Prevalence of vitamin A deficiency among preschool children, pregnant and lactating women in four Iraqi governorates

By

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List of Abbreviations

CFSVA …………………..Comprehensive Food Security and Vulnerability Analysis

HPLC ……………………High Performance Liquid Chromatography

M …………………………Mean

NRI ………………………Nutrition Research Institute

SD ………………………..Standard Deviation

SR ………………………..Serum Retinol

VAD ……………………..Vitamin A Deficiency

WHO …………………….World Health Organization

Summery

The present study is an attempt to estimate the prevalence of vitamin A deficiency among preschool age children, pregnant and lactating women visiting 12 primary health care centers in four governorates Ninevah, Basrah, Thi-Qar and Diayla (3 in each governorate), the study was conducted for the period from 11-14/October /2010

The sample was comprised of 600 subjects (150 for each governorate and an average of 50 subjects per primary health care center), a total of 225 (37.5 %) preschool age children, 192 (32.0 %) Lactating women, and 183 (30.5 %) pregnant were included in the study.

The data were collected through direct interview; blood samples were taken and analyzed for serum retinol, anthropometric measurements were obtained for the preschool age children.

The study showed that the overall prevalence of vitamin A deficiency was (6.7%) with a percentage of (13.8%) among preschool age children (below 6 years), (2.7 %) among lactating women and (1.6 %) among pregnant women.

Introduction

Vitamin A deficiency: a public health problem

Vitamin A deficiency (VAD) is a major nutritional problem in poor societies, especially in lower income countries. The prevalence of vitamin A deficiency in a population is assessed by specific biochemical and clinical indicators of status. The main underlying cause of VAD as a public health problem is a diet that is chronically insufficient in vitamin A that can lead to lower body stores and fail to meet physiologic needs (e.g. support tissue growth, normal metabolism, resistance to infection).

Deficiency of sufficient duration or severity can lead to disorders that are common in vitamin A deficient populations such as xerophthalmia (xeros = dryness;-ophthalmia = pertaining to the eye), the leading cause of preventable childhood blindness, anemia, and weakened host resistance to infection, which can increase the severity of infectious diseases and risk of death. A poor diet and infection frequently coexist and interact in populations whereVAD is widespread. In such settings, VAD can increase the severity of infection which, in turn, can reduce intake and accelerate body losses of vitamin A to exacerbate deficiency.

The prevalence and severity of xerophthalmia, anemia and the (less-measurable) "vicious cycle" between VAD and infection in vulnerable groups (notably young children and pregnant or lactating mothers) represent the most compelling consequences of VAD and underlie its significance as a public health problem around the world.(4)

In 1987, WHO estimated that vitamin A deficiency was endemic in 39 countries based on the ocular manifestations of xerophthalmia or deficient serum (plasma) retinol concentrations(<0.35 μmol/l). In 1995, WHO updated these estimates and reported that vitamin A deficiency was of public health significance in 60 countries, and was likely to be a problem in an additional 13 countries. The current estimates reflect the time period between 1995 and 2005 indicate that 45 and 122 countries have vitamin A deficiencyof public health significance based on the prevalence of night blindness and biochemical vitamin A deficiency (serum retinol concentration <0.70 μmol/l), respectively, in preschool-age children. In 1995, the World Health Organization estimated 254 million children to be vitamin A-deficient and 2.8 million to have xerophthalmia. Subsequently, estimates were changed to 75–140 million and 3.3 million, respectively.(*12*)

Estimates of vitamin A deficiencyare provided for preschool-age children and also for pregnant and lactating women assessed by more widely adopted serum (plasma) retinol concentration,using a cut-off of <0.70 μmol/l (<20 μg/dl) to define deficiency.(14)

Etiology

Vitamin A is an essential nutrient needed in small amountsfor the normal functioning of the visual system, and maintenance of cell function for growth, epithelial integrity, red blood cell production, immunity and reproduction. Essential nutrients can not be synthesized by the body and therefore must be provided through diet. When dietary intake is chronically low, there will be insufficient vitamin A to support vision and cellular processes, leading to impaired tissue function.

Low vitamin A intake during nutritionally demanding periods in life, such as infancy, childhood, pregnancy and lactation, greatly raises the risk of health consequences, or vitamin A deficiency disorders.

Dietary deficiency can begin early in life, with colostrums being discarded or breastfeeding being inadequate, there by denying infants of their first, critical source of vitamin A(*1*). Thereafter, into adulthood, a diet deficient in vitaminA lacks foods containing either preformed vitamin A esters,such as liver, milk, cheese, eggs or food products fortified with vitamin A or lacking its carotenoid precursors (mainly beta-carotene), such as green leaves, carrots, ripe mangos,eggs, and other orange-yellow vegetables and fruits. Where animal source or fortified foods are minimally consumed, dietary adequacy must rely heavily on foods providing beta-carotene. However, while nutritious in many ways, a diet with modest amounts of vegetables and fruits as the sole source of vitamin A may not deliver adequate amounts, based on an intestinal carotenoid-to-retinol conversion ratio of 12:1 (*2*). This ratio reflects a conversion efficiency thatis about half that previously thought, leading to greater appreciation for why VAD may coexist in cultures that heavily depend on vegetables and fruits as their sole or maindietary source of vitamin A.Usually, VAD develops in an environment of ecological, social and economical deprivation, in which a chronically deficient dietary intake of vitamin A coexists with severe infections, such as measles, and frequent infections causing diarrhea and respiratory diseases that can lower intake through depressed appetite and absorption, and deplete body stores of vitamin A through excessive metabolism and excretion (*3*, *4*). The consequent "synergism" can result in the body's liver stores becoming depleted and peripheral tissueand serum retinol concentrations decreasing to deficient levels, raising the risks of xerophthalmia, further infection, other VADD and mortality.(*12*)

