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Relationship between Anemia and Aluminum Uptake from Aluminum Cookware among Children in Gaza Governorates.

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Thesis Approval

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Dedication

I dedicate this work to

my mother, and the soul of my beloved father.

my wife, for her continuous encouragement and support.

my lovely children, khaled and Mohamed.

Kamal Hamo

Declaration

I certify that this entire thesis submitted for the degree of Master is the result of my own research, except where otherwise acknowledged, and that this thesis has not been submitted for a higher degree to any other university or institution.

Signed: **Dr. Kamal Hamo**

Date: March 2010

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Abstract

Anemia is a major public health problem world-wide. In spite of different campaigns of iron and foliate supplementation, anemia prevalence among Palestinian population is still very high, especially in women and children. Aluminum (Al) is the most abundant metallic element on Earth, and has been used extensively in foodstuffs, utensils and packaging. Al is considered as a potential toxic metal and the over dose of Al may lead to three serious types of disorders: Al- induced bone disease, microcytic anemia and encephalopathy.

This study aimed to assess the relationship between anemia, and using Aluminum cookware (AlC), especially bad quality ones, among children 1-3 years old, at United Nation Relief and Working Agency for Palestine Refugees in the Near East (UNRWA) clinics in Gaza Governorates, in order to provide information that could improve the children nutritional status. This study is descriptive analytical cross sectional one, conducted on a sample of 5 UNRWA health centers. A sum of 350 children chosen through a multi- stage sampling method were their guardians interviewed in the well-baby clinic through a self-constructed interviewed questionnaire with response rate of 81.7%. Additionally, blood sample was taken from each child to examine the hemoglobin and serum AL concentration.

The study finding revealed that, 48.3% of children were anemic (Hb <11 g/dl). Serum Aluminum mean was 38.5 µg/ L. About 25.2% of children had serum Aluminum level (SAL) at dangers level (> 60 µg/ L). The statistically significant factors associated SAL were family income, father and mother education and employment status. Child age, child recent weight and type of foods were also significant factors.

The study revealed that, there was positive relationships between anemia prevalence and the SAL, this relation expressed by the negative relationships between hemoglobin (Hb) concentration and SAL. Also there was positive relationships between anemia prevalence and using bad quality ALC. Bivariate analysis was carried out using logistic regression in order to control the confounders, after logistic regression analysis, the only significant factor was SAL.

The study results showed that, Aluminum cookware (AlC) was the most (81.3%) available utensils in Gazans houses, most (61.1%) of that found of bad quality. The significant factors associated with using ALC in preparing and saving foods were area of residency and family income, father and mother education and employment status. The majority (83.2%) of participants have a low grade of knowledge of exposure to AL and its adverse health effects.

The study suggested that, dissemination of information and knowledge about the hazard of exposure to Al though ALC can be of great value to protect the Gazas people form such hazard. Emphasizing effective monitoring and strengthening the supervision of local markets and domestic manufactures, and promote benefits of iron supplementation.

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List of abbreviations

Al	Aluminum
AlC	Aluminum Cookware
CI	Confidence Interval
CVI	Content Validity Index
d L	Deciliter
EMR	Eastern Mediterranean Region
Epi -info	Epidemiological Information program
Hb	Hemoglobin
ID	Iron deficiency
IDA	Iron deficiency anemia
ILC	International Labour Conference
IMR	Infant mortality rates
MCH	Mother and Child Health
mL	Milliliter
MOH	Ministry Of Health
NGOs	Non Governmental Organization
OPT	Occupied Palestinian Territories
OR	Odds Ratio
PCBS	Palestinian Central Bureau of Statistics
PHC	Primary Health Care
PTWI	Provisional Tolerance Weekly Intake
SAL	Seroum Aluminum Level
SAL	Serum Aluminum Level
SPSS	Statistical Package Of Social Science
sq km	Squared kilometer
UNRWA	United Nation Relief and Working Agency for Palestine Refugees in the Near East.
WHO	World Health Organization

Chapter 1: Introduction

1.1 Research Background

Anemia is a major public health problem world-wide, world health Organization (WHO) rates iron deficiency (ID) as one of the top ten causes of mortality and disability adjusted life years lost globally (WHO, 2001). ID continues to be the leading single-nutrient deficiency in the world, affecting the lives of more than 2 billion persons despite considerable efforts to decrease its prevalence for the past 3 decades (WHO, 2004). Many of these affected individuals live in the developing world, it estimated that around 30% of the world populations are affected (Massawe, 2002).

In the Ministry of Health (MOH), in West Bank, blood samples were collected from 48,745 infants aged 9 months who visited Mother and Child Health (MCH) in the 10 governorate for measles vaccination, the results indicated that 39.8% of infants suffered from anemia. In the Gaza Strip a sample of 1,298 blood samples were collected from children aged 9 months in Primary Health Care (PHC) clinics; about 942 (72.5%) of them suffered from anemia (MOH, 2005). According to United Nation for Relief and Work Agency (UNRWA), the prevalence rate of anemia among refugee children aged 6-36 months was 54.7% in Gaza strip and 34.2% in the West Bank (UNRWA, 2009). According to the WHO, anemia prevalence in Gaza strip increased from 37.9% in 2002 to 49.9% in 2007, affecting nearly half of children (WHO, 2009a).

Anemia treatment includes iron supplementation and dietary changes such as increasing the amount of iron-rich foods (Ojukwu, &Okebe, 2007), so ferrous sulfate and folic acid as a tonic are distributed for pregnant women and children under 3 years in MOH and UNRWA centers free of charge (MOH, 2005).

In spite of different campaigns of iron and foliate supplementation, anemia prevalence among Palestinian population is still very high, especially in women and children. All the concerns still focusing on dietary intake of iron, but little done with other factors that may be affected the hemoglobin level in blood like some trace minerals

which enters our bodies through food or additives or drugs, one of the most popular elements is Al.

Aluminum (Al) is the most abundant metallic element on Earth, comprising some (8%) of the Earth's crust. Al has been used extensively in foodstuffs, utensils and packaging (Baxter et al., 1989; Karbouj, 2007). Depending on the meal, the cooking in aluminum cookware (AlC) can expose humans to the ingestion of important quantities of Al. In our human body, Al ions can inhibit different metabolism processes by competition reactions with other ions such as iron, magnesium, calcium, phosphor, fluoride and others (Mahieu, *et al*., 2004; Aikoh, *et al*., 2005; Kaur, & Gill, 2005).
Using AlC may leach significant amounts of Al into the diet, which raise the amounts of Al to high levels. This may exceed the allowed amounts of Provisional Tolerance Weekly Intake (PTWI) by WHO and may be dangerous to the elderly and people with kidney problems **(**Al-Juhaiman, 2006**).**

Elevation in Serum Aluminum Level (SAL) is associated with anemia, osteomalacia, and a neurologic syndrome known as dialysis encephalopathy (Malluche, 2002; Savory, *et al*., 1986). Al sources entering human body are range from food, water, beverages cosmetics, medicines, food additives and leaching of Al from AlC (Müller, *et al*., 1989).

