



Evaluation of the Nutritional Status and Dietary Intake of Children with Cow's Milk Allergy on the Cow's Milk Exclusion Diet

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Abstract: Background: Cow's milk protein allergy (CMA) is one of the most common food allergies, affecting mostly infants and children. The incidence of CMA during first year of life is estimated to be 2% to 7.5%. Children with an allergy to cow's milk are required to follow a strict diet that excludes milk which may resulted in nutritional deficiencies, especially with unsupervised dietary advice. **Objectives:** The aim of the current study is to assess the nutritional status and dietary intake of children with cow's milk allergy on a cow's milk free diet without previous appropriate dietary advice to highlight the adverse nutritional consequences of the cow's milk exclusion diet. **Methods:** The study performed by an observational cross section design study enrolled 63 infants and young children with cow's milk allergy on the cow's milk free diets (CMF) that attended Pediatric out patients' clinics of National Nutrition Institute, Cairo, Egypt. The participated children assessed by physical examination, anthropometric measurement, and dietary analysis with three separate 24hrs recalls and food frequency questionnaire. Also, the laboratory investigations including the complete blood picture & serum ionized calcium were done. **Results:** Our study included 63 participated infants and young children with mean \pm SD of age in months was 14.8 ± 11.7 (range 4 - 36 mo), and categorized into three feeding subgroups according to the feeding patterns: the breast feeding group (BF: n 20) 31.7%, the special milk formula feeding group (SF: n18) 28.6%, and the food intake feeding group (FI: n 25) 39.7%. The study was found 48 - 49 % of the participated children under weight and stunted for age. The full food intake children feeding group growth was more affected; while, the special milk formulae feeding group (SF) was the least affected with no statistical differences between the three feeding groups, which may be attributed to its higher contents of energy and nutrient elements needed to growth of the children with cow's milk allergy on cow's milk exclusion diet. We found 42.9% of the participated children unmet their recommended daily dietary intake (<75% RDA) of energy, protein, carbohydrate with no statistical significant differences among the three feeding groups; while, 31.7 % of participates had low dietary fat intake and 56% of children on the food intake unmet their RDA fat intake with statistical significant different than the other feeding groups (p- value < 009). We found 47.6 % of the participated children had low daily dietary calcium intake with 88% of food intake children group had statistical significant lower dietary calcium intake comparing with the other feeding groups (p- value < 0.0001). Also the study was showed 44.4 % of participants unmet the daily dietary iron intake (<75%RDA), with 48 - 50% were found on each of food intake and breast feeding groups while, only 32% among special milk formula feeding children group; however, with no statistical significant different among the feeding groups. We found a positive correlations between dietary iron intake and blood HB gm/dl ($r= 0.356$, p-value< 0.004), RBCs, and MCHC of the participated children. While, 60% of breast feeding children group had lower daily dietary zinc intake with statistical significant different than the other feeding groups (p – value < 0.018). Also, 60% of the children of food intake feeding group had highly statistical significant lower daily dietary vitamin A intake (RDA) than the other feeding groups (p – value < 0.0001). **Conclusion:** The children on cow's milk exclusion diet are at risk, as it may has a negative impact of the nutritional quality of children diet and their nutritional status, It lead to nutritional deficiencies and malnutrition in children. Therefore, it is imperative to replace the important elements in milk in the diets. Parents of babies who eat non-dairy meals need appropriate medical and nutritional advice about nutritional options to decrease the risk of low energy, fat, protein and carbohydrate intake while closely monitoring the growth of children with milk allergy. Complementary feeding should be introduced at 6 months of age. Adding milk substitutes enhance the nutritional elements of non-dairy diets. Also supplements of calcium, vitamin A, riboflavin and zinc as indicated.

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Key words: Cow's milk allergy, children, cow's milk exclusion diet, dietary intake, nutritional status.

1. Introduction:

Cow's milk allergy (CMA) is one of the commonest food allergies. The cow's milk protein allergy mainly affects children younger than three years [1, 2], the occurrence of CMA through first year of life is recorded to be 2% to 7.5% [1,3]; while, the spread of CMA in breast-fed children is 0.5% [4]. CMA has been constantly increasing according to epidemiological research [5]. The only effective way of treating CMA is a milk exclusion diet [6]. The number of the infants on non-dairy diet is exactly higher, due to parentally realized harmful reaction to milk is even more widespread [7,8].

Adequate nutritional elements intake in childhood is important to ensure adequate physiological and mental development [9]. Elimination of any group of nutrients can lead to a diet that is deficient in nutrition, due to both, due to both of highly significant reduced dietary variety [10,11], and deficiencies of specific micronutrients [7], but the elimination of milk in infancy is particularly likely to cause nutritional deficiencies [12]. Cows' milk free diets have been related to poor growth in infancy [13,14], due to unjustified dietary restrictions and unintended dietary mistakes [15].

Parents of reactive infants are advised that their babies should use non-cow's milk diet even the allergy is outgrown. The CMA usually outgrows with variable resolution time, which is mainly at the age of 3–5 years when cow's milk allergic symptoms subside; but, these symptoms may continue after a childhood in some patients [16]. The infants with CMA are treated by cow's milk free diet (CMF), so they are given special milk formula substitutes (casein hydrolysate or amino acids formula), or maternal cow's milk exclusion diet in the exclusively breastfed infants [17]. Then at the weaning need to introduce an appropriate cow's milk free complementary solid food [6]. It is hard to obtain a long CMF diet compliance to fill the daily recommended nutrients requirements without ideally supported dietary advice because the milk is the natural and usual diet of infants and children in the first few years of life.

Unwarranted exclusion diets are often initiated by parents [18]. The infants on cows' milk free diets are at risk of malnutrition and specific nutrient deficiencies [19]. Many studies point to possible harmful impacts of restrictive diets in infants, and the actual nutritional consequences of a diet without cow's milk protein was not well known [20].

Aim of the study:

Our study are aiming to estimate the nutritional state and the nutritional intake of the babies and young children with cow's milk allergy on cows' exclusion diet without previous dietetic input to explain the nutritional implications of unsupervised cows' milk free diets according to the different feeding patterns. This study highlights the unsupervised milk elimination diets at a time in life that is critical for growth, development and establishment of eating habits.

2. Subjects and Methods:

Subjects:

The study population included the infants and young children had suspected cow's milk allergy on the cow's milk free diets (CMF) that attended the Pediatrics outpatient clinics of National Nutrition Institute, Cairo Egypt that were seeking for dietary advices. The study sample size was 63 of infants and young children patients in the first years of age had adverse reactions to cow's milk protein and were already diagnosed with cow's milk allergy according to the positive clinical history and physical examination, specific IgE, and or skin prick test, and confirmed by improvement of the symptoms with milk elimination diet followed by recurrence of these symptoms with reintroduction of oral cow's milk food challenge.

Study Design:

The study performed by a descriptive cross-sectional study design. The study sample population was randomly selected from the allergic cow's milk children of first years of age with cow's milk allergy on cow's milk free diets (CMF) that attended the Pediatric outpatients' clinics of National Nutrition Institute and met the inclusion & exclusion criteria. The recruitment of participants was done between January and June 2020.