Health consequences

Vitamin A deficiency impairs numerous functions and, as a result, can lead to many health consequences, to which infants, young children and pregnant women appear to be at greatest risk. Xerophthalmia is the most specific vitamin A deficiency disorders, and is the leading preventable cause of blindness in children throughout the world (*5*). Night blindness often appears during pregnancy, a likely consequence of preexisting,marginal maternal vitamin A status superimposed by nutritional demands of pregnancy and inter current infections(*6*). Anemia can result from VAD in children and women,likely due to multiple apparent roles of vitamin A in supporting iron mobilization and transport, and hematopoiesis(*7*). Preexisting VAD appears to worsen infection (*8*) and vitamin A supplementation has been shown to reduce the risk of death in 6–59 month old children by about 23–30% (*9–11*). Three trials from southern Asia have reported that neonatal vitamin A supplementation reduced mortality by 21% in the first six months of life (*12*) while two other studies conducted in Africa showed no impact of this intervention(*13, 14*). One study has reported an approximate 40%reduction in maternal mortality following routine dietary supplementation with vitamin A during pregnancy (*15*).

Assessing vitamin A status and deficiency

The main objective of assessing vitamin A status is to determinethe magnitude, severity and distribution of VAD in a population. Most surveys assess its prevalence in young children and, with increasing frequency, in pregnant or lactating women, as reported here. Although VAD is likely to be wide spread following the preschool years, few data exist to reveal the extent of VAD in school-age and young adolescentchildren (*16*). Estimating the national prevalenceis to be encouraged as such data aids in targeting regions for interventions, and provides baseline values for monitoring population trends and intervention programme impact over time.

Two sets of indicators of VAD are commonly used for population surveys: clinically assessed eye signs and biochemically determined concentrations of retinol in plasma or serum. The term xerophthalmia encompasses the clinical spectrum of ocular manifestations of VAD, from milder stages of night blindness and Bitot`s spots, to potentially blinding stages of corneal xerosis, ulceration and necrosis (keratomalacia) (*17*). The stages of xerophthalmia are regarded both as disorders and clinicalindicators of VAD, and thus can be used to estimate an important aspect of morbidity and blinding disability as wellas the prevalence of deficiency. As corneal disease is rare, the most commonly assessed stages are night blindness, obtainable by history, and Bitot`s spots, observable by hand light examination of the conjunctival surface. Standard procedures exist for assessing xerophthalmia (*17*). Although night blindness and Bitot`s spots are considered mild stagesof eye disease, both represent moderate-to-severe systemicVAD, as evidenced by low serum retinol concentrations(*19*), and increased severity of infectious morbidity (i.e. diarrhea and respiratory infections) and mortality in children(*5*) and pregnant women (*6*, *20*).

Measuring serum retinol concentrations in a population constitutes the second major approach to assessing vitamin A status in a population, with values below a cut-off of0.70 μmol/l representing VAD (*21*), and below

0.35 μmol/lrepresenting severe VAD. Although there is not yet international consensus, a serum retinol concentration below a cut off of 1.05 μmol/l has been proposed to reflect low vitaminA status among pregnant and lactating women (*22*). While the distribution of serum retinol concentrations below appropriatecut-offs are considered to reflect inadequate states of vitamin A nurture, a low biochemical concentration of retinol in circulation is not considered a VAD. Also, while an inadequate dietary intake of vitamin A or beta-carotene likely reveals an important and preventable cause of VAD in a population, it is not an indicator of vitamin A status.

Aims of the study

1) To estimate the extent of vitamin A deficiency among preschool age children, pregnant and lactating women in four Iraqi provinces
2) The relation between VAD with some demographical, nutritional, biologicaland environmental variables has also been considered.

Materials and Methods

Selection of survey data and study design

This study a cross-sectional study was performed in four Iraqi provinces (Basrah, Thiqar, Dialya and Ninevah) during the period from 11-14 / October/ 2010. The overall study sample is 600 persons (preschool age children, pregnant and lactating women) attending 12 Primary Health Care centers (PHC) selected conviently (3 PHC for each province) according to indicators of the Comprehensive Food Security and Vulnerability Analysis (CFSVA 2008).