Normal people can excrete Al from the body through their urinary system; however, Al accumulation in the body is a problem especially for those people with kidney failure. Provisional Tolerance Weekly Intake (PTWI) based on short-term toxicity was recommended by WHO as 7mg/kg body weight for an adult (WHO, 1989). As found by Lione the inappropriate choices of foods, method of preparation and non prescription medicines can increase the daily intake of Al to several hundred milligrams per day (Lione, 1983). It has been established that cooking of acidic foods in AlC causes leaching of Al into food (Neelam, & Kaladhar, 2000; Verissimo, *et al*., 2006).

The sources of AlC which available in the local markets is not clear, and most of available AlC are import from Egypt, locally manufactured and other sources. During the

last three years, different political and socioeconomical changes happened in Gaza Stripe, extended siege, borders closure, scarcity of industrial materials, goods smuggles though tunnels opened the markets to uncontrolled production and trade. In addition to that, and the demolition of the industrial infrastructure, due to last Israeli war on Gaza, killed any hope in industrial and economical development. All these factors weakened the controlling of the markets and remaining industries. In addition to that, the absence of regulations, and roles and weak involvement of the Non Governmental Organizations (NGOs) in protecting the population from unhealthy and poor quality goods, which increased the risk of exposure to different hazards such as exposure to Al from AlC specially bad quality AlC.

1.2 Problem Statement

In spite of preventive and curative efforts done by MOH, UNRWA, and NGOs, anemia prevalence is still very high among different groups of the Palestinian people, especially in the most vulnerable groups, women, children, and elders. On the other hand, Al considered as a potential toxic metal and exposure to over dose of Al can lead to three serious types of disorders: Al- induced bone disease, microcytic anemia, and encephalopathy. During foods processing and storage in AlC, a considerable amount of Al leached from AlC can entered into foods, this amount is dependent on the type of foods, processing method, some additives like spices and the quality of AlC.

Unfortunately the locally manufactured AlC in Gaza is fare away from manufacturing standards, and its use increased dramatically because of borders blockage especially in low socioeconomically class, also some of imported AlC through uncontrolled smuggles from Egypt are low in quality. This study aimed to explore the relation between one of the most important and prevalent disorders in our society, anemia, and the using of AlC.

1 .3 Justification of the study

The continuous using of AlC different countries including Palestine despite its association with serious health problems is still one of a considerable problem facing the community. Al considered as a nicey and pricy goods but unfortunately unhealthy, and different studies examine the quantity of AL leached in food from using AlC. Few studies were done in our region to shed some light on Al leaching from bad quality AlC on human health, and some of its certain adverse effect like anemia. Thus, the aim of this study is to shed some light on the relationship between anemia among children in Gaza governorates, and using AlC especially bad quality AlC. Therefore, the importance of the study emerges from the fact that this research is the first research in Palestine and may be in the region, which tries to study the relationship between Al, and human health at this level, the second things is that this study deals with issue concerns of our children health and our future.

1. 4 Objectives of the study

1 .4 .1 General objective

To assess the relationship between anemia, and using AlC, especially bad quality, among children 1-3 years old, in Gaza governorates.

1. 4 .2 Specific objectives

1. To examine the relationship between anemia and Serum Aluminum level SAL.
2. To assess the relationship between anemia and using AlC in Gaza governorates.
3. To estimate the serum Aluminum mean among the children 1-3 years old.
4. To explore the prevalence of using AlC in Gaza governorates.
5. To assess the population knowledge about the ways of exposure to Al, and the hazard of Al uptake.

6. To conclude recommendations that could help protecting the Palestinian people from Al hazard.

1.5 Research Questions

To achieve the research objectives, the study attempted to answer the following research questions:

1. Is there a relationship between anemia and using AlC according to its quality?
2. Is there a relationship between anemia and SAL?
3. Dose the serum Al mean exceed the international accepted level?
4. Is there a relationship between SAL and some socio-demographic variables?
5. Is there a relationship between SAL and child characteristics?
6. What is the prevalence of using AlC in Gaza governorates?
7. Is there a relationship between using AlC and some socio-demographic variables
8. Is there sufficient knowledge regarding the ways of exposure to Al, and the hazard of Al uptake?
9. Is there sufficient knowledge regarding the hazard of Al uptake?

1 .6 Context of the study

In this section the researcher presents background information about the Palestinian population, geography, demography, socio-economy and political situation. The current study will be conduct in UNRWA health centers in Gaza governorates.

1 .6 .1 Demographic contexts

Historical Palestine constitutes the southwestern part of a huge geographical unity in the eastern part of the Arab world, which is Belad El-Sham; it is about 27,000 Km^2, the borders of Palestine start with Lebanon in north, Mediterranean Sea in west, Jordan in

east, and Egypt in south (annex1). Now, Palestine comprises two areas separated geographically: West Bank and Gaza Strip the total area of Occupied Palestinian Territories (OPT) is 6,020 Km^2; with total population living in are 3,761,646individuals (PCBS, 2007). West Bank is area of 5,655 Km^2, divided into four geographical regions. The population density is 420 inhabitants/ Km^2. West Bank the total population is 2,350,583 in year 2007 (PCBS, 2007).

Gaza strip is a narrow piece of land lying on the coast of the Mediterranean sea, Gaza Strip is very crowded place with area 365 $Km^2$and constitute 6.1% of total area of Palestinian territory land (annex 2). In mid year of 2007 the population number is to be 1.416.543, 67.9% of them are refugees ,and the population density is 3988 inhabitants/km2 mainly concentrated in the cities, small village, and eight refugee camps, and comprises the following main five governorates: North Gaza, Gaza City, Mid-zone, Khanuonis and Rafah (MOH, 2005) . More than 17% of the population resides in the north of Gaza the total number is 265,932 individual with capita per sq km 4,360, 51% in the central, Gaza city total population is 487,904 with capita per sq km 6,593, Mid-Zone is 201,112 with capita 3,467 and 32% in the southern area, Khanuonis 269,601 with capita per Km^2, 2,496 and Rafah is 165,240 with capita per sq km 2,582 (PCBS, 2007).

Moreover, age structure in the Gaza Strip is similar to that in many developing countries, where 48.3% of the total population is under 15 years(annex3), 49% between 15 and 49 years and 2.7% more than 65 years old (PCBS, 2007).