Inclusion criteria:

- Children were on the milk exclusion diet for at least two months without previous dietary advice, after the physician-diagnosed cow's milk allergy
- Age of children was at the first few years (0 - 3 years).
- The parents accept to enroll in the study.
- Medical records contain the complete three separate 24 hrs recall of daily intake and food frequency Questionnaire of the children.

Exclusion criteria:

The study excluded premature birth, intrauterine growth retardations, multiple food allergies, chronic

renal diseases, gastrointestinal disease, DM, other chronic systemic disease, and any illnesses affecting the nutrient metabolism.

Methods

All the enrolled children in the study subjected to the following:

- Physical examinations
- Anthropometric measurements.
- Assessments of nutritional intakes performed by using 24hrs dietary recalls of three separate days, and food frequency questionnaire of some selected food items.
- The laboratory investigations: the complete blood picture and serum ionized calcium tests were done for the studied children.

The data obtained through the direct interviews and medical records.

Anthropometric measurements:

Height, weight, weight for length or / height for age z- scores of the infants and young children according to WHO (SDSs) reference values of the age- and sex-specific were assessed. The series of repeated three measurements done, a total of 3 times and averaged for each child were taken then the data were plotted on references growth charts of WHO [21].

The subjects asked to take off the heavy clothes, shoes, and belts during the anthropometric measurements.

Weight for age (per kg):

Weight was measured using a platform scale; the scale was standardized by known weight before the study and corrected according to the test. The subject was standing barefooted and wearing light clothes on the center of platform without touching or leaning on anything. The weight was measured to the nearest 0.1 kg. The weights status was determined according to WHO z-score growth references curves [21] and categorized into:

Normal weight range from -2 SD to $+2$ SD

Underweight < -2 SD

Length / or Height for age (per cm):

Depending on the child's age and ability to stand, the child's length or height measured. If the child less than two years old and cannot walk measured child's length in recumbent position using a board (with fixed headboard and moveable footboard) which should be placed on a flat, stable surface as a table, by contrast to the child two years or older, who can walk, the height measured by using the Raven Minimetre, with direct reading of height with an accuracy of ± 0.1 cm. The child was

standing barefooted on flat surface, feet parallel, the arms hanged freely the sides and the head, back, buttocks, and heels were in contact with the wall. The head is snugly attached to the outer boundary of the orbit with the external auditory meatus in the same horizontal plane. The measuring arm is lowered below people's head with their back against the wall. The red indicator line was giving an accurate height measurement, the height Measured to the nearest 0.1 cm. Heights status determined according to WHO z-score of references growth curves [21] and categorized into:

Normal height range from -2 SD to $+2$ SD

Stunted < -2 SD

Weight for length / or height for age:

The children were classified according to WHO z-score growth references curves [21] into:

Normal weight for length /or height range from -2 SD to $+2$ SD

Wasting < -2 SD

Dietary assessment:

The studied children divided into three groups according to the feeding patterns, first children group was mainly on the breast feeding (BF) as received more than 50% of their estimated energy requirements from their breast milk mothers on cow's milk exclusion diet, the second special formula children group (SF) was mainly on special milk formula (amino acid based formula, mainly available formula) that was specialized infant formula used in CMA, and received more than 50% of their estimated energy requirements from this milk formula, considering the previous two groups may start a little of complementary food according to their age; while, the third children group was on full food intake (FI) that included all solids and liquids except the milk either of the breast milk or special milk formula. Methods were used to measure the nutritional intake of the eligible infants divided into two main methods groups. The first one known as quantitative daily consumption method, comprised of recalls designed to record the quantity of foods consumed over one day period "twenty four hours dietary recall" method. The second methods involved the manner of diet.

Twenty four hours dietary recalls (24hrs recalls) method:

By this methods the twenty four hours dietary recalls of the quantity of foods consumed of three separate days including usual day, holiday, and shopping day over the last week were taken from every child's mother to calculate the average of quantities of daily food consumed over one day period from the previous three separate days. The parent was asked the type and volume of infant

formula, cow's milk substitutes, the child food or drank per day and / or the approximate duration and times of breastfeed per 24 hours. The quantities of foods estimated with detailed of all food and beverages consumed in household measures and grams which carried out by using the pre-prepared list of weights of commonly used household measures in Egypt developed by National Nutrition Institute. The compiled food composition tables (FCT) of the National Nutrition Institute used to estimate the energy and nutrient intakes of the food consumed by every infant [22], and then the sufficiency of the diet was determined by comparing these energy and nutrients intake of the every child with the recommended dietary allowances of age and sex "RDA" (RDAs, of FAO/WHO/UNU) [23], that were considered as cut off points of nutrients. Basis of the analysis of dietary adequacy of the energy and nutrients % RDA categorizes into (< 50%, 50 - < 75%, 75 - < 120%, > 120%). Iron determination was based on its bio-availability according to the daily diet content of heme iron source in grams (Meat, Poultry and Fish) or Ascorbic acid (mg): Low bio-availability: < 30 mg of heme iron source or < 25 mg of ascorbic acid, Intermediate bioavailability: 30 - 90 mg of heme iron source or 25 - 75 mg of ascorbic acid, High bioavailability: > 90 mg of heme iron source or > 75 mg of ascorbic acid [24].

The analysis of grams of food and beverages to energy and nutrients was used by computer with certain program (Sight and life/Newsletter 2002) [24].

Dietary pattern (Food Frequency Questionnaire).

Food frequency questionnaire method used to give the qualitative descriptive information of dietary pattern of children which are recruited in the study by asking about food items of different food groups consumed on daily, weekly and monthly basis.

Breast milk intake was determined by age using mean values obtained from late published reports [25, 26]. World Health Organization/The Food and Agriculture Organization of the United Nations energy recommendations for breast-fed infants under the age of 12 months, 80 kcal/ kg/ day, were used as reference value [27]. Also, the validated infant test weighing procedure was used by weighing a baby before and after breastfeeding for three days to get representative values to determine milk feed intake amount [28].

Principles of Infant Test Weighing:

- Weighing a baby before and after breastfeeding with the exact same clothes, diaper, blanket, burp cloth, etc.

- Using digital scale accurate to 2 grams or less with computer integration for movement of the infants and a digital readout.

- Subtract the first (before) weight from the second (after) weight. The difference in grams is considered the feed milk intake in milliliters.

A healthy mother may produce about 750 – 800 ml of milk a day to feed her infant with about 500 kcal/ day. 120 ml maximal breast feed amount taking at least 7-10 minutes of breast feeding [29].

The composition of human milk per 100 ml are energy 65 kcal, protein 1.1 gm, carbohydrate 7.4 gm, fat 3.4 gm, calcium 28 mg, carotene (vit A) 137 µg (456 IU), thiamine (vit B1) 0.02 µg, riboflavin (vit B2) 0.02 µg, and vitamin C 3 mg, while the human milk contain small amount of iron 0.5 - 1 mg/L with high bioavailability reported by NIH, National Institute of Nutrition ICMR, Hyderabad.

