Vitamin A Status amongst Malnourished Children under 5 Years Old Attending Ard El-Insan Association in Gaza City

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Vitamin A Status amongst Malnourished Children
under 5 Years Old Attending Ard El-Insan Association
in Gaza City

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نتيجة الحكم على أطروحة ماجستير

بناءً على موافقة شئون البحث العلمي والدراسات العليا بالجامعة الإسلامية بغزة على تشكيك لجنة الحكم على أطروحة الباحثة/ ميرفت حسن ابراهيم عبد ربه لنيل درجة الماجستير في كلية العلوم قسم العلوم الحياتية- علم الحيوان وموضوعها:

مستوى فيتامين أ بين الأطفال تحت 5 سنوات المصابين بسوء التغذية ويتتدون عن جمعية أرض الإنسان في مدينة غزة

Vitamin A Status amongst Malnourished Children under 5 Years Old Attending Ard El-Insan Association in Gaza City

وبعد المناقشة التي تمت اليوم السبت 01 ذو الحجة 1437هـ الموافق 03/09/2016 الساعة الحادية عشر صباحاً، اجتمعت لجنة الحكم على الأطروحة والمكونة من:

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واللجنة إذ تمنح هذه الدرجة فإنها توصيها بتقوى الله ورزوع طاعته وأن يسخر عما في يديه من موهبه.

والله وﾛﺤﻨﺎ  ﻭapple،
نائب الرئيس لشؤون البحث العلمي والدراسات العليا
أ.د. عبد الرؤوف على المناعمة
Abstract

**Background:** Malnutrition in children often begins at birth and is associated with retarded physical and cognitive development. Vitamin A is a fat soluble vitamin and an essential micronutrient needed in small amounts for the normal functioning of the visual system, maintenance of cell function for growth, epithelial integrity, red blood cell production, immunity and reproduction.

**Objective:** To investigate vitamin A status among malnourished children aged under 5 years attending Ard El-Insan Association.

**Methodology:** This cross sectional study consisted of 150 malnourished children under 5 years old from both sexes. Questionnaire interview with parents was used. Anthropometric measurements (weight, length and height) were taken. Blood samples were drawn for determination of serum vitamin A, iron, zinc and Hb. Statistical analysis was performed using SPSS version 18.0.

**Results:** The study population was (150) cases; (53.3%) males and (46.7%) females. The majority of surveyed children (90.7%) received immediate breastfeeding, and more than two third (71.3%) of them were breast fed exclusively. Vitamin A status among malnourished children showed (26%) of them had serum vitamin A level below (300) μg/L. There were insignificant associations between gender, source of income, monthly income with serum vitamin A level. In contrast, there was a significant association between degree of W/H/A with serum vitamin A level. In addition, there was a significant association between birth weight with serum vitamin A level. The majority of surveyed children (82.7%) had low level of hemoglobin (Hb<11). Also (29%) of the participants in the study who were anemic, their serum vitamin A level was below normal.

**Conclusions and Recommendations:** The present study provided base line information regarding malnutrition among children under 5 years old in Gaza city. Interventions to improve children nutritional status must be in concern. Raising the level of nutritional knowledge among health professionals and their staff on the health of children and the need for clinical nutritionist to be present within the follow-up group for malnourished children is required.

**Key words:** Vitamin A status, anthropometric measurements, malnutrition, children under 5 years old, Gaza city.
المستخلص

معلومات أساسية: سوء تغذية الأطفال غالباً ما يبدأ عند الولادة ويتراوح مع تراجع النمو البدني والمعرفي لهم فيتمين (أ) هو فيتامين قابل للذوبان في الدهون ويعتبر من المغذيات الأساسية اللازمة لكميات صغيرة للعمل الطبيعي للنظام البصري، وتحقيق الأهداف على وظيفة الخلايا النمو سلامة النسج الطلائي، إنتاج خلايا الدم الحمراء والقانون والتكرار.

الهدف: فحص ودراسة مستوى فيتمين (أ) لدى الأطفال المصابين بسوء التغذية الذين تقل أعمارهم عن 5 سنوات الذين يترددون على جمعية أرض الإنسان.

المنهجية: تتألف هذه الدراسة المقطعية من (150) طفل يمن تقل أعمارهم عن خمس سنوات ويعانون من سوء التغذية من كلا الجنسين وتم استخدام استبيان مقابلة مع أولياء الأمور، وإجراء القياسات الجسمانية (الوزن والطول والارتفاع). وأخذت عينات دم لتحديد مصل فيتمين (أ)، الزنك، الحديد وخضاب الدم. قد تم أيضاً إجراء التحليل الإحصائي باستخدام نسخة (18) من برنامج SPSS.

النتائج: تكوّن مجتمع الدراسة من (150) حالة (53.3%) من الذكور و (46.7%) من الإناث. تقلّب غالبية الأطفال الذين شملهم الاستبان (90.7%) رضاعة طبيعية قوية، وحصل أكثر من ثلثي الأطفال (71.3%) على تغذية نباتي حريصاً، أظهر وضع فيتمين (أ) بأن نسبة (26%) من الأطفال الذين يعانون سوء التغذية لديهم مستوى فيتمين (أ) أقل من (300) ميكروغرام / لتر، ولم يكتن هناك علاقة ذات دلالة إحصائية بين الجنس، مصدر الدخل، النضج الشهري ومستوى فيتمين (أ)، وعلى النقيض كانت هناك علاقة ذات دلالة إحصائية بين درجة الوزن بالنسبة للعمر مع مستوى فيتمين (أ) بالإضافة، وجد علاقة ذات دلالة إحصائية بين الوزن عند الولادة ومستوى فيتمين (أ)، وجد لدى نسبة (82.7%) من الأطفال الذين شملهم الاستبان مستوى منخفض من خضاب الدم، كما أن نسبة (29%) من الأطفال المشاركين في استبان الدراسة كانوا مصابين فقر الدم، كان مستوى فيتمين (أ) لديهم أقل من الطبيعي.

النماذج الفرعية: تؤسس هذه الدراسة قاعدة أساسية للمعلومات بشأن سوء التغذية بين الأطفال دون 5 سنوات من العمر في مدينة غزة، ويجب أن تكون التدخلات الرامية إلى تحسين وضع التغذية للأطفال موضع اهتمام، كما أنه من الضروري رفع مستوى المعرفة الغذائية بين صفوف المهن الأطبائية والعاملين على صحة الأطفال والحاجة إلى وجود أخصائي التغذية السريري ضمن مجموعة المتابعة للأطفال الذين يعانون سوء التغذية.

الكلمات المفتاحية: مستوى فيتمين (أ)، القياسات الجسمانية، سوء التغذية، الأطفال، مدينة غزة.
بسم الله الرحمن الرحيم

قال منان: «يتولّها أَلْبَسَتْنَا إِذًا قَالَ لَكُنْ تَفَسَّحُوا فِي الْمَجِلِّسِ فَأَفْسَحُوا يَقْسِجُ اللهُ لَكُونَا إِذًا قَالَ أَنْسِروا فَأَنْسِروْا يَقْرِعُ اللهُ أَلْبَسَتْنَا مَنْوًا وَذَٰلِكَ أَوْلُو الْجَهَّرِ وَاللهُ يَحْبَسُ ۗ وَلَلَّهِ مَا ۖ [المجادلة: 11]»
Dedication

This Research is lovingly dedicated to my beloved Prophet Mohammad (Peace Be Upon Him) the first humanity teacher. To my family, for the sacrifices that they made, the unflagging love, and the support they provided throughout my life that which permitted me to achieve my lifelong goals especially my father Dr. Hassan Abdraboh who has helped me in translation and Auditing this research.

I dedicate this modest effort, and asking ALLAH the full reward.
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At the end, I am very grateful to those who participated and helped me to complete this study.

**The Candidate**

**Mirvat H. Abdraboh**
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<td>Vitamin A</td>
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<td>AEI</td>
<td>Ard El-Insan</td>
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<td>RDA</td>
<td>Recommended Daily Allowance</td>
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<td>VAD</td>
<td>Vitamin A Deficiency</td>
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<td>WHO</td>
<td>World Health Organization</td>
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<td>OPT</td>
<td>Occupied Palestinian Territory</td>
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<td>PNA</td>
<td>Palestinian National Authority</td>
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<td>GS</td>
<td>Gaza Strip</td>
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<td>WB</td>
<td>West Bank</td>
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<td>PCBS</td>
<td>Palestinian Central Bureau of Statistic</td>
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<td>MoH</td>
<td>Ministry of Health</td>
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<td>Multiple Indicator Cluster Survey</td>
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<td>Protein-Energy Malnutrition</td>
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<td>Palestinian Micronutrient Survey</td>
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<td>New Israel Shekel</td>
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<td>Medical Aid for Palestinians</td>
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<td>World Health Assembly</td>
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<td>ICU</td>
<td>Intensive Care Unit</td>
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Chapter 1
Introduction
Chapter 1
Introduction

1.1 Overview

This study focuses on vitamin A (VA) status among malnourished children under 5 years old attending Ard El-Insan (AEI) services in Gaza city. Malnutrition in children often begins at birth and is associated with retarded physical and cognitive development. This, in turn, yields serious implications for the overall national development agenda. Palestine is an exception as malnutrition appears among children under-five. Between the years 2000 and 2010, prevalence of malnutrition rose by (41.3%) on the national level while Gaza Strip demonstrated a huge increase of (60.0%). Currently, (11) out of (100) children under-five suffer chronic malnutrition including (11.3%) in the West Bank (WB) and (9.9%) in Gaza Strip (GS) (Palestinian Central Bureau of Statistic (PCBS), 2011).

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. Known clinical outcomes of micronutrient deficiencies include impaired growth and cognitive development, poor birth outcomes, anemia, cretinism and blindness (MARAM, 2004).

Vitamin A is a fat soluble vitamin and an essential nutrient needed in small amounts for the normal functioning of the visual system, and maintenance of cell function for growth, epithelial integrity, red blood cell production, immunity and reproduction (WHO, 2009).

Vitamin A is found in several food sources and adequate amounts are generally provided by a healthy, balanced diet with no need for extra supplementation. VA is available in both animal (eggs, cheese, yoghurt and spreads) and plant foods (orange and yellow fruits and vegetables), as well as in the form of artificial supplements (Mandal, 2014).
The Recommended Daily Allowance (RDA), that is the amount of VA that should be taken to prevent vitamin A deficiency, is about (300) ug/day for children aged (1-3) years and (300) ug/day for ages (4-8) years (MARAM, 2004).

Vitamin A deficiency (VAD) is a major nutritional concern in poor societies, especially in lower income countries. The main underlying cause of VAD as a public health problem is a diet that is chronically insufficient in VA that can lead to lower body stores and fail to meet physiologic needs (e.g. support tissue growth, normal metabolism, resistance to infection). Deficiency of sufficient duration or severity can lead to disorders that are common in VA deficient populations such as xerophthalmia, the leading cause of preventable childhood blindness, anemia and weakened host resistance to infection, which can increase the severity of infectious diseases and risk of death (WHO, 2009).

The World Health Organization (WHO) recommended that children who are (6–59) months of age with severe acute malnutrition should receive the daily recommended nutrient intake of VA throughout the treatment period. Children with severe acute malnutrition should be provided with about (5000) IU vitamin A daily, either as an integral part of therapeutic foods or as part of a multi-micronutrient formulation (WHO, 2015).

1.2 Justifications of the Study

- Prevalence of VAD among children in developing or low income countries.
- Globally, malnutrition is the most important risk factor for illness and death.
- According to study conducted in 2004 among children aged (12 to 59) months which showed that (50%) of the studied children had VAD meaning that VAD is a serious public health problem in the Occupied Palestinian Territory (OPT) and this study finding requires further investigation.
1.3 Objective of the Study

1.3.1 General Objective:

To investigate vitamin A status among malnourished children aged under 5 years attending AEI services in Gaza city.

1.3.2 Specific Objectives:

1- To clarify the prevalence of VAD among malnourished children under 5 years.

2- To identify socio-economic and economical factors and their relation to VA level of the children.

3- To determine neonatal history that may affect on the VA level of the children.

4- To investigate nutritional history and its relation to VA level of the children.

5- To asses other malnutrition parameters such as weight, height and physical growth among the children.

6- To study the relation between some micronutrients including iron and zinc and VA level of the children.

1.4 Ard El Insan Palestinian Benevolent Association

Ard El Insan is a local Palestinian Non-Governmental Organization in the GS. AEI was established in 1984 as an affiliate of the Swiss Agency —Terre Des Hommes” and was localized to become an independent local organization in 1997. It provides nutritional and health services to the most needy and malnourished children under-fives and their mothers. Over the years AEI has become the leading health community and nutrition services provider in the GS. This has been achieved through adopting consistent technical intervention strategies in: medical intervention, nutrition therapy, counseling, health and nutrition awareness, psychological support, promotion of breast-feeding and conducting researches related to nutrition, community and environmental health.
1.5 Context of the Study

1.5.1 Geographic and Demographic Context:

The territories of the Palestinian National Authority (PNA) include two separated geographical areas, the West Bank and the Gaza Strip with a total population of (4.68) million; (2.38) million males and (2.30) million females. The estimated population was (2.86) million in WB and (1.82) million in GS (PCBS, 2015).