1.6.2 Socio-political context

The situation for around 1.5 million Palestinians in the Gaza Strip became worse than it has ever been since the start of the Israeli military occupation in 1967. Gaza Strip is suffering form a critical political situation since Israel withdrawal from Gaza, Israel continues its military activities, engaging in missile attacks, artillery fire, house searches, arrests, detentions, land requisitions and leveling, curfews, house demolitions, closure-caused food shortages, the limitation of access to basic health and educational services,

and the limitation of access to agricultural lands and other natural resources (World Bank, 2004). Israel still hold overalls sovereignty over the Gaza Strip, it has the upper hand over borders, movement of goods and travelers in and out of the Gaza, the majority of Gaza's has been hit harder due to the current closure policy and siege after Hammas movement takeover of Gaza Strip, trade and labor was shut out of Israel, frequent disruption to electrical services due to Israel's bombing of Gaza's only power station, shortage of fuel is common nowadays. All these conditions reflect deteriorating of economic situation, limited income and lack of work opportunities which leads to low standards of living and inadequate health facilities, poor families cannot pay for health insurance or private fees (WHO, 2006). Unprecedented division of Palestinians resulted in difficulties in Palestinian present life and future.

1. 6. 3 Socio-economic contexts

Today's, economic crisis has been caused by restriction on the movement of people and goods. The Palestinian recession is among the worst in the modern history; average personal incomes have been declined by more than a third since 2000, and nearly a half of Palestinian now live below the poverty line, 43% still live below the poverty average (World Bank, 2004). According to PCBS, the relative poverty line 572$ and the absolute poverty line 457$ for the reference household in the Palestinian Territory in 2007, and the total diffusion of poverty among Palestinian households in the Palestinian Territory is 30.3% in 2007, (of which 19.1% in the West Bank and 51.8% in Gaza Strip), while 57.2% of households were found to obtain an income less than the national poverty line in 2007 (of which 45.7% in the West Bank and 79.4% in Gaza Strip). Also, the consumption data indicates that 18.3% of the households in the Palestinian territory were suffering from deep poverty in 2007, (of which 9.7% in the West Bank and 35.0% in Gaza Strip), and it increases to 46.3% if the income data is used. The results showed a decrease of 1.6% of poverty rates in the Palestinian territory during year 2007 compared with year 2006, while it decreased in the West Bank with a percentage of 13.2% and increased in Gaza Strip with a percentage of 8.1% (PCBS, 2007).

The economic siege imposed on Gaza since the Hammas electoral victory in January 2006 was further intensified after it effectively took control of the Strip in June 2007. Israel, which already controlled Gaza's borders, coastline and airspace, declared Gaza a "hostile entity" and further tightened closure of the borders, curtailing all movement of people and most goods(ILC, 2008).

In 2008, Israel continued its closure on the Gaza Strip, placing extreme restrictions on the Strip's foreign trade, and closed the crossings into Gaza and placed major restrictions on the entry of goods into it, including fuel, medical equipment, and replacement parts. In 2008, the tunnel economy between southern Gaza and Egyptian Rafah greatly expanded. Many goods of various kinds were brought into Gaza through the tunnels. However, entry of merchandise through the tunnels is not a proper substitute for Gaza's entire trade industry, which is carried out almost completely at crossings under total Israeli control (B'Tselem, 2008). The war on Gaza which started on December 27th 2008 has further deteriorated the already miserable situations, increased unemployment rates-more than 50%, an increase in the prevalence of poverty- more 75%, collapse of economy and rapidly increasing dependence on food aid than ever before (more than 85% of population received food aid assistance).

1.6.4 Health care context

Palestine experience in health care system is rather unique and complicated. The several years of occupation and the following unilateral withdrawal of the Israeli government did strongly influence the health care system in Palestine. The consequences of closures and separation formed a great challenge for the ministry of health as it created obstacles regarding the accessibility to health care services and affects the unity of the health care system in all Palestinian governorates (MOH, 2005).

Health care services in Palestine are provided by four sectors, which is Ministry of Health (MOH), Non Governmental institutions (NGOs), UNRWA, Private sector. Primary health centers in Palestine 654 centers (MOH 63.6%, UNRWA 8.1% and 28.3% NGOs)

(MOH, 2005), and UNRWA plays an important role in health service delivery, providing free of charge primary health care through 55 centers in Gaza and West Bank (18 primary health centers in Gaza Strip and 37 in West Bank), and purchasing secondary and tertiary health care for the registered Palestinian refugees (UNRWA, 2006).

In Gaza Strip there are 24 hospitals , 12 of theme managed by MOH, 10 by NGOs and 2 private sector with a total beds 1917 in Gaza the registered refuges who served from UNRWA are 838,500(80% of total population). Served infants below 1 year are 36241, from 1-2 years 31964 with 63% regular attendance and 30531from 2-3 years and regular attendance 39%(UNRWA, 2009).

1.7 The health status in Palestine

The fiscal consequences of political developments in the (OPT) in 2006 have had an impact on the (MOH)'s budget, and consequently on the delivery of health services and programs. For instance, they affected its capacity to maintain a stock of pharmaceuticals and consumables, which negatively affect the health service delivery, to maintain in a state that can met the increase demand of the population. WHO estimate that more than 50% of women of child- bearing age suffer from anemia, 60% of children less than 2 years suffering from anemia, malnourished and stunted growth is prevalent (WHO, 2006). Hospital and medical-clinic services suffered greatly too. Most medical institutions relied on generators because of the power cuts, and the shortage of replacement parts and raw materials led to poor maintenance of medical equipment and physical infrastructure, Also, the closure created a shortage in personnel and in medical specialists, since Israel prevented medical staff from going abroad for in-service training and for improving their expertise (ILC, 2008).

1.7.1 Child health status

The coordination between MOH and UNRWA in vaccination programs, make it one of the most effective programs in the region (PCBS, 2006). Child health indicators

and their trends demonstrate the change of child health status over time. Infant mortality rates (IMR) are the most health indices that reflect socioeconomic level and status of a community. It helps the process of health surveillance and the evaluation of health programs. Countries set their health polices based on change of their health indices Infant mortality rate in Palestine scored 24 deaths per 1000 live births in 2005 reducing from 32.8 deaths/1000 live births in 1994. The mortality rate in Gaza strip (30.2 deaths/1000 live births) is higher as compared to West Bank (20 deaths/1000 live births) (PCBS, 2006). Crude birth rate was 27.5 per 1,000. Crude death rate was 2.7 per 1,000, prematurely and low birth weight accounted for 41.1% of the total deaths and congenital anomalies were responsible for 14.3 % (MOH, 2005). Anemia is highly prevalent amongst under 5 year olds across the region (Abu Hamad and Johnson, 2010).

Respiratory tract infections and diarrhea were responsible for 13.7% of the total infant mortality in Palestine (MOH 2005). About 27% of children who did during 2008 were not hospitalized due to increasing in difficulties facing the refuges to access hospitals (UNRWA, 2008).

Stunting and anemia are still very high among children, while acute malnutrition is low. Wasting level among children 6-59 month in 2006 was 1.2%, while stunting 13.2% and it's higher than the threshold level 10% that considered as a public health problem (WHO, 2009a).

Among Palestine refugee children in the Gaza Strip the prevalence of post-traumatic stress disorder after major traumatic experiences is high. Successive studies have highlighted the short-and long-term negative effects of the ongoing conflict on Palestinian children and including fear, bedwetting, difficulty in concentrating, eating and sleeping disorders, irritability, and increased antisocial behavior during adolescence and neurotic problems during adulthood (WHO, 2009b).