Information on the nutrient composition of special amino acid based formula which is specialized infant formula used in CMA was provided by labial manufactures and added to the database. The composition of special amino acid based formula 1 for infants in first year of age contains in 100 gm powder 483 kcal energy, 13.5 mg protein, 52.5 gm CHO, 24.5 gm fat, 561 mg calcium, 7.3 mg iron, and 5.3 mg zinc, vitamin A 406 µg (1352 IU), thiamine (B1) 540 µg, riboflavin (B2) 540 µg, vitamin C 51.6 mg; while, amino acid based formula 2 for older children above one year of age contains in 100 gm powder 479 kcal energy, 14.8 mg protein, 51.5 gm CHO, 24 gm fat, 565 mg calcium, 7.4 mg iron, and 4.7 mg zinc, vitamin A 287 µg (956 IU), thiamine (B1) 0.48 mg, riboflavin (B2) 0.96 mg, and vitamin C 44.6 mg.

Laboratory investigations:

Venous blood samples obtained from the studied children to perform the complete blood picture and serum ionized calcium tests. Complete blood picture was done by counting with Siemens ADVIA 360 Hematology system, WHO cutoff level of HB% of anemia for children below five years of age is 11gm/dl [30]. The serum ionized calcium was measured by ion-selective electrode techniques, ionized calcium form is unaffected by changes in serum albumin levels with normal range for children is 1.2 – 1.38 mmol/L [31], performed with Diamond SMARLYTE, CARELYTE, GEMLYTE, Roche AVL 9180 Analyzers 2018/10.

Ethical, consent and permissions:

The written informed consents signed by both parents or the guardian of eligible children were obtained and all participants received individual

dietary advices of appropriate milk free diet from a clinical nutritionist after the study was completed.

Statistical analysis:

We described the data as mean \pm SD or median and interquartile range (IQR) for the numeric variables according to their distribution. While the frequency, percentages, or proportion for the categorical variables for each group separately and tested with chi-square test. Determination of the distribution and normality of numerical variables is by visual assessment of histograms, kurtosis, and skewness. Due to the sample size and the fact that some of the distributions of the nutrient data were skewed, non-parametric testing was used. The nonparametric data were presented by the median with interquartile range (25-75th percentile). A non-parametric test for comparison of variables between of more than two independent groups performed with Kruskal- Wallis test to estimate whether there was a difference in the dietary intake between the feeding groups of the macronutrients and some selected micronutrients. While one way ANOVAs test was used to compare means of continues data with normal distributed. Relationship between numerical variables was assessed by spearman rho correlation coefficient (r). It was statistical significant different if p - value < 0.05. The level of significance for all analysis was 2

sided and set to 0.05. The daily values of nutrient intakes were calculated by the dietary analysis package, imported into Statistical Package for the Social Sciences software SPSS Inc (IBM, version 21Armonk, NY, USA) [32], and compared recommended daily allowances (RDA) refers to (RDAs, of FAO/WHO/UNU) [23].

3. Results:

Sixty-three infants and young children with suspected cow's milk allergy were on the milk exclusion diet that met the inclusion and exclusion criteria participated in the study, with mean \pm SD of age in months was 14.8 ± 11.7 (range 4 - 36 mo), 52.4% boys and 47.6% girls. The children had adverse reaction to cow's milk protein on the milk-free diet (CMF) categorized into three subgroups according to the feeding pattern, the first one, breast feeding group (BF, n. 20) 31.7%, all their mother were recommended to consume a cow's milk free diet, the second, special formula feeding group (SF, n. 18) 28.6%, and the third feeding group on full food intake (FI, n. 25) 39.7%.

Tables (1) & (2): show the mean \pm SD of age in month of the breast feeding children 8.8 ± 3.9 were statistical significantly younger age than special formula (9.4 ± 7.2) and Food Intake (23.6 ± 13.2) groups (p - value < 0.0001).

Table (1): Percentage distribution of anthropometric measures of children with cow's milk allergy according to feeding groups

	SpecialFormula n:18		Breast Feeding n:20		Food Intake n:25		Total n:63		<i>p</i> value
	No	%	No	%	No	%	No	%	
sex									
Male	8	44.4	14	70.0	11	44.0	33	52.4	0.161
Female	10	55.6	6	30.0	14	56.0	30	47.6	
Weight for height									
Wasted	1	5.6	2	10.0	4	16.0	7	11.1	0.551
Normal	17	94.4	18	90.0	21	84.0	56	88.9	
Height for age									
Stunted	7	38.9	11	55.0	13	52.0	31	49.2	0.573
Normal	11	61.1	9	45.0	12	48.0	32	50.8	
Weight for age									
Underweight	6	33.3	8	40.0	16	64.0	30	47.6	0.099
Normal	12	66.7	12	60.0	9	36.0	33	52.4	

The mean \pm SD of the weight in kg of the participated children was 7.8 ± 2.7 , and height in cm was 71.0 ± 11.3 . The mean of weight for age standard deviations score (SDS) was -1.9 ± 1.3 , with 47.6% underweight subjects (< - 2SD), height for age SDS was -1.8 ± 1.5 , with 49.2% stunted subjects (< - 2SD), and weight for height SDS -0.9 ± 1.1 with 11.1% wasted subjects (< - 2SD). Regarding to the

three feeding groups, the children on food intake (FI) were 64% underweight, 52% stunted, and 16% wasted, more affected than the children on breast feeding (BF) were 40% underweight, 55% stunted, and 10% wasted, while the children on special formula feeding (SF) were 33.3% underweight, 38.9% stunted, and 5.6% wasted the least affected children with no statistical significant differences

between the feeding groups ($p - \text{value} > 0.05$). The mean \pm SD of weight in kg of the breast feeding children group (BF) was 6.7 ± 1.6 statistically lower than of other SF and FI feeding groups (7.0 ± 2.4 , 9.3 ± 2.9 respectively) with $p - \text{value} < 0.001$, and also the mean height in cm \pm SD of breast feeding children group was 65.8 ± 6.7 statistically lower than of other SF and FI groups (66.4 ± 9.2 , 78.4 ± 11.9 respectively) with $p - \text{value} < 0.0001$. The mean weight for age SDS of food intake and breast feeding children groups were -2.2 ± 1.3 , -2.0 ± 1.2 , respectively, affected more than the special formula children group -1.4 ± 1.3 , with no statistical

significant differences between the feeding groups ($p - \text{value} < 0.137$). Also the mean height for age SDS of food intake group children was -2.0 ± 1.6 more affected than the BF and SF feeding groups (-1.9 ± 1.4 , -1.3 ± 1.3 respectively) with no statistical significant differences between the feeding groups ($p - \text{value} < 0.280$), and the mean weight for height SDS of food intake children group was -1.2 ± 1.0 affected more than of BF and SF feeding groups (-0.8 ± 1.2 , -0.6 ± 0.9 respectively) with no statistical significant differences between the three feeding groups ($p - \text{value} < 0.148$).

