

**PREVALENCE OF VITAMIN A DEFICIENCY
AMONG CHILDREN, AGED 12 – 59 MONTHS,
IN THE WEST BANK AND GAZA STRIP**

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The MARAM Project

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THE MARAM PROJECT

The Maram Project (MARAM) is a three-year health sector project funded by the United States Agency for International Development (USAID) under prime contract no. 294-C-00-01-00110-00, issued to IBM Global Services. MARAM is implementing project activities in cooperation with the USAID West Bank and Gaza Mission and various health care providers, including the Palestinian Ministry of Health (MOH), the United Nations Relief Works Agency (UNRWA), local non-governmental organizations (NGOs), and the private sector. The goal of MARAM is to support improvements in the health of Palestinian families by strengthening the capacity of Palestinian health institutions to plan and deliver quality services on a sustainable basis, and by supporting and encouraging appropriate health-seeking behaviors within communities and the general population.

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LIST OF ABBREVIATIONS

CDC	Centers for Disease Control
HKI	Helen Keller International
HPLC	High Pressure Liquid Chromatography
IMCI	Integrated Management of Childhood Illness
IMMPaCt	International Micronutrient Malnutrition Prevention and Control
IVACG	International Vitamin A Consultative Group
JUST	Jordan University of Science and Technology
MI	Micronutrient Initiative
MOH	Ministry of Health
MOST	The USAID Micronutrient Program
NIST	National Institute for Standards and Technology
PCBS	Palestinian Central Bureau of Statistics
RBP	Retinol Binding Protein
RDA	Recommended Daily Allowance
UNICEF	United Nations Children's Fund
WHO	World Health Organization

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To conduct a study like this, the cooperation and involvement of great people is needed, and in this MARAM has been extraordinarily fortunate.

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EXECUTIVE SUMMARY

Micronutrient deficiencies, a significant cause of malnutrition, are associated with ill health among populations in developing countries. Deficiencies in vitamin A, iodine, and iron are known to be prevalent, and associated with a range of mild (often reversible) to severe (often irreversible) effects.

Vitamin A deficiency disorders (VADD) refer to all physiological disturbances caused by low vitamin A status, including clinical signs and symptoms as well as subclinical manifestations.

MARAM, in coordination with the Ministry of Health (MOH), conducted a vitamin A survey at the household level in the West Bank and Gaza Strip, with technical advice from Dr. Omar Dary (MOST Project), and Dr. Ibrahim Khatib (Jordan University of Science and Technology).

The objective of this laboratory based-study was to establish national baseline information on nutritional status relative to vitamin A. The approach was to assess the prevalence of vitamin A deficiency through determination of retinol in plasma samples collected from children 12 to 59 months of age.

The sampling design was prepared in coordination with the Palestinian MOH and the MOST Project. The study sample consisted of 1,127 children selected from the different regions of the West Bank and Gaza Strip. The selected districts/governorates were Jenin and Nablus (representing the north region of West Bank), Ramallah and Jerusalem (representing the middle region of West Bank), Hebron (representing the south region of West Bank) along with Gaza City (representing the northern Gaza Strip), Deir Al-Balah, and Khan Yunis (representing the southern Gaza Strip).

In all regions combined, 22% of children were found to have low vitamin-A plasma levels ($< 200 \mu\text{g/L}$). The estimated prevalence would be considered to fall into the severe category ($\geq 20\%$) according to the WHO classification cut-off point for judging that vitamin A deficiency in a community constitutes a public health problem.

Furthermore, more than half of the children participating in the study (53.9%) had levels of vitamin A in the range of 200-299 $\mu\text{g/L}$., meaning that 75.9% of children had vitamin A levels below 300 $\mu\text{g/L}$.

In addition, results showed a significant difference between the prevalence of vitamin A deficiency in the West Bank (18.9%) compared to the Gaza Strip (26.5%). On the other hand, results revealed no significant differences in vitamin A deficiency with respect to gender, age groups or whether children lived in camp or non-camp areas.

Blood analysis indicated that 50.9% of children 12-59 months of age had elevated levels of alpha acid glycoprotein (AGP), with concentrations above 1.0 g/L. Further statistical analysis between AGP and vitamin A showed that vitamin A deficiency among non-infected children with normal levels of AGP ($\leq 1.0 \text{ g/L}$) was 11.6%. On the other hand, vitamin A deficiency among infected children (AGP levels $> 1.0 \text{ g/L}$) proved to be 32%. This observation clearly reveals the effect of infection on retinol levels, falsely increasing the apparent prevalence of vitamin A deficiency.

Furthermore, there was a significant difference between vitamin A deficiency among non-infected children in the West Bank (8.9%) compared to the Gaza Strip (15.6%). This difference indicates that in the Gaza Strip, in addition to infection/inflammation, low vitamin A intake is an important factor contributing to vitamin A deficiency.

The overall prevalence of anemia among children aged 12 - 59 months was 23%. The prevalence of anemia varied significantly between the West Bank (17.4%) and Gaza Strip (31.2%).

Results revealed that 33.9% of vitamin A deficient children were anemic, indicating that vitamin A deficient children are more likely to become anemic than children with normal levels of vitamin A.

In conclusion, the prevalence of VAD in the West Bank and Gaza Strip, meets both the WHO (20%) and the IVACG (15%) criteria for a public health problem that requires immediate action. VAD is associated with infection/inflammation in all communities, and in the Gaza Strip, in addition to the former factor, low intake of this nutrient in the diet is an obvious contributing factor.

The international vitamin A effort recommends different interventions in the areas of: advocacy and policy; fortification of staple foods; food consumption and diversification; supplementation; and monitoring and evaluation, all intended to be complementary and necessary parts of a comprehensive approach.

CHAPTER I

INTRODUCTION

I.1. OVERVIEW

Micronutrient deficiencies, a significant cause of malnutrition, are associated with ill health among populations in developing countries. Deficiencies in vitamin A, iodine, and iron are known to be especially prevalent, and are associated with a range of mild (often reversible) to severe (often irreversible) effects. At the sub-clinical level of micronutrient deficiency, poor general health and decreased school and work performance are likely to result. Additionally, mortality risk increases. Known clinical outcomes of micronutrient deficiencies include impaired growth and cognitive development, poor birth outcomes, anemia, cretinism, and blindness [Mason *et al.*, 2001].

In recent years, international statistical reports have begun to show a global relative decline in the severe clinical type of primary malnutrition (traditionally known as protein energy malnutrition) However, the incidence of micronutrient malnutrition that is caused by hidden chronic forms of micronutrient deficiencies (MNDs) and is observed clinically as stunted growth remains the devious face of the problem [United Nations, 2000].

Vitamin A deficiency (VAD) among children in many developing countries remains the leading cause of preventable severe visual impairment and nutritional blindness. Vitamin A deficiency at levels severe enough to cause pathological signs such as visual impairment is referred to as clinical vitamin A deficiency. Even at less severe or sub-clinical levels, vitamin A deficiency is a significant contributor to severe infections and death. VAD is also likely to increase vulnerability to other illnesses in women and children such as iron deficiency anemia, more frequent and severe episodes of diarrhea and measles, and growth failure [Underwood, 1998].

The most well-known and understood process involving vitamin A is that of vision. Other processes include: growth and development, fertility, impaired immune response, haemopoiesis, regulation of gene expression, cell division, cell differentiation and morphogenesis [Institute of Medicine, 2001; Gerster, 1997; Ross and Gardner, 1994; McLaren and Frigg, 2001].

Vitamin A helps maintain the surface linings of the eyes, and the respiratory, urinary and intestinal tracts. When those linings break down, bacteria can enter the body and cause infection [Stephens, *et al.*, 1996].

At least 3 million children develop xerophthalmia, damage to the cornea of the eye, and 250,000 to 500,000 go blind each year from a deficiency of vitamin A [Institute of Medicine, 2001]. Vitamin A deficiency may also be responsible for as many as 1.3 to 2.5 million deaths annually [Humphrey *et al.*, 1996]. The increased risk of illness leads to an increased risk of death. Studies show that in communities where vitamin A deficiency is prevalent, improving vitamin A status reduces child deaths by an average of 23 percent in infants and children between 6 months and five years of age [Beaton *et al.*, 1993].

A study of breastfeeding practices in developing countries has revealed that vitamin A intakes from non-breast milk sources were extremely low at all ages. The study has reported that during the second year of life, vitamin A intake among non-breastfed children met only 60% of the reference-recommended dietary intake. In contrast, the intake of breast-fed children met approximately 90% of the reference value. Maternal

education and socioeconomic status were positively associated with both vitamin A and retinol intake [Ramakrishnan *et al.*, 1999].

On a global basis, it is estimated that 75-140 million preschool children are affected by sub-clinical vitamin A deficiency, with the upper limit of this range thought to be more likely. The highest prevalence of both clinical and sub-clinical vitamin A deficiency occurs in South Asia and sub-Saharan Africa, where 30% to 40% of preschool children are at heightened risk of ill health and death because of this deficiency [Mason *et al.*, 2001].

I.2. VITAMIN A SOURCES AND RECOMMENDED DIETARY ALLOWANCE

Human communities rely on a very wide range of plant and animal foods to meet their dietary requirements for vitamin A. Traditionally, it was assumed that green leafy vegetables were the best plant source of vitamin A. However, more recent research has shown that fruits and vegetables have less available vitamin A precursors. Moreover, de Pee states that "orange fruits [are] more effective in improving vitamin A status than dark green leafy vegetables." [de Pee *et al.*, 1998a; de Pee *et al.*, 1998b] Overall, the bioavailability of vitamin A from plant sources is considerably lower than that of animal sources [WHO, Vitamin A deficiency, Advocacy].

The Recommended Dietary Allowance (RDA) is the average daily dietary intake level sufficient to meet the nutrient requirements of nearly all (97-98%) healthy individuals in each age and gender group [Institute of Medicine, 2001]. RDAs for vitamin A are listed in Table 1. Since there is insufficient information to establish an RDA of vitamin A for infants, an adequate intake (AI) that is based on the amount of vitamin A consumed by healthy breastfed infants, as shown in Table 2, has been established as a gold standard [Alaimo *et al.*, CDC 1994].

Table 1. Recommended Dietary Allowances for Vitamin A in Micrograms (µg) and International Units (IUs) For Children and Adults

Age (years)	Children	Men	Women	Pregnancy	Lactation
1-3	300 ug or 1000 IU				
4-8	400 ug or 1333 IU				
9-13	600 ug or 2000 IU				
14-18		900 ug or 3000 IU	700 ug or 2330 IU	750 ug or 2500 IU	1200 ug or 4000 IU
19 +		900 ug or 3000 IU	700 ug or 2330 IU	770 ug or 2565 IU	1300 ug or 4335 IU

Table 2. Adequate Intake For Vitamin A In Micrograms (µg) and International Units (IU) For Infants

Age (months)	Males and Females
0-6	400 µg or 1330 IU
7-12	500 µg or 1665 IU

I.3. VITAMIN A DEFICIENCY (VAD)

Vitamin A deficiency (VAD) refers to a state in which liver stores of vitamin A and its surrogates are below 20 µg/g [Report of the XXI IVACG, 2003]. Vitamin A deficiency can occur at any age, with consequences ranging from sub-clinical effects that increase risk of morbidity and mortality to blinding malnutrition (Keratomalacia) indicating clinical VAD [WHO, 1995]. In the past, non-ocular, systemic manifestations of VAD have been referred to as sub-clinical VAD; however, this phrase can be misleading as it seems to suggest that these consequences of VAD are less important. In fact, these physiological manifestations can be severe and are associated with an increase in the risk of death, which resulted in the International Vitamin A Consultative Group (IVACG) recommending abandoning the term “subclinical” [Report of the XXI IVACG, 2003].

VAD occurs when body stores are depleted to the extent that physiological functions are impaired, even though clinical eye signs may not be evident. The level of depletion at which physiological functions begin to be impaired is not entirely clear [WHO, 1995].

VAD is the result of two primary factors. The first is a persistent low intake of vitamin A inadequate to satisfy physiological needs. The second factor is a high frequency of infection. Infection depresses appetite and prompts an elevation in the body's vitamin A utilization, leading to inefficient conservation of the nutrient [WHO, Vitamin A deficiency, Advocacy].

VAD also occurs when body stores are depleted at times of high requirement - such as during pregnancy and lactation, and phases of rapid growth [WHO, Vitamin A deficiency, Advocacy]. Other conditions related to poverty, e.g. low social status (particularly affecting women), inadequate environmental sanitation, and insufficient water supply for drinking, growing food and maintaining adequate personal hygiene are generally associated with malnutrition, often including VAD [WHO, 1995]. Non-breastfed infants and children between the ages of 6-59 months experience more serious effects of VAD than any other groups besides pregnant and lactating women who are the most vulnerable groups at high risk of VAD I [WHO, Vitamin A deficiency, Advocacy].

I.4. VITAMIN A DEFICIENCY DISORDERS (VADD)

Vitamin A deficiency disorders (VADD) refers to all physiological disturbances caused by low vitamin A status, including clinical signs and symptoms as well as subclinical manifestations [Report of the XXI IVACG, 2003].

Vitamin A deficiency most dramatically impacts the eye [Mclaren and Frigg, 2001] In fact, it is the leading cause of severe preventable visual impairment and nutritional blindness among children in developing nations [Underwood and Arthur, 1996]. The earliest evidence of vitamin A deficiency is impaired dark adaptation or night blindness. Mild vitamin A deficiency may result in changes in the conjunctiva called Bitot's spots. Severe or prolonged vitamin A deficiency causes a condition called xerophthalmia, characterized by changes in the cells of the cornea (clear covering of the eye) that ultimately result in corneal ulcers, scarring, and blindness [Semba, 2001; Brody, 1999].