Post-traumatic stress and other psychological and behavioral disorders are an emerging health priority. The chronically harsh living conditions of Palestine refugees

coupled with long-term political instability, violence and uncertainty are taking their toll, in particular on children and adolescents (Qouta and El Sarraj, 2004).

1. 8 Operational definitions of terms

Anemia: the WHO defines anemia as (Hb) less than 11gm/dl (WHO, 1992).

Uptake: Entry of a substance into the body, into an organ, into a tissue, into a cell, or into the body fluids by passage through a membrane or by other means (NLM, 2009).

Aluminum: Aluminum metal is light in weight and silvery-white in appearance, and used for beverage cans, pots and pans, and other industrial products (ATSDR, 2008).

Aluminum cookware: any kitchen utensil made of aluminum metal used for cooking or saving foods.

Small clinic: The clinic which is in one shift and its staff less than50 employee.

Large clinic: The clinic which is in two shifts and its staff more than50 employee.

Knowledge: The state or condition of understanding that fact or subject and being able to apply it (UNICEF, 2010).

Bad quality ALC: That kind of AL utensils with changes in its hardness, smoothness, and difficulty in cleaning.

Leaching: To remove (nutritive or harmful elements) from substance by percolation (Merriam-webster, 2010)

Chapter 2: Literature Review

2.1 Conceptual Framework

In this chapter, the researcher draws ideas extracted from different factors which affecting the relation between anemia and using of AlC, which have been incorporated into the study conceptual framework.

A conceptual model is described as an attempt at organizing and donating a symbolic representation of conceptualization of phenomena with the minimal use of words (Burns and Grove, 1997). Frame work is the conceptual under pining of a study and used to guide and direct the research process and to make research finding more meaningful and generalizable. Also, frame work is efficient mechanisms for drawing together and summarizing accumulating facts as shown in the figure.

There are many factors related to AL uptake from using AlC specially bad quality AlC, the quality of the utensils, food processing, and the nature of the food, and the other factors which play a role in choosing the type of utensils, like knowledge about the hazardous effect of using Al practically bad quality AlC, socioeconomic situation, and education.

2.1.1 Component of the conceptual framework

2.1.1.1Anemia

The World Health Organization (WHO) defines anemia in childhood as a Hb concentration below 11g/dL (WHO, 2007).

2.1.1.1.1 Iron deficiency anemia

ID is the result of long-term negative iron balance**,** Because anemia is the most common indicator used to screen for iron deficiency, the terms anemia, iron deficiency, and iron deficiency anemia are sometimes used interchangeably (WHO, 2001).

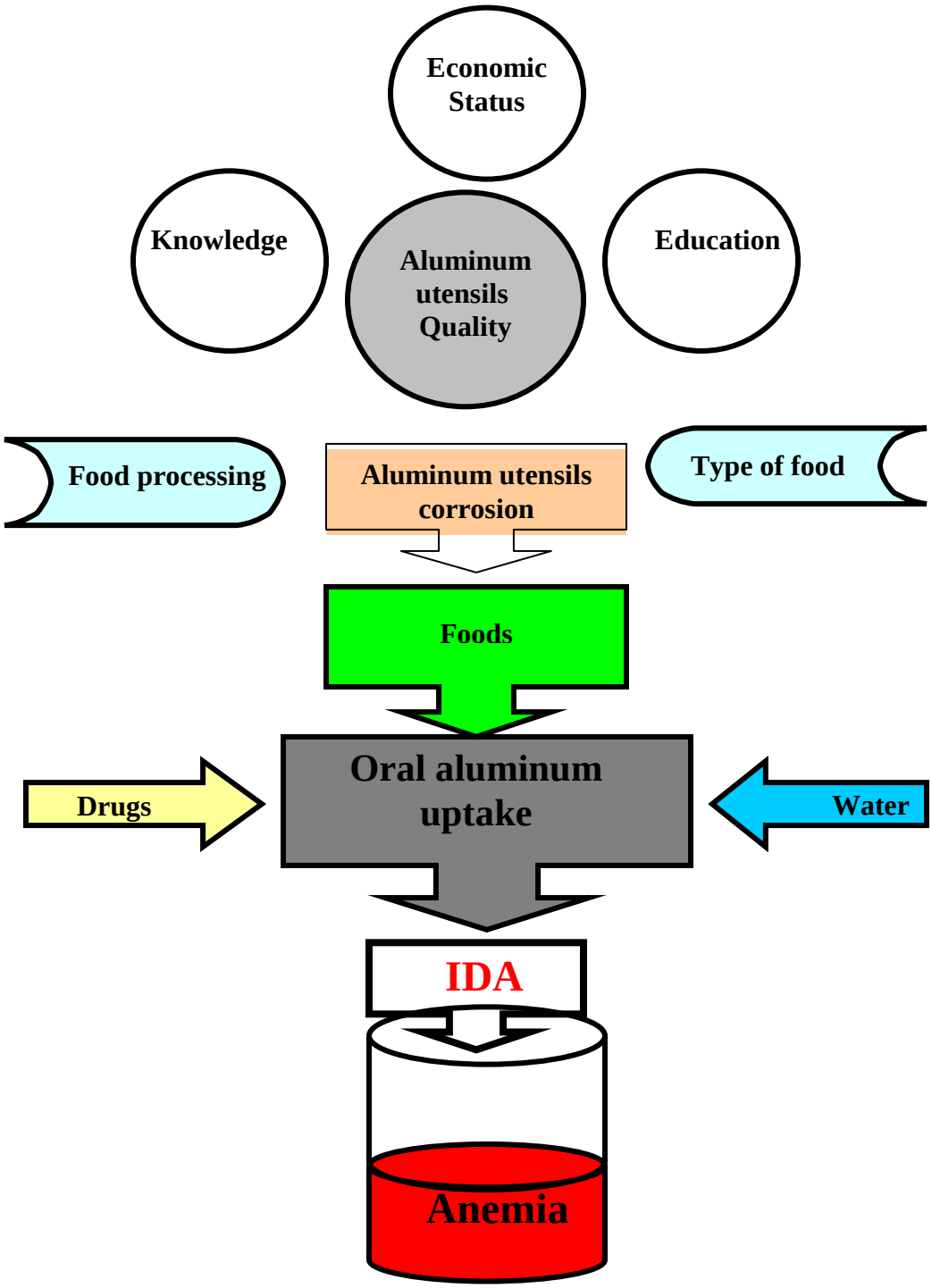

Figure 2.1: Conceptual framework

2.1.1.2 Aluminum oral uptake

2.1.1.2.1 Water

Most surface water treatment plants use Al in the form of Al (Al sulphate) to help remove harmful waterborne microorganisms and other particles by causing them to clump together (coagulate) into larger particles that are then easily removed by sedimentation and filtration, the intake of Al in drinking water generally amounts to less than 5% of the total daily intake for an adult (Health Canada, 2007).