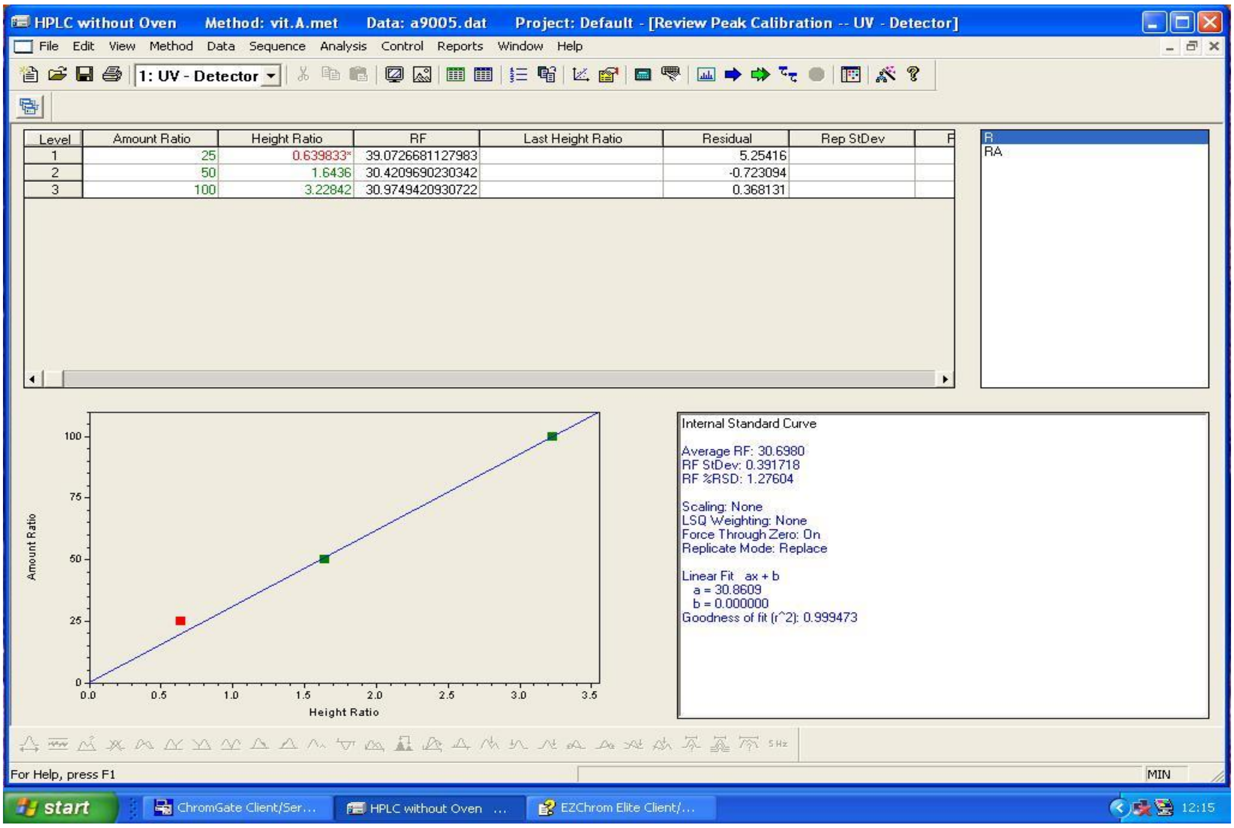
Data Collection

Four qualified central supervising members from Nutrition Research Institute (NRI) were trained on survey questionnaire which includes information on different demographical, educational, social ,laboratory and nutritional parameters for the study sample (preschool age children , pregnant and lactating women).Three peripheral teams (each team consists of 3 members ranging from health workers and lab technicians) along with one local supervisor for each province included in the study were trained locally on sample preparation laboratory techniques , questionnaire form and anthropometry by the central supervisors dispatched to each governorate. Data collection carried out for the period between October11th to 14th, 2010 and 150 samples were collected (including both preschool age children and pregnant and lactating women) for each province (an average of 50 samples per PHC and 600 overall study samples).

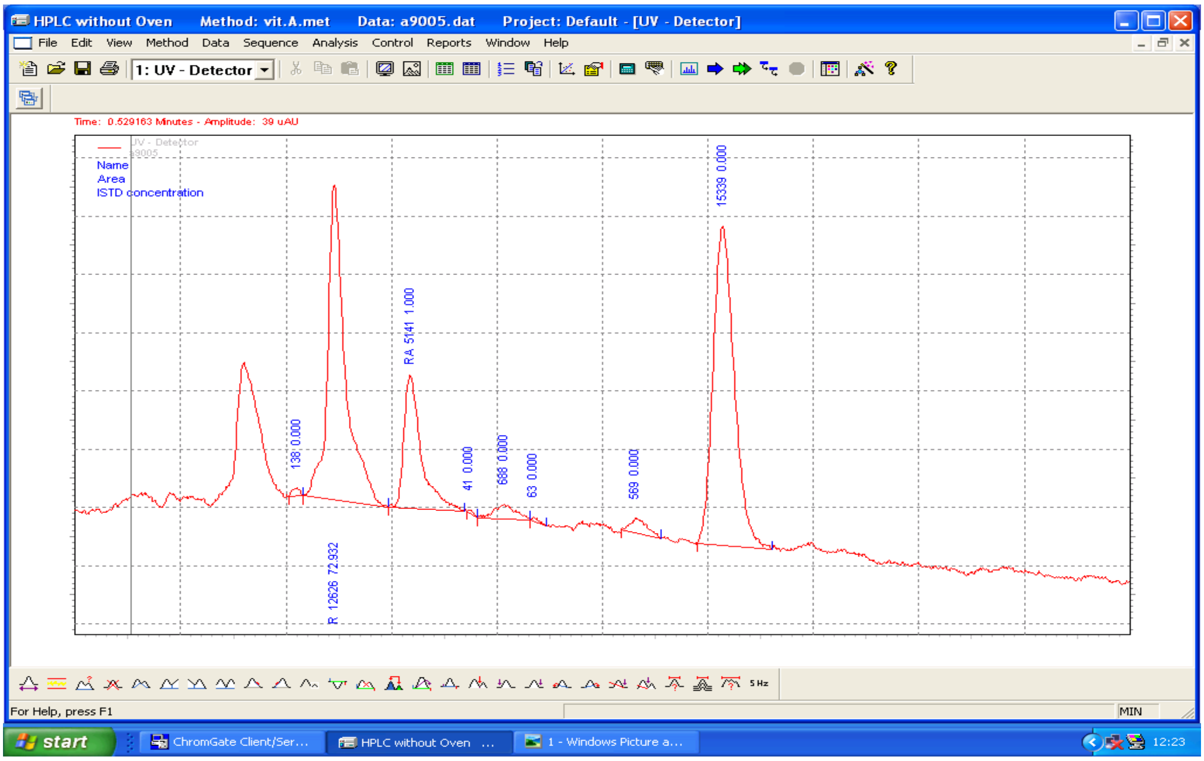
Blood sampling and biochemical measurements