Table (2): Mean \pm SD of the anthropometric measures of children with cow's milk allergy according to the feeding groups

	Special Formula	Breast Feeding	Food Intake	Total	<i>p</i> value
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	
Age (month)	9.4 ± 7.2	8.8 ± 3.9	23.6 ± 13.2	14.8 ± 11.7	0.000
Weight	7.0 ± 2.4	6.7 ± 1.6	9.3 ± 2.9	7.8 ± 2.7	0.001
Height	66.4 ± 9.2	65.8 ± 6.7	78.4 ± 11.9	71.0 ± 11.3	0.000
Weight for height	-0.6 ± 0.9	-0.8 ± 1.2	-1.2 ± 1.0	-0.9 ± 1.1	0.148
Height for age	-1.3 ± 1.3	-1.9 ± 1.4	-2.0 ± 1.6	-1.8 ± 1.5	0.280
Weight for age	-1.4 ± 1.3	-2.0 ± 1.2	-2.2 ± 1.3	-1.9 ± 1.3	0.137

Table (3): In regarding to the dietary adequacy of the energy and macronutrients, the data showed 42.9% of the participated children had low daily dietary intake less than 75% RDA of energy with median 634.3 kcal/day (IQR 25–75th: 414.9–1091.3),

protein with median 17.9 gm/day (9.1–32.0), and carbohydrate with median 94.4 gm/day (53.8 – 156.0), while 31.7 % of studied children had low fat dietary intake less than 75% of RDA with median 24.1 gm (14.7 – 36.8).

Table (3): Distribution and median & IQR of the energy and macronutrient of total children with cow's milk allergy

	No	%	Median	IQR (25 – 75 th)
Calories			638.3 kcal	414.9 – 1091.3
< 50% RDA	7	11.1		
50-75%	20	31.7		
75-120%	18	28.6		
>120%	18	28.6		
Protein			17.9 gm	9.1 – 32.0
< 50% RDA	10	15.9		
50-75%	17	27.0		
75-120%	14	22.2		
>120%	22	34.9		
Carbohydrate			94.4 gm	53.8 – 156.0
< 50% RDA	11	17.5		
50-75%	16	25.4		
75-120%	16	25.4		
>120%	20	31.7		
Fat			24.1gm	14.7 – 36.8
< 50% RDA	15	23.8		
50-75%	5	7.9		
75-120%	18	28.6		
>120%	25	39.7		

Table (4): In regarding to the dietary adequacy of some minerals and vitamins, the data showed 47.6 % of the studied children had low daily dietary calcium intake less than 75% RDA with median 233.8 mg (IQR: 152.4–338.7) below the minimum acceptable level < 300 mg, considering all participants used the vitamin D supplements to meet their RDA. While 44.4 % of studied children had low daily iron intake with median 4.4 mg (1.7 – 8.7), and 30.2 % had low daily dietary zinc intake with median

3.2 mg (1.8 – 5.9) less than 75% of RDA. Daily dietary intake of the vitamins of the participants were showed 23.8 % had low daily dietary vitamin A intake with median 994.4 IU (266.6 – 1435.1), 47.6 % had low dietary vitamin C intake with median 32.2 mg (18.7 – 49.7), 38% had low vitamin B1 intake with median 0.4 µg (0.2 – 0.6), and 39.7 % had low of vitamin B2 intake with median 0.4 µg (0.4 – 0.6) less than 75% RDA.

Table (4): Distribution and median & IQR of some minerals and vitamins of total children with cow's milk allergy

	No	%	Median	IQR (25 – 75 th)
Calcium				
< 50% RDA	21	33.3	233.8 mg	152.4 – 338.7
50-75%	9	14.3		
75-120%	20	31.7		
>120%	13	20.7		
Iron			4.4 mg	1.7 – 8.7
< 50%	21	33.3		
50-75%	7	11.1		
75-120%	7	11.1		
>120%	28	44.4		
Zinc			3.2 mg	1.8 – 5.9
< 50% RDA	6	9.6		
50-75%	13	20.6		
75-120%	15	23.8		
>120%	29	46.0		
Vitamin A			994.4 IU	266.6 – 1435.1
< 50% RDA	13	20.6		
50-75%	2	3.2		
75-120%	6	9.5		
>120%	42	66.7		
Vitamin C			32.2 mg	18.7 – 49.7
< 50% RDA	16	25.4		
50-75%	14	22.2		
75-120%	7	11.1		
>120%	26	41.3		
Vitamin B1			0.4 µg	0.2 – 0.6
< 50% RDA	12	19.0		
50-75%	12	19.0		
75-120%	13	20.6		
>120%	26	41.4		
Vitamin B2			0.4 µg	0.2 – 0.6
< 50% of RDA	10	15.9		
50-75%	15	23.8		
75-120%	18	28.6		
>120%	20	31.7		

Table (5) shows no statistical significant differences of dietary intakes of energy, protein and carbohydrates between the three feeding groups (p-

value > 0.05), while 56% of food intake feeding children group (FI) had low dietary fat intake less

than 75% of RDA with statistical significant lower than the other feeding groups (p-value < 0.009).

Table (6) shows 88% of food intake feeding children group (FI) had lower daily dietary calcium intake <75% RDA than the breast feeding (BF) and special formula (SF) groups (35%, 5.6% respectively) with statistical significant different (p- value < 0.0001), considering 60 % of the children on breast milk feeding met the acceptable level of daily dietary calcium (> 75% RDA). While, we found the low daily dietary iron intake <75% RDA in 50 % of the breast feeding children group, 48% of food intake feeding children group and only 32% of the children on the special formula feeding without statistical significant different between the three feeding groups (p- value < 0.652). In addition, 60% of children among the breast feeding group had low daily dietary zinc intake < 75% RDA with statistical significant different from the other feeding groups (p-value < 0.018).

Table (7) shows sufficient daily dietary vitamin A intake among the children on the breast feeding (BF) and special CMA formula (SF) feeding groups; contrast by, 60% of the food intake feeding children group (FI) had low daily dietary vitamin A intake <75% RDA with highly statistical significant different from the other feeding groups (p – value < 0.0001). Also 65% of the breast feeding children group had low daily dietary vitamin B1 intake < 75% RDA with statistical significant differences from the other groups (p- value < 0.019), while 56% of the children among food intake feeding group had low dietary vitamin B2 intake < 75% RDA with statistical significant differences from other feeding groups (p- value < 0.001). Regarding to the daily dietary vitamin C intake, 65% of the children of breast feeding group, 40% of food intake and 38% special formula feeding groups had low vitamin C dietary intake < 75% RDA without statistical significant difference between the feeding groups (p- value < 0.260).

Table (5) Distribution of the dietary intakes of the calories, protein, carbohydrate and fat according to the feeding groups

	Special Formula N:18		Breast Feeding n:20		Food Intake n:25		Total n:63		p value
	No	%	No	%	No	%	No	%	
Calories									
< 50% of RDA	2	11.1	0	0.0	5	20.0	7	11.1	0.088
50-75%	7	38.9	8	40.0	5	20.0	20	31.7	
75-120%	4	22.2	9	45.0	5	20.0	18	28.6	
>120%	5	27.8	3	15.0	10	40.0	18	28.6	
Protein									
< 50% of RDA	2	11.1	5	25.0	3	12.0	10	15.9	0.405
50-75%	5	27.8	7	35.0	5	20.0	17	27.0	
75-120%	3	16.7	5	25.0	6	24.0	14	22.2	
>120%	8	44.4	3	15.0	11	44.0	22	34.9	
Carbohydrate									
< 50% of RDA	4	22.2	4	20.0	3	12.0	11	17.5	0.103
50-75%	4	22.2	8	40.0	4	16.0	16	25.4	
75-120%	7	38.9	4	20.0	5	20.0	16	25.4	
>120%	3	16.7	4	20.0	13	52.0	20	31.7	
Fat									
< 50% of RDA	4	22.2	0	0.0	11	44.0	15	23.8	0.009
50-75%	2	11.1	0	0.0	3	12.0	5	7.9	
75-120%	6	33.3	8	40.0	4	16.0	18	28.6	
>120%	6	33.3	12	60.0	7	28.0	25	39.7	