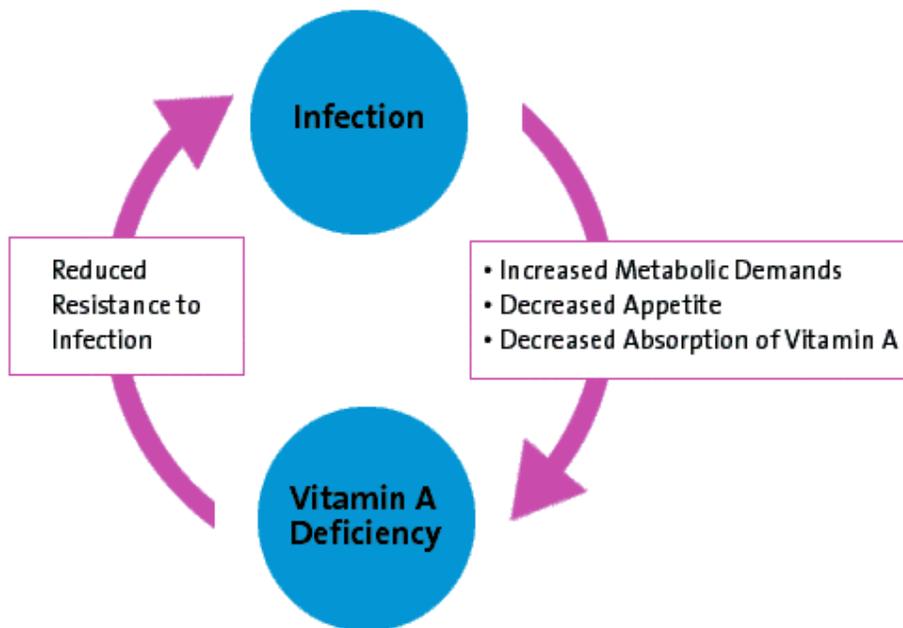
Vitamin A deficiency can be considered a nutritionally acquired immunodeficiency disease [Semba, 1997]. Even children who are only mildly deficient in vitamin A have a higher incidence of respiratory disease and diarrhea, as well as a higher rate of mortality from infectious diseases, compared to children who consume sufficient vitamin A [Field, 2002]. In fact, the strongest association between vitamin A and infection is found with diarrhea, especially when it is persistent, chronic, or severe. In countries where immunization programs are not widespread and vitamin A deficiency is common, millions

of children die each year from complications of infectious diseases such as pneumonia and measles (Stephens, 1996). When vitamin A stores are inadequate, cells lining the lung lose their ability to remove disease-causing microorganisms. This may contribute to the pneumonia associated with vitamin A deficiency [Ross, 1999; Semba, 1998; Ross, 1998].

Measles occupies a unique position among common childhood infectious diseases and vitamin A deficiency. Measles generally takes a more serious form in the undernourished child, resulting in more frequent and more serious complications and a much higher death rate than in the well-nourished child [Mclaren and Frigg, 2001]. Supplementation with vitamin A has been found to decrease the severity of, and number of deaths, from measles in developing countries, where vitamin A deficiency is common [West, 2000].

The association between vitamin A deficiency and anemia is well established, although the mechanism is not yet fully understood. It has long been known that vitamin A deficiency and iron deficiency tend to exist together in population groups. This might be expected to occur because inadequate diets are usually deficient in more than a single nutrient. In controlled trials carried out in several countries vitamin A supplementation brought about significant increases in hemoglobin levels [Sommer and West, 1996]. While better understanding of the interrelationships between vitamin A and iron must be pursued, the prevention of vitamin A deficiency should be considered along with iron supplementation for the control of nutritional anemia [IVACG, 1998].

I.5. CYCLE OF DISEASE AND VITAMIN A DEFICIENCY



I.6. RETINOL AND ALPHA ACID GLYCOPROTEIN

Serum retinol is a useful indicator of vitamin A status and can be used to identify subjects with low or depleted liver vitamin A stores [Gibson, 1990; Underwood, 1994]. The WHO 1996 report recommended to retain the "low" value at 0.7 $\mu\text{mol/l}$ (200 $\mu\text{g/L}$)

as a cut-off level and to consider this consistent with the presence of a sub-clinical deficiency status [WHO, 1996]. However, serum retinol concentrations decrease transiently during the acute phase response to infection [Mitra *et al.*, 1998; Beisel, 1998; Thurnham, 1997; Ross and Stephensen, 1994; Filteau *et al.*, 1993]. Such decreases do not reflect changes in liver vitamin A stores and thus can interfere with the use of serum retinol as an indicator of vitamin A status. In populations with high prevalence of infections, such as young children living in poor areas of developing countries, this phenomenon can be a source of false-cases diagnosed as VAD in surveys designed to determine the prevalence of micronutrient deficiencies [Brown *et al.*, 1993].

Infection and trauma are accompanied by an acute phase response in which various acute phase proteins are elevated in the plasma. The presence of increased concentrations of the different proteins can indicate something about the severity of the infection and the time of occurrence. Alpha 1-acid glycoprotein achieves maximum concentrations 2-5 days after infection and remains elevated for a long period of time.

The measurement of acute phase proteins, such as α 1-acid glycoprotein (AGP), has been considered to improve the interpretation of plasma retinol concentrations in populations with a high prevalence of morbidity [Filteau *et al.*, 1993].

I.7. OBJECTIVE OF THE STUDY

The objective of this laboratory based-study was to establish baseline information on nutritional status relative to Vitamin A by assessing the prevalence of Vitamin A deficiency through determination of retinol. Interpretation was supported using alpha-acid glycoprotein in plasma samples collected from children 12 to 59 months of age during a household level survey. The results are intended to provide information required for informed adoption of strategies for preventing VAD.

CHAPTER II

METHODOLOGY

The diet of the Palestinian population in the West Bank and Gaza Strip has deteriorated since the beginning of the *Intifada*, a result of movement restrictions and deterioration of the economy. Furthermore, the availability and accessibility of highly nutritional foods such as meat, poultry, fish, milk and milk products have decreased. As a consequence, consumption of folate, iron, zinc, vitamin A and other micronutrients might be affected.

MARAM, in coordination with the MOH, conducted a Vitamin A survey in the West Bank and Gaza Strip with technical advice from Dr. Omar Dary, consultant from the MOST Project. Later, upon agreement with the MOH, Dr. Ibrahim Khatib [Assistant Professor, Community and Metabolic Nutrition, Faculty of Medicine, Jordan University of Science & Technology (JUST)], was asked to join the team as a consultant/trainer. Dr. Khatib - head of the JUST laboratory, certified as a reference laboratory by the U.S. Center for Disease Control in Atlanta, Georgia - has been conducting similar studies in Jordan since 1997.

II.1. SAMPLE SIZE AND SELECTION

The sampling design was prepared in coordination with the Palestinian MOH and the MOST Project. Taking into consideration an estimated prevalence of VAD of 25%, a confidence interval of 90%, and a non-response rate of 15%, the estimated study sample consisted of 1,127 children selected from the different regions of the West Bank and Gaza Strip. The sample was calculated based on the probability proportional to population size (PPS) method.

The selected districts/governorates were Jenin and Nablus (representing the north region of the West Bank), Ramallah and Jerusalem (representing the middle region of the West Bank), Hebron (representing the south region of the West Bank) along with Gaza City (representing the northern Gaza Strip), Deir Al-Balah, and Khan Yunis (representing the southern Gaza Strip).

Within selected districts/governorates, localities were divided into three categories: urban, rural, and camps, according to the Palestinian Central Bureau of Statistics (PCBS) classification. The sample calculation as well as the selection of districts/governorates and localities are summarized in Annex I. The distribution of the vitamin A survey sample, based on population size (PCBS figures), is described in the Table shown in Annex I.

Using standard household random selection processes, households were randomly selected for participation. For this study, "household" was defined as all persons sharing a single kitchen, a definition commonly used in research in the West Bank and Gaza Strip. At each household, every child aged 12 – 59 months (whether present in the house at the time or not) was assigned a number. These numbers were written on pieces of paper, and one piece of paper was randomly selected. The child assigned to that number was thus selected as the index child for the purpose of the data collection. If the selected child was not at home, or if the family refused to allow the data collectors to draw a blood sample from the child, the data collectors moved on to the nearest household. If there was no nearby house available, the original house was included among the non-respondents.

In addition, if the data collectors had difficulties in drawing blood from the selected child, then another child in the same household was randomly selected. If no child was

available at that household, the data collectors proceeded to the next nearest household and acted as described above.

II.2. TRAINING

Training for the study staff began with the training of four master trainers (two from the West Bank and two from the Gaza Strip.) These trainers then participated in training a number of field workers and headquarters staff, and were responsible for the overall supervision of the survey work in the field. The initial training workshop for the four master trainers was conducted at the Jordan University of Science and Technology (JUST) in Irbid, Jordan, under the supervision of Dr. Ibrahim Khatib. The JUST training workshop covered laboratory techniques as well as the components and considerations required for implementation of a valid, high quality vitamin A survey involving collection and maintenance of blood samples.

Subsequently, the master trainers conducted two workshops in the West Bank and Gaza Strip to train the field sample collectors. The field teams recruited for blood collection in each district/governorate included a medical doctor, a nurse skilled in venipuncture, a certified medical technologist experienced in all aspects of laboratory practice, and a driver with an air conditioned car/ambulance to help assure the safety and stability of the samples during transportation (in accordance with international regulations and recommendations described below.) The workshop covered background information and focused on logistics, methods of blood collection, precautions, quality control, labeling, processing, storage, and transport. The participants were also provided with a manual for field work.

Additionally, two Palestinian laboratory technicians from the MOH were sent to Jordan to attend a training program in measurement of retinol by HPLC method and alpha-acid glycoprotein by immunoturbidimetry at the Jordan University of Science and Technology metabolic lab. It is expected that these lab technicians will be able to perform the laboratory analysis required for surveillance and monitoring of micronutrient status in the future. A summary of the training workshop is illustrated in Annex II.

II.3. SURVEY QUESTIONNAIRE

In addition to the blood sample collection described below, the vitamin A survey included collection of basic data covering household demographics, incidence of illness in the index child during the two weeks prior to the survey, and the child's normal intake of vitamin A supplements, iron supplements and iodized salt. The questionnaire was developed by MARAM technical staff with input from key stakeholders and nutrition experts. The questionnaire was translated from English to Arabic, and field tested prior to the formal start of data collection. It was then administered to the mothers of the index children in the households included in the survey. Both versions of the questionnaire are shown in Annex III.

II.4. BLOOD SAMPLE COLLECTION AND PROCESSING

The blood sample collection process began with blood collection at households, followed by immediate processing at stationary laboratories. The samples were then transported to storage at -20°C in the central laboratories, followed by shipment of plasma specimens under frozen conditions across the Jordanian border to JUST.

II.4.1. SAMPLE COLLECTION

A list of equipment required for the field survey activities - including drawing blood, processing, analyzing and storing the samples - is shown in Annex IV.

All personnel who collected the specimens were well trained in, and familiar with, the collection procedure, as well as in the use of universal precautions against the transmission of blood-borne pathogens. In all cases, informed consent (Annex V) was obtained before the start of specimen collection, and the procedure was explained to the parent or guardian.

Blood collection was performed before noon to avoid lipemic samples subsequent to heavy meals.

Approximately 4.5 milliliters of venous blood were obtained from each randomly selected child by using lithium heparinized tube-syringes with a 21 gauge needle (or 22, 23 gauge as necessary). Subsequently, blood-containing tubes were immediately wrapped with aluminum foil to prevent exposure to direct natural light. Protocols for blood collection are described in Annex VI.

II.4.2. SAMPLE PROCESSING

Within 4 hours after the bloods samples were drawn on each day of survey implementation, the blood samples were transported to each district stationary laboratory in an ice-box containing frozen ice packs.

At the district level, a complete blood cell count (CBC) was carried out utilizing full automated apparatus. Blood calibrators were used with each CBC run as a component of quality control and the readings were recorded. This was followed by centrifugation of blood tubes for plasma separation and further yield collection into 4 cryovials labeled a, b, c, and d. Plasma yields were then stored at either 4 or -20°C. Direct exposure to natural illumination was completely avoided throughout all stages of blood collection, processing, transport, and in all locations.

All plasma samples were transported to the MOH Central Laboratories in coolers fitted with frozen ice packs and stored frozen at -20°C or below. Samples collected in the Gaza Strip were then transferred to the West Bank in a cooler fitted with frozen ice packs in which they were preserved for 5 hours. Afterwards, they were stored in a freezer at -20°C at the Central MOH Lab in Ramallah. Two plasma vessels labeled "a" and "b" were destined for the measurement of retinol and alpha acid glycoprotein respectively, and the remaining two labeled "c" and "d" were retained at the Central MOH Lab in Ramallah as replicates and for future micronutrient analyses. Protocols for blood processing are described in Annex VII.

Plasma samples were shipped from the Central MOH Lab to JUST within 12 hours in a chilled ice box. All conditions were met to ensure stability of samples.

II.5. LABORATORY AND QUALITY CONTROL

Retinol assessment by High Pressure Liquid Chromatography (HPLC) method is described in Annex VIII. The HPLC method reported here concurrently measures both retinol and α -tocopherol (vitamin E) [Catignani and Bieri, 1983]. Results of vitamin E are shown in Annex IX.

The α 1-acid glycoprotein test principle is a turbidimetric assay [Lievins *et al.*, 1996]. The test was performed using Roche – reagents kits (cat number 11557602) and a Hitachi 912 – autoanalyzer.

II.5.1. LABORATORY QUALITY ASSURANCE AT JUST

Elements of the quality assurance interventions applied included:

- Written guidelines and technical procedure manuals.
- Record-keeping.
- Continuing education and safety training for lab personnel.
- Equipment maintenance programs.
- Sustaining open channels with international Proficiency testing (PT) for the laboratory equipment, procedures, and results twice per year to maintain its position with External Quality Assurance (EQA) programs, as well as with the Center for Disease Control (CDC) in the USA.
- Consistent use of chemicals (all of the highest HPLC grade, purchased from reputable manufactures in the world market), columns (from Waters), and standards (all from /or through Roche).
- Use of QC sera from NIST (US-National Institute for Standards and Technology), and from CDC.