A blood sample (5 ml) was collected by vene-puncture, and the volume of sample was about 1 ml for children whose ages were less than 1 year old. The specimens were collected in EDTA tubes, continuously shielded from light, centrifugation. Aliquots of plasma were made and immediately frozen at -20°C; the plasma retinol concentration was determined by reversed-phase high-performance liquid chromatography (HPLC). A total of 0.2 ml plasma was added to 0.2 ml standard solution of retinyl acetate, and was depolarized by ethanol. plasma vitamin A was extracted with hexane (1 ml) and a portion of the sample (0.5 ml) evaporated to dryness under nitrogen and re-dissolved in 0.5 ml mobile phase(methanol: water, 95:5 by vol.), and injected into a C_{18}, reversed phase HPLC column (5 mm particle size; knauer Instruments, Inc.). The flow rate of mobile phase was 2.5 ml/min. Retinol was detected by monitoring the absorption at 287 nm in a knauer ultraviolet detector. The vitamin A concentration was quantified to the peak high of the internal retinyl acetate standard. For plasma retinol, the within-assay and between assay CVs were 5% and 7%, respectively.

The following figures describe the process of determining plasma retinol levels during which Injection of 20 µl of human plasma extract and retinol acetate as internal standard. The retinol had a retention time of 2.4minutes and 3.1 minutes for the internal standard. All compounds are resolute in relation to the peak of retinol as in figure (5 and 6).



Typical chromatograms of calibrators as detected with Calibration mixture containing 50 µg/dl internal standard, Linearity fit, Concentration (5–100) µg/dl, r (0.999)



Chromatogram of human plasma analyzed by HPLC

Anthropometric measurements

Anthropometric measurements were obtained for preschool age children during the study as a measure for the dimensions and composition of the human body. Weight was measured to the nearest 0.1 kg with a sun - powered digital scale (Uniscale). Height was measured to the nearest 0.1 cm with a height board and height measuring tape. Weight was recorded using a weighing scale. Height was measured in a standing position (and length is taken for children less than 2 years old). Z-scores for the four growth indicators {height (length)-for-age, weight-for-height (length), weight-for-age and BMI-for-age} have been calculated. A cut-off of less than minus two standard deviations (-2SD) was used to define malnutrition {stunt (height/length-for-age Z-score), wasting (weight-for-height/length Z-score), and underweight (weight-for-age Z-score) ;(BMI-for-Age Z-score)}.

Definition of outcome

Two sets of indicators of VAD are commonly used for population surveys: clinically assessed eye signs and biochemically determined concentrations of retinol in plasma or serum. According to the WHO criteria, Measuring serum retinol concentrations in a population constitutes the second major approach to assessing vitaminA status in a population, with values below a cut-off of 0.70 µmol/l (20 µg/dL) representing VAD (12), and below 0.35 µmol/l(10 µg/dL) representing severe VAD whereas values between 0.70-1.05 µmol/L(between 20 and 30 µg/dL) were taken as marginal VAD.(16)

WHO growth references (WHO, 2005; 2007) for children under 5 years old and 5-19 years old were used to estimate Z-scores for the four growth indicators and detect the nutritional status of children enrolled in the study.

Statistical Analyses

Data analysis for the inquired variables was done by using data analysis soft wares namely SPSS , Excel and WHO Anthro and Anthro plus and the results were represented by using tables and charts describing the distributions of variables under study according to demographic, biologic and environmental factors reaching to determining the answer for our main research question in the study.

The study sample comprised 600 persons, a total of 225 (37.5 %) preschool age children, 192 (32.0 %) Lactating women and 183 (30.5 %) pregnant, the preschool children have been classified into 3 subgroups below 6 months (4.0 %), 6 months to below 2years (23.1 %) and 2 - 6 years (72.9%) , as shown in Table (1).

Table (1): The distribution of study sample by age category.

Age Category		**Frequency**	**Percent**
Preschool age children	Below 6 months	9	4.0 %
	6m - <2Year	52	23.1 %
	2 - 6year	166	72.9%
	Total	**225**	**37.5 %**
Lactating		**192**	**32.0 %**
pregnant		**183**	**30.5 %**
Grand Total		**600**	**100.0 %**

Four hundred and seven subjects (83.1%) of the overall study persons were from urban areas which also represents the highest proportions in pregnant and lactating women (78.7%, 83.3%) respectively and preschool age children (88.3%) as shown in figure (1) .