Table (6): Distribution of the dietary intakes of the some minerals of children with cow's milk allergy according to feeding groups

	Special Formula n:18		Breast Feeding n:20		Food Intake n:25		Total n:63		p value
	No	%	No	%	No	%	No	%	
Calcium									
< 50% of RDA	1	5.6	0	0.0	20	80.0	21	33.3	0.000
50-75%	0	0.0	7	35.0	2	8.0	9	14.3	
75-120%	6	33.3	12	60.0	2	8.0	20	31.7	
>120%	11	61.1	1	5.0	1	4.0	13	20.7	
Iron									
< 50% of RDA	5	27.8	8	40.0	8	32.0	21	33.3	0.652
50-75%	1	5.6	2	10.0	4	16.0	7	11.1	
75-120%	1	5.6	2	10.0	4	16.0	7	11.1	
>120%	11	61.0	8	40.0	9	36.0	28	44.4	
Zinc									
< 50% of RDA	1	5.6	3	15.0	2	8.0	6	9.6	0.018
50-75%	0	0.0	9	45.0	4	16.0	13	20.6	
75-120%	5	27.8	3	15.0	7	28.0	15	23.8	
>120%	12	66.6	5	25.0	12	48.0	29	46.0	

Table (7): Distribution of the dietary intakes of some vitamins of children with cow's milk allergy according to feeding groups

	Special Formula n:18		Breast Feeding n:20		Food Intake n:25		Total n:63		p value
	No	%	No	%	No	%	No	%	
Vitamin A									
< 50%	0	0.0	0	0.0	13	52.0	13	20.6	0.000
50-75%	0	0.0	0	0.0	2	8.0	2	3.2	
75-120%	4	22.2	0	0.0	2	8.0	6	9.5	
> 120%	14	77.8	20	100.0	8	32.0	42	66.7	
Vitamin C									
< 50%	4	22.2	7	35.0	5	20.0	16	25.4	0.260
50-75%	3	16.7	6	30.0	5	20.0	14	22.2	
75-120%	4	22.23	2	10.0	1	4.0	7	11.1	
> 120%	7	8.9	5	25.0	14	56.0	26	41.3	
Vitamin B1									
< 50%	0	0.0	8	40.0	4	16.0	12	19.0	0.019
50-75%	2	11.1	5	25.0	5	20.0	12	19.0	
75-120%	5	27.8	4	20.0	4	16.0	13	20.6	
> 120%	11	61.1	3	15.0	12	48.0	26	41.4	
Vitamin B2									
< 50%	0	0.0	0	0.0	10	40.0	10	15.9	0.001
50-75%	3	16.7	8	40.0	4	16.0	15	23.8	
75-120%	5	27.8	7	35.0	6	24.0	18	28.6	
> 120%	10	55.5	5	25.0	5	20.0	20	31.7	

Table (8) shows the median & interquartile range (IQR: 25–75th) of energy and macronutrients of the feeding groups that found the food intake feeding group had the median of daily dietary intake of calories, protein, carbohydrates were 954.8 kcal, 27.1 gm, 154 gm respectively which was statistically

significant higher than other feeding groups (*p*-value < 0.003, 0.0001, 0.0001 respectively), while it was no statistical significant difference of the median of the daily dietary fat intake between the feeding groups (*p*-value < 0.526) .

Table (8): Median & IQR (25-75th) of dietary intakes of the calories, protein, carbohydrate and fat according to feeding groups of children with cow's milk allergy

	Special Formula n: 18	Breast Feeding n: 20	Food Intake n: 25	Total n: 63	p value
Calories					
Median (kcal)	578.9	539.9	954.8	638.3	0.003
IQR (25 – 75 th)	331.6 – 881.4	399.9 – 860.1	523.4 – 1752.8	414.9 – 1091.3	
Protein					
Median (gm)	16.2	9.7	27.1	17.9	0.000
IQR (25 – 75 th)	8.5 – 25.7	6.9 – 23.6	17.1 – 65.6	9.1 – 32.0	
Carbohydrate					
Median (gm)	78.9	62.9	154.0	94.4	0.000
IQR (25 – 75 th)	43.3 – 112.7	41.4 – 121.2	95.7 – 250.4	53.8 – 156.0	
Fat					
Median (gm)	19.7	26.5	20.6	24.1	0.526
IQR (25 – 75 th)	14.1 – 34.1	23.2 – 37.3	6.8 – 37.3	14.7 – 36.8	

Table (9) shows the median & IQR of some minerals and vitamins, the data showed the median of daily dietary calcium intake of the special formula feeding children group was 378 mg (IQR 25-75th: 253.1 – 672.7), higher than breast feeding 229.5 mg (191.0 – 256.3) and food intake groups 131 mg (85.6 – 222.9) that had the lowest daily dietary calcium intake, with highly statistical significant differences between the feeding groups (p-value < 0.0001).

The median of daily dietary iron intake was 6.7 mg (3.9 – 9.8) of the food intake feeding children group higher than special formula feeding group 5.2 mg (4.2 – 11.4), and breast feeding group 1.4 mg (0.6 – 4.0) that had the lowest daily dietary iron intake with statistical significant difference between the three feeding groups (p-value < 0.004).

Also, the median of daily dietary zinc intake was 3.6 mg (3.2 – 7.3) of special formula children

group higher than food intake feeding group with 3.5 mg (3.6 – 7.0), and breast feeding group with 1.6 mg (1.3 – 3.7) that had the lowest daily dietary zinc intake, with statistical significant between the three feeding groups (p-value < 0.005).

The median of daily dietary vitamin B1 intake was 0.4 µg (0.2 – 0.7) of the breast feeding children group with statistical significant lower than other feeding groups (p-value < 0.003), while the median daily dietary intake of vitamin B2 among special formula feeding group was 0.5 µg (0.3 – 0.8) with statistical significant higher than the breast feeding and food intake groups with the same median 0.4 µg (0.2 – 0.5) (p-value < 0.013). While, median of the daily dietary vitamin A & C intakes were showed no statistical significant differences between the feeding groups.