The average annual population growth rate is (2.6%); one of the highest in the Region. The population is expected to increase by (50%) by 2020. The population density in the GS is one of the highest in the world. The refugee population is (1.7) million, constituting (29%) of the population in the WB and (69%) in the GS, living in (27) refugee camps (WHO, 2010).

About half of the Palestinian population is under the age of (18) years, while the proportion of elderly individuals is low. These percentages indicate high fertility rates and the fact that Palestinian society is a young society (PCBS, 2013)

Child mortality rates over the past decade in Palestine are comparable to those in upper middle-income countries. However, the infant mortality rate was (18.9) per 1000 live births between 2006 and 2010. And the under-five mortality rate was (23.4) per 1000 live births. The GS had the highest rates at (26.8) per 1000 live births compared to the WB at (21.0) per 1000 live births (PCBS, 2013)

1.5.2 Socio-economic Context:

According to annual report of PCBS in April, 2013. Only (20.8%) of Palestinian households are childless, while the majority of Palestinian households (79.2%) have children.

The poverty rate in 2011 indicated that the total distribution of poverty among Palestinian households was (2.9%), which was higher among households with children than among households without children (PCBS, 2013)

Labour Force Survey estimated the number of unemployed was (342,200) in the 4th quarter 2015; distributed as (184,500) in GS and (157,700) in the WB. The unemployment rate in GS was higher than that in the WB in the 4th quarter 2015. And the unemployment rate for males in Palestine was lower than that for females in
Moreover, the highest unemployment rate in the 4th quarter 2015 was (41.7%) among youth aged (20-24) years (PCBS, 2015).

1.5.3 Health Services Context:

The four main health providers of health services in Palestine are Ministry of Health (MoH), United Nations Relief and Works Agency (UNRWA), Nongovernmental health organizations (NGOs) and the private sector. The MoH owns and operates the largest network of facilities, with (425) Primary health care (PHC) centers and (24) hospitals with (2857) beds in the WB and GS. There are (76) hospitals in OPT, with (4878) bed capacity and about (13) beds per (1000) population, while MoH hospitals are often crowded, nongovernmental hospitals, private hospitals and mental health hospitals are underutilized. However, the average occupancy rate of MoH hospitals was estimated at (70%) while the overall average of occupancy rate of hospitals is (62%) (WHO, 2010).

On the other hand, UNRWA is responsible for providing PHC services for the refugee population of over (1) million. It operates mainly PHC services and serves those Palestinians, and their descendents, who were displaced in the war of (1948). Moreover, nongovernmental organizations operate (26.5%) of all PHC centers and (31.1%) of hospital beds. They employ (28%) of the human resources in the health sector. In addition, NGOs support to the health sector varies from longstanding missionary hospitals, to facilities supported by international organizations, to community health centers organized by political factions or supported by Islamic charities. Furthermore, Police Medical Services provide medical care to the police forces and their families in the WB (WHO, 2010).

1.5.4 Nutrition Service Context:

According to MoH, the main players implementing nutrition-related programs in the OPT are the MoH and UNRWA. Several other United Nations (UN) agencies and NGOs (as AEI through their PHC services) are also involved in programming (MoH, 2005). There are many other agencies (such as the Red Cross) and NGOs who carry out smaller nutrition-related programs. The MoH is responsible for nutrition in the OPT and is the main provider of PHC services. It operates (391) PHC centers (54 in the GS and 337 in the WB) through which essential preventive nutrition services are
provided for non refugees and also refugees. Services include growth monitoring, micronutrient supplementation, nutrition education and counseling on breast feeding and complementary feeding. But the MoH does not have facilities for the rehabilitation of severely malnourished children at clinic level but refers cases to hospitals and NGO clinics. UNRWA clinics provide growth monitoring, breast feeding and nutrition counseling services. All UNWRA maternity centers are classified as Baby Friendly Hospitals. UNRWA has always provided food aid to ‘hardship cases. UNICEF supports the MoH in a number of core areas of nutrition. These include the development of nutrition awareness-raising campaigns and also working on the development and implementation of national policy and guidelines for infant and child nutrition where the focus is on the promotion of breastfeeding and associated legislation. In addition, UNICEF has provided partial support to various nutrition surveys. WHO’s aim in the OPT is to improve nutrition coordination and it is secretary of the Nutrition Steering Committee. A one-year nutrition project was initiated in late 2004. The purpose of the project is to address the nutritional needs of the OPT population by strengthening the capacity of the Palestinian MoH in policy and planning, management, follow up and coordination of nutrition related issues. Moreover, the MARAM project was initiated in 2001 and ran a three year project to improve the health and nutrition status of women and children. Nutrition-related achievements reported at the end of the project included finalizing a population-based VA survey, supporting the Ministry of Education (MoE) on iron and vitamin supplementation for school children, developing nutrition protocols and nutrition Information Education and Communication (IEC) materials. A follow-up project was launched in January 2005. This three year project aims to enhance the quality of health services available to (60%) of the non-refugee population of mothers and children in the WB and GS. Activities will include promoting healthier lifestyles, disease prevention and birth spacing, improving the skills of health care providers, educators and community leaders. AEI runs eight nutrition rehabilitation centers and is the main referral body for MoH clinics that detect child malnutrition and also supports the development of nutrition protocols, research, information, IEC materials and undertakes nutrition surveys (MoH, 2005).
1.6 Definitions of Terms:

1.6.1 Breastfeeding:
Breastfeeding is the normal way of providing young infants with the nutrients they need for healthy growth and development. Virtually, all mothers can breastfeed, they have accurate information, the support of their family, the health care system and society at large (WHO, 2016).

1.6.2 Immediate Breastfeeding:
Provision of mother’s breast milk to infants within one hour of birth and ensures that the infant receives the colostrum, or “first milk”, which is rich in protective factors (WHO, 2016).

1.6.3 Exclusive Breastfeeding:
Exclusive breastfeeding means that the infant receives only breast milk. No other liquids or solids are given – not even water – with the exception of oral rehydration solution, or drops/syrups of vitamins, minerals or medicines (WHO, 2016).

1.6.4 Complementary Food:
Any non-breast milk foods or nutritive liquids that are given to young children after six months of age and complementary feeding is the process of introducing these foods (UNICEF, 2016).

1.6.5 Infant Formula:
An artificial substitute for breast milk intended for feeding infants. It can come in powdered form to be mixed with water or in instant liquid form (Collins, 2016).

1.6.6 Weight for Height/ Length (W/H-L):
Used as an indicator of acute malnutrition. The weight for height index expresses malnutrition evident immediately, comparing the weight of the child with the weight of the reference population for the same height. The weight for height ratio reflects body proportion, or the harmony of growth and is particularly sensitive to recent growth disturbances (Abdeen et al., 2003).
1.6.7 Height for Age (H//A):
Used as an indicator of chronic malnutrition. The height for age index expresses the past nutritional history (weeks to months to years) of a child rather than the current nutritional status, comparing the growth deficit for a child to the reference population of the same age (Abdeen et al., 2003).

1.6.8 Weight for Age (W//A):
Used an indicator of insufficient weight gain relative to age or weight loss. The advantage of this index is that it reflects both past (chronic) and/or present (acute) under-nutrition (although it is unable to distinguish between the two). Low weight for age index identifies the condition of being underweight, for a specific age (Wadi, 2014).

1.6.9 Wasting or thinness:
Expressed as a low body weight relative to height– results from a current significant loss of weigh observable by a deficit in tissue and fat mass. Wasting can be caused by insufficient nutrients intake (lack of access to food) or absorption (poor health status and disease) (Garcia, 2012).

1.6.10 Stunting or shortness:
Expressed as low height relative to age– results from a slowing in skeletal growth. Stunting can be caused by poor dietary intake over time as well as poor health conditions and reflects a failure to reach growth potential (Garcia, 2012).

1.6.11 Underweight:
Expressed as low weight for age – results from either a failure to gain weight relative to age or a loss of weight relative to height. Underweight is a combination of the weight-for-height and height-for-age indices (Garcia, 2012).
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2.1 Malnutrition

2.1.1 Definition:
Child malnutrition may be defined as a pathological state resulting from inadequate nutrition, including under-nutrition (protein-energy malnutrition) due to insufficient intake of energy and other nutrients; over-nutrition (overweight and obesity) due to excessive consumption of energy and other nutrients. WHO defined malnutrition as the cellular imbalance between supply of nutrients and energy and the body’s demand for them to ensure growth, maintenance and specific functions (Taha, 2011).

2.1.2 Causes and Symptoms:
Malnutrition is estimated to contribute to more than one third of all child deaths, although it is rarely listed as the direct cause. The causes of malnutrition are complex and multifaceted. In developing countries; dietary factors (intake of dietary supplements (iron and vitamin A and D) exclusive breast feeding for (4-6) months, complementary feeding at (6) months, maternal education, maternal mental health, and family socioeconomic and environmental factors (deprivation, social support, and hygiene ) all may be associated with malnutrition (Wadi, 2014). In addition, lack of access to highly nutritious foods, especially rising food prices, poor feeding practices such as inadequate breastfeeding, offering the wrong foods, and not ensuring that the child gets enough nutritious food, contribute to malnutrition. Infection – particularly frequent or persistent diarrhoea, pneumonia, measles and malaria – also undermines a child's nutritional status (WHO, 2016).

Malnutrition symptoms in the children include: growth failure, this may be manifested as failure to grow at a normal expected rate in terms of weight, height or both; irritability, sluggishness and excessive crying along with behavioral changes like anxiety, attention deficit are common in children with malnutrition; the skin becomes dry and flaky and hair may turn dry, dull and straw like in appearance. In addition, there may be hair loss as well; muscle wasting and lack of strength in the muscles and swelling of the abdomen and legs. The abdomen is swollen because of
lack of strength of the muscles of the abdomen which causes the contents of the abdomen to bulge out making the abdomen swollen. Legs are swollen due to edema that caused by the lack of vital nutrients. These two symptoms are seen in children with severe malnutrition (Mandal, 2012).

2.1.3 Measurement of Malnutrition:

To determine a child's nutritional status, we need to compare that child's status with a reference for healthy children. Anthropometric indices can be expressed in relationship to the reference population in two different statistical terms: standard deviations from the median or percentage of the median (Webb & Bhatia, 2005).

Standard Deviations, or Z-scores: This is the preferred expression for anthropometric indicators. It is the difference between the value for an individual and the median value of the reference population for the same age or height, divided by the standard deviation of the reference population. In other words, using the Z-score, describe how far a child's weight is from the median weight of a child at the same height in the reference value.

\[
Z\text{-SCORE} = \frac{\text{measured value} - \text{median of reference population}}{\text{standard deviation of the reference population}}
\]

Percentage of Median: The percentage of median is commonly used and recommended for admission/discharge criteria for selective feeding programs. Percentage of median is the ratio of the child's weight to the median weight of a child of the same height in the reference data, expressed as a percentage.

\[
\text{PERCENTAGE OF THE MEDIAN} = \frac{\text{measured weight of the child}}{\text{median weight of the reference population}} \times 100
\]

2.1.4 Prevalence of Malnutrition:

Malnutrition is estimated to contribute to more than one third of all child deaths, although it is rarely listed as the direct cause (WHO, 2016). In September 2015, UNICEF, WHO and World Bank Group released updated joint child malnutrition estimates for the 1990 to 2014 period in which (159) million children around the world were stunted and (50) million were wasted. In addition, more than half of all
stunted children under (5) lived in Asia and more than one third lived in Africa. While almost all wasted children under 5 lived in Asia and Africa. (UNICEF, WHO and World Bank, 2015).

The prevalence of malnutrition among Saudi children younger than 5 years old was as follows: the prevalence of moderate and severe underweight was (6.9%) and (1.3%), respectively; the prevalence of moderate and severe wasting was (9.8%) and (2.9%), respectively; finally, the prevalence of moderate and severe stunting was (10.9%) and (2.8%), respectively (El Mouzan et al., 2010).

Egypt Demographic and Health Surveys (EDHS) in 2008 found that; (29%) of children under the age of five were stunted and (14%) were severely stunted; (7%) of were wasted and (3%) were severely wasted; (6%) were underweight (UNICEF & UNFPA, 2008).

Nutritional status of (124) children aged (6-7) years old in Elshagalwa village basic school in Nile state, North Sudan assessed that; (5.6%) were moderately wasted; (11.3%) were moderately under weight, whereas (4%) were found to be severely stunted and (16.9%) moderately stunted (Ahmed & Mohamed, 2014).

The deterioration in nutritional status of Palestinian children has become well recognized at both national and international levels. Results of a nutrition survey carried out in August 2002 found (13.2%) of children in the Gaza Strip suffering from acute malnutrition. This compares unfavorably with survey figures from 1995, where only (5.7%) of children under 5 years were acutely malnourished (Al Wahaidi, 2003).