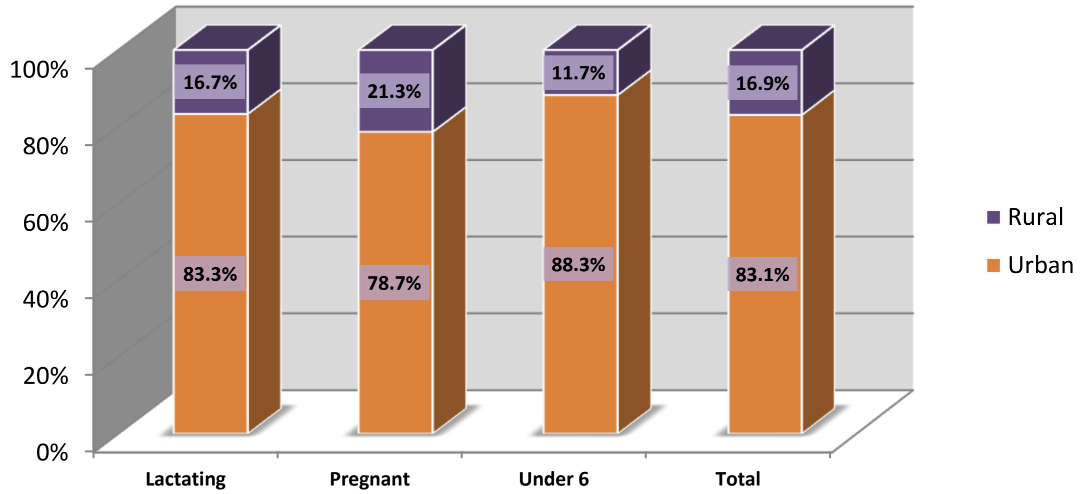


Figure (1): Distribution of study groups enrolled by living environment.

Most of the food groups included in the study questionnaire were consumed as shown in figure (2) which is true in the three different study groups (school age children, pregnant and lactating women) which has to be linked to construction of Food Consumption Score cut-off for best match of proportion of food pattern, the highest proportion of food group consumed (around 85%) found in carbohydrates and proteins around for the study groups enrolled in the study which represent a good percentage when combined with other food groups as a crucial part of the balanced diet .

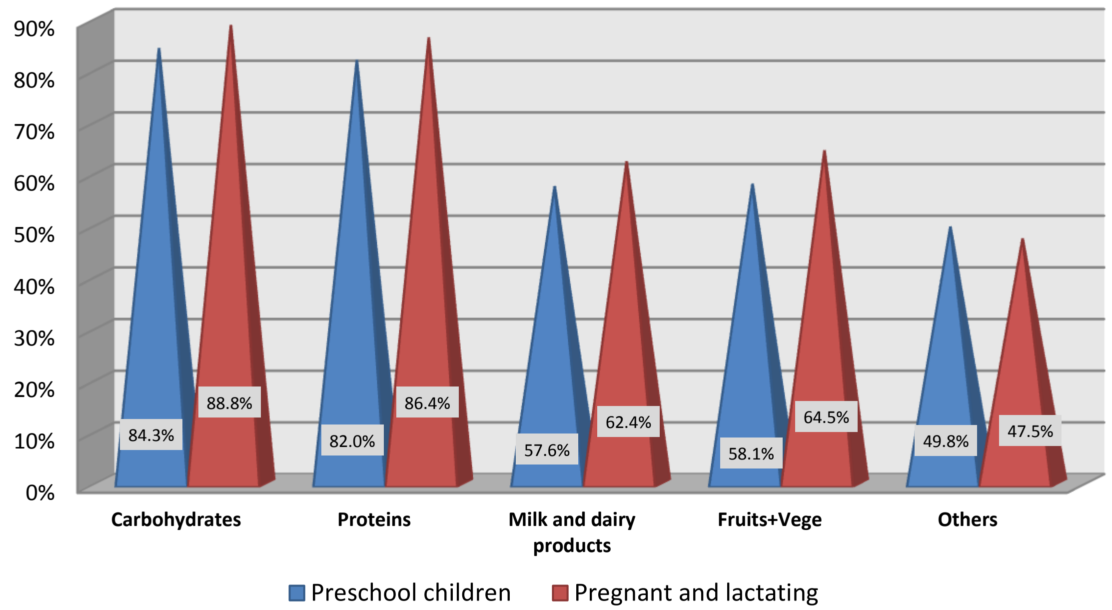


Figure (2): Distribution of food groups' consumption according to study groups enrolled.

Anthropometrical measurements of 225 preschool age children revealed that the overall distribution of malnutrition indicators prevalence rates (wasting, stunting and underweight) for under 5 years and 5 to under 6 years old children shown in figure (3), compared to the national average (CFSVA, 2008) shows that wasting percentage (9.3%) is higher than the national average while all other rates are lower than national average (stunting 17.4 % , underweight 6.1%) which only can give a clue about malnutrition rates in related areas , and a larger sample size is needed to reflect the results on the general population nation-wide. Overweight as part of malnutrition state is (4.7 %) of the children enrolled in the study, for children age between 5 to under 6 years old, (21.6%)were overweight based on the WHO-2007 for 5-19 years old growth standards and (13.5%) suffers from thinness (low BMI-for-age less than -2SD) ,(10.3%) suffer from underweight and (10.8%) suffer from stunting.