Table (9): Median & IQR (25-75th) of some minerals & vitamins according to feeding groups of children with cow's milk allergy

	Special Formula n: 18	Breast Feeding n: 20	Food Intake n: 25	Total n: 63	p value
Calcium					
Median (mg)	378.0	229.5	131.0	233.8	0.000
IQR (25 – 75 th)	253.1 – 672.7	191.0 – 256.3	85.6 – 222.9	152.4 – 338.7	
Iron					
Median (mg)	5.2	1.4	6.7	4.4	0.004
IQR (25 – 75 th)	4.2 – 11.4	0.6 – 4.0	3.9 – 9.8	1.7 – 8.7	
Zinc					
Median (mg)	3.4	1.6	3.5	3.2	0.005
IQR (25 – 75 th)	3.2 – 7.3	1.3 – 3.7	3.6 – 7.0	1.8 – 5.9	
Vitamin A					
Median (IU)	799.6	1292.2	130.0	994.4	0.200
IQR (25 – 75 th)	550.6 – 2063.3	1191.6 – 1460.2	9.8 – 576.1	266.6 – 1435.1	
Vitamin C					
Median (mg)	36.3	25.3	34.4	32.2	0.198
IQR (25 – 75 th)	24.1 – 62.0	19.1 – 39.9	10.5 – 61.0	18.7 – 49.7	
Vitamin B1					
Median (µg)	0.4	0.1	0.6	0.4	0.003
IQR (25 – 75 th)	0.2 – 0.7	0.1 – 0.4	0.3 – 0.7	0.2 – 0.6	
Vitamin B2					
Median (µg)	0.5	0.3	0.3	0.4	0.013
IQR (25 – 75 th)	0.3 – 0.8	0.2 – 0.5	0.2 – 0.5	0.4 – 0.6	

Table (10) shows the most frequent food items consumed by the participated infants with cow's milk allergy on cow's milk exclusion diet were the beverages, fruits, cereals, potatoes and vegetables then meat respectively; while, the least frequent food items intakes were fat then legumes. Vegetables intake by the children on food intake feeding was higher than the other feeding groups with statistical significant differences (p-value <0.008). While, no statistical significant differences the other food items were found between the feeding groups.

Table (11) shows the mean \pm SD of the serum ionized calcium of studied children with cow's milk allergy was 1.1 ± 0.1 mmol/L with no statistical significant differences between the three feeding groups (p-value < 0.670). Also the study was found

no correlation between the dietary calcium intake and serum ionized calcium among the feeding groups. The mean \pm SD of blood HB gm/dl of the studied children was 10.3 ± 1.2 gm/dl with no statistical significant differences between the feeding groups (p-value < 0.063). A positive correlations were found between the dietary iron intake and blood HB gm/dl ($r= 0.356$, p-value< 0.004), RBCs ($r= 0.408$, p-value <0.007), and MCHC ($r=0.345$, p-value< 0.05) of the participated children; while, in regarding to the feeding groups, a positive correlation was found between the dietary iron intake and blood HB gm/dl among the food intake feeding children group (FI) only ($r=462$, p-value <0.02), without correlation to the others feeding groups.

Table (10): Mean \pm SD of food frequency amount of children with cow's milk allergy according to feeding groups

	Special Formula	Breast Feeding	Food Intake	Total	P value
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	
Cereals	51.1 \pm 36.4	60.0 \pm 55.0	93.2 \pm 73.8	77.5 \pm 65.9	0.198
Potatoes	37.4 \pm 32.6	62.0 \pm 36.3	72.8 \pm 40.1	66.1 \pm 38.9	0.354
Legumes	9.6 \pm 8.8	30.6 \pm 21.4	35.0 \pm 48.5	30.0 \pm 41.3	0.483
Oils	4.1 \pm 1.7	6.7 \pm 2.6	8.3 \pm 3.4	7.5 \pm 3.4	0.099
Meat products	42.9 \pm 30.3	32.6 \pm 19.7	57.0 \pm 37.3	49.5 \pm 34.0	0.225
Vegetables	21.1 \pm 28.1	39.6 \pm 31.4	102.6 \pm 105.4	64.6 \pm 82.0	0.008
Fruits	95.5 \pm 136.8	54.9 \pm 47.3	97.3 \pm 107.5	85.0 \pm 97.0	0.523
Beverages	46.4 \pm 25.3	21.4 \pm 10.1	112.5 \pm 108.0	94.0 \pm 100.1	0.403

A significant positive correlations were found between age and the dietary intakes of calories, protein, carbohydrate, iron, zinc and vitamin B1 of the participants ($r: 0.513, .0627, 0.622, 0.472, 0.387, 0.472$ respectively with p - value < 0.0001), a significant positive correlations had found between the weight of the participants and dietary intakes of calories, protein, carbohydrate, iron ($r= 0.447, 0.543, 0.506, 0.460$, respectively with p-value <0.0001) and zinc ($r=0.348$, p-value <0.005), as well the height of participated children had a significant positive correlations to the dietary intakes of calories, protein, carbohydrate, iron ($r= 0.453, 0.542, 0.540, 0.443$, respectively with p-value <0.0001) and zinc ($r=0.323$, p-value <0.010). While significant positive correlations were found between the dietary calcium intake and both weight for height and weight for age of participated children ($r: 0.311, p- value < 0.013, r: 0.307, p- value < 0.014$ respectively).

Table (12) shows the positive significant correlations of height to the dietary intakes of the

calories, protein, carbohydrate, fat, calcium, iron, zinc, vitamins B1 and B2 among the children on the breast feeding; while, the height of children on the special formula feeding (SF) had been positive significant correlations to the dietary intakes of calories, protein, carbohydrate and vitamin B1.

Also, among the breast feeding children (BF), the data showed positive significant correlations between age and weight to the dietary intakes of calories, protein, carbohydrate, fat, calcium, iron, zinc vitamins C & B1 & B2. While, the special formula feeding children (SF) had positive significant correlations between the height for age and the dietary intakes of the calories, protein, carbohydrate and fat ($r: 0.552, p value < 0.017, r: 0.554, p - value < 0.017, r: 0.486, p- value <0.041, r: 0.536, p- value <0.022$ respectively), also positive significant correlations to vitamins C & B1& B2 ($r: 0.563, p - value <0.015, r: 0.559, p - value < 0.016, r: 0.598, p - value < 0.009$ respectively).

Table (11): Mean \pm SD of the laboratory investigations of children with cow's milk allergy according to feeding groups

	Special Formula	Breast Feeding	Food Intake	Total	p value
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	
HB gm/dl	10.0 \pm 1.3	10.1 \pm 0.8	10.8 \pm 1.3	10.3 \pm 1.2	0.063
HCT %	33.2 \pm 4.4	30.7 \pm 2.2	32.9 \pm 4.1	32.4 \pm 3.8	0.448
RBC	4.0 \pm 0.2	3.9 \pm 0.4	4.1 \pm 0.5	4.0 \pm 0.4	0.586
MCV (fl)	71.0 \pm 7.1	70.8 \pm 6.7	71.7 \pm 10.3	71.2 \pm 8.3	0.928
MCH pg	23.0 \pm 2.0	22.6 \pm 1.8	23.5 \pm 2.4	23.1 \pm 2.1	0.372
MCHC g/dl	31.6 \pm 0.8	30.2 \pm 2.0	31.9 \pm 1.5	31.2 \pm 1.6	0.036
Plts	246.8 \pm 110.6	306.4 \pm 129.6	341.9 \pm 125.3	301.1 \pm 126.2	0.094
WBC	9.7 \pm 2.0	9.8 \pm 2.2	8.5 \pm 1.6	9.3 \pm 2.0	0.113
Serum IonizedCa ⁺ mmol/L	1.1 \pm 0.1	1.1 \pm 0.1	1.1 \pm 0.1	1.1 \pm 0.1	0.670

Table (12): Correlation between height and nutrients intake of children with cow's milk allergy according to feeding groups