In addition, the Palestinian Multiple Indicator Cluster Survey (MICS) carried out in 2014 by the PCBS revealed that (7.4%) of children under the age of five in Palestine suffer from moderate and severe stunting. The percentage was (7.7%) in the WB and (7.1%) in GS. Furthermore, (1.4%) of children suffer from moderate and severe underweight (1.5% in the WB and 1.3% in GS). And (1.2%) of children suffer from moderate and severe wasting. The percentage was (1.7%) in the WB and (0.7%) in GS (PCBS, 2015).

In 2011, PCBS showed that 11 out of 100 children under five suffer from chronic malnutrition including (11.3%) in the West Bank and (9.9%) in Gaza Strip. In
addition, the rates of underweight climbed in 2006 and dropped back in 2010 reaching a national rate of (3.7%) for the WB and GS (PCBS, 2011).

In 2007, the overall prevalence of both acute and chronic malnutrition among children aged 6 to 59 months was (3.4%),(10.7%) in the GS and WB, respectively (Abdeen et al., 2007).

According to the annual report of AEI Benevolent Association in GS, the prevalence of stunting among children aged (6-59) months was (42.3%) and the prevalence of wasting was (11.5%) (Taha, 2011).

2.2 Micronutrient Deficiencies

Micronutrients are defined as nutrients that are only needed by the body in minute amounts. Micronutrients, which include vitamin A, zinc and iron, are essential for healthy growth and development. Deficiency of these micronutrients can lead to serious health problems, including wasting, reduced resistance to infectious diseases, iron deficiency anemia, blindness, lethargy, reduced learning capacity, mental retardation and in some cases to death (Taha, 2011).

2.2.1 Iron :

Iron is a micronutrient that is essential to the structure of every cell in the body, but particularly red blood cells (hemoglobin), which transport oxygen in the blood to tissues in the body. In addition, iron is also a key component in proteins in muscle tissue and is critical for the normal development of the central nervous system and is a key component of enzymes involved in the development of the brain. Iron is rich in foods such as: Meats, poultry and fish; fortified cereals and oatmeal; legumes (e.g. soybeans and lentils); leafy greens and seeds (e.g. sesame and pumpkin)(Orphan Nutrition, 2016).

Iron deficiency is the most common trace element deficiency worldwide, affecting (20%–50%) of the world's population, mainly infants, children and women of childbearing age (Katona & Katona-Apte, 2008). The most commonly recognized condition associated with iron deficiency is anemia.

Iron deficiency anemia (IDA) is a major problem affecting more than (2) billion people more than one-third of the entire world population. According to Draper
IDA is more common in situations of: social disadvantage (e.g. poverty, poor housing, overcrowding and low levels of parental education); psychological disadvantage (e.g. lack of stimulation), and biological disadvantage (e.g. low birth weight, high infection rates and other nutritional deficiencies) (Taha, 2011).

In iron deficiency, the amount of iron stored away for later use is reduced as indexed by a low serum ferritin level, but has no effect on the iron needed to meet the daily needs of an individual. When the body lacks sufficient iron to make adequate hemoglobin, red blood cells cannot transport adequate oxygen to tissues throughout the body. However, children with severe anemia may display many symptoms such as: fatigue and weakness; pale skin and hair loss; shortness of breath; headache and lightheadedness; cold hands and feet; inflammation or soreness of tongue; brittle or spoon-shaped nails; difficulty thinking and rapid heartbeat (Orphan Nutrition, 2016).

2.2.2 Zinc:

Zinc is a trace mineral that is essential for all species and is required for the activities of more than (300) enzymes that have a major role in carbohydrate and energy metabolism, protein synthesis and degradation, nucleic acid production and carbon dioxide transport. In addition, zinc plays a critical role in the structure of cell membranes and in the function of immune cells. Inadequate zinc supply prevents normal release of vitamin A from the liver; clinically, it is associated with growth retardation, mal-absorption syndromes, fetal loss, neonatal death, and congenital abnormalities (Katona & Katona-Apte, 2008).

The food resources which high in zinc include: meats and seafood; eggs; whole grains and oats; nuts and seeds; leafy greens; vegetables and herbs and yogurt (Orphan Nutrition, 2016).

Worldwide, zinc deficiency is responsible for approximately (16%) of lower respiratory tract infections, (18%) of malaria and (10%) of diarrheal disease (WHO, 2002).

Severe zinc deficiency has been associated with stunting of growth, impaired immunity, skin disorders, learning disabilities and anorexia. Zinc deficient children are at increased risk of restricted growth and developing diarrheal diseases, as well as
respiratory tract infections such as acute lower respiratory tract infections (WHO, 2011).

2.2.3 Vitamin A:

Vitamin A (retinol) is an essential nutrient needed in small amounts by humans for the normal functioning of the visual system; growth and development; and maintenance of epithelial cellular integrity, immune function and reproduction. These dietary needs for VA are normally provided for as preformed retinol and provitamin A carotenoids (WHO & FAO, 2004)

Pre-formed retinol is fat-soluble and well absorbed in the body and is found mainly in animal-based foods such as liver, butter, cheese, eggs, fish oil, salmon, mackerel, herring, fortified milk and is added to most fat spreads. The plant-based carotenoids (over 600 types) are found primarily in colourful fruits and vegetables such as carrots, sweet potato, green vegetables, tomatoes, oranges, and cantaloupe melons (Al Shawwa, 2014).

Vitamin A functions at two levels in the body: the first is in the visual cycle in the retina of the eye; the second is in all body tissues where it systemically maintains the growth and soundness of cells. In the visual system, carrier bound retinol is transported to ocular tissue and to the retina by intracellular binding and transport proteins. Rhodopsin, the visual pigment critical to dim-light vision, is formed in rod cells after conversion of all-trans-retinol to retinaldehyde, isomerization to the 11-cis-form and binding to opsin. Alteration of rhodopsin through a cascade of photochemical reactions results in the ability to see objects in dim light. The speed at which rhodopsin is regenerated is related to the availability of retinol. Night blindness is usually an indicator of inadequate available retinol, but it can also be due to a deficit of other nutrients that are critical to the regeneration of rhodopsin, such as protein and zinc, and to some inherited diseases, such as retinitis pigmentosa (WHO & FAO, 2004).

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. RDAs for vitamin A are listed in Table (2.1). Since there is insufficient information to establish an RDA of VA for infants,
an adequate intake (AI) that is based on the amount of vitamin A consumed by healthy breastfed infants, as shown in Table (2.2) has been established as a gold standard (MARAM, 2004).

**Table (2.1):** Recommended Dietary Allowances for Vitamin A in Micrograms (μg) and International Units (IUs) for Children and Adults (MARAM, 2004).

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Children</th>
<th>Men</th>
<th>Women</th>
<th>Pregnancy</th>
<th>Lactation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>300 μg or 1000 IU</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-8</td>
<td>400 μg or 1333 IU</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-13</td>
<td>600 μg or 2000 IU</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14-18</td>
<td>900 μg or 3000 IU</td>
<td>700 μg or 2330 IU</td>
<td>750 μg or 2500 IU</td>
<td>1200 μg or 4000 IU</td>
<td></td>
</tr>
<tr>
<td>19+</td>
<td>900 μg or 3000 IU</td>
<td>700 μg or 2330 IU</td>
<td>770 μg or 2565 IU</td>
<td>1300 μg or 4335 IU</td>
<td></td>
</tr>
</tbody>
</table>

**Table (2.2):** Adequate Intake for Vitamin A in Micrograms (μg) and International Units (IU) for Infants (MARAM, 2004).

<table>
<thead>
<tr>
<th>Age (months)</th>
<th>Males and Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6</td>
<td>400 μg or 1330 IU</td>
</tr>
<tr>
<td>7-12</td>
<td>500 or 1665 IU</td>
</tr>
</tbody>
</table>
Vitamin A deficiency is common in developing countries. Approximately (250,000) to (500,000) malnourished children in the developing world go blind each year from a VAD (Taha, 2011). VAD occurs when body stores are depleted at times of high requirement such as during pregnancy and lactation, and phases of rapid growth. 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. 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 (MARAM, 2004). VAD leads to many symptoms such as: impaired vision, particularly in dim light (night blindness); a dryness of the eyes referred to as exophthalmia; impaired immunity and susceptibility to infection; whitish lumps at the hair follicles due to hypo keratosis and squamous metaplasia of the normal epithelium in respiratory passages (Mandal, 2014).

2.3 Vitamin A and Iron

Recent studies suggest that the metabolism of VA and iron is interrelated. In VA-deficient organisms, systemic iron availability appears to be significantly reduced and iron is accumulated in tissues, especially in the spleen (Mendes et al., 2016). Moreover, VA appears to be involved in the pathogenesis of anemia through diverse biological mechanisms, such as the enhancement of growth and differentiation of erythrocyte progenitor cells, potentiation of immunity to infection and reduction of the anemia of infection and mobilization of iron stores from tissues. Epidemiological surveys show that the prevalence of anemia is high in populations affected by VAD in developing countries. Improvement of VA status has generally been shown to reduce anemia (Semba & Bloem, 2002). Other study Concluded that anemia among school-aged children in rural Kazakhstan appears to be related to iron indices and VA status (Hashizume et al., 2005). Furthermore, iron deficiency inhibits mobilization of VA stores and may decrease the absorption and irreversible utilization of VA (Jang et al., 2000).


2.4 Vitamin A and Zinc

Zinc is necessary to maintain normal concentrations of VA in plasma (Smith et al., 1973). Zinc status influences several aspects of VA metabolism, including its absorption, transport and utilization. Two common mechanisms postulated to explain this dependence relate to the regulatory role of zinc in VA transport mediated through protein synthesis and the oxidative conversion of retinol to retinal that requires the action of a zinc-dependent retinol dehydrogenase enzyme (Christian & West, 1998). Moreover, in disease states in which liver function is severely compromised and both zinc and VA metabolism and transport are impaired, serum zinc and VA concentrations tend to be positively correlated (Christian & West, 1998). However, zinc is involved in maintaining the plasma retinal binding protein (RBP), a specific transporter for VA (Watts, 1991).

2.5 Vitamin A and Malnutrition

There were 21 studies evaluating preventive effect of vitamin A supplementation (VAS) in community settings which reported all-cause mortality. Twelve of these also reported cause specific mortality for diarrhea and pneumonia and six reported measles specific mortality. Combined results from six studies showed that neonatal VAS reduced all-cause mortality by (12 %) and also reduced diarrhea specific mortality by (30%) in children (6-59) months. This effect has been recommended for inclusion in the Lives Saved Tool (Imdad et al., 2011).

Vitamin A deficiency is a major nutritional problem in many developing countries. Vitamin A status has been reported to be adversely affected in protein-energy malnutrition (PEM). The prevalence of low serum retinol (<0.70 μmol l) was (41.2%) in children aged less than (60) months old with severe PEM and (24.1%) in normal children. However, malnourished children with diarrhoea showed lower serum retinol concentrations compared to those without diarrhea (Caminha et al., 2008). Other study assessed (415) pre-school children's VA status in a population where protein-energy malnutrition (PEM) was endemic and serum retinol binding protein and transthyretin concentrations were low. This survey suggested that in this population of the South-Kivu Province in Zaire, VAD co-existed with PEM and was
a public health problem even with non-malnourished and non-infected children (Donnen et al., 1996).

2.6 Prevalence of Vitamin A Deficiency

In 1987, WHO estimated that VAD was endemic in (39) countries based on the ocular manifestations of xerophthalmia or deficient serum (plasma) retinol concentrations (<0.35 µmol/l). In 1995, WHO updated these estimates and reported that VAD was of public health significance in (60) countries, and was likely to be a problem in an additional 13 countries. The current estimates reflect the time period between 1995 and 2005, and indicate that (45) and (122) countries have VAD of public health significance based on the prevalence of night blindness and biochemical VAD (serum retinol concentration <0.70 µmol/l) in preschool-age children (WHO, 2009).

Globally, night blindness is estimated to affect (5.2) million preschool-age children and (9.8) million pregnant women. In addition, low serum retinol concentration (<0.70 µmol/l) affects an estimated (190) million preschool-age children and (19.1) million pregnant women. This corresponds to (33.3%) of the preschool-age population and (15.3%) of pregnant women in populations at risk of VAD, globally. The WHO Regions of Africa and South-East Asia were found to be the most affected by vitamin A deficiency for both population groups. Most VAD children live in South-East Asia where (91.5) million preschool children had serum retinol concentrations (<20 µg/dL). Moreover, night blindness in preschool children was the highest in South-East Asia (82.4%) compared to very low in Europe (1%) and almost nil (0%) in America (WHO, 2009).