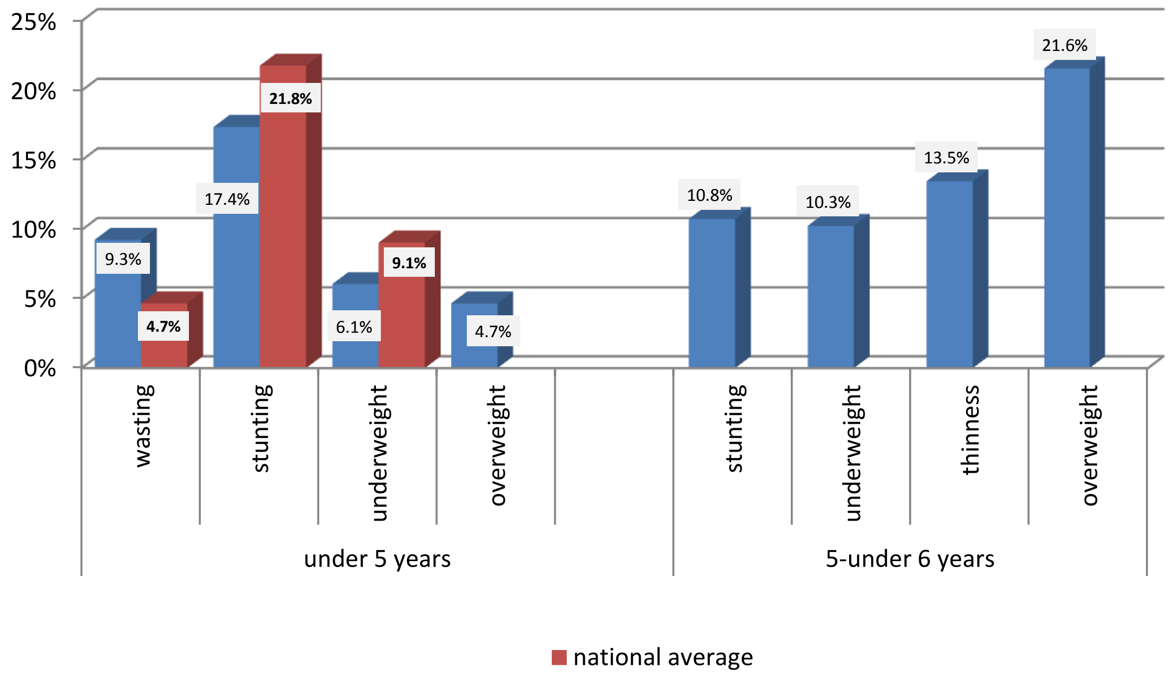
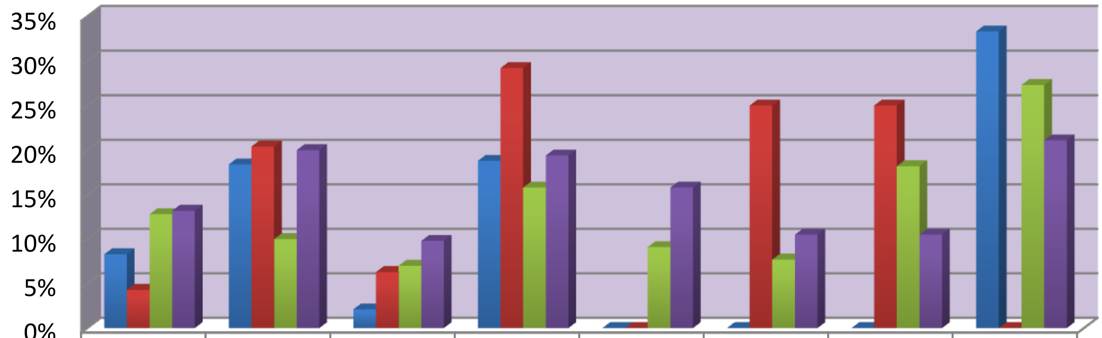


Figure (3): Malnutrition indicators compared to the national averages.

Figure (4) shows the distribution of malnutrition rates by governorates enrolled in the study and for children under 6 years of age were Thiqar has the highest percentage of stunting and overweight (20.4%,29.2%) respectively , While Ninevah has the highest percentages of underweight and wasting (9.8%, 13.2%) respectively in under 5 years old children . Basrah has the highest percentage of overweight (33.3%), and Thiqar in thinness and underweight (25%) for both indicators,Ninevah has the highest percentages in stunting (15.8%) for children between 5 and under 6 years old .



	under 5 years				5-under 6 years			
	wasting	stunting	underweigh t	overweight	stunting	underweigh t	thinness	overweight
Basrah	8.3%	18.4%	2.1%	18.8%	0.0%	0.0%	0.0%	33.3%
Thi qar	4.3%	20.4%	6.3%	29.2%	0.0%	25.0%	25.0%	0.0%
Diala	12.8%	10.0%	7.0%	15.8%	9.1%	7.7%	18.2%	27.3%
Ninevah	13.2%	20.0%	9.8%	19.4%	15.8%	10.5%	10.5%	21.1%

Figure (4): Preschool childrenmalnutrition indicators by governorates.

The overall mean (±SD) serum retinol level in this study is (35.6±13.2) µg/dL, in preschool children this mean (±SD) is (28.5±8.9) µg/dL, whereas in pregnant and lactating women the mean serum retinol level (±SD) is (44.5±14.6) ;(34.7±10.3) µg/dL respectively. The present study showed that the overall prevalence of vitamin A deficiency is (6.7%) with a percentage of (13.8%) among preschool age children (below 6 years) , (2.7 %) among lactating women and (1.6 %) among pregnant women; which can be defined as a corroborative evidence of a moderate public health problem in preschool age children (above 10%-below 20% in children above 1 year olds with serum retinol below 20 µg/dL defined as moderate VAD public health problem) [17] as shown in figure (5) .