II.5.2. SURVEY DATA ANALYSIS AND QUALITY ASSURANCE

The survey questionnaires were checked for completeness and accuracy at three levels prior to data entry: by field supervisors in the field; by principal investigators at MARAM; and by data entry staff at Jaffa.Net who coded and entered the data using Microsoft Access, and then transferred the data to the Statistical Package for the Social Sciences (SPSS) Windows version 8.0 for data analysis. Bivariate analysis compared the outcomes of interest in the two study groups. T-tests and Chi Square tests were used to measure the significance of differences between the different variables.

II.5.3. RETINOL ASSESSMENT VALIDATION

As part of the overall quality control for the survey, 15 randomly selected samples within 3 categories (5 with normal values, 5 with borderline values, and 5 with low values) from those replicates retained at the Central MOH laboratory were sent to Wageningen University in the Netherlands (an international reference laboratory), for external validation. The University's Division of Human Nutrition is a partner with the Division of Laboratory Sciences, Inorganic Toxicology and Nutrition Branch of the Center for Disease Prevention and Control (CDC) in the development of the VITAL-EQA program. The outcome of the analysis at the Wageningen University lab showed that the sub-sample results were consistent with the survey results for these samples.

CHAPTER III

RESULTS AND DISCUSSION

III.1. SAMPLE CHARACTERISTICS

The total sample included in the study was 1,127 children. However, samples from twenty children were excluded due to the fact that three were found with heavy hemolysis, whereas 17 were found to be outside the age range of 12 – 59 months. The total number of cases included in the statistical analysis was 1,107. Since only one child was selected per household, the number of cases represents the total number of households. Within the sample population, 52.4 % were male and 46.6% were female.

Sixty percent of children were selected from the West Bank and 40% from Gaza Strip. 14.1% of children were selected from camps and the rest from non-camp areas. The percentage of children selected from within the West Bank regions was as follows; 24.4% from northern West Bank, 16.4% from the middle, and 19.1% from the southern region. As for Gaza Strip regions, 20.9% were from the north of Gaza while 19% were from the southern region (see Table 3).

Table 3. Children Distribution by Region in the West Bank and Gaza Strip

REGION	Freq	%
WEST BANK		
North	270	24.4
Middle	181	16.4
South	211	19.1
GAZA STRIP		
North	231	20.9
South	214	19.3
TOTAL	1107	100.0

The age distribution of participating children was as follows (see Table 4.) 21% were 12-23 months of age; 30.6% were 24-35 months of age; 30.9% were 36-47 months of age; and 17.5% were 48-59 months of age. The mean age was 34.9 months, and the median age 35 months.

Table 4. Age Distribution of Children

Age Groups (months)	Freq	%
12-23	232	21.0
24-35	339	30.6
36-47	342	30.9
48-59	194	17.5
TOTAL	1107	100.0

The number of children, aged 12-59 months, per household ranged from 1-12 with an average of approximately 2 children in that age group per household.

As for interviewed mothers, the mean age was 27.4 years. Only 2.5% of mothers were under 20 years old, 74.9% of the mothers ranged between 20-34 years old, with 22.6 % aged 35 years and older.

III.2. PREVALENCE OF VAD

The currently recommended WHO cut-off point for judging that VAD in a community constitutes a public health problem and assessing its level of importance is a prevalence rate of ($\geq 2 - <10\%$) for mild, ($\geq 10 - < 20\%$) for moderate and ($\geq 20\%$) for severe levels of Vitamin A deficiency. This is based on a serum retinol cut-off value of $<200 \mu\text{g/L}$ [WHO, 1995]. Whereas, for IVACG, the prevalent cut-off point is 15% [Sommer and Davidson, 2002].

Low vitamin-A plasma levels ($<200 \mu\text{g/L}$) in all regions was 22%. The estimated prevalence would be considered, according to the WHO classification, as falling into the severe category ($\geq 20\%$).

Moreover, more than half (53.9%) of the studied children had levels of vitamin A in the range of 200-299 $\mu\text{g/L}$. This means that around 75.9% of children had vitamin A levels below 300 $\mu\text{g/L}$. (See Table 5).

Table 5. Vitamin A Levels Among Children 12-59 Months Of Age

Vitamin A Intervals ($\mu\text{g/L}$)	Freq	%	Cumulative %
<200	243	22.0	22.0
200-299	597	53.9	75.9
≥ 300	267	24.1	100.0
TOTAL	1107	100.0	

The mean and median plasma vitamin A concentration values for the population under study were 255.7 (sd ± 72.8) and 251 $\mu\text{g/L}$, respectively. This indicates that the mean and median vitamin A concentrations are close to the cut-off point for vitamin A deficiency. In the absence of improvement in the economic and nutrition situation of the Palestinian children, they are at risk of experiencing higher rates of vitamin A deficiency.

Results in Table 6 show a significant difference between the prevalence of vitamin A deficiency in the West Bank (18.9%) and Gaza Strip (26.5%) ($P = .003$). The lowest prevalence of vitamin A deficiency was found in the middle of the West Bank (13.8%), compared to the northern (21.9%), and southern (19.4%) West Bank regions. On the other hand, prevalence in the northern Gaza Strip (31.2%) was higher than in the southern regions (21.5%) ($P = .000$).

Table 6. Vitamin A Deficiency Among Children 12-59 Months Of Age By Region

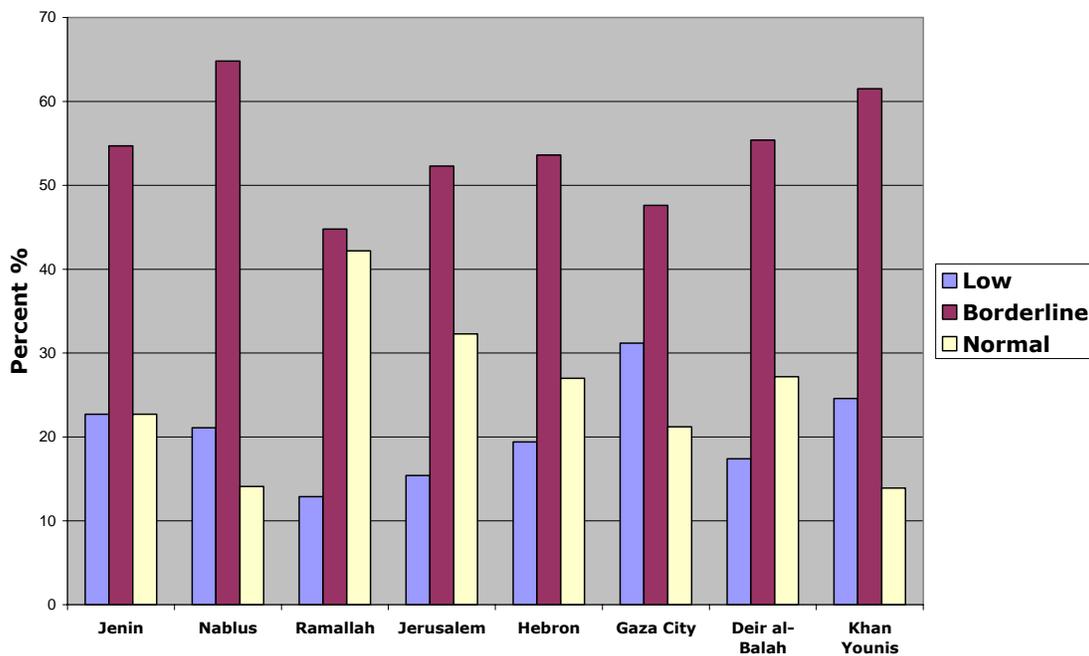
REGION	Vitamin A Intervals ($\mu\text{g/L}$)						TOTAL	
	Low <200		Borderline 200-299		Normal ≥ 300			
	Freq	%	Freq	%	Freq	%	Freq	%
WEST BANK								
North	59	21.9	162	60	49	18.1	270	100.0
Middle	25	13.8	86	47.5	70	38.7	181	100.0
South	41	19.4	113	53.6	57	27.0	211	100.0
GAZA STRIP								
North	72	31.2	110	57.6	49	21.2	231	100.0
South	46	21.5	126	58.9	42	19.6	214	100.0
TOTAL	243	22	597	53.9	267	24.1	1107	100.0

Gender-specific vitamin A deficiency showed that VAD prevalence among male children (22.6%) is similar to that of female children (21.4%) with no significant difference between the two groups.

As for age-specific vitamin A deficiency, results indicate no significant difference among the different age groups of children 12-59 months of age, or across the different levels of vitamin A deficiencies.

A strong variation in vitamin A deficiency was found among the different districts of the West Bank and Gaza Strip (see Figure 1). Gaza City (31.2%), Khan Younis (24.6%) and Jenin (22.7%) districts had the highest prevalences of vitamin A deficiency when compared with other districts. On the other hand, the lowest prevalences were found in Ramallah (12.9%) and Jerusalem (15.4%) respectively. Again, there is a strong significant difference in vitamin A deficiency among the selected districts in the West Bank and Gaza Strip ($P = .000$) (For more details see Annex X).

Figure 1. Vitamin A Status Among Children 12-59 Months Of Age By District



Among the survey sample population, 39.2% of children were living in rural areas, 46.7% were from urban areas, and 12.1% were from camp areas in the West Bank and Gaza Strip. When analyzed by locality, the data indicated that the relationship between vitamin A status and urban/rural/camp residence was insignificant. After combining rural and urban residents into a single “non-camp” category analysis showed that the prevalence of vitamin A deficiency among children 12-59 months (Table 7) was a little higher in camps (27.6%) than in non-camps (21%), but no significant difference was found between the two groups at 0.05 alpha level.

Among husbands of the mothers interviewed during the study, approximately 80% had some type of work or employment, while the majority of mothers were mainly housewives and only 6.6% had work outside their home.

Table 7. Vitamin A Deficiency Among Children 12-59 Months Of Age In Camps Vs Non-Camps

Vitamin A Intervals (µg/L)	Locality				TOTAL	
	Camps		Non-Camps			
	Freq	%	Freq	%	Freq	%
<200	43	27.6	200	21.0	243	22.0
200-299	71	45.5	526	55.3	597	53.9
≥300	42	26.9	225	23.7	267	24.1
TOTAL	156	100	951	100	1107	100

Results revealed that 44.1% of the interviewed families reported that their average income during the 3 months prior to the survey was less than 1000 NIS (the prevailing exchange rate at the time of the survey was NIS 4.5: US\$1.00). An additional 42% had incomes of (1100-2000 NIS), 10.8% (2100-4000 NIS), and 0.9% (>4000 NIS), while 2.2% could not tell their exact income.

Results also showed that there are significant associations between vitamin A deficiency and the level of family income, where more than 90% of the vitamin A deficient children come from families with average incomes of 2000 NIS and less (See Table 8).

As illustrated in Table 8, 23.4% and 22.8% of children belonging to families with an average income of <1000 and 1100-2000 respectively were found to be vitamin A deficient (P= .002).

Table 8. Relationship Between VAD And Family Income

Average Income Intervals (NIS)	Vitamin A Intervals (µg/L)						TOTAL	
	Low <200		Borderline 200-299		Normal ≥300			
	Freq	%	Freq	%	Freq	%	Freq	%
<1000	113	23.4	273	56.6	96	20.0	482	100.0
1100-2000	105	22.8	230	50.0	125	27.2	460	100.0
2100-4000	15	12.7	67	56.8	36	30.5	118	100.0
>4100	2	20.0	2	20.0	6	60.0	10	100.0
DK	6	25.0	15	62.5	3	12.5	24	100.0
TOTAL	241	22.0	587	53.7	266	24.3	1094	100.0

Around 98% of the mothers had some kind of education. 12% of the mothers completed up to the sixth grade, 31.9% between 7-9 grades, 40.5% up to 10-12 grades, and 13.4% had more than 13 years of education.

The prevalence of vitamin A deficiency among children of illiterate mothers was 41.7%, compared to 23.5% among children of mothers that had completed up to 12 years of education. The prevalence dropped to 11.5% among children with mothers who had higher education. There is a significant decrease in the prevalence of VAD among children relative to increased years of education attained by their mothers (P= .003) (See Table 9).

Income and education are correlated. With increasing educational attainment, the sample's income level also increases. This confirms the relationship to VAD, and also postulates that maybe not all vitamin A deficiency is related to current economic and political realities.

Table 9. Relation between VAD and mothers' education

Mothers' Education (years)	Vitamin A Intervals ($\mu\text{g/L}$)						TOTAL	
	Low <200		Borderline 200-299		Normal ≥ 300			
	Freq	%	Freq	%	Freq	%	Freq	%
0.0	10	41.7	12	50.0	2	8.3	24	100.0
1-6	34	25.6	78	58.6	21	15.8	133	100.0
7-9	77	21.9	189	53.7	86	24.4	352	100.0
10-12	105	23.5	232	51.9	110	24.6	447	100.0
13+	17	11.5	85	57.4	46	31.1	148	100.0
TOTAL	243	22.0	596	53.9	265	24.0	1104	100.0

III.3. POTENTIAL CONFOUNDING FACTORS

Potential confounding factors that could impact the findings of any analysis of vitamin A in a population include the presence of children suffering from infection during the study (identified by analysis of their alpha acid glycoprotein levels) and children already taking vitamin A supplements in some form. This study has accounted for both potential constraints, as described below.