In addition, India has the highest prevalence of clinical and subclinical VAD among South Asian countries; (62%) of preschool children were reported to be deficient in vitamin A. These dramatic results suggested high mortality rate, leading to an annual 330,000 child deaths. Approximately (53%) avoidable cases of blindness, of which (58%) could be preventable were identified in a local school for blind and deaf children in Karachi. Low serum retinol concentration among pregnant women with night blindness in Karachi was also detected suggestive of higher VAD prevalence in periurban areas of Karachi. VAD has been identified as a problem of public-health
significance in Sri Lanka. National survey with clinical and laboratory assessment was conducted by the Medical Research Institute (MRI) in 1995-1996, covering (2,869) children aged (6-71) months to assess the magnitude of the problem among preschool children. The proportion of children with VAD was significantly higher in the presence of respiratory tract infections during the two weeks prior to the survey. In Bangladesh, it showed that approximately (1.5%) of (381) school children aged (11-16) years to suffer from subclinical VAD (i.e. serum retinol <0.70 µmol/L). Another study reported that 51% pregnant women had deficit in diets to meet RDA for VA and (18.5%) manifested VAD (serum retinol <0.70 µmol/L) suggesting VAD to be highly prevalent among pregnant women (Akhtar et al., 2013).

Another study found that (38.7%) of studied schoolchildren have low serum retinol in Burkina Faso and VAD was significantly higher in public than private schools (Daboné et al., 2011).

Approximately, half of the children (51.1%) aged (6-9) years old in Ethiopia has shown VAD (<0.70µ mol/L) (Kassaye et al., 2001).

In Jordan, a longitudinal study assessed growth and vitamin A status of schoolchildren after earlier surveys had linked stunting among Jordanian children to dietary zinc and iron inadequacies. A group of (1,023) subjects ages (5.5) to (9.9) years were randomly recruited for study from seven disadvantaged semirural districts. Baseline assessment included anthropometric and laboratory data with the relevant dietary information. At baseline there was a (19.9%) prevalence of stunting, (18.8%) for anemia and (21.8%) for subclinical VAD. Furthermore about (60%) of subjects had serum retinol levels in the range (200-300) µg/L (Khatib, 2002).

Another study conducted on (560) healthy schoolchildren aged (5.5-10) years in North Badia, Jordan revealed that mean prevalence of nutritional deficits among children were stunting (23.4%), anemia (57.5%), VAD (29.5%), iron deficiency (28.4%) and vitamin E deficiency (17.1%). Including those with borderline values, the proportion of children vulnerable to VAD threats reached (90%) (Khatib & Elmadfa, 2009).

In 1998, the Syrian Ministry of Health in collaboration with UN organizations carried out the first study in the country to describe the vitamin A status of children under 6 years of age and that of their mothers. A total of (1,118) children and (252)
mothers were included in the assessment of clinical signs and measurement of serum retinol. Findings from the study show that only (0.3%) of children had clinical signs and (9%) had low serum retinol (sub-clinical VAD). Serum retinol was low (<20μg/dL) in only one woman out of the (252) under study (FAO, 2005).

In Egypt, food consumption studies showed that there were insufficient intake of vitamin A, iron and zinc. VAD among preschoolers and their mothers is considered to be a subclinical, mild-to-moderate and public health problem (FAO, 2003).

2.7 Prevalence of Vitamin A Deficiency in Palestine

In 2002, vitamin A intake was evaluated by (24) hour food recall of children’s diets by their mothers among (477) children aged (12-59) months. Results were expressed as percentage of children with intakes below (80%) of RDAs. Among children aged (1-3) years, half of the children living in the WB were below the cut-off point. In the GS, (65%) of the children were below (80%) of RDAs. These percentages were higher among children aged (4-5) years: (64%),(71%) in the WB and GS, respectively had insufficient intakes of VA (FAO, 2005).

In 2003, Nutritional Assessment conducted on (2,027) children ages (13-59) months in WB and GS revealed that (79.5%) of (1-3) years and (88.1%) of (4-5) years were deficient in daily VA intake compared to WB (64.1%) for (1-3) years and (75.1%) for (4-5) years (Abdeen et al., 2003).

In the WB and GS, MARAM Project (2004) showed that (22%) of children aged (12 – 59) months were found to have low VA plasma levels (<200 μg/L). Furthermore, more than half of the children participating in the study (53.9%) had levels of vitamin A in the range of (200-299 μg/L), meaning that (75.9%) of children had VA levels below (300 μg/L). In addition, results showed a significant difference between the prevalence of VAD in the WB (18.9%) compared to the GS (26.5%).

In 2013, Palestinian Micronutrient Survey (PMS) showed that in only (26-28%) of the children under 5 years (6-59 months) in WB and GS the VA status was sufficient, the rest showing concentrations in the low or even deficient range. Again, children from the GS were more severely affected with (40.4%) of the boys and (33.2%) of the girls deficient. In addition, a particularly critical status was found for β- carotene.
Although, this micronutrient has so far not been identified as essential, it was noticed that it plays an important role as antioxidant as well as pro-vitamin A especially when intake of preformed VA (from foods of animal origin or from fortified foods) is low. (93.3%) and (95.9%) of children from both provinces, respectively had markedly low plasma β-carotene concentrations (<0.373 μmol/L), whereas less than (1%) were within the concentration range considered normal (>0.745 μmol/L) (Elmadfa et al., 2014).

2.8 The Nutritional Situation in Palestine

Nutritional Assessment of the West Bank and Gaza Strip, 2003 revealed that (81.3%) of children aged (1-3) years old in the WB and (88.7%) of them in GS were deficient in daily iron intake. While the prevalence of zinc intake deficiency among children aged (1-3) years old in WB and GS was (95.0%) and (95.2%), respectively (Abdeen et al., 2003).

In 2003, a survey showed that intakes of folate and zinc in children aged (1-5) years old were low below (80%) of RDAs (FAO, 2005)

In 2004, the prevalence of anemia among children aged (12-59) months ranged from (14%) to (22%) in the WB, while it reached (31%) in the of north GS (MARAM, 2004).

In 2013, the Palestinian MoH decided together with UNICEF, with the scientific cooperation of the University of Vienna, to conduct a representative cross sectional study on the micronutrient status, prevalence and causes of nutritional anemia, coverage and use of flour fortification, salt iodization, micronutrient supplements and life style and behavioral aspects of breastfeeding, physical activity, smoking and frequency of food consumption and anthropometric characteristics. The study was carried out on children (6–59) months, (7–12) years, adolescents (15–18) years, pregnant women (18–43) years. The results of the laboratory assessment showed that high prevalence of low serum concentrations, iron and zinc status in all studied population groups. Moreover, in children aged (6-59) months mild anemia was found in (11–25%) and moderate anemia in (6-8%), whereas boys were more affected than girls and children in the GS more affected than those in the WB. Furthermore, zinc
status assessed through the serum level was on average above the reference level (9.9) \( \mu \text{mol/L} \) only in children from the WB. In the GS, (67.2\%) of boys and (75.2\%) of girls had serum zinc levels below the sufficiency threshold compared to (42.2\%) and (36.0\%), respectively, in the WB (Elmadfa et al., 2014).
Chapter 3
Methodology
Chapter 3
Methodology

In this chapter, it stated the study design, sample population, sample size, questionnaire interview, blood sample collection and processing, anthropometric measurements and biochemical analysis.

3.1 Study Design

Cross sectional study was applied among malnourished children in Gaza city.

3.2 Sample Population

The sample population was malnourished children under 5 years old in Gaza city.

3.3 Sample Size

The sample size was consisted of (150) malnourished children (male and female) who were attending AEI services in the Gaza center.

3.4 Study period

The study was conducted during the period from October, 2015 to June, 2016.

3.5 Questionnaire Interview

A meeting interview was used for filling the questionnaire (Annex 2). The questionnaire was based on AEI Benevolent Association questions. The questionnaire included questions about child personal data (area, age, and sex); occupation of children parents; socioeconomic status (family income, source of income, number of household and type of home); child anthropometric measurements (bodyweight, length/height); child neonatal history (birth weight, admission to ICU and neonatal Jaundice) and child nutrition history (immediate
breast feeding, exclusive breast feeding, duration of breastfeeding and introducing each of infant formula and complementary food).

3.6 Blood Sample Collection and Processing

The blood sample collection process began with blood collection at AEI, followed by immediate processing at stationary laboratories. The samples then transported to storage at (-20°) C in the central laboratories.

Five ml venous blood samples were obtained from each child and divided into EDTA tube (1.0 ml) and vacutainer plain tube (4.0 ml). Vacutainer plain tubes were left for short time to allow blood to clot, and then clear serum samples were obtained by centrifugation at 1000 rpm for 20 minutes. The separated serum was placed in plain tubes and sealed. Samples that used within 5 days were stored at 2-8OC, otherwise samples stored at -20OC to avoid loss of bioactivity and contamination.

3.7 Anthropometric Measurements

Anthropometric measurements (weight and height) of the children were measured by a well trained nurse to determine their nutritional status. Weight was measured in kg (to the nearest 100 grams) using an electronic digital scale (Seca model 770; Seca Hamburg, Germany) and its accuracy was periodically verified using reference weights. The child was weighed in light clothing, by determining the mean weights of light clothes dressed, and a correction for the clothing was made during weighing by subtracting 100 grams from each children weight.

Length was measured in cm (measured to the nearest mm) using a pediatric measuring board. Children were measured in a recumbent position (lying down). The software program for assessing growth and development of the world's children was used to make comparisons to the reference standards. The software program combines the raw data on the variables (age, sex, length, weight) to compute a nutritional status index such as weight-for-height, weight-for-age and height-for-age.
3.8 Biochemical Analysis

3.8.1 Vitamin A Assay

Serum vitamin A was measured by ELISA technique using human vitamin A, vitamin A ELISA kit. Microplate Reader was used to perform qualitative or quantitative determination of samples in accordance with Lamber-Beer law (MR-96A, SHENZHEN MINDRAY BIO-MEDICAL ELECTRONICS CO., LTD. China).

Principle

The microtiter plate provided in this kit has been pre-coated with an antibody specific to vitamin A. Standards or samples are then added to the appropriate microtiter plate wells with a biotin-conjugated polyclonal antibody preparation specific for VA. Next, avidin conjugated to Horse Radish Peroxidase (HRP) is added to each microplate well and incubated. Then a TMB substrate solution is added to each well. Only those wells that contain vitamin A, biotin conjugated antibody and enzyme-conjugated avidin will exhibit a change in color. The enzyme-substrate reaction is terminated by the addition of a sulphuric acid solution and the color change is measured spectrophotometrically at a wavelength of 450 nm. The concentration of VA in the samples is then determined by comparing the O.D. of the samples to the standard curve.

Reagents and materials

<table>
<thead>
<tr>
<th>Reagents</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-coated, ready to use 96-well strip plate</td>
<td>1</td>
</tr>
<tr>
<td>Plate sealer for 96 wells</td>
<td>4</td>
</tr>
<tr>
<td>Standard (freeze dried)</td>
<td>2</td>
</tr>
<tr>
<td>Standard Diluent</td>
<td>1 × 20 ml</td>
</tr>
<tr>
<td>Detection Reagent A</td>
<td>1 × 120 μl</td>
</tr>
<tr>
<td>Detection Reagent B</td>
<td>1 × 120 μl</td>
</tr>
<tr>
<td>Assay Diluent A (2 x concentrate)</td>
<td>1 × 6 ml</td>
</tr>
<tr>
<td>Assay Diluent B (2 x concentrate)</td>
<td>1 × 6 ml</td>
</tr>
<tr>
<td>TMB Substrate</td>
<td>1 × 9 ml</td>
</tr>
<tr>
<td>Stop Solution</td>
<td>1 × 6 ml</td>
</tr>
<tr>
<td>Wash Buffer(30 x concentrate)</td>
<td>1 × 20 ml</td>
</tr>
</tbody>
</table>
Preparation of Reagents

1. Bring all kit components and samples to room temperature (18-25°C) before use.

2. Standard - reconstitute the Standard with (1.0) ml of standard diluent, kept for (10) minutes at room temperature, shake gently (not to foam). The concentration of the standard in the stock solution is (10) μmol/L. Use the stock standard solution to produce a dilution series (shown below). Mix each tube thoroughly before the next transfer. Set up (7) points of diluted standard such as (10) μmol/L, (5) μmol/L, (2.5) μmol/L, (1.25) μmol/L, (0.625) μmol/L, (0.312) μmol/L, (0.156) μmol/L, and the last EP tubes with standard diluent is the blank as (0) μmol/L.

3. Assay diluent A and assay diluent B - dilute (6) ml of assay diluent A or B concentrate with (6) ml of deionized or distilled water to prepare (12) ml of assay diluents A or B. The prepared working dilution can't be frozen.

4. Detection reagent A and detection reagent B - briefly spin or centrifuge the stock detection A and detection B before use. Dilute to the working concentration with working assay diluent A or B, respectively (1:100).

5. Wash solution - dilute (20) ml of wash solution concentrate (30) with (580) ml of deionized or distilled water to prepare 600 ml of wash solution.

6. TMB substrate - Aspirate the needed dosage of the solution with sterilized tips and do not dump the residual solution into the vial again.

Assay Procedure

Please predict the concentration before assaying. If values for these are not within the range of the standard curve, users must determine the optimal sample dilutions for their particular experiments.