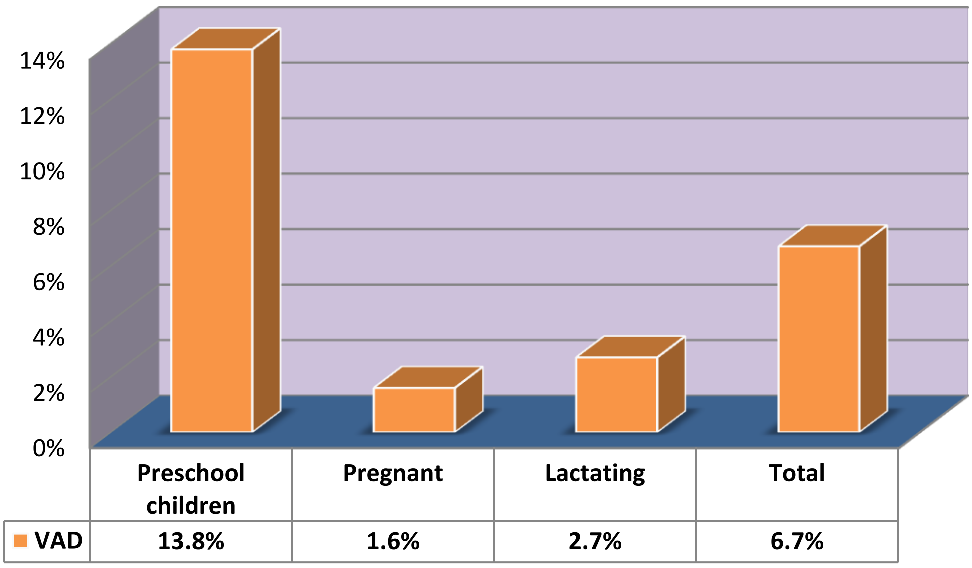


Figure (5): Prevalence of VAD (SR<20 ug/dL) by study groups.

Table (2) shows the prevalence of low serum retinol level categorized into 3 categories (sever VAD (below 10 µg/dL) , VAD (below 20 µg/dL) and marginal VAD (between 20 and 30 µg/dL) and its distribution among different characteristics in preschool age children , The overall prevalence of VAD in preschool age children is (13.8%) and (41%) have marginal VAD, One can find the highest percentage (22.2 %) of VAD found in below 6 months children with no sever VAD and the least percentage is found in 60-71.9 months of age which can be taken as indicator of how VAD distribute with different age groups in below 6 years children, a higher proportion of VAD can be seen in males (15.9%) than in females which can be attributed to their food consumption pattern and food habits which can be also a reason for finding VAD proportion is higher (21.2%) in rural areas than Urban, Distributing VAD proportions by governorates shown that Ninevah has the highest proportion (19.7%) ,Its been shown by different studies the relationship between VAD and Infection in general and this was also right in this study where the highest percentage of VAD can be found in those suffering from Diarrhea (18.3%) , Respiratory infection (19.0%) and Measles (14.3%), compared to those who doesn't suffer, VAD has been found to be higher in those not suffering from night blindness (14.3%) , (25%) of those under 2 years old bottle fed which is higher prevalence compared to other feeding types

Table (2): Prevalence of low serum retinol levels among preschool children (0-71 months) enrolled in the study by their characteristics.

Characteristics of preschool children	**N**	**Prevalence (%) of serum retinol:**		
		<10 µg/dL	<20 µg/dL	20-30 µg/dL
Age group (months)				
0-5.9	9	0%	22.2%	66.7%
6-11.9	10		0.0%	20.0%
12-23.9	42		16.7%	38.1%
24-35.9	46		19.6%	41.3%
36-47.9	38		18.4%	36.8%
48-59.9	38		7.9%	50.0%
60-71.9	42		7.1%	40.5%
SEX				
Male	132	0%	15.9%	43.9%
Female	93		10.8%	37.6%
Residence				
Urban	159	0%	10.7%	39.0%
Rural	66		21.2%	47.0%
Governorate				
Basrah	53	0%	7.5%	43.4%
ThiQar	55		12.7%	41.8%
Diala	56		14.3%	30.4%
Ninevah	61		19.7%	49.2%
Diarrhea				
Yes	82	0%	18.3%	41.5%
No	143		11.2%	41.3%
Respiratory Infection				
Yes	84	0%	19.0%	41.7%
No	141		10.6%	41.1%
Measles				
Yes	8	0%	14.3%	42.9%
No	217		13.8%	41.0%

Night Blindness				
Yes	15	0%	0.0%	26.7%
No	210		14.3%	42.4%
Feeding (under 2 years)				
exclusive Breast Feeding	10	0%	20.0%	50.0%
Bottle feeding	12		25.0%	33.3%
mixed	16		18.8%	37.5%
complementary with BF	18		11.1%	44.4%
Complementary alone	92		4.3%	39.1%
TOTAL	**225**	**0%**	**13.8%**	**41.3%**

In Table (3) in both pregnant and lactating women (21.6%) suffers from marginal VAD, distributing VAD prevalence on different characteristics shows that (2.3%) of housekeepers suffers from VAD, Basrah and Thiqar have the highest percentages of VAD (2.6% , 2.0%) respectively , both ignorant and those who read and write women enrolled in the study carries the highest percentages around 4%, higher percentage of VAD has been found in women suffering from night blindness (3.1%) compared to those who doesn't , (2.2%) of non-smoking women suffer from VAD, no sever VAD has been found in pregnant and lactating women. These findings might be attributed to the food habits and daily consumed food items or low vitamin A supplements coverage rates.

Table (3): Prevalence of low serum retinol levels among pregnant and lactating women enrolled in the study by their characteristics.