2.1.1.2.2 Drugs

Drugs like internal analgesics (buffered aspirins), anti-ulcerative medications, antidiarrheals, and antacids that also contain Al compounds will result in exposure to Al, Al-containing medications contain much higher levels of Al, for example 104–208 mg of Al per tablet/capsule/5 mL dose for many antacids (Zhou, & Yokel, 2005).

2.1.1.2.3 Food

Al occurs naturally in many foods, but usually only in low concentrations. The tea plant is an exception, as it accumulates large amounts of Al, which can then leach from the tea leaves into brewed tea. Al can also leach into food from cookware, utensils and wrappings. Certain foods, such as dairy products, grains, desserts and beverages, may contain levels of Al that are higher than naturally-occurring background levels owing to the use of Al compounds (e.g., sodium Al phosphate) as food additives (Health Canada, 2007).

2.1.1.3 Aluminum cookware corrosion

2.1.1.3.1 Food processing

Al leaching depends on pH, solution composition and concentration, temperature, and Al alloy composition, and Using of AlC may leach significant amounts of Al into the diet, which raise the amounts of Al to high levels (Al-Juhaiman, 2007).

2.1.1.3.2 Type of food

Food that has been cooked or stored in Al pots and Al foil; more Al is leached into acidic foods. Estimates say that as much as 4 milligrams of Al can be transferred to each serving of an acidic food such as tomatoes or citrus fruits that have been heated or stored with Al (Greger, *et al*., 1985).

2.1.1.3.3 Al utensils quality

Utensils and packaging materials made of low quality Al are not safe for cooking and storage of acid foods (pH - 5.0); utensils and packaging materials made of high quality Al are safe for cooking and storage of foods (Rao, & Rao, 1995).

2.1.1.4 Socioeconomic factors:

2.1.1.4.1Family income

Family income plays an important role in choosing the type and quality of AlC, according to its cost

2.1.1.4.2Knowledge

Knowledge about the hazard of using AL utensils may play a role in choosing the type and quality of utensils.

2.1.1.4.3Education

The level of education may be may play a role in choosing the type and quality of utensils.

2.2Literature Review

In this chapter, the researcher presented the reviewed literatures regarding anemia and its causes, sourer of Al exposure, and the relation between Al uptake and different health adverse affects particularly anemia.

2.2.1Anemia

Anemia is a global public health problem affecting both developing and developed countries with major consequences for human health as well as social and economic development. It occurs at all stages of the life cycle, but is more prevalent in pregnant women and young children (WHO, 2002).

Anemia develops slowly after normal stores of iron have been depleted and as results Hb levels are low. Hb is an oxygen-carrying constituent built into the red blood cells. Since the red blood cells are responsible for delivering oxygen to other cells in the body, any problem with the oxygen delivery system will result in the body struggling to work properly (Nancy, *et al.*, 2002).

The most significant contributor to the onset of anemia is ID. Although the terms ID and IDA are used as synonymous they are not the same condition. ID occurs when there is a long-term negative iron imbalance and anemia is the most severe stage of this deficiency (WHO, 2001), but some researcher considered the two conditions as the same.

2.2.1.1 Definition

Anemia is defined as a pathological process in which Hb concentration in red cells is abnormally low, considering variations as to age, gender, sea-level altitude, as a result of several situations such as chronic infections, hereditary blood conditions, deficiency of one or more essential nutrients that are necessary for the formation of Hb e.g.: folic acid, B12, B6 and C vitamins, and proteins (UNRWA, 2001). WHO defines anemia as Hb less than 11gm /dl (WHO, 1992).

IDA diagnosed by measuring the Hb concentration. Other tests that measure iron stores such as serum Ferritin and Transferrin saturation are of little clinical significance. Hb ranging between 10.9 g/dL and 10.0 g/dL considered mild anemia, while 9.9 g/dL to 7.0 g/dL as moderate anemia and below 7.0 g/dL considered as sever anemia (UNRWA, 2001).

2.2.1.2 Etiology of anemia

Anemia is the result of a wide variety of causes that can be isolated, but more often coexist. Globally, the most significant contributor to the onset of anemia is ID so that IDA and anemia are often used synonymously, and the prevalence of anemia has often been used as a proxy for IDA. It is generally assumed that 50% of the cases of anemia are due to iron deficiency (WHO, 2001), but the proportion may vary among population groups and in different areas according to the local conditions. The main risk factors for IDA include a low intake of iron, poor absorption of iron from diets high in phytate or phenolic compounds, and period of life when iron requirements are especially high (i.e. growth and pregnancy). Among the other causes of anemia, heavy blood loss as a result of menstruation, or parasite infections such as hookworms, Ascaris, and Schistosomiasis can lower blood Hb concentrations. Acute and chronic infections including Malaria, Cancer, and Tuberculosis, can also lowering Hb concentrations. The presence of other micronutrient deficiencies, including vitamins A and B12, Folate, Riboflavin, and Copper can increase the risk of anemia. Furthermore, the impact of haemoglobinopathies on anemia prevalence needs to be considered within some populations (Benoist, *et al*., 2008).

In low-birth weight infants or those with perinatal blood loss, stored iron may be depleted earlier and dietary sources become of paramount importance. In term infants, anemia caused solely by inadequate dietary iron is unusual before 6 months and usually occurs at 9–24 months of age. Thereafter, it is relatively infrequent. The usual dietary pattern observed in infants with iron-deficiency anemia is consumption of large amounts of cow's milk and of foods not supplemented with iron (Behrman, *et al*., 2003).

Infants, children and adolescents require iron for expanding their red cell mass and growing body tissue. Iron requirements for infants and children are lower than that for adults. But since they have lower total energy requirements than adults, they eat less and are at greater risk of developing iron deficiency, especially if their dietary iron is of low bioavailability (UNRWA, 2001)

Although the cause of a anemia mong young children can be multifactorial, the consumption of foods with low bioavailable iron is likely the primary contributing factor. In industrialized countries, the prevalence of anemia among children has been greatly reduced with the advent of fortified foods, such as iron-fortified infant cereals, specifically targeted toward children (Christofides, *et al*., 2005).

In many populations, the amount of iron absorbed from the diet is not sufficient to meet many individual's requirements. This is especially likely to be true during infancy, pregnancy, and postpartum, when physiological iron requirements are the highest, so it is necessary that if the amount of absorbable iron in the diet cannot be immediately improved, iron supplementation will be a necessary component of programs to control IDA (UNICEF, *et al.*, 1998).

Body iron can be considered as having two main components, functional iron and storage iron. The functional component is found largely in the circulating Hb. The storage component is found as Ferritin and Haemosiderin in the liver, spleen and bone marrow. A deficiency of iron in the functional component does not occur until stores are exhausted .Iron stores diminish due to imbalance between iron absorption and the body's needs. Such an imbalance can arise from low iron intake, or inadequate absorption/utilization of ingested iron, or increased demand (UNRWA, 2001).