1. Determine wells for diluted standard, blank and sample. Prepare (7) wells for standard, (1) well for blank. Add (100) μl each of dilutions of standard (read reagent preparation ), blank and samples into the appropriate wells. Cover with the plate sealer. Incubate for (2) hours at (37°C).

2. Remove the liquid of each well, don’t wash.

3. Add (100) μl of detection reagent A working solution to each well. Incubate for (1) hour at (37 °C) after covering it with the plate sealer.
4. Aspirate the solution and wash with (400) of 1X Wash Solution to each well using a squirt bottle, multi-channel pipette, manifold dispenser or auto washer, and let it sit for (1-2) minutes. Remove the remaining liquid from all wells completely by snapping the plate onto absorbent paper. Repeat (3) times. After the last wash, remove any remaining wash buffer by aspirating or decanting. Invert the plate and blot it against absorbent paper.

5. Add (100) μl of detection reagent B working solution to each well. Incubate for (30) minutes at (37°C) after covering it with the Plate sealer.

6. Repeat the aspiration/wash process for five times as conducted in step 4.

7. Add (90) μl of substrate solution to each well. Cover with a new plate sealer. Incubate for (15-25) minutes at (37°C) (don't exceed 30 minutes). Protect from light. The liquid will turn blue by the addition of substrate solution.

8. Add (50) μl of stop solution to each well. The liquid will turn yellow by the addition of stop solution. Mix the liquid by tapping the side of the plate. If color change does not appear uniform, gently tap the plate to ensure thorough mixing.

9. Remove any drop of water and fingerprint on the bottom of the plate and confirm there is no bubble on the surface of the liquid. Then, run the microplate reader and conduct measurement at 450nm immediately.

**Calculation**

Average the duplicate readings for each standard, control, and samples and subtract the average zero standard optical density. Create a standard curve by reducing the data using computer software capable of generating a four parameter logistic (4-PL) curve-fit. As an alternative, construct a standard curve by plotting the mean absorbance for each standard on the y-axis against the concentration on the x-axis and draw a best fit curve through the points on the graph. The data may be linearized by plotting the log of the VA concentrations versus the log of the O.D. and the best fit line can be determined by regression analysis. It is recommended to use some related software to do this calculation, such as curve expert (13.0) . This procedure will produce an adequate but less precise fit of the data. If samples have been diluted, the concentration read from the standard curve must be multiplied by the dilution factor.
**Detection range**
0.156-10 μmol/L. The standard curve concentrations used for the ELISA’s were (10) μmol/L, (5) μmol/L, (2.5) μmol/L, (1.25) μmol/L, (0.625) μmol/L, (0.312) μmol/L, (0.156) μmol/L.

![Graph](3.1)

**Figure (3.1): Standard Curve of VA Elisa kit**

### 3.8.2 Zinc assay
Zinc was analyzed by spectrophotometric methods, using a colorimetric biochemistry auto analyzer system (Chem.Well, Awareness Technology Inc.).

**Principle**
Zn++ reacts with NTRO-PAPS yielding at room temperature a colored complex which intensity is proportional to the zinc concentration present in the sample. The method does not require sample deproteinization either sample blank.

**Reagent composition**

**Reagent A**
- Borate buffer pH 8.2 370 mmol/l
- Salicilaldoxime 12.5 mmol/l
- Dimetilgloxime 1.25 mmol/l
- Surfactants and preservatives
**Reagent B**
NITRO-PAPS 0.4 mmol/l
Preservatives

**Standard**
1x5 ml
Nitrate zinc 200 μg/dl as Zn++ ion

**Preparation of reagents**
Mix 4 part of reagent A and 1 part of reagent B to obtain the working reagent

**Storage and stability**
Store at 2-8 °C. Do not freeze the reagents. The reagents are stable up to the expiry date stated on the label if contamination and evaporation are avoided, protected from light. The above conditions are valid if the vials are opened just only for the time to take the reagent, closed immediately with their cap and stored at the indicated conservation temperature working reagent is stable for 15 days at 2-8 °C.

**Assay procedure**
Pipette into disposable or well clean cuvettes:

<table>
<thead>
<tr>
<th></th>
<th>Blank</th>
<th>Standard</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working reagent</td>
<td>1000 μl</td>
<td>1000 μl</td>
<td>1000 μl</td>
</tr>
<tr>
<td>Distilled H2O</td>
<td>50 μl</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Standard</td>
<td>-</td>
<td>50 μl</td>
<td>-</td>
</tr>
<tr>
<td>Sample</td>
<td>-</td>
<td>-</td>
<td>50 μl</td>
</tr>
</tbody>
</table>

Mix and incubate for 5 minutes at room temperature (20-25ºC). Read the absorbance (A) of the standard and samples at 578 (570-582) nm against blank. Color is stable for 30 minutes.

**Calculation**
Zinc, μg/dl = A sample / A standard × 200

**Reference values**
Serum or plasma 60-107 μg/dl
3.8.3 Iron assay

Iron was analyzed by spectrophotometric methods, using a colorimetric biochemistry auto analyzer system (Chem.Well, Awareness Technology Inc.).

Principle

Fe++ reacts with cromazurol B yielding at room temperature a colored complex whose intensity is proportional to the Iron concentration present in the sample.

Reagent composition

Reagent A

Acetate buffer, pH 4.7 0.2 mol/l
CTMA bromide 0.7 mmol/l
Cromazurol B 2 mmol/l

Standard

1x5 ml
Iron 200 μg/dl
Verified against NIST reference material.

Preparation of reagents

Reagents are liquids ready to use.

Storage and stability

Store at room temperature (15-25 °C). Do not freeze the reagents. The reagents are stable up to the expiry date stated on the label if contamination and evaporation are avoided, protected from light.

The above conditions are valid if the vials are opened just only for the time to take the reagent, closed immediately with their cap and stored at the indicated conservation temperature.

Assay procedure

Allow the reagents to reach working temperature before using.

Pipette into disposable or well clean cuvettes:

<table>
<thead>
<tr>
<th></th>
<th>Blank</th>
<th>Standard</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reagent A</td>
<td>1000 µl</td>
<td>1000 µl</td>
<td>1000 µl</td>
</tr>
<tr>
<td>Distilled H2O</td>
<td>40 µl</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Standard</td>
<td>-</td>
<td>40 µl</td>
<td>-</td>
</tr>
<tr>
<td>Sample</td>
<td>-</td>
<td>-</td>
<td>40 µl</td>
</tr>
</tbody>
</table>
Mix and incubate for 10 minutes at room temperature (20-25°C). Read the absorbance (A) of the standard and samples at 630 (620-640) nm against blank. Color is stable for 60 minutes protected from light.

**Calculation**

Iron, μg/dl = A sample / A standard × 200

**Reference values**

Serum or plasma 60-170 μg/dl

3.8.4 **Hematological analysis**

Blood samples were processed by an automatic counter for haemoglobin Concentration (ABX Micros ES60, HORIBA ABX Diagnostics).

3.9 **Data Analysis**

Data processing and analysis was carried out using the Statistical Package for Social Sciences (SPSS) version 18.0. The cross tabulations and the Chi-square tests at a significance level of (5%) were used to investigate the statistical correlation between the VA level and other factors.
Chapter 4
Results
Chapter 4
Results

This chapter presents the results of the statistical analysis of data that was collected through a structured questionnaire. Data analysis was performed using SPSS, version 18.0 computer software. Descriptive statistics presented the socio-demographic factors of the participants as well as neonatal history, nutrition history, anthropometric measures, and determined the association between serum blood level of VA and these factors.

4.1 Socio-demographic Characteristics of the Study Population

Table (4.1) shows the study population was (150) cases; (53.3%) males and (46.7%) females. Their age between (1-2) years was (46.7%), (2-3) years was (42.7%) and more than (3) years was (10.6%). Forty two percent of the study population's family consisted of (1-5) members, while (43.3%) consisted of (6-10) members, (11.3%) of them consisted of (11-15) members, and (3.3%) consisted of (16-20) members.

More than forty five percent (45.3%) of the study population's families didn’t have an income source, while about twenty nine percent (28.7%) of the families’ heads were employed, (25.3%) of them were freelancers, and (0.7%) of them were owners.

In addition, (43.3%) of the surveyed children's family didn’t get monthly salary, while (28%) of them got less than (500)NIS, fifteen percent (14.7%) got a salary between (500-1000)NIS, (13.3%) got a salary between (1000-3000)NIS, and just one of them (0.7%) got more than (5000)NIS.

Thirty eight percent of the surveyed children's families owned their homes, while (9.3%) of them were rented apartment, while twenty five percent (24.7%) lived in apartment and (25.3%) of them lived in a home.
Table (4.1): Socio-demographic Characteristics of the Study Population.

<table>
<thead>
<tr>
<th>Variable</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>80</td>
<td>53.3</td>
</tr>
<tr>
<td>Female</td>
<td>70</td>
<td>46.7</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Age (Year)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥1-&lt;2</td>
<td>70</td>
<td>46.7</td>
</tr>
<tr>
<td>≥2-&lt;3</td>
<td>64</td>
<td>42.7</td>
</tr>
<tr>
<td>&gt;3</td>
<td>16</td>
<td>10.6</td>
</tr>
<tr>
<td><strong>Number of household</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-5</td>
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<td>6-10</td>
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<tr>
<td>16-20</td>
<td>5</td>
<td>3.3</td>
</tr>
<tr>
<td><strong>Source of income</strong></td>
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<tr>
<td>Employee</td>
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<tr>
<td>Free profession</td>
<td>38</td>
<td>25.3</td>
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<tr>
<td>Owner</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Unemployed</td>
<td>68</td>
<td>45.3</td>
</tr>
<tr>
<td>Relief receiver</td>
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<td>0.0</td>
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<tr>
<td><strong>Monthly income (NIS)</strong></td>
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<tr>
<td>No income</td>
<td>65</td>
<td>43.3</td>
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<tr>
<td>&lt; 500</td>
<td>42</td>
<td>28.0</td>
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<tr>
<td>≥ 500 &lt; 1000</td>
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<td>20</td>
<td>13.3</td>
</tr>
<tr>
<td>≥ 5000</td>
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<td>0.7</td>
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<tr>
<td><strong>Home</strong></td>
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<td></td>
</tr>
<tr>
<td>Owned</td>
<td>57</td>
<td>38.0</td>
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<tr>
<td>Rented</td>
<td>14</td>
<td>9.3</td>
</tr>
<tr>
<td>Flat</td>
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<td>24.7</td>
</tr>
<tr>
<td>House</td>
<td>38</td>
<td>25.3</td>
</tr>
<tr>
<td>Missing</td>
<td>4</td>
<td>2.7</td>
</tr>
</tbody>
</table>
4.2 Anthropometric Assessment Measurements of the Study Population

Anthropometric measurements of children participating in the study is shown in table (4.2). About (5%) of children were found to have weight less than (5) kg. While more than two third of them (69.3%) had weight between (5-8) kg and twenty six percent of children their weight were more than (8) kg. In addition, results showed that only five children (3.3%) their height less than (60) cm. Furthermore, high percentage of children in the study had height in the range of (60-80) cm. While (16.7%) of them, their height were more than (80) cm.

4.2.1 Weight for Age (W//A):

Table (4.2) shows that normal values based on the z-score (\( \geq -1z \) to \( \leq +1z \)) were not found in the study sample. On the other hand it was found that (11.3%) of children were mildly underweight (\( \geq -2z \) to \( < -1z \)), (62%) moderately underweight (\( \geq -3z \) to \( < -2z \)) and twenty seven percent of them (26.7%) severely underweight (\( < -3z \)).

4.2.2 Length-Height for Age (L-H//A):

Table (4.2) shows that normal values based (\( \geq -1z \) to \( \leq +1z \)) were observed in about fifteen percent (15.3%) of children. In turn, the prevalence of stunting was higher in study sample which (26%) mildly (\( \geq -2z \) to \( < -1z \)), (40%) moderately (\( \geq -3z \) to \( < -2z \)) and (17.3%) severely stunted(\( < -3z \)).

4.2.3 Weight for Length-Height (W//L-H):

Table (4.2) shows that the percentage of children with a normal weight for length-height was (14%). In addition, forty one percent (40.7%) of the children were mildly wasted (\( \geq -2z \) to \( < -1z \)), third percent of sample (32.7%) was moderately (\( \geq -3z \) to \( < -2z \)) and thirteen percent (12.7%) were severely wasted (\( < -3z \)).
Table (4.2): Anthropometric Assessment Measurements of the Study Population.