Characteristics of pregnant and lactating women	N	Prevalence (%) of serum retinol:		
		<10 µg/dL	<20 µg/dL	20-30 µg/dL
Status				
Pregnant	192	0%	1.6%	10.4%
Lactating	183		2.7%	33.3%
Occupation				
Employee	21	0%	0.0%	23.8%
Free work	8		0.0%	0.0%
Housekeeper	346		2.3%	22.0%
Governorate				
Basrah	151	0%	2.6%	16.6%
ThiQar	149		2.0%	15.4%
Diala	150		0.7%	10.7%
Ninevah	150		0.0%	11.3%
Mother Education				
Ignorant	103	0%	3.9%	25.2%
Read & write	80		3.8%	18.8%
Elementary	119		0.8%	17.6%
Intermediate	34		0.0%	29.4%
Secondary	19		0.0%	21.1%
University	20		0.0%	25.0%
Night Blindness				
Yes	15	0%	3.1%	10.9%
No	210		1.9%	23.8%
Smoking				
Yes	7	0%	0.0%	28.6%
No	363		2.2%	21.8%
TOTAL	**375**	**0%**	**2.1%**	**21.6%**

Figures (6,7) shows whether vitamin doses taken in preschool age children and lactating women where (34.7%) of preschoolers received vitamin A doses while (77.8%) of pregnant and (81.2%) of lactating women received vitamin A doses during the last three years (of completed pregnancies).

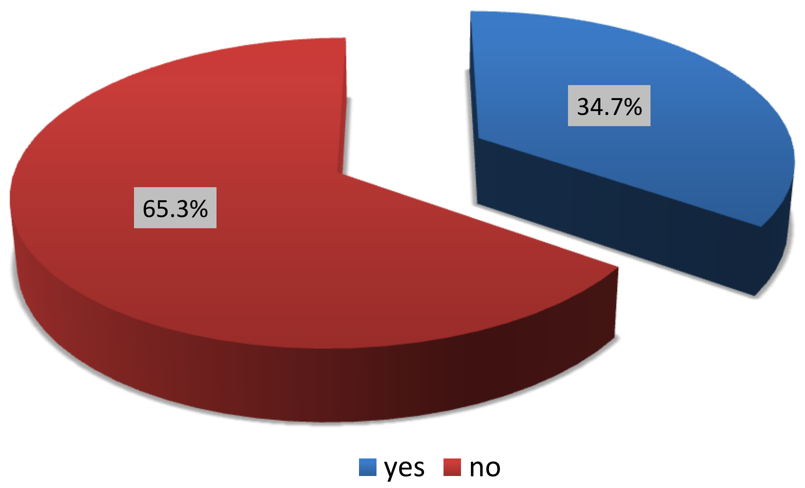


Figure (6): Percentages of whether vitamin A doses received or not in preschool children.

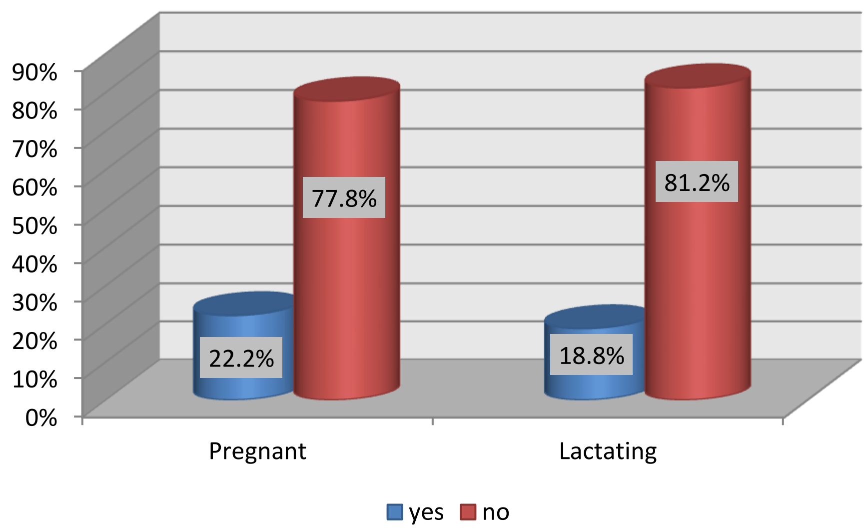


Figure (7): Percentages of whether vitamin A doses received or notduring the last three years (for completed pregnancies).

Conclusions

The extent of vitamin A deficiency in 3 groups (preschool age children, pregnant and lactating women) was (13.8%) of (225 preschool children), mainly in boys (15.8%) and in rural areas (21.2%) and Ninevah have the highest percentages of VAD, with higher percentages of VAD among children with infections, a percentage of (1.6%) of (183 pregnant) and (2.7%) of (192 lactating women) have vitamin A deficiency mainly in Basrah (2.6%) , Nutritional assessment is also performed to preschoolers and (9.3%) of under 5 years old (138 child) are wasted , (17.4%) are stunted ,(6.1%) are underweight and (4.7%) have overweight with Thi-Qar has the highest percentage of stunting and overweight (20.4%,29.2%) respectively , While Ninevah has the highest percentages of underweight and wasting (9.8%, 13.2%) respectively.

Further investigation is needed to identify risk factors and evaluate interventions to address nutrition programs towards preventing and controlling VAD nation-wide.

Recommendations

1) Food-based approach to prevent and control of VAD including dietary diversification , nutrition education and fortification of staple and value-added foods through increasing the variety and frequency of micronutrient rich food sources and improved food preparation and cooking methods .
2) Supplementation with vitamin A capsules with increasing interest in a multimicornutrient supplement according to prevention and treatment vitamin A schedule doses.
3) Effective nutrition education and information on health and nutrition to increase the demand for consumption of such foods using the available mass and multimedia like television and radio and supporting behavioral change to improve micronutrient intake.
4) Public health interventions such as immunization, adding vitamin A supplementation to national immunization days, promotion of breast-feeding and treatment of infectious diseases.
5) Establish a nation-wide survey on VAD and anemia and create a national database on micronutrient deficiencies.

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