III.3.1. ALPHA ACID GLYCOPROTEIN

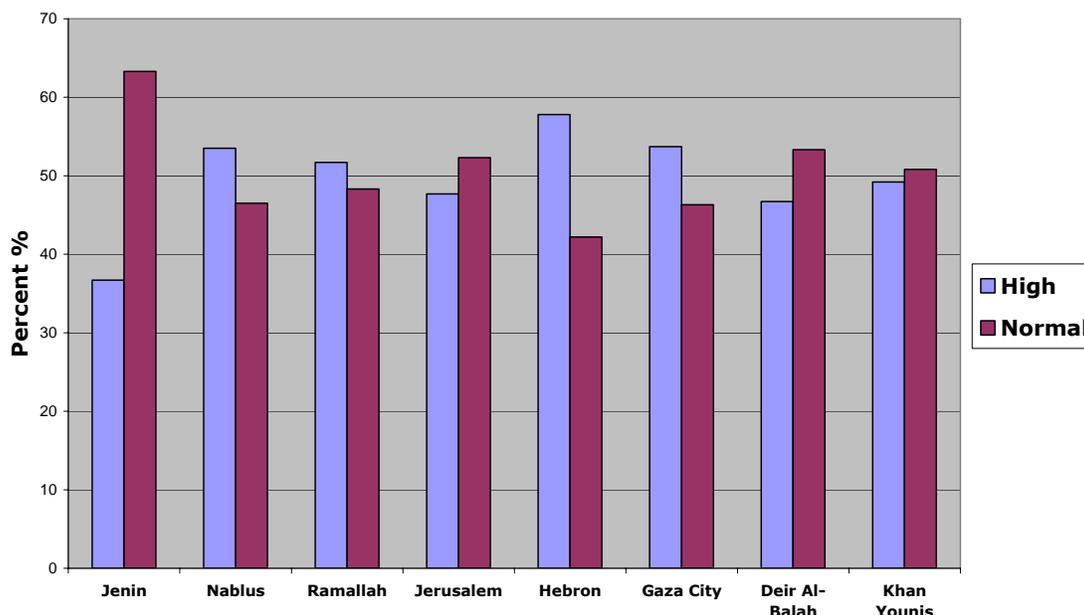
Blood analysis indicated that 50.9% of children 12-59 months of age had elevated levels of alpha acid glycoprotein, with concentrations above 1.0 g/L. The difference in AGP prevalence among the different regions in the West Bank and Gaza Strip was found to be insignificant (See Table 10).

Table 10. Plasma Alpha Acid Glycoprotein Levels In The Different Regions Of The West Bank And Gaza Strip

REGION	AGP levels (g/L)				TOTAL	
	High AGP > 1.0		Normal AGP ≤ 1.0			
	Freq	%	Freq	%	Freq	%
WEST BANK						
North	123	45.6	147	54.4	270	100
Middle	91	50.3	90	49.7	181	100
South	122	57.8	89	42.2	211	100
GAZA STRIP						
North	124	53.7	107	46.3	231	100
South	103	48.1	111	51.9	214	100
TOTAL	563	50.9	544	49.1	1107	100

A variation in alpha acid glycoprotein levels was found among the different districts of the West Bank and Gaza Strip (Figure 2). In the Gaza Strip, Gaza City had the highest (53.7%) prevalence of high AGP (AGP > 1.0), followed by Khan Younis (49.2%). In the West Bank, Hebron ranked the highest (57.8%), followed by Nablus (53.5%) (P= .000). For more detail see Annex XI.

Figure 2. Plasma Alpha Acid Glycoprotein Levels Among Different Districts In The West Bank And Gaza Strip



Further statistical analysis by cross tabulation between alpha acid glycoprotein and vitamin A showed that vitamin A deficiency among non-infected children (children with normal levels of AGP ≤ 1.0 g/L) was 11.6% (Table 11). On the other hand, vitamin A deficiency among infected children (AGP levels > 1.0 g/L) proved to be 32%. This observation clearly reveals the effect of infection on retinol levels, falsely increasing the apparent prevalence of vitamin A deficiency ($P = .000$).

Table 11. Vitamin A Deficiency Vs. Alpha Acid Glycoprotein Levels Among Children Aged 12-59 Months

Vitamin A Intervals ($\mu\text{g/L}$)	AGP levels (g/L)				TOTAL	
	High AGP > 1.0		Normal AGP ≤ 1.0			
	Freq	%	Freq	%	Freq	%
<200	180	32	63	11.6	243	22
200-299	281	49.9	316	58.1	597	53.9
≥ 300	102	18.1	165	30.3	267	24.1
TOTAL	563	100	544	100	1107	100

Vitamin A deficiency affects child morbidity and survival. Low plasma retinol concentrations are used to quantify the VAD problem, but since plasma retinol is depressed by both clinical and subclinical infection, its use overestimates the problem. Therefore, under this study alpha acid glycoprotein was measured in order to provide more accurate estimates of VAD by quantifying the depression in plasma retinol associated with infection or convalescence. (For more information about the reported recent infections among children participating in the study please see Annex XII).

Table 12 shows that in the West Bank, 8.9% of non-infected children were vitamin A deficient. Whereas, in the Gaza Strip, vitamin A deficiency among non-infected children

rose to 15.6%. The difference between West Bank and Gaza Strip is statistically significant (P= .05). This indicates that in the Gaza Strip, in addition to infection/inflammation, low vitamin A intake is an important factor contributing to vitamin A deficiency.

Table 12. Vitamin A Deficiency vs. Alpha Acid Glycoprotein Levels Among Children Aged 12-59 Months by Area (Percentages are in parenthesis)

AREA	AGP Levels (g/L)							
	High AGP > 1.0				Normal AGP ≤ 1.0			
	Vitamin A Intervals (µg/L)			TOTAL	Vitamin A Intervals (µg/L)			TOTAL
	Low <200	Borderline 200-299	Normal ≥300		Low <200	Borderline 200-299	Normal ≥300	
WEST BANK	96 (28.6)	168 (50.0)	72 (21.4)	336 (100.0)	29 (8.9)	193 (59.2)	104 (31.9)	326 (100.0)
GAZA STRIP	84 (37.0)	113 (49.8)	30 (13.2)	227 (100.0)	34 (15.6)	123 (56.4)	61 (28.0)	218 (100.0)
TOTAL	180 (32.0)	281 (49.9)	102 (18.1)	563 (100.0)	63 (11.6)	316 (58.1)	165 (30.3)	544 (100.0)

III.3.2. VITAMIN A SUPPLEMENTATION

Results showed that a group of 22 children had been taking vitamin A drops for at least 3-4 weeks at the time of the survey. When the prevalence of vitamin A deficiency was calculated among this group, it was found that 18.2% (a total of 4 children) were vitamin A deficient.

When asked to show the data collectors the vitamin A & D bottles, only 14 mothers were able to produce the bottles. The data collectors checked the bottles and found 7 with the MOH logo (supported by the MARAM) and the other 7 from other sources. Upon asking those mothers about the frequency with which they gave their children the Vitamin A and D supplementation, 10 mothers gave vitamin drops to their children once a day and 3 mothers gave it twice a day. (One mother did not respond to the question).

III.4. ANEMIA STATUS

The overall prevalence of anemia among children aged 12 - 59 months was 23%. Of the 254 children found to be anemic, only 2 cases (0.2%) had severe anemia (Hb < 7).

As illustrated in Table 13, the prevalence of anemia varied significantly between the West Bank (17.4%) and Gaza Strip (31.2%). Moreover, prevalence rates of anemia in the north, middle and south regions of the West Bank were 21.5, 14.9% and 14.3% respectively, while the rates in the northern and southern regions of Gaza were 30.7% and 31.8% respectively (P= .000).

Furthermore, calculation of the prevalence of anemia among children aged 12-59 months was assessed for the 42 children who were receiving iron syrup at the time of the interviews (for at least 3-4 weeks). The estimated prevalence of anemia was found to be 28.6% (a total of 12 children).

Mothers were asked to show the bottle of iron syrup. Only 31 mothers were able to show the bottles. The interviewers checked the bottles and found 17 with the MOH logo (supported by MARAM) and the remaining 14 from other sources.

Table 13. Prevalence Of Anemia Among Children 12-59 Months In The Different Regions In The West Bank and Gaza Strip

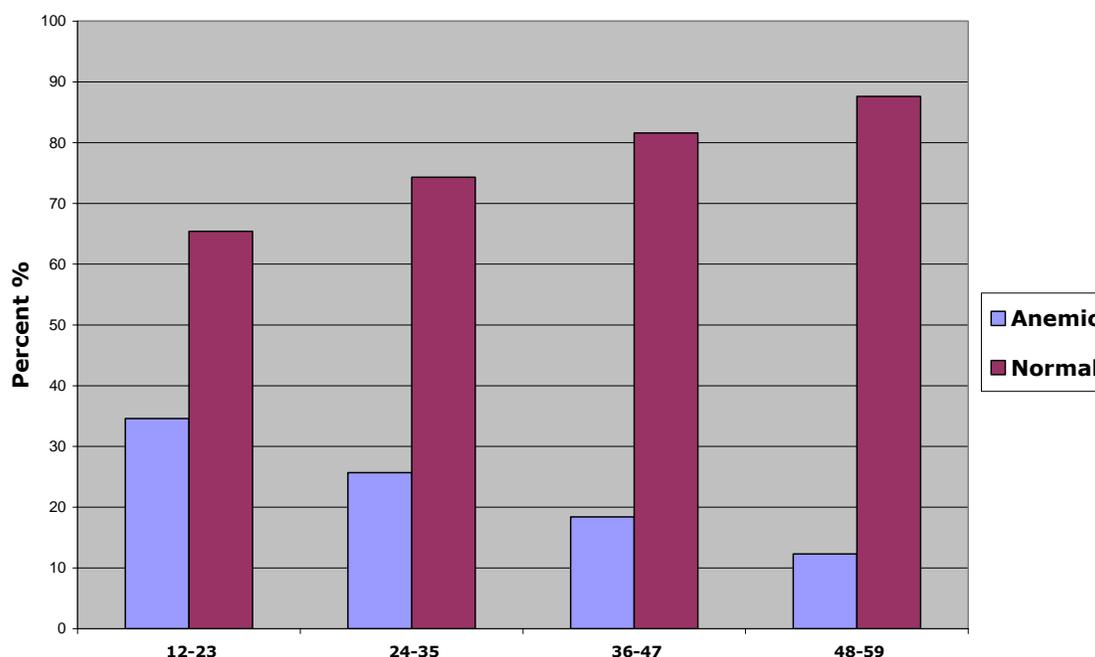
REGION	Hb Levels (g/dl)				TOTAL	
	Anemic Hb<11		Normal Hb ≥11			
	Freq	%	Freq	%	Freq	%
WEST BANK						
North	58	21.5	212	78.5	270	100
Middle	27	14.9	154	85.1	181	100
South	30	14.3	180	85.7	210	100
GAZA STRIP						
North	71	30.7	160	69.3	231	100
South	68	31.8	146	68.2	214	100
TOTAL	254	23	852	77	1106	100

Upon asking these mothers about the frequency of giving their children iron supplementation, 24 mothers were giving iron doses to their children once a day, and 6 mothers were giving it twice or more a day.

No significant difference was found in the relationship between anemia and child gender, or between anemia among children who live in camps and those who do not. Moreover, the mothers' years of education were found to have no significant relationship with anemic children.

The results did show, however, that anemia was significantly related to the age of the children in the different age categories (See Figure 3). The highest percentage of anemia was found among children in the 12-23 month age group (34.7%), followed by children in the 24-35 month age group (25.7%), the 36-47 month age group (18.5%) The lowest (12.4%) was among children between 48-59 months old (P= .000).

Figure 3. Hemoglobin Levels Among Different Age Groups



III.4.1. VITAMIN A DEFICIENCY AND ANEMIA

The results revealed that 33.9% of vitamin A deficient children were also anemic (see Table 14), indicating that vitamin A deficient children are more likely to be anemic than children with normal levels of vitamin A.

Table 14. Vitamin A Deficiency vs Anemia Among Children Aged 12-59 Months of Age

Vitamin A Intervals (µg/L)	Hb Levels (g/dl)				TOTAL	
	Anemic Hb < 11		Normal Hb ≥ 11			
	Freq	%	Freq	%	Freq	%
<200	82	33.9	160	66.1	242	100.0
200-299	132	22.2	465	77.9	597	100.0
≥300	40	15.0	227	85.0	267	100.0
TOTAL	254	23	852	77	1106	100.0

III.5. SUPPLEMENTATION PRACTICES

Interviewed mothers indicated that 31% of their children received iron syrup during the first year of life, while only 14.7% received iron during the second year of life. Mothers indicated that 72.9% of their children received Vitamin A & D drops during the first year of life, while only 7.3% received A & D supplements during the second year.

These findings in a way might reflect the Palestinian Ministry of Health policies which indicate that children should receive daily vitamin A/D syrup from 21 days to 12 months of age. Moreover, the policy calling for iron with vitamin C in the form of syrup to be provided during the first 6 to 12 months for therapeutic and preventive purposes has

been extended to up to 36 months for therapeutic reasons. One should be cautious, however, in the interpretation of these results given the possibility of recall bias by mothers.

It should be mentioned that supplies of these micronutrient supplements are provided to families during the well-child visits at health centers. The amount provided is enough to meet recommended doses for at least 3-4 months.

Micronutrient malnutrition usually involves more than one micronutrient. Supplementation and fortification are often the most appropriate solutions to deficiencies. The West Bank and Gaza Strip has recently had experience with iodized salt; therefore the survey included an investigation of use of iodized salt in the participating households. For more information, see Annex XIII.

III.6. INTERNATIONAL COMPARISON OF VITAMIN A STATUS

Comparing vitamin A deficiency prevalence reported in the present study with those from other countries revealed several similarities and differences. In looking at the prevalence of serum retinol levels less than 200µg/L, West Bank & Gaza Strip is comparable to Oman, where the prevalence was 20.8% in 1995, and to the Dominican Republic, which had a prevalence of 19.6% in 1995 (more recent data are not available). A study conducted in Jordan and published in 2004 indicated that the prevalence of serum retinol levels less than 200µg/L was 15.2%. On the other hand, studies conducted in 1993 indicated very high prevalence in Ghana (73.4%), Yemen (62.4%), and Pakistan (48.3%) More recently, in 2003, the prevalence in Morocco was found to be 40.9%. None of the above studies adjusted findings for infections (For more detail see Annex XIV).