2.2.1.3 Risk group of IDA

Women of childbearing age, particularly pregnant women, postpartum, nursing mother,adolescents, Infants and pre-school children are at greatest risk of developing anemia. Some studies showed that preschool children are more severely affected than

women, with reported prevalence in many countries of more than 60%. Only a few countries report data from school-age children; values range from 32% in Bahrain to 78% in Oman (Verster, &Pols, 1995).

Adolescents and school age children are also vulnerable groups, and an estimated 37% of school age children are affected. Adolescent pregnancies are common in developing countries and anemia is one of the serious health problems for the girls (Brabin, *et al*., 1998).

There is an estimate that 25% of the world population is affected by iron deficiency; the population groups which are most affected is infants aged between 4 and 24 months, school age children, female adolescents and pregnant women (Yip, 1999).

2.2.1.4 Consequences of anemia

Anemia is a silent killer and it deprives people of vitality, productivity, earning capacity, the ability to learn, and makes them more susceptible to infections (WHO, 2007). In addition anemia can be considered as an indicator of both poor nutrition and poor health. The most dramatic health effects of anemia, i.e., increased risk of maternal and child mortality due to severe anemia, in addition, the negative consequences of anemia on cognitive and physical development of children, and on physical performance particularly work productivity in adults – are of major concern (WHO, 2001).

Anemia causes impairment of body functions. In children, this condition has been associated with child development retardation, compromised cellular immunity and reduced intellectual capacity. An important consequence of anemia is an apparent increased risk of heavy-metal poisoning in children. Iron-deficient individuals have an increased absorption capacity that is not specific to iron. Absorption of other divalent heavy metals, including toxic metals such as lead and Cadmium, is also increased (Masawe, *et al.*, 1978).

Anemia generally develops slowly and is not clinically apparent until anemia is severe though deficiency in functional iron exists. During infancy and childhood the impaired motor development and coordination can be developed, also impaired language development and scholastic achievement and psychological and behavioral effects can as consequences of anemia in addition to decreasing the physical activity of the child. While during adolescents anemia can caused imperilment in cognitive development, imperilment in scholastic achievement and decreasing work capacity and productivity (UNRWA, 2001).

In adult anemia decreased physical work and earning capacity and decreased resistance to fatigue. For Pregnant women, increased maternal morbidity and mortality, increased foetal morbidity and mortality, increased risk of low birth weight, increased intrauterine growth retardation, increased peri-natal mortality, increased morbidity from infectious diseases(UNRWA, 2001).

Young children between six and 24 months of age are at greatest risk for IDA due to their high dietary iron requirements during this period of rapid growth and limited access to iron-containing foods. In children, IDA has a significant impact on motor, cognitive and socioemotional development that may not be reversible (Grantham, & Ani, 2001)

2.2.1.5 The prevalence of anemia

The prevalence of anemia due to ID is hardly ever directly estimated because specific indicators of iron stores in the body (serum ferritin, saturation of transferrin, zinc protoporphyrin, and receptors of serum transferrin) are more difficult to be measured than Hb levels. However, the prevalence of IDA can be estimated assuming that about 90% of anemia cases are due to ID (WHO, 2001).

2.2.1.5. 1 Global anemia magnitude

Anemia is a major public health problem world-wide. WHO rates ID as one of the top ten causes of mortality and disability adjusted life years lost globally (WHO, 2001). ID continues to be the leading single-nutrient deficiency in the world, affecting the lives of more than 2 billion persons despite considerable efforts to decrease its prevalence for the past 3 decades (WHO, 2004). Many of these affected individuals live in the developing world, it estimated that around 30% of the world populations are affected (Massawe, 2002; World Bank, 2004).

Globally, anemia affects 1.62 billion people, which corresponds to 24.8% of the population. The highest prevalence is in preschool-age children (47.4%), the lowest prevalence is in men (12.7%), in school –age children 25.4%, in pregnant women 41.8%, in non-pregnant women 30.2%, and in elder 23.9%. WHO regional estimates generated for preschool-age children and pregnant and non pregnant women indicate that the highest proportion of individuals affected are in Africa (47.5–67.6%), while the greatest number affected are in South-East Asia where 315 million (Benoist, *et al*., 2008).

Prevalence of anemia in developing countries is relatively high (33% to 75%) (Cyril, 2005), The prevalence of anemia was estimated in America 30%, Asia 44%, Europe 11%, North America 10% and Oceania 70% (Scrimshaw, *et al*., 1998). In sub-Saharan Africa, the prevalence of iron-deficiency anemia is estimated around 60 % (Ojukwu, *et al*., 2007).

ID remains the most common preventable nutritional deficiency in the world, despite continued global efforts to control it. The latest WHO and United Nations Children's Fund (UNICEF) estimates suggest that the number of children with ID and anemia is approximately 750 million (UNICEF, 2005).

In Cambodia anemia remains a major public health problem a study conducted estimate that approximately 50% of anemia is caused by iron deficiency. The prevalence

of anemia remains high among women and children, with 47% of women of reproductive age anemic and 57% of pregnant women anemic (CDHS, 2005).

In Brazil, population-based studies show high prevalence of anemia ranging between 30% and 60%. The study showed that 30.2% of the children studied had anemia, and this condition was inversely associated to age and family income, which indicates a role of social inequalities in the development of anemia (Assunção, *et al*., 2007).

In India the over all prevalence of anemia was 60% -90%, regarding children 66.4% was anemic, there was no statistically significant difference between the males and females regarding anemia prevalence, while the prevalence was higher in children in young children(6-35months) than old children(6-11 years) (Sethi, *et al.*,2003).

In Canada and the United States, approximately 5% of children from one to five years of age suffer from ID and anemia compared with 40% to 50% of children in non-industrialized countries (Zlotkin, *et al*., 1996).

2.2.1.5. 2Regional anemia magnitude

According to world wide prevalence of anemia 1993-2005 report the prevalence of anima in EMR was 46%in preschool-age children, 44% in pregnant women, and 32% in non pregnant women (Benoist, *et al*., 2008). A nutrition survey was performed among Palestinian refuge(in Syria, Jordan, Lebanon, Gaza, West Bank) children aged 6-35 months reveled that, the over all anemia prevalence was 67%, in Jordan 57%, Syria 75%and in Lebanon 70% (Hassan, *et al.*, 1997).

2.2.1.5. 3 locally anemia prevalence

In 1998, UNRWA conducted a study to assess the quality of child health care which revealed that the prevalence of anemia among children 0-3 years of age was 35.9% in Jordan, 49.7% in the West Bank, 74.9% in Gaza, 29.6% in Lebanon and 28.0% in

Syria. In 1998, the results of nutritional survey in Gaza Strip revealed that IDA was still high among high-risk groups, namely infants, preschool children and pregnant women. This suggests that in spite of the interventions that the Agency had, so far, undertaken, iron-deficiency anemia IDA, still represents a major public health problem (UNRWA, 2001).