<table>
<thead>
<tr>
<th>Anthropometric Measurements</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body weight (kg)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5</td>
<td>7</td>
<td>4.7</td>
</tr>
<tr>
<td>≤5&lt;8</td>
<td>104</td>
<td>69.3</td>
</tr>
<tr>
<td>&gt;8</td>
<td>39</td>
<td>26.0</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Length/Height (cm)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;60</td>
<td>5</td>
<td>3.3</td>
</tr>
<tr>
<td>60&lt;80</td>
<td>120</td>
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<td>&gt;80</td>
<td>25</td>
<td>16.7</td>
</tr>
<tr>
<td>Total</td>
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<td>100.0</td>
</tr>
<tr>
<td><strong>Degree of weight for age W//A (SD)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥-1≤+1</td>
<td>0</td>
<td>00.0</td>
</tr>
<tr>
<td>≥-2&lt;-1</td>
<td>17</td>
<td>11.3</td>
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<td>≥-3&lt;-2</td>
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<td>40</td>
<td>26.7</td>
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<td>Total</td>
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<tr>
<td><strong>Degree of length-height for age L-H//A (SD)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥-1≤+1</td>
<td>23</td>
<td>15.3</td>
</tr>
<tr>
<td>≥-2&lt;-1</td>
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<tr>
<td>Total</td>
<td>150</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Degree of weight for length-height W//L-H (SD)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥-1≤+1</td>
<td>21</td>
<td>14.0</td>
</tr>
<tr>
<td>≥-2&lt;-1</td>
<td>61</td>
<td>40.7</td>
</tr>
<tr>
<td>≥-3&lt;-2</td>
<td>49</td>
<td>32.7</td>
</tr>
<tr>
<td>&lt;-3</td>
<td>19</td>
<td>12.7</td>
</tr>
</tbody>
</table>
4.3 Neonatal History of the Study Population

Low birth weight (LBW) has been defined by the WHO as weight at birth of less than (2,500) grams (WHO, 2004). Table (4.3) shows about twenty five percent of surveyed children's birth weight was less than (2.5) kg, (74%) of children's weight at birth were between (2.5-4) kg, while more than (4) kg was observed in about two percent of them. In addition, (9.3%) of the children participants entered to ICU, while (90.7%) did not enter to ICU. About third of sample (32.7%) had neonatal jaundice at birth, while (67.3%) didn't have neonatal jaundice.

Table (4.3): Neonatal History of the Study Population.

<table>
<thead>
<tr>
<th>Variable</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight (kg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2.5</td>
<td>37</td>
<td>24.7</td>
</tr>
<tr>
<td>2.5-4</td>
<td>111</td>
<td>74</td>
</tr>
<tr>
<td>&gt;4</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100.0</td>
</tr>
<tr>
<td>Admission to ICU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>14</td>
<td>9.3</td>
</tr>
<tr>
<td>No</td>
<td>136</td>
<td>90.7</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100.0</td>
</tr>
<tr>
<td>Neonatal Jaundice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>49</td>
<td>32.7</td>
</tr>
<tr>
<td>No</td>
<td>101</td>
<td>67.3</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100.0</td>
</tr>
</tbody>
</table>
4.4 Nutritional History of the Study Population

The nutrition history of study sample is shown in table (4.4). It's clear that the majority of surveyed children (90.7%) received immediate breastfeeding, while 9.3% didn't breastfed immediately.

More than two third (71.3%) of the children were breast fed exclusively, while (28.7%) didn't receive exclusive breastfeeding.

About sixteen percent of the children had breastfeeding period less than one month, while (72.7%) had between (1-10) months and just six children (4.0%) had period of breastfeeding between (10-20) months.

It was also found that (49.3%) of the children were received infant formula with age less than (6) months. While (9.3%) of them gave infant formula between (6-12) months and just (4) children were given infant formula after the first year.

Moreover, more than half of study population (54.7%) were received complementary foods with age less than (6) months and twenty eight percent of them at age between (6-12) months. While just (2) malnourished children were given complementary foods after the first year.
Table (4.4): Nutritional History of the Study Population.

<table>
<thead>
<tr>
<th>Variable</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Immediate breastfeeding</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>136</td>
<td>90.7</td>
</tr>
<tr>
<td>No</td>
<td>14</td>
<td>9.3</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td><strong>Exclusive breastfeeding</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>107</td>
<td>71.3</td>
</tr>
<tr>
<td>No</td>
<td>43</td>
<td>28.7</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td><strong>Length of breastfeeding period (month)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1</td>
<td>24</td>
<td>16.0</td>
</tr>
<tr>
<td>≥1≤10</td>
<td>109</td>
<td>72.7</td>
</tr>
<tr>
<td>&gt;10≤20</td>
<td>6</td>
<td>4.0</td>
</tr>
<tr>
<td>Missing Values</td>
<td>11</td>
<td>7.3</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td><strong>Infant formula (month)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;6</td>
<td>74</td>
<td>49.3</td>
</tr>
<tr>
<td>6-12</td>
<td>14</td>
<td>9.3</td>
</tr>
<tr>
<td>&gt;12</td>
<td>4</td>
<td>2.7</td>
</tr>
<tr>
<td>Missing Values</td>
<td>58</td>
<td>38.7</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td><strong>Complementary foods (month)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;6</td>
<td>82</td>
<td>54.7</td>
</tr>
<tr>
<td>6-12</td>
<td>42</td>
<td>28.0</td>
</tr>
<tr>
<td>&gt;12</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>Missing Values</td>
<td>24</td>
<td>16.0</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100</td>
</tr>
</tbody>
</table>
4.5 Vitamin A Status of the Study Population

Vitamin A status among malnourished children is shown in table (4.5). It was found that (5.3%) of children were found to have low serum VA level (<200) µg/L. Furthermore, (20.7%) of the children had serum of VA level in the range of (200-299) µg/L, meaning that (26%) of the children participants had VA serum level below (300) µg/L. While more than two third of sample (74.0%) had serum of VA level more than (300) µg/L.

Table (4.5): Vitamin A Status of the Study Population.

<table>
<thead>
<tr>
<th>Vitamin A Intervals (µg/L)</th>
<th>NO.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;200</td>
<td>8</td>
<td>5.3</td>
</tr>
<tr>
<td>200-299</td>
<td>31</td>
<td>20.7</td>
</tr>
<tr>
<td>≥300</td>
<td>111</td>
<td>74.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>150</td>
<td>100</td>
</tr>
</tbody>
</table>

4.6 Socio-demographic Characteristics and Serum Vitamin A Level of the Study Population

Table (4.6) shows that there was an insignificant association between gender, number of household, source of income, monthly income and home with serum VA level.
Table (4.6): Socio-demographic and Serum Vitamin A Level of the Study Population.

<table>
<thead>
<tr>
<th>Socio-demographic Characteristics</th>
<th>Vitamin A Intervals (µg/L)</th>
<th>Total</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low &lt;200</td>
<td>Borderline 200-299</td>
<td>Normal ≥300</td>
</tr>
<tr>
<td>Male</td>
<td>4 (5.0)</td>
<td>19 (23.8)</td>
<td>57 (71.3)</td>
</tr>
<tr>
<td>Female</td>
<td>4 (5.7)</td>
<td>11 (15.7)</td>
<td>55 (78.6)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
<tr>
<td>Number of Household</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-5</td>
<td>3 (4.8)</td>
<td>12 (19.0)</td>
<td>48 (76.2)</td>
</tr>
<tr>
<td>6-10</td>
<td>4 (6.2)</td>
<td>13 (20.0)</td>
<td>48 (73.8)</td>
</tr>
<tr>
<td>11-15</td>
<td>0 (0.0)</td>
<td>4 (23.5)</td>
<td>13 (76.5)</td>
</tr>
<tr>
<td>16-20</td>
<td>1 (20.0)</td>
<td>1 (20.0)</td>
<td>3 (60.0)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
<tr>
<td>Source of Income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employee</td>
<td>4 (11.8)</td>
<td>6 (17.6)</td>
<td>33 (97.1)</td>
</tr>
<tr>
<td>Free Profession</td>
<td>1 (2.6)</td>
<td>8 (21.1)</td>
<td>29 (76.3)</td>
</tr>
<tr>
<td>Owner</td>
<td>0 (0.0)</td>
<td>1 (100)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Unemployed</td>
<td>3 (4.4)</td>
<td>15 (22.1)</td>
<td>50 (73.5)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
<tr>
<td>Monthly Income (NIS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Income</td>
<td>3 (4.6)</td>
<td>14 (21.5)</td>
<td>48 (73.8)</td>
</tr>
<tr>
<td>&lt;500</td>
<td>2 (4.8)</td>
<td>6 (14.3)</td>
<td>34 (81.0)</td>
</tr>
<tr>
<td>500-999</td>
<td>1 (4.5)</td>
<td>6 (27.3)</td>
<td>15 (68.2)</td>
</tr>
<tr>
<td>1000-2999</td>
<td>2 (10.0)</td>
<td>3 (15.0)</td>
<td>15 (75.0)</td>
</tr>
<tr>
<td>&gt;5000</td>
<td>0 (0.0)</td>
<td>1 (100)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
<tr>
<td>Home</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owned</td>
<td>4 (6.9)</td>
<td>12 (20.7)</td>
<td>42 (72.4)</td>
</tr>
<tr>
<td>Rented</td>
<td>1 (5.9)</td>
<td>1 (5.9)</td>
<td>15 (88.2)</td>
</tr>
<tr>
<td>Flat</td>
<td>2 (5.4)</td>
<td>6 (16.2)</td>
<td>29 (78.4)</td>
</tr>
<tr>
<td>House</td>
<td>1 (2.6)</td>
<td>11 (28.9)</td>
<td>26 (68.4)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
</tbody>
</table>
### 4.7 Anthropometric Assessment Measurements and Serum Vitamin A Level of the Study Population

The association between anthropometric assessment measurements with serum VA level of the study population is shown in table (4.7). It is clear that there was a significant association between degree of W//A with serum VA level while no association between degree of each of the L-H//A and W//L-H with serum VA level, where the p-value > 0.05.

**Table (4.7):** Anthropometric Assessment Measurements and Serum Vitamin A Level of the Study Population.

<table>
<thead>
<tr>
<th>Anthropometric Measurements</th>
<th>Vitamin A Intervals (µg/L)</th>
<th>Total</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low &lt;200</td>
<td>Borderline 200-299</td>
<td>Normal ≥300</td>
</tr>
<tr>
<td><strong>Degree of W//A (SD)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥1≤+1</td>
<td>0  (0.0)</td>
<td>0  (0.0)</td>
<td>0  (0.0)</td>
</tr>
<tr>
<td>≥-2≤-1</td>
<td>1 (6.2)</td>
<td>7 (43.8)</td>
<td>8 (50.0)</td>
</tr>
<tr>
<td>≥-3≤-2</td>
<td>2 (2.2)</td>
<td>17 (18.2)</td>
<td>74 (79.6)</td>
</tr>
<tr>
<td>&lt; - 3</td>
<td>5 (12.2)</td>
<td>6 (14.6)</td>
<td>30 (73.2)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
<tr>
<td><strong>Degree of L-H//A (SD)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥1≤+1</td>
<td>1 (4.3)</td>
<td>5 (21.7)</td>
<td>17 (73.9)</td>
</tr>
<tr>
<td>≥-2≤-1</td>
<td>1 (2.5)</td>
<td>10 (25.0)</td>
<td>29 (72.5)</td>
</tr>
<tr>
<td>≥-3≤-2</td>
<td>5 (8.2)</td>
<td>12 (19.7)</td>
<td>44 (72.1)</td>
</tr>
<tr>
<td>&lt; - 3</td>
<td>1 (3.8)</td>
<td>3 (11.5)</td>
<td>22 (84.6)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
<tr>
<td><strong>Degree of W//L-H (SD)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥1≤+1</td>
<td>1 (4.8)</td>
<td>3 (14.3)</td>
<td>17 (81.0)</td>
</tr>
<tr>
<td>≥-2≤-1</td>
<td>2 (3.3)</td>
<td>13 (21.3)</td>
<td>46 (75.4)</td>
</tr>
<tr>
<td>≥-3≤-2</td>
<td>2 (4.2)</td>
<td>11 (22.9)</td>
<td>35 (72.9)</td>
</tr>
<tr>
<td>&lt; - 3</td>
<td>3 (15.0)</td>
<td>3 (15.0)</td>
<td>14 (70.0)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
</tbody>
</table>

*Statistically significant (p-value <0.05)
4.8 Neonatal History and Serum Vitamin A Level of the Study Population

The results in table (4.8) show that there was a significant association between birth weight with serum VA at (0.05) level of significant. Ten (27%) of the children participants in the study who had low birth weight (<2.5kg), their serum VA level was below normal while 27(73%) of them their serum VA level is normal. In addition, the result also showed that an insignificant association between admission to ICU, neonatal jaundice with serum VA level.

Table (4.8): Neonatal History and Serum Vitamin A Level of the Study Population.