RECOMMENDATIONS

The prevalence of VAD in the West Bank and Gaza Strip meets both the WHO (20%) and the IVACG (15%) criteria for a public health problem that requires immediate action. VAD is associated with infection/inflammation in all communities, and in the Gaza Strip - in addition to the former factor - low intake of this nutrient in the diet is clearly a contributing factor. The international vitamin A effort recommends five areas of response that are complementary and necessary as part of a comprehensive approach:

- **ADVOCACY AND POLICY:** A clear commitment by policy makers to a comprehensive program, with clear guidelines and targets for implementation, combined with widespread consumer demand, are critical elements in an effective and sustainable vitamin A program. Policy makers should include representatives of the MOH, UNRWA, NGO and donor communities. UNRWA has already agreed to collaborate actively in an agreed-upon approach. To be comprehensive, this policy should include:
 - Protocols that include micronutrient practices, based both on Palestinian needs and international standards.
 - Behavior change strategies to inform and motivate - both the community and health providers - about the importance of vitamin A and other micronutrients. Issues to be addressed will include the safety of any supplements for the general population, the level of need in the overall population, the impact and effects of VAD, and international consensus/experience with MN programs.
 - Education and training for health providers on the MN protocols, program objectives and effective counseling.
 - The creation of a micronutrient committee representing active stakeholders and specialists. The committee will help to coordinate all donor and program efforts to avoid duplication, gaps or diversion of funds, or efforts to projects that are of lower priority, or are not relevant to the national effort.

- **FORTIFICATION OF STAPLE FOODS:** The Palestinian Ministry of Health is moving forward with plans to fortify wheat flour and possibly staples, such as oils or milk. The active involvement of the private sector in the production and marketing of such fortified products is strongly recommended, as it adds to feasibility as well as sustainability to the effort. A private sector initiative has already developed fortified biscuits, now in production, that include vitamin A with other micro-nutrients. The private sector makes an essential contribution in other countries, including the United States and Britain, in the fight against MN deficiencies. Palestinian efforts should support this model.

Fortification cannot, however, be the only strategy for meeting the needs identified in this study. In order to avoid any possibility of overdose, the formulation for any universal fortification is designed to meet the needs of the overall population, rather than the higher levels of need of vulnerable groups, such as pregnant and lactating women or young children. It is not clear that Palestine will be able to control enough of the production or distribution of these fortified products to assure adequate coverage, even of the general population. Fortification will need to be part of a comprehensive plan.

- **FOOD CONSUMPTION AND DIVERSIFICATION:** IVACG has recommended that breast milk with adequate vitamin A is the most reliable food for children under two, so increasing breast milk consumption during this period should be strongly promoted. Consumption of vitamin A rich foods should also be stressed for pregnant and lactating women, for infants and children, and for children who

are recuperating from illness. While improvement in food consumption patterns is an important part of the overall strategy to reduce MN deficiencies, many of the products richest in absorbable vitamin A (foods from animal origin) are expensive. Consumption of these foods in adequate amounts will require improvement in the economy, as well as in more reliable access to these foods.

- **SUPPLEMENTATION:** Vitamin A supplementation is highly cost effective, and has been proven relatively easy to deliver. A supplementation program should be put in place at least for the short term, until improvement of economic status, access to a diverse diet, and fortification can be assured. Possibly, supplementation will be always necessary for infants and young children. WHO recommendations are tested, clear and easy to follow. Details of these recommendations are included in the following section.
- **MONITORING AND EVALUATION:** Experience has shown that effective nutrition programs require the setting up and systematic monitoring of clear targets. Coverage, compliance and impact of programs needs to be followed, reported and acted upon. Within the West Bank & Gaza Strip, there has been successful experience in monitoring and reporting on immunization coverage. A similar dedication to detail and systematic follow-up should be applied to monitoring vitamin A supplementation (WHO recommendations for vitamin a supplementation using high dose are illustrated in Annex XV).

COVERAGE OF SUPPLEMENTATION FOR PREVENTION

Policy makers should decide to what age they will supplement: age one, fifteen months, or two, three or five years. IVACG currently recommends that vitamin A supplementation should continue to at least age three. In fact, this study showed that children aged 3 to 5 years are as vitamin A deficient as younger children, and therefore should not be excluded from a supplementation program. A longer period of supplementation, covering children up to five years, should be considered.

Current MOH policy, as well as the new Palestinian IMCI guidelines, calls for use of A and D syrup for infants from the age of 21 days until one year. This approach has been in place for many years.

Although the A&D syrups are widely accepted, there are no data on either coverage or compliance, so effectiveness is not possible to measure. If policy-makers wish to choose to continue to rely on syrup, possibly prescribed for a larger age group, it is important that they verify its success and solve any problems in coverage/compliance.

Overall, any supplementation program should take into account the fact that there were no significant differences in VAD between camps and the general public, by gender or as stated for ages between one and five years.

SUPPLEMENTATION FOR SICK CHILDREN

WHO recommends providing vitamin A for children with prolonged or severe illness, or for any case of measles to boost retinol levels (Supplementation of vitamin A capsules for sick children is shown in Annex XV).

POST PARTUM SUPPLEMENTATION

Almost all infants are born with low vitamin A stores, although even low levels of vitamin A offer highly beneficial contributions to infants' immune status. To meet a newborn's immediate need, nature has designed colostrum with three times as much vitamin A and

ten times the amount of retinol as ordinary breast milk. This transitional milk is two times richer in vitamin A, all in an easily digested and absorbable form [Breast milk, Facts for Feeding, 2001]. However, amounts of vitamin A in breast milk are dependent upon maternal stores; therefore where VAD is present it must be assumed that breast milk may lack sufficient vitamin A. The risk of VAD is greater for young children whose mothers are vitamin A deficient [Breastmilk, Facts for Feeding, 2001] For this reason, WHO recommends:

- o All infants receive as much colostrums and transitional milk as possible.
- o All mothers receive vitamin A supplementation at delivery [WHO, Distribution of vitamin A, 1998].
- o All mothers should receive counseling on MN rich foods during lactation [Breastmilk, Facts for Feeding, 2001].

Post partum supplementation is difficult in many countries where delivery is not centralized, but should be easily done in the West Bank & Gaza Strip (until food fortification with vitamin A is ready available.) WHO and IVACG call for completing this supplementation in the first six weeks [WHO, Distribution of vitamin A, 1998], but because the West Bank & Gaza Strip is so easily done, and women often become pregnant again soon after delivery, policy makers should consider requiring it in the first four weeks after delivery - to avoid any possibility of harmful side effects to a new fetus.

VITAMIN A AND ANEMIA

The clear link between vitamin A deficiency and anemia, and the endemic nature of anemia in vulnerable Palestinian populations suggests that reduction of VAD can play an important role in the reduction of anemia, and therefore treatment of anemia should be accompanied by assurance that vitamin A status is adequate. This suggests that until a comprehensive fortification program for the general population is in place, those with anemia should also receive vitamin A supplements (except in the case of women who are or could be pregnant.)

IODINE DEFICIENCY

Our study showed that only 50% of mothers knew if they were using iodized salt, despite the clear problem with iodine deficiency in the West Bank & Gaza Strip. An intensive campaign to raise awareness and demand to earlier levels should be conducted and sustained, as experience has shown that public awareness must be reinforced over time to avoid slippage in demand. The role of locally produced iodized salt and its capacity to meet the possible increase in demand should be assessed, and if feasible, the local product should be supported.

HIGH LEVELS OF INFECTION/INFLAMMATION

The study showed a surprisingly high level of infection/inflammation in the sample population. Over half of the children had had an infection in the past two weeks, and such children were significantly more likely to be vitamin A deficient. This not only suggests that a therapeutic vitamin A policy is needed, but that stronger medical intervention for prevention and management of childhood diseases should be in place. Media and educational materials on home management of colds and fevers and in season, diarrhea, is also needed. Most of these illnesses are seasonal. During the summer months, illness is weighted toward diarrhea. Hygiene, and environmental health and home management of illnesses, should be a priority of local health authorities.

ANNEX I: SAMPLE FRAMEWORK

Sample Framework was prepared by statisticians from the Palestinian Ministry of Health.

Sample Calculation

Prevalence = 25%, Confidence Interval (CI) = 90%, $K = 1.64$ (for CI of 90%), $Re = 0.10$, $N = 814$, design effect = 0.2, percentage of non-respond = 0.15

$N(\text{Final}) = N + (N * \text{design effect}) + \text{number of non-respond}$

$N(\text{Final}) = 814 + 162 + 146 = 1122$ (1127)

$N = K^2 * S^2 / E^2$

For, CI = 90%, $K = 1.64$

$S^2 = P(1-P)$

$E^2 = Re * P$

$Re = 0.10$

$N = 814$

Design effect = 0.2

$0.2 * 814 = 162$

Percentage of non-respond = 0.15

$0.15 * 976 = 146$

$N(\text{Final}) = N + (N * \text{design effect}) + \text{number of non-respond}$

$N(\text{Final}) = 814 + 162 + 146 = 1122$ (1127)

Governorate Selection

1. Governorates were divided into 2 regions, the West Bank and Gaza Strip, then ranked from north to south.
2. Population size for each governorate was determined from PCBS figures, and then the cumulative population size was calculated.
3. Sample interval for the West Bank and Gaza Strip was calculated as 320,020 and 333,856 respectively.
4. A random number between 1 and the sampling interval, for both regions was selected as 100,000 for the West Bank and 200,000 for Gaza Strip. Accordingly, clusters were identified.
5. Selected governorates were: Jenin, Nablus, Ramallah, Jerusalem, and Hebron from the West Bank; Gaza City, Deir al-Balah and Khan Yunis from the Gaza Strip.

Calculations were made utilizing Probability Proportional to Population Size (PPS) method.

Localities selection

1. Selected governorates were classified into 3 categories (Urban, Rural, and Camps; PCBS classification).

2. Sample size for each governorate was calculated according to the percentage of each category; PCBS figures.
3. Localities in each governorate were distributed into the 3 categories; Urban, Rural and Camps according to PCBS classification.
4. Localities in each category were ranked, excluding those with population size of less than 500.
5. Random sample method was utilized to select the localities.
6. Percentage of each locality was calculated according to the corresponding population size; thereafter, the number of samples for each category was estimated.

Distribution of Vitamin A Survey Sample, Based on Population Size (PCBS figures)

Districts	Population (Census data, PCBS)	%	No. of sample	Urban		Rural		Camps	
				%	No. of sample	%	No. of sample	%	No. of sample
Jenin	230,515	19	131	38.4	50	56.2	74	5.3	7
Nablus	251,392	21	143	41.7	60	47.9	68	10.5	15
Ramallah	205,448	17	117	34.1	40	59.5	70	6.4	7
Jerusalem	113,896	10	65	40.0	26	54.1	35	5.9	4
Hebron	390,272	33	220	67.6	149	29.7	65	2.8	6
West Bank	1,191,523	100	676		325		312		39
Gaza	359,941	51	232	81.0	188	1.8	4	17.2	40
Deir al-Balah	144,890	21	93	31.3	29	3.1	3	65.6	61
Khan Yunis	196,662	28	126	69.6	88	12.8	16	17.6	22
Gaza Strip	701,493	100	451		305		23		123
			1,127		630		335		162

ANNEX II: TRAINING WORKSHOP ON VITAMIN A ASSESSMENT

JUST-(November 30th to December 11th)

Summary of Accomplished Tasks/Objectives

A. PRACTICAL SKILLS

1. HPLC Instrument

Categories: normal, reverse phase

Types: isocratic, low pressure and high pressure gradient

Parts: pump, detector, auto-sampler, manual injector, controller

Operating System: on/off

Checkup on System Suitability

Running the Software: method, report, sequence development, data acquisition

Pump Calibration

Troubleshooting

2. Methodology

Specimen Treatment:

- Plasma Handling; Receiving, pipetting, extracting, evaporating (using sample concentrator), and reconstituting.
- Preparing vials for auto-sampler.

Solutions: Stock and working solutions' preparation of certified standards

Constructing standard curve using controls

Running a batch of unknown specimens

Use of Tools:

Micropipette (using and calibrating)

HPLC syringe

B. Preparation of Laboratory Guides

- a. Guide for vitamin A assay and hematological parameters
- b. HPLC Software

ANNEX III: QUESTIONNAIRE

**Palestinian Vitamin A Survey
All Information in this Questionnaire is for Research Purpose Only
Addressed Person: Mother's Child**

<p>1. Consent</p> <p><u>FOR INTERVIEWER:</u></p> <p>Date of visit: _____/_____/2003</p> <p>Interviewer's name: (First) _____ (last) _____</p> <p>Signature: _____</p> <p><u>FOR DATA COLLECTORS</u></p>	<p align="center"><u>FOR CENTER USE ONLY</u></p> <p align="center"><input type="checkbox"/></p> <p align="center">____-____-2003</p> <p align="center">____</p>
<p>2. District: _____</p>	
<p>3. District code: _____</p>	<p align="center"><input type="checkbox"/><input type="checkbox"/></p>
<p>4. Sample number: _____</p>	<p align="center"><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/></p>
<p>5. Name of locality: _____</p> <p>a. Village</p> <p>b. Town</p> <p>c. Camp</p>	<p align="center"><input type="checkbox"/></p> <p align="center"><input type="checkbox"/></p> <p align="center"><input type="checkbox"/></p>
<p>6. Household address: _____</p>	<p align="center"><input type="checkbox"/><input type="checkbox"/></p>
<p>7. Phone No. (if possible): _____</p>	
<p>8. Total number of household members (individuals present at home throughout the last month): _____</p>	<p align="center"><input type="checkbox"/><input type="checkbox"/></p>
<p>9. Number of children from 12 – 59 months: _____</p>	<p align="center"><input type="checkbox"/><input type="checkbox"/></p>
<p>10. What is the educational attainment of the household's head?</p> <p>a. Illiterate</p> <p>b. Literate Years of education: _____</p>	<p align="center"><input type="checkbox"/></p> <p align="center"><input type="checkbox"/> <input type="checkbox"/><input type="checkbox"/></p>
<p>11. What is the educational attainment of mother?</p> <p>a. Illiterate</p> <p>b. Literate Years of education: _____</p>	<p align="center"><input type="checkbox"/></p> <p align="center"><input type="checkbox"/> <input type="checkbox"/><input type="checkbox"/></p>

12. Does the mother work? 1. Yes, how many hours per day: _____ hrs 2. No	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
13. Does the father work? 1. Yes, how many hours per day: _____ hrs 2. No	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
14. Age of mother: _____ years	<input type="checkbox"/> <input type="checkbox"/>
15. Name of selected* child (First) _____ (last) _____	
16. Birth date of selected child: (check mother's ID) _____/_____/19__	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
17. Child's Gender 1. Male 2. Female	<input type="checkbox"/> <input type="checkbox"/>
18. What is the average income of the household for the last 3 months? 1. Less than 1000 NIS 2. 1100- 2000 NIS 3. 2100 – 4000 NIS 4. Greater than 4100 NIS 5. Don't Know	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
*in case there is more than one child age 12 – 59 months at home; only one will be selected by assigning every child a number, writing it on a piece of paper, then randomly picking up one.	