A study conducted by UNRWA's Department of Health in 2006 revealed that the prevalence of anemia among pregnant women was 44.9% in the Gaza Strip and 31.1% in the West Bank, while prevalence of anemia among children 6 to 36 months of age was 57.5% in the Gaza Strip and 37.1% in the West Bank, a sharp increase from 54.7% and 34.2% respectively, as observed in the 2004 survey (WHO, 2007). Another study shows that the prevalence of anemia among children less than 2 years un Gaza strip was 72.8% (Radi, 2009).

A nutrition survey was performed among Palestinian refugee children aged 6-35 months reveled that, the over all anemia prevalence was 67%, in Gaza 72%, in West Bank 54%, Anemia prevalence was higher in low mother education level, stunting and never had been –breast feed (Hassan et al, 1997).

A cross-sectional study was conducted to examine the impact of socioeconomic conditions and intestinal parasitic infection on hemoglobin level among children aged 2-15 years in Um-Unnasser village, Gaza revealed that .25% of children were anemic and the prevalence was higher in children aged below six years (Al-Zain, 2009).

2.2.1.6Anemia assessment

The concentration of Hb is the most reliable indicator of anemia at the population level, as opposed to clinical measures which are subjective and therefore have more room for error. Measuring Hb concentration is relatively easy and inexpensive, and this measurement is frequently used as a proxy indicator of iron deficiency (Benoist, *et al*., 2008).

2.2.1.7 Strategies for the prevention and control of iron deficiency

The prevention and control of anemia is an important component of the treatment and care and contributes to slowing the progression of many diseases and reduce morbidity and mortality (Shigeru, 2005). The four basic approaches to the prevention of iron-deficiency anemia are dietary change and diversification to increase iron intake; supplementation with medical iron; fortification of a suitable staple food with iron; and the control of infection through public health activities (UNICEF, 1998).

Fortification has been successful in developed countries and is the most direct approach to eliminating micronutrient deficiencies. Developing countries can learn from the developed countries in this respect. In the USA, two-thirds of the recommended daily allowance for iron comes from fortified foods. Universal fortification avoids the compliance problem and makes the programs sustainable (WHO/EMERO, 2000).

2.2.1.7.1 Strategy for treatment and prevention of IDA in UNRWA

Early detection of anemia cases among risky groups is one of the most important component of the UNRWA strategy in prevention and treatment of anemia. For that all pregnant women, at time of first registration and at 24 weeks of gestation, pregnant women and Nursing mothers must be screened for anemia.

Also all children at the age of 12 months screened for anemia as a routine measure using the Hb concentration test, in addition to that infants at 6 months age with special conditions (Pre-term or low birth weight, Growth-retardation, Special care needs such as: chronic infection, inflammatory disorders, restricted diets, or extensive blood loss from wound, accident or surgery) must be assess for anemia.

After one month of treatment with iron supplementation Hb measurement must be performed, if Hb concentration improves, reinforce dietary counseling, continue iron treatment for 2 more months, then recheck Hb concentration. Reassess Hb concentration approximately 6 months after successful treatment is completed (UNRWA, 2001).

2.2.2 Aluminum (background)

Al is an environmentally abundant element to which we are all exposed. It is, like oxygen, cannot be avoided. Al is the third most abundant element in the earth's crust (8% of the earth's crust) and is widely used in the production of medicines, cooking and storage utensils. It is also used in food additives, water purification and in industry. Although Al is abundant in nature, it has no known biochemical role, but in the last decade, Al toxicity and its effect have been given increased attention. Recently, there has been evidence that it can be a potent neurotoxic agent to humans and has been regarded as a factor in human disorders of the nervous system (Zatta, 2000) and in iron adequate microcytic anemia (Suwalsky, *et al*., 2000).

2.2.2.1 Aluminum uptake

With the industrialization and consequent pollution, Al is increasingly taken into our bodies through foods, water, and even drugs. Al present in many manufactured foods and added to drinking water for purification purposes (Nayak, 2002).

Since Al is ubiquitous in the environment, the general population will be exposed to Al by the inhalation of ambient air and the ingestion of food and water, Al and its compounds are often used in food as additives which is major sources of Al in the diet (Saiyed, & Yokel, 2005), in drugs like internal analgesics (buffered aspirins), anti-ulcerative medications, antidiarrheals, and antacids that also contain AL compounds will result in exposure to AL, in consumer products (e.g., cooking utensils and Al foil), in antiperspirants, cosmetics, and in the treatment of drinking water (e.g., coagulants). The intake of Al from food and drinking water is low, especially compared with that consumed by people taking AL-containing medicinal preparations.

Daily intakes of Al from food range from 3.4 to 9 mg/day (Biego, *et al*., 1998), whereas Al-containing medications contain much higher levels of Al, for example 104–208 mg of Al per tablet/capsule/5 mL dose for many antacids (Zhou, & Yokel, 2005).

While Al is naturally present in food and water, the greatest contribution to Al in food and water by far is the Al-containing additives used in water treatment and processing certain types of food such as grain-based products and processed cheese. Al has no known physiological role in the human body (Nayak, 2002). The Al content of human breast milk generally ranged from 9.2 to 49 μ g/L (Fernandez-Lorenzo, et al., 1999)Soy-based infant formulas contain higher concentrations of AL, as compared to milk-based infant formulas or breast milk. Recent reports provide average AL concentrations of 460–930 μg/L for soy-based infant formulas and 58–150 μ g/L for milk-based formulas (Ikem, et al., 2002; Navarro-Blasco, &Alvarez-Galindo, 2003).

Although AL is generally very poorly absorbed in the gastrointestinal tract for healthy individuals, its bioavalability depends on the chemical species of AL ingested and it is markedly enhanced by some food additives like citrate, tartarate and glutamate (Rengel, 2004).

2.2.2.2 Aluminum Sources

Al can be found in different products which may be considered as essential component of modern life; some of these products are medical and may be descried as over counter medications (buffered aspirin, antacids….) for example antacids contain 300–600 mg aluminum hydroxide (approximately 104–208 mg of aluminum) per tablet/capsule/5 mL dose (Zhou, & Yokel, 2005), and personal care products (antiperspirants, deodorant “crystals,” douche, toothpaste). Aluminum compounds are also used extensively in the manufacture of cosmetics (e.g., aluminum hexahydrate in deodorants) and in medical treatments (e.g., aluminum hydroxide in antacids to control gastric hyperacidity or aluminum oxide in dental ceramic implants). The other types of medications are intravenous fluids and vaccines (which contain Al hydroxide, Al phosphate, or Al sulfate) (FDA, 2002).

Beverages in Al containers includes virtually all canned sodas, beers and tea also contained considerable amount of Al. Food that has been cooked or stored in Al pots and Al foil polluted by Al, some factors affected corrosion from pots of foil into foods some

of them is acidity, that more Al is leached into acidic foods. Estimates say that as much as 4 milligrams of Al can be transferred to each serving of an acidic food such as tomatoes or citrus fruits that has been heated or stored with Al (Health Canada, 2007).