	Height							
	Special Formula		Breast Feeding		Food Intake		Total	
	r	p	r	p	r	p	r	p
Calories	0.654	0.003	0.666	0.001	-0.128	0.541	0.453	0.000
Protein	0.627	0.005	0.649	0.002	0.032	0.880	0.542	0.000
Carbohydrate	0.681	0.002	0.680	0.001	-0.075	0.721	0.540	0.000
Fat	0.323	0.191	0.546	0.013	-0.003	0.987	0.109	0.396
Calcium	0.219	0.382	0.524	0.018	0.145	0.489	-0.104	0.416
Iron	0.418	0.084	0.615	0.004	0.244	0.240	0.443	0.000
Zinc	0.441	0.067	0.606	0.005	0.011	0.958	0.323	0.010
Vitamin A	-0.087	0.739	0.081	0.733	-0.171	0.414	-0.385	0.002
Vitamin C	0.311	0.209	0.394	0.085	0.281	0.173	0.236	0.063
Vitamin B1	0.578	0.012	0.636	0.003	0.074	0.724	0.446	0.000
Vitamin B2	0.393	0.106	0.451	0.046	0.028	0.894	0.080	0.534

4. Discussion

Cow's milk allergy (CMA) is an important form of food allergy has been steadily increasing over the past two decades [33]. Cow's milk allergy (CMA) has the potential to affect nutrition and growth [34]. The only available treatment is exclusion of milk from the diet. However, as milk is an essential source of nutrients in infants, a milk-free diet may not sufficiently meet the babies' nutritional requirements.

Our study was an observational cross-section study to assess the nutritional status and the dietary intakes of the infants and young children with adverse reactions to cow's milk protein on cows' milk exclusion diet without previous appropriate dietary advices aiming to explain the nutritional implications of unsupervised cows' milk elimination diets according to the different feeding patters. Our study included 63 participated infants and young children categorized into three subgroups according to their feeding pattern, the breast feeding group (BF) 31.7%,

the special milk formula feeding group (SF) 28.6%, and the food intake feeding group (FI) 39.7%.

We found about half of participated children (48-49%) under weight and stunted for age. The growth of the children on the full solid food intake feeding (FI) was more affected comparing with the other feeding patterns groups regarding the weight, height and weight for height for age. While, the least affected children were found on the special formula feeding (SF), which can be attributed to its higher contents of energy and nutrient elements needed to growth of the children with cow's milk allergy on the cow's milk free diet with no statistical significant differences between the three feeding groups. Therefore, we assumed the nutritional needs of studied children may unmet on cow's milk free diets resulting in the observed growth retardation.

Similarly, the reduced growth in infants on non-dairy meals was cleared in two Finnish investigations [35]. The low energy intake, decreased growth and biochemical signs of insufficient nutrition have been

cleared in babies younger than 4 years with cows' milk allergy followed at the Children's Hospital in Helsinki, Finland [36]. Furthermore, previous study showed the infants were of low relative height (height for age under the 10th percentile) in the group of infants on non-dairy diets with no statistical significance compared with the controls group [20], other study of US children population found mean weight, height, and BMI were significantly lower in those with milk allergy in multivariate analyses [37]. Berni Canani et al. [38] in Italy, proved that dietetic input has a positive significant impact on anthropometric and laboratory biomarkers of nutritional status in young babies with CMA.

Recent study done in Poland enrolled 46 children aged 13–36 months with cow's milk protein allergy diagnosis, following a milk elimination diet and 30 healthy children of the same age as control group that reported only 10.87% of infants with cow's milk protein allergy and 16.67% of infants in the control group were found to be underweight [39].

Interesting data were cleared by Tuokkola, et al. in a study carried out on infants with CMPA treated with a non-dairy meals, where nutritional intake at age 1, 2 and 3 year was evaluated and anthropometric measurements were made once a year until the age of 5. They reported that, in spite of the balanced diets, the growth of these infants was slower in comparison with healthy infants on a traditional meal [40].

Jarvinen et al. [41] showed that babies with a food allergy had a rise in small intestine permeability after eating the offending food and through an exclusion meal. Increased requirements for nutrient elements may be relevant, related to reduced absorption, inflammation, or losses in the gut. The growth retardation may be due to malabsorption before the diagnosis of cow's milk allergy can be possible explanations. Cow's milk allergy in particular is potential risk factors for reduced weight-for-age percentiles, height-for-age percentiles, or both [42].

In the current study, 42.9% of the participated children unmet the recommended daily dietary intakes of energy, protein, carbohydrate (<75%RDA) without statistical significant differences between the three feeding groups; while, 31.7% of studied children unmet the needed daily dietary fat intake with 56% of the children on the food intake feeding had statistical significant lower dietary fat intake than the other feeding groups.

Previous dietary scanning was performed to determine the nutrient intake of 34 infants (31–37 months) on cows' milk-restricted diet, using a four day weighed recording method. The nutrient intake in a group of infants on cows' milk protein-free ($n = 16$) and cows' milk decreased ($n = 8$) diets was compared

with that of a group of cows' milk user ($n = 10$) who all received dietary advice in contrast to our study. This previous study was found energy, fat, protein, calcium, riboflavin, and niacin intakes were substantially lower in children on milk-free diets, with almost half of the infants on non-dairy diets having exactly low fat intakes (<20% energy from fat). The nutritional value of the cows' milk-free diets was increased with the use of milk substitutes [20].

While, a nested matched case-control study done by Maslin et al., [43] done to analyze the diets of 39 infants divided into 13 infants on non-dairy diet following dietary advice from a specialist allergy dietitian and 26 normal infants as control on unrestricted milk diet, mean age of children at diet commencement was 14 weeks (range 5-36 weeks). This study found all children had average intakes in abundant of the determined mean requirements for energy and the recommended nutrient intakes (RNI) for protein, calcium, iron, selenium, zinc, vitamins A, C, and E.

Also, a Poland study was demonstrated excessive intake of protein, carbohydrates, sodium, phosphorus, magnesium, vitamins A and C in both cow's milk allergic children and control groups on the basis of a 3-day food recording for nutrition analysis by participants' parents [40].

In the present study, we found 47.6 % of participated children had unaccepted daily dietary calcium intake with median 233.8 mg and 60% of studied children on breast milk feeding reached acceptable daily calcium intake. While, 88% of the children among food intake feeding group unmet the recommended dietary calcium intake with majority had unsafe intake level < 50% RDA. The median of the daily dietary calcium intake special formula feeding children was statistical significant higher than other feeding groups (p -value < 0.0001). So, the study indicated use of special milk substitute's formula enhanced the nutritional calcium content of the non-dairy diets of studied children, and it was dependent on the amount of formula used, it might to be used when appropriate especially if the children were on the food intake.

As reported in previous study that none of the infants in the non-dairy group reached the recommended calcium intake levels. This is a well known consequence of non-dairy diets [44], with probability of enhanced risk of osteoporotic fractures. However, the impact of low calcium intake on the harmful of osteoporotic fractures has been difficult to assess in epidemiological investigates [45].

Meyer et al. [46] cleared that both reduction and overuse of calcium is found in infants consuming elimination diets, implying that individualized

dietetic advice rather than blanket recommendation of supplementation is warranted.