Has the child been ill with any of the followings?		a	b	c	
		Yes	No	Don't know	
19.	Fever within the last 2 weeks?				<input type="checkbox"/>
20.	Cough within the last 2 weeks?				<input type="checkbox"/>
21.	Continuous diarrhea* for a minimum of two weeks within the last 3 months?				<input type="checkbox"/>
22.	Diarrhea within the last 2 weeks?				<input type="checkbox"/>

*Diarrhea: an abnormal increase in the frequency and liquidity of your child' stool

23a.	Has the child ever been affected with measles?	
1.	Yes	<input type="checkbox"/>
2.	No	<input type="checkbox"/>
3.	Don't Know	<input type="checkbox"/>
23b.	If yes,	
1.	How old was the child: _____ months	<input type="checkbox"/> <input type="checkbox"/>
2.	Has the child been diagnosed by a physician?	
a.	Yes	<input type="checkbox"/>
b.	No	<input type="checkbox"/>
c.	Don't Know	<input type="checkbox"/>

For interviewer: ask questions in column A then column B (you can encircle more than one choice)

A: Vitamin (A & D)				B: Iron			
24.A	Did the child take vitamin A&D drops?	(1) Yes	(2) No	24.B	Did the child take iron syrup?	(1) Yes	(2) No
	a. Within 1 -12 months of age	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	a. Within 6 -12 months of age	<input type="checkbox"/>	<input type="checkbox"/>
	b. Within 13 -36 months of age	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	b. Within 13 -36 months of age	<input type="checkbox"/>	<input type="checkbox"/>
	c. Within 37 -59 months of age	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	c. Within 37 -59 months of age	<input type="checkbox"/>	<input type="checkbox"/>
25.A	If yes, for how long have you given drops to the child? _____months	<input type="checkbox"/>	<input type="checkbox"/>	25.B	If yes: for how long have you given syrup to the child? _____months	<input type="checkbox"/>	<input type="checkbox"/>
26.A	Is the child currently (for at least 3 – 4 weeks) taking vitamin A&D drops?			26.B	Is the child currently (for at least 3 – 4 weeks) taking iron syrup?		
a.	Yes	<input type="checkbox"/>		a.	Yes	<input type="checkbox"/>	
b.	No	<input type="checkbox"/>		b.	No	<input type="checkbox"/>	
c.	Don't know, can't remember	<input type="checkbox"/>		c.	Don't know, can't remember	<input type="checkbox"/>	
27.A	If yes, how old was the child when you first started giving him/her vitamin A&D drops? _____months	<input type="checkbox"/>	<input type="checkbox"/>	27.B	If yes, how old was the child when you first started giving him/her iron syrup? _____months	<input type="checkbox"/>	<input type="checkbox"/>
28.A	If yes, can you please show me the bottle?			28.B	If yes, can you please show me the bottle?		
1.	MOH logo (for interviewer)	<input type="checkbox"/>		1.	MOH logo (for interviewer)	<input type="checkbox"/>	
2.	Others (for interviewer)	<input type="checkbox"/>		2.	Others (for interviewer)	<input type="checkbox"/>	
3.	Doesn't have it, can't find it	<input type="checkbox"/>		3.	Doesn't have it, can't find it	<input type="checkbox"/>	
29.A	How frequent do you give your child vitamin drops?			29.B	How frequent do you give your child iron syrup?		
1.	_____ times a day	<input type="checkbox"/>		1.	_____ times a day	<input type="checkbox"/>	
2.	_____ times a week	<input type="checkbox"/>		2.	_____ times a week	<input type="checkbox"/>	
3.	_____ times a month	<input type="checkbox"/>		3.	_____ times a month	<input type="checkbox"/>	
4.	Irregular	<input type="checkbox"/>		4.	Irregular	<input type="checkbox"/>	
5.	Don't know, can't remember	<input type="checkbox"/>		5.	Don't know, can't remember	<input type="checkbox"/>	

30.	Do you utilize iodized salt?	
1.	Yes	<input type="checkbox"/>
2.	No	<input type="checkbox"/>
3.	Don't know	<input type="checkbox"/>
31.	May I please see the container?	
1.	Iodized	<input type="checkbox"/>
2.	Not iodized	<input type="checkbox"/>

المسح الفلسطيني الخاص بفيتامين " أ "
 كل المعلومات في هذه الإستمارة هي لأغراض البحث فقط
 المبحوث : أم الطفل

<p><u>لاستخدام المركز فقط</u></p> <p><input type="checkbox"/></p> <p>2003-<input type="checkbox"/><input type="checkbox"/>-<input type="checkbox"/><input type="checkbox"/></p> <p><input type="checkbox"/><input type="checkbox"/></p>	<p>1. بيان الموافقة على المشاركة في الدراسة</p> <p><u>للباحث</u></p> <p>2003</p> <p>تاريخ الزيارة : ___ / ___ / ___</p> <p>اسم الباحث : _____</p> <p>التوقيع : _____</p> <p><u>للباحثين الميدانيين</u></p>	<p>.1</p>
	<p>المحافظة _____</p>	<p>.2</p>
<p><input type="checkbox"/><input type="checkbox"/></p>	<p>رمز المحافظة _____</p>	<p>.3</p>
<p><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/></p>	<p>رقم العينة _____</p>	<p>.4</p>
<p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p>	<p>اسم المنطقة _____</p> <p>أ. قرية</p> <p>ب. مدينة</p> <p>ج. مخيم</p>	<p>.5</p>
	<p>عنوان المنزل _____</p>	<p>.6</p>
	<p>رقم التلفون (إذا أمكن) _____</p>	<p>.7</p>
<p><input type="checkbox"/><input type="checkbox"/></p>	<p>عدد أفراد المنزل (المتواجدين في البيت خلال الشهر الماضي) _____</p>	<p>.8</p>
<p><input type="checkbox"/><input type="checkbox"/></p>	<p>عدد الأطفال بين عمر 59 -12 شهر : _____</p>	<p>.9</p>
<p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/><input type="checkbox"/></p>	<p>ما هو التحصيل العلمي لرب الأسرة :</p> <p>أ. غير متعلم (أمي)</p> <p>ب. متعلم</p> <p>عدد سنوات الدراسة _____</p>	<p>.10</p>
<p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/><input type="checkbox"/></p>	<p>ما هو التحصيل العلمي للأم:</p> <p>أ. غير متعلمة (أمية)</p> <p>ب. متعلمة</p> <p>عدد سنوات الدراسة _____</p>	<p>.11</p>
<p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/><input type="checkbox"/></p>	<p>هل تعمل الأم؟</p> <p>أ. نعم، كم ساعة في اليوم: _____ ساعة</p> <p>ب. لا</p>	<p>.12</p>

هل يعمل الأب؟ أ. نعم، كم ساعة باليوم : _____ ساعة ب. لا	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
13.	
14. عمر الأم : _____ سنة	<input type="checkbox"/> <input type="checkbox"/>
15. اسم الطفل الذي تم اختياره*:	_____
16. تاريخ ميلاد الطفل: (للباحث: تأكد من التاريخ من هوية الأم الشخصية)	____/____/____
17. جنس الطفل : أ. ذكر ب. أنثى	<input type="checkbox"/>
18. ما هو معدل دخل الأسرة خلال الثلاث أشهر الماضية؟ أ. أقل من 1000 شيكل ب. 1100-2000 شيكل ت. 2100-4000 شيكل ث. أكثر من 4100 شيكل ج. لا أعلم	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
*سوف يتم إعداد قائمة تتضمن جميع الأطفال من سن 12- 59 شهرا ثم يتم السحب عشوائيا عن طريق القرعة	

هل أصيب الطفل بأي من الأمراض التالية :			
أ	ب	ج	
نعم	لا	لا أعلم	
			19. حرارة خلال الأسبوعين الماضيين
			20. سعال خلال الأسبوعين الماضيين
			21. متواصل لمدة أسبوعين أو أكثر خلال الثلاث اشهر الماضية*إسهال
			22. إسهال خلال الأسبوعين الماضيين
*الإسهال: زيادة غير عادية في عدد مرات الإخراج وسيولة البراز لدى الطفل			
			23أ هل أصيب الطفل بالحصبة؟ 1. نعم 2. لا 3. لا أعلم
			23ب إذا كان الجواب نعم : 1. كم كان عمر الطفل : _____ شهر 2. هل تم تشخيص الطفل بأنه مصاب بالحصبة من قبل الطبيب؟ أ. نعم ب. لا ج. لا أعلم

للباحث: إسأل الأسئلة في العمود " أ " ومن ثم انتقل للأسئلة في العمود " ب " (يجوز وضع أكثر من دائرة حول الاختيارات)

ب: الحديد		أ: فيتامين "أ" و "د"																			
هل تتناول الطفل شراب الحديد؟ (1) نعم (2) لا	ب24.	هل تتناول الطفل نقط فيتامين "أ" و "د" ؟ (1) نعم (2) لا	أ24.																		
<table border="1"> <tr> <td><input type="checkbox"/></td> <td>أ.</td> <td>شهر من عمره 12-6 خلال</td> </tr> <tr> <td><input type="checkbox"/></td> <td>ب.</td> <td>شهر من عمره 36-13 خلال</td> </tr> <tr> <td><input type="checkbox"/></td> <td>ج.</td> <td>59 شهر من عمره -37 خلال</td> </tr> </table>	<input type="checkbox"/>	أ.	شهر من عمره 12-6 خلال	<input type="checkbox"/>	ب.	شهر من عمره 36-13 خلال	<input type="checkbox"/>	ج.	59 شهر من عمره -37 خلال		<table border="1"> <tr> <td><input type="checkbox"/></td> <td>أ.</td> <td>شهر من عمره 12-1 خلال</td> </tr> <tr> <td><input type="checkbox"/></td> <td>ب.</td> <td>شهر من عمره 36-13 خلال</td> </tr> <tr> <td><input type="checkbox"/></td> <td>ج.</td> <td>59 شهر من عمره -37 خلال</td> </tr> </table>	<input type="checkbox"/>	أ.	شهر من عمره 12-1 خلال	<input type="checkbox"/>	ب.	شهر من عمره 36-13 خلال	<input type="checkbox"/>	ج.	59 شهر من عمره -37 خلال	
<input type="checkbox"/>	أ.	شهر من عمره 12-6 خلال																			
<input type="checkbox"/>	ب.	شهر من عمره 36-13 خلال																			
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<input type="checkbox"/>	ب.	شهر من عمره 36-13 خلال																			
<input type="checkbox"/>	ج.	59 شهر من عمره -37 خلال																			
إذا كان الجواب نعم: ما هي المدة التي أعطي خلالها الشراب أشهر _____	ب25.	إذا كان الجواب نعم: ما هي المدة التي أعطيت خلالها النقط أشهر _____	أ25.																		
هل يتناول الطفل حالياً (لمدة لا تقل عن 3 - 4 أسابيع) شراب الحديد؟ نعم لا لا أعلم، لا أذكر	ب26.	هل يتناول الطفل حالياً (لمدة لا تقل عن 3 - 4 أسابيع) نقط فيتامين "أ" و "د" ؟ نعم لا لا أعلم، لا أذكر	أ26.																		
إذا كان الجواب نعم: كم كان عمر الطفل عندما بدأت بإعطائه شراب الحديد؟ أشهر _____	ب27.	إذا كان الجواب نعم: كم كان عمر الطفل عندما بدأت بإعطائه نقط فيتامين "أ" و "د" ؟ أشهر _____	أ27.																		
إذا كان الجواب نعم هل يمكنني أن أرى العبوة؟ عليها شعار وزارة الصحة (للباحث فقط) عليها شعار آخر (للباحث فقط) ليست موجودة، لا تستطيع العثور عليها	ب28.	إذا كان الجواب نعم هل يمكنني أن أرى العبوة؟ عليها شعار وزارة الصحة (للباحث فقط) عليها شعار آخر (للباحث فقط) ليست موجودة، لا تستطيع العثور عليها	أ28.																		
كم مرة تعطي طفلك من شراب الحديد ؟ 1. مرات في اليوم 2. مرات في الأسبوع 3. مرات في الشهر 4. غير منتظم 5. لا أدري، لا أذكر	ب29.	كم مرة تعطي طفلك من نقط الفيتامين؟ 1. مرات في اليوم 2. مرات في الأسبوع 3. مرات في الشهر 4. غير منتظم 5. لا أدري، لا أذكر	أ29.																		
		هل تستعملين الملح المدعم باليود؟ نعم لا لا أعلم	ب30.																		
		هل يمكنني أن أرى العبوة ؟ مدعم باليود غير مدعم باليود	ب31.																		

ANNEX IV: MATERIALS REQUIRED FOR THE FIELD SURVEY

SUPPLIES:

1. Alcohol pads
2. Sterilized cotton wool pack
3. Sterile medical gauze
4. Band-aids for post-injection use
5. Tourniquets
6. Monovette butterfly needles 21 G x 3/4" TW
7. Monovette needles 22 G x 1 1/2"
8. Butterfly needles 23 G (without adapter)
9. Monovette Lithium heparinized tube-syringes 4.5 mL
10. Screw cap 0.5 ml microtubes (cryovials) with writing space
11. Rack D12 for Monovette tubes and microtubes
12. Storage boxes for microtubes
13. Bio-hazard sharps containers
14. Ice box
15. Ice packs, frozen
16. Aluminum foil
17. Labels of high quality for tubes and vials
18. Pens
19. Permanent ink marker (fine tipped) water proof
20. Masking tape
21. Scissors
22. Stapler and staples
23. Disposable gloves (medium) and (large)
24. Soap, liquid
25. Napkins, or toilet paper
26. Packs of candies (for social comforting of child)

EQUIPMENT:

1. Centrifuge,
2. Full automated CBC apparatus (+ calibrator)
3. Micro-Pipettes
4. Disposable tips
5. Glass Pasteur pipettes (+ rubber teats)

ANNEX V: CONSENT FORM

Consent on Participation in the Vitamin A Survey

The Maram Project, in coordination with the Palestinian Ministry of Health, is conducting a survey to assess vitamin A status among children 12 – 59 months of age, in order to estimate the prevalence of vitamin A deficiency in the mentioned target group. Vitamin A deficiency is one of the major nutritional problems in the developing world that is rarely seen in the developed world.