<table>
<thead>
<tr>
<th>Neonatal History</th>
<th>Vitamin A Intervals (µg/L)</th>
<th>Total</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low &lt;200</td>
<td>Borderline 200-299</td>
<td>Normal ≥300</td>
</tr>
<tr>
<td>Birth Weight (kg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2.5</td>
<td>3 (8.1)</td>
<td>7 (18.9)</td>
<td>27 (73.0)</td>
</tr>
<tr>
<td>2.5-4</td>
<td>4 (3.6)</td>
<td>23 (20.7)</td>
<td>84 (75.7)</td>
</tr>
<tr>
<td>&gt; 4</td>
<td>1 (50)</td>
<td>0 (0)</td>
<td>1 (50)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
<tr>
<td>Admission to ICU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1 (7.1)</td>
<td>5 (35.7)</td>
<td>8 (57.1)</td>
</tr>
<tr>
<td>No</td>
<td>7 (5.1)</td>
<td>25 (18.4)</td>
<td>104 (76.5)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
<tr>
<td>Neonatal Jaundice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2 (4.1)</td>
<td>10 (20.4)</td>
<td>37 (75.5)</td>
</tr>
<tr>
<td>No</td>
<td>6 (5.9)</td>
<td>20 (19.8)</td>
<td>75 (74.3)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
</tbody>
</table>

*Statistically significant (p-value <0.05)
4.9 Nutrition History and Serum Vitamin A Level of the Study Population

The results showed that there was no significant association between immediate breastfeeding and exclusive breastfeeding with serum VA level. In addition, there were insignificant association between three other variables namely (length of breastfeeding period, age of introducing infant formula, age of introducing complementary foods) with serum VA level.

Table (4.9): Nutrition History and Serum Vitamin A Level of the Study Population.

<table>
<thead>
<tr>
<th>Nutrition History</th>
<th>Vitamin A Intervals (µg/L)</th>
<th>Total</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low &lt;200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediate Breastfeeding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>7 (5.1)</td>
<td>28 (20.6)</td>
<td>101 (74.3)</td>
</tr>
<tr>
<td>No</td>
<td>1 (7.1)</td>
<td>2 (14.3)</td>
<td>11 (78.6)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
<tr>
<td>Exclusive Breastfeeding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>5 (4.7)</td>
<td>25 (23.4)</td>
<td>77 (72.0)</td>
</tr>
<tr>
<td>No</td>
<td>3 (7.0)</td>
<td>5 (11.6)</td>
<td>35 (81.4)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
<tr>
<td>Length of Breastfeeding Period (month)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-10</td>
<td>4 (5.1)</td>
<td>19 (24.1)</td>
<td>56 (70.9)</td>
</tr>
<tr>
<td>&gt;10</td>
<td>4 (5.6)</td>
<td>11 (15.5)</td>
<td>56 (78.9)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
<tr>
<td>Age of Introducing Infant Formula(month)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;6</td>
<td>5 (5.0)</td>
<td>20 (19.8)</td>
<td>76 (75.2)</td>
</tr>
<tr>
<td>6-12</td>
<td>3 (6.7)</td>
<td>10 (22.2)</td>
<td>32 (71.1)</td>
</tr>
<tr>
<td>&gt;12</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>4 (100.0)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
<tr>
<td>Age of Introducing Complementary Foods (month)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;6</td>
<td>3 (8.8)</td>
<td>6 (17.6)</td>
<td>25 (73.5)</td>
</tr>
<tr>
<td>6-12</td>
<td>5 (4.4)</td>
<td>24 (21.1)</td>
<td>85 (74.6)</td>
</tr>
<tr>
<td>&gt;12</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>2 (100.0)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
</tbody>
</table>
4.10 Vitamin A and Some Micronutrients of the Study Population

Table (4.11) shows that the least and highest value for the levels of zinc, iron and hemoglobin of the sample study and its correlation with serum VA level. It was found that no correlation between zinc with serum VA level, while the correlation between each of iron and Hb with serum VA level was statistical significant.

**Table (4.10): Vitamin A Serum Level and Some Micronutrients of the Study Population**

<table>
<thead>
<tr>
<th>Micronutrients</th>
<th>NO.</th>
<th>R-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc (µg/dL)</td>
<td>79.82±15.57</td>
<td>0.14</td>
<td>0.09</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>48-130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron (µg/dL)</td>
<td>76.38 ± 29.92</td>
<td>0.32</td>
<td>0.00*</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>40-160</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hb (g/dL)</td>
<td>9.94 ± 1.09</td>
<td>0.20</td>
<td>0.00*</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>8-13.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin A(µg/L)</td>
<td>395.98 ±126.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>162.71-861.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Statistical Significant at P(<0.05)
4.11 Anemia Status of the Study Population

The anemia status among study sample is shown in table (4.10). It is clear that the majority of surveyed children (82.7%) had low level of hemoglobin (Hb<11), while (16.7%) of them had normal level of Hb.

**Table (4.11): Anemia Status of the Study Population.**

<table>
<thead>
<tr>
<th>Hb Level (g/dl)</th>
<th>NO.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hb&lt;11</td>
<td>124</td>
<td>82.7</td>
</tr>
<tr>
<td>Hb ≥11</td>
<td>25</td>
<td>16.7</td>
</tr>
<tr>
<td>Missing Values</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100</td>
</tr>
</tbody>
</table>

4.12 Anemia and Vitamin A Serum Level of the Study Population

The results showed that about twenty nine percent of the children participants in the study who were anemic, their serum VA level was below normal while (71.5%) of them, their serum VA level was normal indicating that an insignificant association between anemia with serum VA level.

**Table (4.12): Anemia and Vitamin A Serum Level of the Study Population.**

<table>
<thead>
<tr>
<th>Hb Levels (g/dl)</th>
<th>Vitamin A Intervals (µg/L)</th>
<th>Total</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low &lt;200</td>
<td>Borderline 200-299</td>
<td>Normal ≥300</td>
</tr>
<tr>
<td>Anemic Hb&lt;11</td>
<td>6 (4.9)</td>
<td>29 (23.6)</td>
<td>88 (71.5)</td>
</tr>
<tr>
<td>Normal Hb≥11</td>
<td>2 (7.4)</td>
<td>1 (3.7)</td>
<td>24 (88.9)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (5.3)</td>
<td>30 (20.0)</td>
<td>112 (74.7)</td>
</tr>
</tbody>
</table>
Chapter 5
Discussion
Chapter 5
Discussion

In this chapter, it is explained the findings of this study in the light of other studies. The study was of cross-sectional design included 150 malnourished children under 5 years old attending AEI clinics in the Gaza city and determined VA status among this sample and the impact of socio-demographic, neonatal history, nutrition history on VA level. In addition, this study clarified association of anemia with serum VA. The current study followed a systematic analysis, thus we can comment on the following issue:

5.1 Socio-demographic Characteristics of the Study Population

The results showed nearly equal percentage of the males and females among children under 5 years. This characterizes the Gazan community that has almost equal percentages of males and females. PCBS (2015) estimated that the population of GS totaled (1.82) million of which (925) thousand males and (895) thousand females.

In addition, the majority of the surveyed children had family members ranged from (1-10). PCBS (2013) reported that the majority of Palestinian households have children.

It was also observed that more than forty five percent of the families’ heads were not employed. PCBS (2016) reported that the unemployment rate was about forty percent in GS.

On the other hand, more than two third of the children participants belong to families with monthly income less than (1000)NIS. This indicates that, there was a considerable proportion of families in the GS who did not have adequate monthly income which reflected the state of poverty in the Palestinian community. Middle East Monitor (2016) reported that the Israeli siege imposed on the GS for a decade has damaged the enclave’s economy.

Moreover, thirty eight percent of the surveyed children's families owned their homes, while about (10%) of them rented apartments. This finding is consistent with GS situation characteristics, where people prefer to live in their owned houses and
abstained from renting ones, unless they would not have any other choice (Kanoa et al., 2011).

5.2 Anthropometric Assessment Measurements of the Study Population

Measured weight, length/height as well as the age and weight for length/height were used to assess the prevalence of underweight, stunting and wasting.

It was found that (11.3%) of surveyed children were mildly underweight, more than two third of them were moderately and twenty seven percent were severely underweight. The causes of malnutrition are complex and multifaceted. In developing countries; dietary factors (intake of dietary supplements (iron, VA and D), exclusive breast-feeding for (4-6) months, complementary feeding at 6 months), maternal education, maternal mental health, family socioeconomic and environmental factors (deprivation, social support and hygiene) all may be associated with malnutrition. In addition, maternal mental health has been shown to suffer with exposure to war-related violence (Massad et al, 2012).

Moreover, prevalence of stunting was higher in study sample which (26%) mildly, (40%) moderately and (17.3%) severely stunted (<-3z). Studies showed that there was a strong relationship between a child's age, family size, birth interval and stunting. In communities that have little access to/and contact with health care, children are more vulnerable to malnutrition as a consequence of inadequate treatment of common illnesses, low immunization rates, and poor antenatal care. Poor environmental sanitation, including insufficient safe water supply, also puts children at risk of infection which increases susceptibility to malnutrition (Gugsa, 2000). In addition, chronic malnutrition was a disease of poverty in Gaza, where the World Bank estimated that Gaza had the highest rate of unemployment in the world (43%) among adults and (60%) among youth. The diet of Palestinians in Gaza is largely focused on bread, meaning that many people lack the variety and nutritional components needed to remain healthy (Ferguson, 2015).

The data analysis also revealed that about forty one percent of the children were mildly wasted, thirty three percent were moderately and thirteen percent were severely wasted. Children become wasted when they lose weight rapidly, usually as a direct result of a combination of infection and diets that do not cover nutritional
needs. In addition, other reasons may cause wasting such as: poor access to appropriate; timely and affordable health care; inadequate caring and feeding practices (e.g. exclusive breastfeeding or low quantity and quality of complementary food); poor food security – not only in humanitarian situations, but also an ongoing lack of food quantity and diversity, characterized in many resource-poor settings by a monotonous diet with low nutrient density, together with inadequate knowledge of patterns of food storage, preparation and consumption; and lack of a sanitary environment including access to safe water, sanitation and hygiene services (WHO, 2014).

5.3 Neonatal History of the Study Population

The result of the study found that seventy four percent of surveyed children's birth weight was between (2.5-4) kg. A previous study carried out in Gaza city showed there was a direct correlation between ethnicity, age, marital status and educational status with increased negative pregnancy outcomes, such as low birth weight. In addition the nutritional status of pregnant mother was the most important determinant of infant birth weight (AlShawwa, 2014). Moreover, about twenty five percent of children's birth weight was less than (2.5) kg which might be due to status of maternal nutrition during pregnancy, stress (psychological) factors previous premature delivery, poor socio-economic status and early marriage which are very common in the Palestinian community. Furthermore, about ten percent of the children participants in the study entered to ICU, that was because of several reasons such as: premature birth, lack of oxygen, respiratory distress, problems in the chest, a hole in the roof of the mouth and problems in the trachea. While the majority of study sample did not enter to ICU.

About thirty three percent of the surveyed children had neonatal jaundice, while more than two third of them didn't have neonatal jaundice. Jaundice is common in newborns and even among premature infants. Jaundice may result from serious disorders such as: incompatibility of the newborn’s and mother’s blood type, excessive breakdown of red blood cells or/and severe infection (Kopelman, 2016).
5.4 Nutritional History of the Study Population

In the current study (90.7%) of the study sample received immediate breastfeeding and (71.3%) of them were breast fed exclusively. This finding is consistent with the Palestinian Family Health Survey (2006) which indicated that (97.5%) of children received breastfeeding, more than half of infants (65%) started breastfeeding in the first hour after birth, (9.0%) had breastfeeding six hours or more after their birth for one reason or another (El Najjar, 2014). Other cross-sectional study evaluated data of (690) clinic files from (3) refugee camps in Nablus, Palestine in (2007) and revealed that about (70%) of infants aged (0–6) months were exclusively breastfed and only (14.3%) were exclusively formula fed (Musmar et.al., 2012). Another survey found exclusive breast-feeding prevalence of (86.5%), (66.7%), and (25.3%) among infants 1, 3, and 6 months old (Castillo et.al., 1996).

About half of the children participating in the study (49.3%) received infant formula with age less than 6 months (the majority in the first month) that was for several reasons such as : the mother was pregnant, child refused the breastfeeding, inadequate child from breast milk and the mother was employed.

Moreover, more than half of study population (54.7%) received complementary foods with age less than 6 months. The previous study conducted in GS showed that (24.9%) of children up to 2 years old received complementary feeding before the age of three months while (55%) received complementary feeding between ages of (3-5) months (Kanoa et al., 2011).

5.5 Vitamin A Status of the Study Population

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 (≥ 2 – <10%) for mild, (≥ 10-< 20%) for moderate and (≥ 20%) for severe levels of VAD. This is based on a serum retinol cut-off value of (<200)μg/L (MARAM, 2004). In the present study, (26%) of the study sample had VA levels below (300)μg/L. MARAM study (2004) conducted on (1.127) children in the WB and GS showed different result whereby (75.9%) of children had VA levels below (300)μg/L. This difference might be due to different sample size.
5.6 Socio-demographic and Serum Vitamin A Level of the Study Population

In the present study, it was found that no statistical significance association between gender with serum VA level for the study population. This finding is consistent with the MARAM study which revealed that gender-specific VAD showed that VAD prevalence among male children was similar to that of female children with no significant difference between the two groups (MARAM, 2004).