Breast milk contains small amounts of calcium (20-34 mg/dl) but with high absorption, yet the infants absorb 67 % of calcium in human milk as compared with only 25 % of that in cow milk [29]. So, all infants in the milk free diet should meet the recommended dietary calcium intake from the other calcium rich foods items guided by the dietary advice as in Maslin et al., study [43], and calcium supplements as needed.

Also, we showed 44.4 % of all participants had reduced daily dietary iron intake and about 48 - 50% were on each of food intake and breast feeding groups had low dietary iron intake probably because of delayed proper weaning with complementary iron rich foods to fill their recommended iron intake (RDA) for age; while, only 32% of children on special formula (SF) feeding due to iron fortification of the milk formula with no statistical significant difference between the feeding groups. Similarly, previous study reported iron intake of the children on milk formula feeding met the RDA, but the breast-fed children unmet, the use of formula was positively correlated to iron intake. Also Maslin et al [43] and Meyer et al [46] cleared the link between the use of special formula and micronutrient intake, involving iron. It is well known that breast milk must be complemented by iron sources from 6 months of age in healthy infants [47].

We found the median dietary iron intake of children among food intake feeding group was statistically significant higher than other feeding groups (p -value < 0.004) with a positive correlation between mean \pm SD blood HB% and dietary iron intake among the food intake feeding group (FI). Also, our data showed no statistical significant differences of the means \pm SD of HB% between the feeding groups children, with positive correlation between dietary iron intake and blood HB% ($r = 0.356$, p -value < 0.004) of the participated children; Cow's milk allergic infants may be at enhanced risk of iron deficiency due to intestinal losses (colitis and inflammation) [47]. Previous study showed the average daily iron intake to be statistical significantly higher of children of the non-dairy group on special milk formula of CMA compared to the control group on standard infant formula between weeks 24 and 28 of age, which can be attributed to the higher iron content of specialized formula used for CMA, compared to standard infant formula [43].

The current study showed 60% of children among breast feeding group had reduced dietary zinc intake with statistically significant lower than other feeding groups; contrast to, the dietary zinc intake

was higher among children on the special formula and food intake feeding groups.

As, previous study was done in children on a cow's milk exclusion diet with three feeding manners include mainly breast-fed, partially breast-fed and no breast fed showed Iron, zinc, and vitamin D deficiencies were found in all feeding groups with lower zinc intake in breast fed infant [48].

Dairy foods are essential dietary sources of zinc. In CMA low intakes of zinc have been cleared, and zinc deficiency has been determined [49]. Also Berni- Canani et al., found 23% of Italian CMA infant and babies had low zinc values, significantly more than in healthy children. Zinc consumption was also lower in CMA than healthy children [49]. The serum zinc is not sensitive biomarker so symptoms of zinc deficiency and low dietary intake may be more essential when evaluated zinc status. Meyer et al., [46], found zinc intake linked to use of milk formula as presented in the current study.

Our study found sufficient dietary vitamin A intake among the children on the breast feeding and special CMA formula (SF) feeding groups; while, 60% of the food intake feeding children group unmet their dietary recommended intake with highly statistical significant than the other feeding groups. Our study found 65% of breast feeding children group had low dietary vitamin C without statistical significant differences between the feeding groups; also, 65% of these children had lower dietary vitamin B1 intake with statistical significant differences from the other feeding groups.

While, 56% of the food intake feeding children group had statistical significant low daily dietary vitamin B2 (riboflavin) intake than other feeding groups.

Also, a previous study reported none of the infants in the non-dairy group reached the recommended riboflavin intake levels [20]. While, other study demonstrated all infants on milk free diet following dietary advice had the recommended nutrient intakes (RNI) for calcium, iron, selenium, zinc, vitamins A, C, D, and E [43]. As reported some components of human milk vary by maternal food intake, such as water soluble B and C vitamins, calcium [50]

It is well recognized that some parents may use restricted diets without medical consultation. [51]. A major strength of our study it was applied to infants on milk exclusion diet without previous dietary advices to assess the nutritional status of infants and young children with cow's milk allergy on cow's milk free, comparable with other many studied demonstrate the nutritional intakes of cow's milk allergy infants who were on milk exclusion diet with dietary advices. In the study, we found cow's milk

allergy children on the milk free diet were at risk and the nutritional needs of cow's milk allergy children were inadequately met that may contribute to the malnutrition observed among these children on the cow's milk exclusion diet. Also the study sample size of 63 children with cow's milk allergy and their dietary assessment of different feeding patterns of the milk free diet comparable with other small some published studies of dietary intake of cow's milk allergy.

We used the 24hrs recalls and food frequency questionnaire to assess the daily nutritional intakes of cow's milk allergic children on cow's milk exclusion diet in this study, the average of three separate 24hrs recalls were taken to eliminate the recall bias and resulted in feasible and reliable data of nutritional intakes of participated children. The weighed food records method was time consuming and hard to be obtained by parents of participants.

Limitation and challenges of our study, the cross sectional design of this study due to the rare nature of the disease, also to be less cost and time consuming. Other limitations were no a healthy references group, and inability to determine the temporal correlations. Also, reported variations of quantities and contents of human breast milk, collection and analyses of breast milk is desiring and difficult, and the data are impacted by alterations in content [52], Human breast milk's composition is dynamic and varies over time, adapting itself to the changing demands of the growing infant [53], with no assessment of maternal diet was not done. More studies of mother's diet on cow's milk exclusion and breast milk composition are needed.

Insufficient nutrition elements in early infancy may have long lasting adverse effects on health; further, researches and studies of cow's milk free diet will be needed to enhance knowledge on nutritional status in infants and children with cow's milk allergy.

Conclusion:

Our study showed cow's milk allergic children on cow's milk exclusion diet had low dietary intake of energy, protein carbohydrate, fat, calcium, zinc and vitamin A & B2, with observed results of malnutrition, unless the precautions are taken to replace the essential nutrients of milk in the diet. Parents of infants on non-dairy diets need appropriate nutritional advice about food choices in order to decrease adverse nutritional consequences of cow's milk exclusion diets. It is important to keep emphasizing to parents and caregivers of children that restricting a child's diet without adequate medical and dietetic intervention is not a proper option.

Recommendation

Infant with suspected cow's milk allergy are demand to follow a strict milk elimination diet which may lead to nutritional deficiencies. The cow's milk exclusion diet should ideally be supported by input from clinical nutritionist and or dietitian to monitor and optimize the nutritional content of the diet and to maintain potential growth for children with milk allergy. The effort should be made to ensure milk exclusion diets are as varied as possible to optimize nutritional intake. Parents of infants on non-dairy diets need dietary advice about food choices in order to decrease the risk of low intake of energy, protein, carbohydrate, fat by providing sufficient amounts. Complementary feeding should be introduced at 6 months of age. Supplementation with milk substitutes enhances the nutritional content of cows' milk free diets significantly. A calcium supplementation is recommended for all small babies (1–3 y of age) on non-dairy diets as needed. Also supplements of vitamin A, riboflavin and zinc as indicated.

Declaration of interest

There are no conflicts of interest reported by the authors. The authors are jointly responsible for the paper's content and writing.

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