This study will support the Ministry of Health in the flour fortification program which will include vitamin A, vitamin B, iron and folic acid supplements.

Vitamin A plays an important role in bone growth, it promotes vision and helps us see in the dark, sustains the immune system and helps maintain the integrity of skin.

Blood will be collected from every subject using disposable, sterile and safe equipment. We would like to notify that you have the right to approve or disapprove of participating in this study, and that all information is confidential and for research purposes only.

Thank you for your cooperation

Sample number _____

Interviewer's name _____

Parent's signature _____

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ANNEX VI: PROTOCOLS FOR BLOOD COLLECTION

Prior to blood collection, prepare required materials for the procedure and label the tube.

BLOOD COLLECTION

1. Position subject.
2. Hyperextend subject's arm.
3. Wear sterile gloves (optional.)
4. Apply the tourniquet just prior to injecting the needle.
5. Apply the tourniquet \approx 2-3 inches above the selected puncture site.
6. Do not place tourniquet too tightly.
7. Remember not to leave tourniquet on for more than 2 minutes.
8. Tell subject (if old enough) to make a fist without pumping the hand.
9. Select a suitable site for venipuncture.
10. With alcohol, cleanse in a circular fashion, beginning at the site and working outward.
11. Allow alcohol to air dry.
12. Grasp arm firmly using your thumb to draw the skin stretched tight and anchor the vein.
13. Insert needle adapted to the syringe tube through skin and into the lumen of vein.
14. Remove tourniquet while the tube to be drawn is filling.
15. Remove needle using a swift backward motion.
16. Press down on the gauze, applying pressure to avoid hematoma and stop bleeding.
17. Apply the adhesive band-aid afterward.
18. Gently rotate the blood sample tube 5 to 10 times to mix blood with anti-coagulant.
19. Wrap with foil, then with labeled sticker and promptly transfer specimen to the rack in the ice box.
20. Dispose of used materials in designated containers.

ANNEX VII: BLOOD PROCESSING PROTOCOLS

1. While blood sample racks are taken out of the icebox, re-freeze the ice packs by transferring them from the icebox to the lab freezer immediately.
2. Locate samples on a shaker until they reach room temperature.
3. Perform start-up procedures and run quality control materials on full automated CBC apparatus.
4. Run CBC for all specimens.
5. Return each specimen to the icebox until CBC for samples is completed.
6. Attach each CBC result with the correspondent questionnaire.
7. Prompt to separating plasma from whole blood by centrifuging the collected blood sample, starting at 3000 rpm and increasing gradually to 5000 rpm. The estimated time needed for the separation is 5 minutes.
8. During centrifugation, label the 4 plasma vials (write serial alphabets: a, b, c, d.) In addition to the code, label the correspondent stickers with the name, code and serial alphabets. Wrap the vials with aluminum foil, and then add the stickers.
9. Using a 500 μ l automatic pipette, transfer and divide the plasma yield (after the centrifugation has ended) to the 0.5 ml cryovials, as 4 aliquots (Note: the volume here is very critical to prevent shortage of sample especially for a and b JUST vials).
10. Place cryovials "a" and "b" in one storage box (labeled JUST). Place each of the other two cryovials "c" and "d" in another different storage box (labeled MOH).
11. Store plasma at -20°C until designed number of samples is gathered.

ANNEX VIII: RETINOL ASSAY BY HPLC

RETINOL ASSESSMENT SIMULTANEOUSLY WITH α -TOCOPHEROL BY HPLC METHOD [Catignani and Bieri, 1983]

PRINCIPLE

Serum or plasma is deproteinized with ethanol that contains the internal standards (retinyl acetate and α -tocopheryl acetate), and the lipid is extracted with hexane. After an aliquot of the solvent phase is evaporated, the residue is dissolved in diethyl ether, then diluted with methanol. A portion of this solution is injected onto a C₁₈ reversed phase chromatographic column, and absorbances of the vitamins and internal standards are measured at 280 nm. Peak-height ratios are used to quantify each vitamin.

MATERIALS AND METHODS REAGENTS

Solvents

Hexane and methanol are liquid-chromatography grade. Anhydrous diethyl ether, absolute ethanol and water are reagent grade; the ethanol should be redistilled before use.

Standards

Standard compounds were all-trans-retinol, all-trans-retinyl acetate, d- α -tocopherol and d- α -tocopheryl acetate. All standards should be from reliable sources. The vitamin E standards can be used without further purification.

[The use of internal standards compensates for possible losses caused by the vapor evaporation and for pipetting variability. These derivatives are stable, readily available from special sources, and have absorptivities similar to those analytes of interest. Furthermore, there are no interfering peaks in plasma with retention times close to the two acetate internal standards].

Purification of Vitamin A Standards

Dissolve 100-150 μ g of retinol or retinyl acetate in methanol and inject the solution into the chromatograph. Collect the middle portion of the peak. Evaporate the eluate under a stream of nitrogen and dissolve the residue in ethanol.

Preparation of Vitamin Standards

Prepare stock standards of retinol and retinyl acetate (100 mg/L) as well as tocopherol and tocopheryl acetate (5 g/L) in ethanol. Dilute each stock standard 100 fold with ethanol to prepare working standards. Working standards of retinyl acetate and α -tocopheryl acetate should be prepared weekly and biweekly, respectively.

Retinol and α -tocopherol standards are usually kept for only a few days while standard curves are being prepared. Confirm the concentration of each working standard spectrophotometrically by using their respective absorptivities ($a^{1\%}_{1\text{cm}}$) in ethanol: retinol 1780 at 325 nm, retinyl acetate 1510 at 328 nm, α -tocopherol 75.8 at 292 nm, and α -tocopheryl acetate 43.6 at 285 nm.

All vitamin standards should be stored at -20°C and never exposed to natural illumination. Under these storing conditions the stock standard of retinyl acetate is stable for one month. The α -tocopheryl acetate stock standard is stable for several months.

[Note: some laboratories have found that retinol and α -tocopherol standards are stable for at least 10 weeks at -20°C. After two weeks, a slight shoulder on the retinyl acetate peak has sometimes been observed, together with a slight decrease in absorbance at 328; these changes are avoided by preparing and storing the retinyl acetate in actinic glassware].

Preparation of Developing Solution

Measure 950 mL of methanol with a glass graduated cylinder, dilute to 1000 mL with water, and mix. Filter through a 0.45- μ m pore-size GA6 membrane (Metric Membrane Filter; Gelman Instrument Co., Ann Arbor, MI 48106) and de-gas by using reduced pressure from a water aspirator for 10 min with stirring.

APPARATUS

Liquid Chromatograph: Shimadzu with auto-sampler (Class-VP, Shimadzu Corporation, Analytical Instruments Division, Kyoto -Japan).

Chromatography Column: Reversed-phase μ Bondapak C₁₈ (10- μ m particle size) stainless steel column, 3.9 mm i.d. x 30 cm (Waters Associates, Inc.)

Guard Column: Stainless steel 3.9 mm. i.d. x 5 cm column packed with 10- μ m μ Bondapak C₁₈ (Waters Associates, Inc.).

Shimadzu Software

COLLECTION AND STABILITY OF SPECIMENS

Either plasma or serum can be used as sample. Specimens collected after overnight fasts are preferred. Direct exposure to nature illumination should be avoided. The samples can be stored at 4°C for as long as 10 days.

[Note: some evaluators report that retinol and α -tocopherol in serum are stable to repeated freezing (-20°C) and thawing (17 cycles over a period of five weeks). They also note considerable variability in stability among different serum samples, but most remain stable for one day at 25 °C, four weeks at 4°C, and one year at -20-C or -70-C. If stored for longer periods of time, it is extremely important to add the hexane immediately after the ethanol or to add ascorbic a. (1g/l) to the ethanol. Otherwise, most of the retinol, tocopherol, and retinyl acetate are destroyed].

PROCEDURES

Preparation of Samples

All transfers involving solvents may be made with high quality pipettes. Steps 2-4, involving hexane, should be carried out in an exhaust hood.

1. Pipette 50 μ L each of retinyl acetate and α -tocopheryl acetate, working standards into a 6 x 50 mm disposable glass test tube. Add 100 μ L of sample and vortex-mix vigorously for 10 s (sample sizes of 100-400 μ L do not affect linearity of the assay, provided that the proportion of ethanol to plasma in the initial precipitation of proteins is not changed).
2. Add 100 μ L of hexane and vortex -mix intermittently and vigorously for 45 s.
3. Centrifuge at 800 x g for 5 min. Transfer 75 μ L of the hexane layer to a 6x50 mm disposable glass test tube.
4. Evaporate the hexane under a stream of air or nitrogen. Tubes may be placed in a 60°C water bath to speed evaporation (hexane boils at 69°C).
5. Dissolve the lipid residue in 25 μ L of diethyl ether. With gentle mixing, add 75 μ L of methanol.

[Note: Some researchers find that these extracts are stable for at least two days at 4°C. Others report that serum extracts stored in ethanol are stable for at least two weeks at -20°C]

6. Using a 10-µL flush of methanol, inject 90 µL of the solution into the chromatograph (injection volumes of 30-90 µL do not affect linearity of the assay).

Chromatography Conditions

Chromatography is performed at ambient temperature. Using the relevant software, follow the next guidelines:

1. Set the detector wavelength to 280 nm and the sensitivity at 0.01 A full-scale. Should additional sensitivity be necessary due to limited sample size (less than 100 µL) or very low vitamin concentrations, the detector may be used at its higher attenuation (0.005 A full-scale).

[Note: Some researchers use a detector wavelength of 292 nm; others monitor the column effluent at 290 nm]

2. Set the flow rate of the solvent delivery pump at 2.5 ml/min. Elution rates in excess of 4 ml/min result in deterioration of resolution.

3. If using a chart, adjust the chart speed of the recorder to operate at 1 cm/min.

Standard Curves and Calculations

Retinol and α-tocopherol were quantified from standard curves of peak-height ratios vs. weight ratios for each vitamin. To prepare the standard curves, a constant amount of the acetate form of each vitamin was combined with variable amounts of the corresponding alcohol form of each vitamin to give solutions with a threefold range of weight ratios. These solutions were chromatographed and the peak-height ratios recorded.

Peak-height ratios of samples are converted to known quantities of retinol and α-tocopherol from the standard curves as follows:

$$\frac{\text{Vitamin peak height of sample}}{\text{Vitamin peak height of internal standard}} = \text{Ratio}$$
$$\frac{\text{Ratio}}{\text{Slope of std. curve}} \times \frac{\text{amount of added internal standard}}{\text{volume of sample size}} = \text{vitamin conc.}$$

Standard curves may also be constructed for peak-area ratio vs. weight ratio. This method eliminates errors encountered when there are slight changes in retention times, such as from altered flow rates, day-to-day solvent inconsistencies, samples with high lipid content, and loss of column efficiency.

Detection Limits

The detection limits of the assay are much lower than the concentrations of retinol and α-tocopherol in plasma that are associated with a state of deficiency.

[Note : detection limits are found to be 100 µg/L for retinol and 0.8 mg/l for α-tocopherol].

ANNEX IX: VITAMIN E

BACKGROUND

Vitamin E is a fat-soluble vitamin that exists in eight different forms, alpha-tocopherol being the most important and most active. Vegetable oils, nuts, and green leafy vegetables are the main dietary sources of vitamin E. [U.S. Department of Agriculture, 1999]. It is a key compound involved in many physiological processes, such as neurological and immune functions. The most common role of vitamin E is its antioxidant effect, protecting molecules and tissues against the deleterious effect of free radicals. Vitamin E also contributes to the stabilization of biological membranes. In addition, it intervenes in the regulation of several enzymes and probably has impact on gene expression [Feki *et al.*, 2001].

FINDINGS OF VITAMIN E ANALYSIS

The overall prevalence of vitamin E deficiency (plasma level less than 5 mg/L) was found to be 18.6% (Table A). Results revealed that among children aged 12-59 months, a significantly higher percentage of those living in the Gaza Strip were vitamin E deficient (23.1%) compared to the same age group living in the West Bank (15.6%) (P= .006).

Within regions of the West Bank and Gaza Strip the prevalence of Vitamin E deficiency varied, but not significantly. The middle region of the West Bank had the highest prevalence (17.1%), while the northern part of the Gaza Strip had the highest prevalence there (25.1%).

Table A. Prevalence of Vitamin E deficiency by Region

REGION	Vitamin E Intervals (mg/L)						TOTAL	
	Low <5		Borderline 5-9.99		Normal ≥10			
	Freq	%	Freq	%	Freq	%	Freq	%
WEST BANK								
North	40	14.8	213	78.9	17	6.3	270	100
Middle	31	17.1	145	80.1	5	2.8	181	100
South	32	15.2	162	76.8	17	8.1	211	100
GAZA STRIP								
North	58	25.1	162	70.1	11	4.8	231	100
South	45	21.0	153	71.5	16	7.5	214	100
TOTAL	206	18.6	835	75.4	66	6.0	1107	100

As shown in Table (B), the highest percentage of vitamin E deficiency was found in Ramallah (23.3%) followed by Jenin (21.9%), Hebron (15.2%), Nablus (8.5%) and Jerusalem (6.2%). In the Gaza Strip the highest percent was detected in Khan Younis (35.2%), followed by Gaza City (25.1%), and the lowest was observed in Deir Al-Balah (2.2%). The variation among different districts is highly significant (p= .000).