It was also observed that there was an insignificance relationship between family's monthly income with serum of VA level for the study sample. This finding is inconsistent with MARAM study which showed that there were significant associations between VAD and the level of family income, where more than (90%) of the VA deficient children came from families with average incomes of (2000) NIS and less.

On the other hand, it was found that an insignificance relationship between source of income, home and number of household the family's of malnourished children with VA serum level. Such unemployed due to Israeli siege on GS raised the level of poverty among Palestinians. It was known that (80%) of families in GS currently depend on humanitarian aids. This decline exposed unprecedented levels of poverty and the inability of a large majority of the population to afford basic food. As a result, food aid increased dramatically to meet the needs of this increasingly impoverished population (Kanoa, 2009).

5.7 Anthropometric Assessment Measurements and Serum Vitamin A Level of the Study Population

The results of the current study found an insignificant association between degree of each of the L-H//A and W//L-H with serum of VA level. This finding is consistent with other study which showed that supplementation with large doses of VA had no effect on growth over 1 year (Lie et al., 1993). Periodic VAS had no effect on the rate of weight or height gain in the total population or on the incidence of wasting, stunting, or wasting and stunting among children who were normally nourished at baseline (Fawzi et al., 1997).
5.8 Neonatal History and Serum Vitamin A Level of the Study Population

In the present study, it was found a significant relationship between birth weight with serum VA level at (0.05) level of significant. This finding is inconsistent with the previous study which showed an insignificant association between child birth weight and serum VA and stated that VAD during pregnancy seemed to be associated with preterm birth, LBW and low neonatal liver stores (AlShawwa, 2014).

In addition, the result showed that there was no significant association between neonatal jaundice with serum VA level. This finding is consistent with AlShawwa (2014) study which revealed an insignificant association between neonatal jaundice and serum VA level.

The data analysis also revealed an insignificant association between admission to ICU with serum VA level. More than half (57.1%) of the children with normal serum VA level, entered to ICU.

5.9 Nutrition History and Serum Vitamin A Level of the Study Population

In the present study, it was found that there was no association between immediate breastfeeding, exclusive breastfeeding and length of breastfeeding period with serum VA for malnourished children participants in the study. This finding is inconsistent with a study conducted in Bangladesh which reported that a (74 %) reduction in risk of VAD in breastfed children aged six months to three years as compared with non-breastfed children and even older children (24-35) months were (65%) less likely to be vitamin A deficient if they were breastfed (Rehydration Project, 2014). Another study suggested that breast-feeding also protected children from any growth deficit attributable to subclinical VAD (Hadi et al., 2000).

In addition, it was found an insignificant association between age of introducing each of infant formula and complementary foods with serum VA. About (29%) and (26%) of malnourished children who received infant formula and complementary food between (6-12) months, respectively had serum VA below normal.
5.10 Vitamin A and Some Micronutrients of the Study Population

In the present study, it was found that there was no correlation between zinc level with serum VA for the study population. This result is inconsistent with the study that concluded supplementation with zinc improved indicators of VA status (Muñoz et al., 2000). While this result agrees with the study which revealed that there was no correlation between plasma levels of VA and zinc and suggested that in vitamin A-deficient children, without protein-energy malnutrition, zinc deficiency does not seem to have a role (Shingwekar et al., 1979).

Moreover, it was found a statistical significant correlation between level of iron with serum VA. This result is consistent with the previous study which revealed that a high VA intake was associated with a significantly lower mean hepatic iron level for the high dietary iron intake group (Staab et al., 1984). Moreover, iron-supplemented infants had significantly lower plasma retinol concentrations and a significantly higher prevalence of VAD, as defined by a plasma retinol concentration <0.70 micromol/L, than did the non-supplemented infants (Wieringa et al., 2003).

It was also observed that there was a statistical significant correlation was recorded between VA level and Hb. This finding is consistent with the previous study showed that vitamin A deficient children were more likely to be anemic than children with normal levels of VA (MARAM, 2004). Other studies have found a significant correlation between serum retinol and hemoglobin concentration. Among Indian preschool children, hemoglobin values were found to be lower in those who had serum retinol below (20µg/dL) compared with those with normal levels (Reddy, 1998).

5.11 Anemia Status of the Study Population

Data analysis of the current study revealed that the majority of the children participants (82.7%) were anemic. This finding is consistent with the previous study which concluded that the prevalence of anemia among preschool children in the GS
was higher indicating that anemia was a major public health problem (ElKishawi et al., 2015).

5.12 Anemia and Vitamin A Serum Level of the Study Population

It was also observed that there was no statistical significant relationship was recorded between anemia with serum VA level for the children participants in the study. This finding is inconsistent with the MARAM study which showed that thirty four percent of vitamin A deficient children aged (12-59) months were also anemic, indicating that vitamin A deficient children were more likely to be anemic than children with normal levels of VA (MARAM, 2004).
Chapter 6
Conclusion and Recommendation
Chapter 6
Conclusion and Recommendation

6.1 Conclusion

The current study included the identification of VA status among malnourished children attending AEI association services and the impact of children's socio-demographic, neonatal and nutrition history on VA status. In addition to assess relationship between VA and the previously mentioned factors.

At the end of the study and after data analysis was included:

- It was found that about half of malnourished children's families consisted of (6-10) members and thirty eight of them owned their homes.
- About half of study sample families didn’t have an income source.
- According to values based on z-score, it was found that more than half of the children participants in the study was moderately underweight, forty percent of them was moderately stunted and about forty one of the samples was mildly wasted.
- Seventy four percent of children's birth weight was between (2.5-4) kg and about ten percent of these children entered to ICU.
- The majority of malnourished children participants received immediate breastfeeding and more than two thirds of them were breastfed exclusively.
- The prevalence rate of VAD among the study population was (23.4%).
- The current study findings indicated an insignificant association between gender, number of household, source of income, monthly income and home with serum VA.
- The current study findings indicated a significant association between degree of W//A with serum VA while no association between degree of each of the L-H//A and W/L-H with serum VA.
- The results showed a significant association between birth weight with serum VA, while no significant association between immediate breastfeeding,
exclusive breastfeeding, length of breastfeeding period, age of introducing infant formula and age of introducing complementary foods with serum VA.

- The current study findings showed that a majority of surveyed children had low level of hemoglobin, while an insignificant association between anemia with serum VA.

## 6.2 Recommendations

Childhood malnutrition among children under 5 years appears to be a public health problem in GS and interventions to improve children nutritional status must be in concern. So, the following recommendations are suggested:

### 6.2.1 Recommendations to Decision Makers and Stakeholders:

Decision makers and stakeholders 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 and the impact and effects of VAD.

- Raising the level of nutritional knowledge among health professionals and their staff on the health of children.

- The need for clinical nutritionist to be present within the follow-up group for malnourished children.

- Presence of nutritionist in each school to provide nutritional advice to children.
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 micronutrients.

6.2.2 **Recommendations to Mothers**:

- 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 through support and encourage mothers to continue breastfeeding.

- Introducing complementary foods along with breastfeeding is essential, so counsel all mothers to introduce complementary foods for their infants at 6 months of age, continuing through age 24 months, while also continuing breastfeeding on demand.

6.2.3 **Recommendations to Community**:

- To have good nourished infant and young children, this requires a good nourished pregnant woman through different nutritional programs.

- Further studies are needed to study independently the relationship between VA and some diseases such as cancer, diabetes and digestive system diseases, and other age groups should be considered.
References
The References list


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Mendes, J., Siqueira, E., Silva, J., & Arruda, S. (2016). Vitamin A deficiency modulates iron metabolism independent of hemojuvelin (Hfe2) and bone morphogenetic protein 6 (Bmp6) transcript levels. Genes Nutr, 11, 1.


Annexes
أما الباحثة: ميرفت حسن إبراهيم عدربه...أقوم بدراسة بحثية حول مستوى فيتامين أ عند الأطفال الذين يعانون من سوء التغذية، بالإضافة إلى دراسة بعض العوامل التي قد يكون لها تأثير على نقص هذا الفيتامين. حيث سيتم اختيار الأطفال الذين تتراوح أعمارهم تحت سن الخامسة. و يقوم بالإشراف على هذه الدراسة برنامج ماجستير العلوم الحياتية قسم الأحياء والتكنولوجيا الإسلامية بالجامعة الإسلامية في غزة.

المشاركة في هذه الاستبانة طريقة. أشكر مشاركتكم معنا لأن إجاباتكم لها قيمة علمية مهمة بالنسبة للبحث.

أرجو مساعدتي في الإجابة على بعض الأسئلة المتعلقة بالطفل والأسرة ككل. كما سأقوم بقياس وزن وطول الطفل وسأقوم بسحب عينة دم ورئوية من الطفل. المعلومات المعطاة سوف تبقى سرية ولن يطلع عليها أحد وتستخدم لأغراض البحث العلمي فقط.

أنا موافقة على تعبئة هذه الاستبانة التي تتعلق بصحة طفل...
التاريخ:........
توقيع:........

شكراً لكم على حسن تعاونكم

الباحثة/ميرفت حسن عدربه
سجل المقابلة

الممركز:

التاريخ: / / 

معلومات أساسية:

• الرقم التسلسل:

• رقم الملف:

معلومات عامة واجتماعية:

الاسم:

• تاريخ الميلاد:

• الجنس:

• العنوان:

• الهاتف/الجوال:

• نوع العائلة: كبيرة

• عدد أفراد العائلة:

• مصدر الدخل:

• موظف

• ممتلكات

• مهنة

• الدولة

• الدخل الشهري:

لا يوجد دخل

أقل من 500 شيكل

0-1000 شيكل

1000-3000 شيكل

أكثر من 5000 شيكل

أكثر من 5000 شيكل

0-1000 شيكل

500-1000 شيكل

أكثر من 5000 شيكل

أكثر من 5000 شيكل
 المنازل:
- ملك
- أجار
- شقة
- منزل كبير
- منزل مع أرض: نعم
- لا

تاريخ الولادة:
- الوزن عند الولادة: كجم
- القبول في العناية المكثفة: نعم
- لا
- إذا كان نعم، أذكر السبب:

البرقان الولادي:
- نعم
- لا
- إذا كان نعم، كم استمر؟

التاريخ الغذائي:
- رضاعة مباشرة: نعم
- لا
- إذا كان لا، أذكر السبب:

- رضاعة حصرية: نعم
- لا
- إذا كان لا، أذكر السبب:

- رضاعة مستمرة: نعم
- لا
- إذا كان لا، أذكر السبب:

- طول مدة الرضاعة
- مدة تقديم:
- الأطعمة المكملة
- حليب الأطفال
قياسات التقييم الجسمانية:

- وزن الجسم: 
- درجة الطول/الارتفاع: 
- درجة الوزن/الطول/الارتفاع: 

تحقيقات: (تتم بعد تحليل عينات الدم في مرحلة متأخرة)

- جرام/دسر
- ميكرو جرام/ليتر
- ميكرو جرام/دسر
- ميكرو غرام/ديس
- ميكرو غرام/ديس
- ميكرو غرام/ديس

شكرًا لكم

توقيع
Annex (2)

Vitamin A Status amongst Malnourished Children under 5 Years Old
Attending Ard El-Insan Association in Gaza City

Date: / /  
Center: 

Basic Information:
- Serial Number: 
- File Number: 

General and Social Information:
- Name: 
- Birth date: 
- Sex: 
- Address: 
- Telephone/Mobile: 
- Family type: Cellular  Extended  
- Number of household 
- Source of income:
  Employee  Free profession  Owner  Unemployed  Relief receiver  
- Monthly income:
  No income  <500 Nis  ≥500 <1000 Nis  
  ≥1000<3000 Nis  ≥3000-5000 Nis  ≥5000 Nis  
Home:
- Owned ☐
- Rented ☐
- Flat ☐
- House ☐
- Land at home: Yes ☐ No ☐

Neonatal History:
- Birth weight: ☐ Kg
- Normal birth state Yes ☐ No ☐
- Admission to ICU Yes ☐ No ☐
  If yes; mention the reason: 
- Neonatal Jaundice Yes ☐ No ☐
  If yes; how long it stayed? 

Nutritional History:
- Immediate breastfeeding: Yes ☐ No ☐
  If no; Mention the reason: 
- Exclusive breastfeeding: Yes ☐ No ☐
  If no; Mention the reason: 
- Continued breastfeeding: Yes ☐ No ☐
  If no; Mention the reason: 
- Length of breastfeeding period ☐
- Age of introducing: Infant formula ☐ Complementary foods ☐
Anthropometric Assessment Measurements:

Body weight:  □ Kg  

Length/Height  □ cm

Degree of W//A □ S.D  

Degree of L-H//A □ S.D  

Degree of W//L-H □ S.D

Investigations: (To be completed after analyzing of blood samples in a later stage):

Hemoglobin level:  □ g/dl  

Serum vitamin A level : □ µg/l

Serum iron level :  □ µg/dl  

Serum zinc level : □ µg/dl

Thank you

Signature:

Revised by: