analysis of demographic health survey 2007. *Mater. Child Nutr.*, 8: 11-27.
32. Mekonnen, T.C., S.B. Workie, T.M. Yimer and W.F. Mersha, 2017. Meal frequency and dietary diversity feeding practices among children 6-23 months of age in Wolaita Sodo town, Southern Ethiopia. *J. Health Popul. Nutr.*, Vol. 36, No. 1. 10.1186/s41043-017-0097-x
33. UNICEF., 2016. Global nutrition report 2016: From promise to impact: Ending malnutrition by 2030. International Food Policy Research Institute, Washington, DC.
34. Dewey, K.G. and K.H. Brown, 2003. Update on technical issues concerning complementary feeding of young children in developing countries and implications for intervention programs. *Food Nutr. Bull.*, 24: 5-28.
35. WHO., 2010. Saudi Arabia country profile. Nutrition, 2010. World Health Organization. <http://apps.who.int/nutrition/landscape/report.aspx?iso=sau>
36. MOH., 2010. The Health Statistical Year Book. Ministry of Health, Riyadh, Kingdom of Saudi Arabia.