Table B. Prevalence of Vitamin E deficiency by District

DISTRICT	Vitamin E Intervals (mg/L)						TOTAL	
	Low <5		Borderline 5-9.99		Normal ≥10			
	Freq	%	Freq	%	Freq	%	Freq	%
Jenin	28	21.9	94	73.4	6	4.7	128	100.0
Nablus	12	8.5	119	83.8	11	7.7	142	100.0
Ramallah	27	23.3	87	75.0	2	1.7	116	100.0
Jerusalem	4	6.2	58	89.2	3	4.6	65	100.0
Hebron	32	15.2	162	76.8	17	8.1	211	100.0
Gaza City	58	25.1	162	70.1	11	4.8	231	100.0
Deir al-Balah	2	2.2	76	82.6	14	15.2	92	100.0
Khan Younis	43	35.2	77	63.1	2	1.6	122	100.0
TOTAL	206	18.6	835	75.4	66	6.0	1107	100.0

Furthermore, the prevalence of VED among children 12-59 months of age who were living in camps was 8.35%, compared to 20.3% for children living in non-camp areas in the West Bank and Gaza Strip. The difference between the two areas was found to be significant ($P = .000$).

Upon examining the relationship between VA and VE status (Table C), results showed a strong association between VAD and VED where 27.2% of children who were vitamin deficient A were found to be vitamin E deficient as well ($P = .000$).

Table C. The Relationship Between Vitamin A And Vitamin E Deficiency

Vitamin A Intervals (µg/L)	Vitamin E Intervals (mg/L)						TOTAL	
	Low <5		Borderline 5-9.99		Normal ≥10			
	Freq	%	Freq	%	Freq	%	Freq	%
<200	66	27.2	174	71.6	3	1.2	243	100.0
200-299	116	19.4	452	75.7	29	4.9	597	100.0
≥300	24	9.0	209	78.3	34	12.7	267	100.0
TOTAL	206	18.6	835	75.4	66	6.0	1107	100.0

Further statistical analysis was done which showed that there was a significant positive correlation between vitamin A and vitamin E levels among children aged 12-59 months.

Upon examining the relationship between VE and anemia status (Table D), results showed an association between VE deficiency and anemia, where 28.6% of the children who were Vitamin E deficient were found to be anemic too ($P = .03$).

Table D. Vitamin E Deficiency Vs Anemia Among Children Aged 12-59 Months

Vitamin E Intervals (mg/L)	Hb Levels (g/dl)				TOTAL	
	Anemic Hb <11		Normal Hb ≥11			
	Freq	%	Freq	%	Freq	%
<5	59	28.6	147	71.4	206	100.0
5-9.99	186	22.3	649	77.7	835	100.0
≥10	9	13.8	56	86.2	65	100.0
TOTAL	254	23	852	77.0	1106	100.0

Moreover, results showed that there was a significant positive correlation between vitamin E and Hb levels among children under the study.

ANNEX X: VITAMIN A DEFICIENCY BY DISTRICT

Vitamin A Deficiency Among Children 12-59 Months Of Age By District

DISTRICT	Vitamin A Intervals ($\mu\text{g/L}$)						TOTAL	
	Low <200		Borderline 200-299		Normal ≥ 300			
	Freq	%	Freq	%	Freq	%	Freq	%
Jenin	29	22.7	70	54.7	29	22.7	128	100.0
Nablus	30	21.1	92	64.8	20	14.1	142	100.0
Ramallah	15	12.9	52	44.8	49	42.2	116	100.0
Jerusalem	10	15.4	34	52.3	21	32.3	65	100.0
Hebron	41	19.4	113	53.6	57	27.0	211	100.0
Gaza City	72	31.2	110	47.6	49	21.2	231	100.0
Deir al-Balah	16	17.4	51	55.4	25	27.2	92	100.0
Khan Younis	30	24.6	75	61.5	17	13.9	122	100.0
TOTAL	243	22	597	53.9	267	24.1	1107	100

ANNEX XI: PLASMA ALPHA ACID GLYCOPROTEIN LEVELS BY DISTRICT

Plasma Alpha Acid Glycoprotein Levels Among Different Districts in The West Bank And Gaza Strip

DISTRICT	AGP levels (g/L)				TOTAL	
	High AGP > 1.0 g/L		Normal AGP ≤ 1.0			
	Freq	%	Freq	%	Freq	%
Jenin	47	36.7	81	63.3	128	100.0
Nablus	76	53.5	66	46.5	142	100.0
Ramallah	60	51.7	56	48.3	116	100.0
Jerusalem	31	47.7	34	52.3	65	100.0
Hebron	122	57.8	89	42.2	211	100.0
Gaza City	124	53.7	107	46.3	231	100.0
Deir Al-Balah	43	46.7	49	53.3	92	100.0
Khan Younis	60	49.2	62	50.8	122	100.0
TOTAL	563	50.9	544	49.1	1107	100

ANNEX XII: RECENT INFECTIONS IN THE SAMPLE POPULATION

COUGH

As indicated in previous research findings, cough contributes to the elevation of AGP levels in blood. As shown in Table A, survey results indicate that 45% of children had cough within the two weeks prior to the interviews; 65.1% of those children were found to have elevated levels of alpha acid glycoprotein. The relationship between cough and elevated levels of alpha glycoprotein among children 12-59 months was found to be highly significant, as expected (P .000).

Table A. Cough Vs. AGP Levels

Cough within the last 2 weeks?	AGP levels (g/L)		TOTAL
	High AGP > 1.0	Normal AGP ≤ 1.0	
YES	322	173	495
% within cough within the last 2 weeks?	65.1	34.9	100.0
% of the Grand Total (1101)	29.2	15.7	45.0
NO	239	367	606
% within cough within the last 2 weeks?	39.4	60.6	100.0
% of the Grand Total (1101)	21.7	33.3	55.0
TOTAL	561	540	1101
% within cough within the last 2 weeks?	51.0	49.0	100.0
% of the Grand Total (1101)	51.0	49.0	100.0

As shown in Table B, 26.5% of children who had cough within the last two weeks prior to the interviews were vitamin A deficient. The association is highly significant (P= .005).

Table B. Cough Vs. VA Levels

Cough within the last 2 weeks?	Vitamin A Intervals (µg/L)						TOTAL	
	Low <200		Borderline 200-299		Normal ≥300			
	Freq	%	Freq	%	Freq	%	Freq	%
YES	131	26.5	253	51.1	111	22.4	495	100.0
NO	111	18.3	342	56.4	153	25.2	606	100.0
TOTAL	242	22.0	595	54.0	264	24.0	1101	100.0

FEVER

Results showed that 41.6% (See Table C) of children had fever within the last two weeks prior to the time of interviews. 68% of children with fever were found to have elevated levels of alpha acid glycoprotein. The relationship between fever and elevated levels of alpha acid glycoprotein among these children was found to be significant (P .000).

Table C. Fever and AGP Levels

Fever within the last two weeks?	AGP levels (g/L)		TOTAL
	High AGP > 1.0	Normal AGP ≤ 1.0	
YES % within Fever within the last 2 weeks? % of the Grand Total (767)	217 68.0 28.3	102 32.0 13.3	319 100 41.6
NO % within Fever within the last 2 weeks? % of the Grand Total (767)	173 38.7 22.6	274 61.3 35.7	447 100 58.3
DK % within Fever within the last 2 weeks? % of the Grand Total (767)		1 100 0.1	1 100 0.1
TOTAL % within Fever within the last 2 weeks? % of the Grand Total (767)	390 50.8 50.8	377 49.2 49.2	767 100 100

Furthermore, results showed that 27.4% of children who had fever within the last two weeks prior to the interviews were vitamin A deficient. The association is highly significant (P .007) (See Table D).

Table D. Fever and VA Levels

Fever within the last two weeks?	Vitamin A Intervals (µg/L)						TOTAL	
	Low <200		Borderline 200-299		Normal ≥300			
	Freq	%	Freq	%	Freq	%	Freq	%
YES	118	27.4	209	48.5	104	24.1	431	100.0
NO	124	18.5	385	57.4	162	24.1	671	100.0
DK			1	100.0			1	100.0
TOTAL	242	21.9	595	53.9	266	24.1	1103	100.0

ACUTE DIARRHEA

For purposes of this study the WHO definition of diarrhea as an abnormal increase in the frequency and liquidity of the child's stool was applied.

Results showed that only 8.4% (47 cases) children had diarrhea within the last two weeks prior to the time of interviews. 56.3% of children with diarrhea were found to have elevated levels of alpha acid glycoprotein. The relationship between diarrhea and elevated levels of alpha acid glycoprotein among these children was not significant.

It is important to take into consideration the seasonal variation as a factor which might explain the relatively low prevalence of acute diarrhea since the study was conducted in November, a winter month.

CHRONIC DIARRHEA

By definition, diarrhea lasting for more than two weeks during the previous three months is considered a case of chronic diarrhea.

Only 4.1% (37 cases) of mothers reported that their children had had diarrhea for two weeks or more during the three months prior to the interview. Of these, 56.1% (18 cases) of children with chronic diarrhea were found to have elevated levels of alpha acid glycoprotein. The relationship between chronic diarrhea and elevated levels of alpha glycoprotein among these children was not significant.

MEASLES

Among the mothers surveyed, 13 reported that their children had been infected with measles at some point. Only one case was reported in a camp area and the other 12 cases were among children living in non-camp areas. Only one case was reported in Gaza, while the other 12 cases occurred in the West Bank.

Out of the 13 cases of measles, the mothers of 10 of those children indicated that their children were diagnosed as having measles by physicians.

ANNEX XIII: HOUSEHOLD UTILIZATION OF IODIZED SALT

Utilization of Iodized Salt

Mothers were asked if they were using iodized salt for cooking purposes (Table A); 44.5% responded positively, 29.3% responded negatively, while 26.2% stated that they did not know whether the salt they were using was iodized or not. Results indicated that less than half of the mothers realized the importance of utilizing iodized salt in their diets.

Table A. Utilization Of Iodized Salt

Do you utilize iodized salt?	Freq	%
YES	485	44.5
NO	320	29.3
DK	286	26.2
TOTAL	1091	100.0

Of the 485 mothers who said they used iodized salt, a total of 464 mothers were able to show the data collectors the salt container they were using at the time; 98.9% of those containers actually contained iodized salt. Of the 320 mothers who said they did not use iodized salt, 19.1% were found to be using iodized salt without realizing it, and 88% of the mothers who did not know if they were using iodized salt (133 mothers) were found to be utilizing an iodized brand. Regardless of whether mothers did or did not realize if they were utilizing iodized salt, around 80 % were in fact utilizing it (See Table B).

Table B. Utilization of Iodized salt Vs. Container

Do you utilize iodized salt?	May I please see the container?				TOTAL	
	Iodized		Not iodized			
	Freq	%	Freq	%	Freq	%
YES	459	98.9	5	1.1	464	100.0
NO	31	19.1	131	80.9	162	100.0
DK	117	88.0	16	12.0	133	100.0
TOTAL	607	80.0	152	20.0	759	100.0

ANNEX XIV: INTERNATIONAL VITAMIN A DEFICIENCY FINDINGS

Country	Geographic Area	Survey year	Age group (years)	Sex	Sample Size	Serum Retinol level <200µg/L	References
EASTERN MEDITERRANEAN REGION							
OMAN	National	1995	0.5 – 6.0	F, M	759	20.8	[National study, 1995]
YEMEN	Rural	1992	1.0 – 5.99	F, M	319	62.4	[Pizzarello, 1993]
PAKISTAN		1990	0.5 – 4.99	F, M	532	48.3	[Molla <i>et al.</i> , 1993]
MIDDLE EAST							
JORDAN	National	2002	< 4.99		1036	15.2	[Jordan-Ministry of Health Staff, 2004]
WB&G	National	2003-2004	1.0 – 4.99	F, M	1127	22.0	[Present Study, 2004]
REGION OF THE AMERICAS							
BOLIVIA	National	1991	1.0 – 5.0	F, M	891	11.3	[Encuesta de vitamina A, 1991]
DOMINICAN REPUBLIC	Southwest	1991	1.0 – 5.0		505	19.6	[WHO,1995]
AFRICAN REGION							
GHANA	VAST morbidity study	1990-1991	0.5 – 4.99	F, M	1455	73.4	[Ghana VAST study team, 1993]
MORROCO	National	1996	0.5 – 5.9		1470	40.9	[Berraho <i>et al.</i> , 2003]
WESTERN PACIFIC REGIONS							
CHINA		1999-2000	0 – 4.99		8669	9.97*	Vitamin A Deficiency, China, 2000
PHILIPPINES		1986	1.0 – 5.99			10.9	[WHO,1995]
* ≤ 200 µg/L and the prevalence was calculated							

ANNEX XV: WHO Recommendations for Vitamin A Supplementation

Table A. WHO Recommendations for Vitamin A Supplementation Using High Dose Capsules

Age Groups	Dose	Frequency
Infants 6 to 11 months of age	100, 000 IU orally	Every 4-6 months
Children 12 months or older	200, 000 IU orally	Every 4-6 months

Infants less than 6 months of age should receive an oral dose of a 50,000 IU vitamin A supplement given once and restricted to the following situations:

- Their mothers did not receive the vitamin A supplementation dose in the delivery room
- The infants are not breastfed

Health care systems must assure that infants less than 6 months of age do not receive the larger dose intended for older children.

Vitamin A supplementation doses should be repeated every 4-6 months, as evidence suggests that vitamin A reserves in deficient individuals can fall below optimal levels 3-6 months following receipt of a high dose.

Table B. Supplementation Of Vitamin A Capsules For Sick Children

Age groups	Dose
• Infants <6 months of age	• 50, 000 IU once orally
• Infants 6 to 11 months of age	• 100, 000 IU once orally
• Children 12 months or older	• 200, 000 IU once orally

- Sick children who had received the routine high dose of Vitamin A supplementation within the last 30 days should not receive any additional dose.
- Sick children suffering from uncomplicated measles are given two doses of vitamin A supplements. The first dose is given upon diagnosis and the second dose the next day. The dosage is the same given for each age group in the table above.

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