Food additives also are an important sources of Al, sodium Al phosphates (baking powder) and anti-caking agents. They are added to cake mixes, frozen dough, pancake mixes, self-rising flours, processed cheese and cheese foods. One of the most dangers sources of Al is Soy-based infant formula which may contain higher levels of AL as compared to milk-based infant formulas and breast milk. Drinking water has considerable amounts of Al which used in clarifying drinking water and buffered water. Food plants and animals that are exposed to Al. It is believed that Al is not accumulated to a significant extent in most plants or animals and it is not expected to undergo bio-magnification (Pfeiffer, 1978).

2.2.2.3 Health effect due to Aluminum exposure

Although the biological effects of Al are not well known, under experimental condition it has been shows that Al accumulates in kidney, stomach, brain, bone and liver (Dlugaszek, *et al*., 2000).

Al is considered a potentially toxic metal, and Al poisoning may lead to three types of disorders: Al-induced bone disease, microcytic anemia and encephalopathy. This is well known in patients with chronic renal failure, but since healthy subjects with normal renal function retain 4% of the Al consumed, they are also at risk of long-term low-grade Al intoxication (Hellström, *et al*., 2005).

Excess Al consumption has been postulated as a precipitating factor in AIzheimer's disease, microcytie anemia, senile dementia and bone disorders (Salusky, *et al*., 1991; Yumoto, *et al*., 1992).

In the human body, Al ions could inhibit different metabolism process caused by competitive on reaction s between Al and other ions such as calcium, magnesium or iron(Macdonald, & Martin, 1988).

2.2.2.3.1 Neurological Effects

Alzheimer's disease is a neurodegenerative disorder, which manifested clinically as a progressive deterioration of memory and cognition. The possible association between Al and Alzheimer's disease was proposed over 40 years ago; however, the evidence that Al may or may not be a risk factor is inconsistent and inconclusive. A number of lines of evidence have been used to support the relationship between Al and Alzheimer's disease (Flaten, 2001). Different studies examine the relation between Al and Alzheimer's disease, a number of these studies have found significant associations between individuals living in areas with elevated Al levels in drinking water and the prevalence of Alzheimer's disease (Gauthier, *et al*., 2000; Rondeau, *et al*., 2001).

Study in North Carolina USA, found that there is a strong relation between there concentration of AL level in children hair and the decrease in children motor performance (Marlowe, 1992). Several studies did not find significant associations between AL exposure and the risk of Alzheimer's disease (Martyn, *et al*., 1997). AL has for long been known as a neurotoxic agent, and has been responsible for causing oxidative stress within brain tissue (Zatta, *et al*., 2003)

2.2.2.3.2 Musculoskeletal Effects

Study in Sweden examine the relation between age and accumulation of Al a in bone in 172 patient aged between 16 and 98 teas old and also investigate whether the Al content of bone differs between controls and hip fracture cases with and without dementia, in particular in those with Alzheimer's disease, the study found an exponential increase in AL content of bone with age. The average Al values, adjusted for age, were similar in men and women, and no significant differences in sex- and age-adjusted mean Al values between the controls and the hip fracture cases with and

without dementia could be detected. The average Al concentration among cases with Alzheimer's disease was also similar to the values of hip fracture patients with other types of dementia. The final results of the research indicate that human accumulate Al in bone over life span, but this does not seem to be of major pathogenetic significance for the occurrence of hip fracture or dementia (Hellström, *et al*., 2005).

But anther study in Pakistan found that aluminium has toxic effect on bone mineralization on male Sprague-Dawley rats (Zafar, & Weavert, 1999**).**

Impairment of renal function may be decrease the urinary excretion of Al, and increased the gastrointestinal absorption of Al results in increased Al body burden leading to markedly increased bone Al levels and the presence of Al between the junction of calcified and non calcified bone(Alfrey, 1993).

Al though healthy individuals do not normally accumulate Al. Al toxicity is enhanced by calcium deficiency, while a small increase in aluminum intake has been reported to decrease the calcium concentration in bones. Moreover calcium deficiency stimulates Al intestinal absorption as well as its mobilization and deposition in the bone, a moderate increase in Al intake also increases serum Al concentrations and decreases parathyroid hormone concentrations in calcium-deficient rats (Boudey, 1997).

According to Bangladeshi study, which examine the effect of consuming of foods cooked in Al or stainless- steel pots on children calcium – deficient rickets, there were no significant relation between cocking in AL pots and rickets and the researcher impute the role to socio-comical and notational factors(Cimma, *et al*. , 2004)

2.2.2.3.3 Hematological effects

Different studies aim to explore the relationship between anemia and Al exposure, but no consensus has been reached among the results. Several studies have shown that Al can adversely affect erythropoeisis. Intermediate-duration exposure has been associated with significant inhibition of colony forming units-erythroid (CFU-E) development in

bone marrow of mice exposed to 13 mg Al/kg as Al citrate or Al chloride administered via gavage 5 days/week for 2 or 22 weeks (Garbossa, *et al*., 1996), rats exposed to 27 mgAl/kg as AL citrate administered via gavage 5 days/week for 15 weeks (Garbossa, *et al*., 1998).

Repeated exposure to Al appears to adversely affect the hematological system of rats and mice. Significant decreases in hemoglobin, hematocrit, and/or erythrocyte osmotic fragility were observed in rats exposed to 420 mg Al/kg/day as Al citrate in drinking water for 15 weeks (Garbossa, *et al*., 1998). Exposure to lower concentrations or for shorter durations resulted in no significant damage to the erythrocytes. (Garbossa, *et al*., 1996).

In Türgut study, which aimed to investigate the change in iron level metabolism related parameters in liver and blood of chronic exposure to AL in mice, found that there were significant decreased in Hb and Ht in Al exposured group with comparing to control group(Türgut,*etal*.,2004).

Al can alter mature erythrocyte morphology; anisocytosis (abnormal variations in cell size), anisochromia (unequal degree of cell staining), and poikilocytosis (abnormal variation in cell shape) have been observed in rats exposed to 230 mg Al/kg/day as Al citrate in drinking water for 8 months (Vittori, *et al*., 1999).

Al overload is a frequent cause of renal anemia. It may present in several stages as a hypochromic, microcytic anemia but in less severe cases can be normochromic and normocytic. Al is toxic to erythropoiesis**,** It inhibits heme synthesis, interacts with iron metabolism, disturbs cell metabolism and membrane function and impairs bone marrow sensitivity to erythropoietin (Grutzmacher, 1991).

Unfortunately no studies were located regarding hematological effects of various forms of Al following acute, intermediate, or chronic duration exposure in humans after

oral exposure to Al or its compounds, but different studies on animals was conducting to study the relation between anemia and exposure to Al.

There is some evidence that Al may affect iron levels in blood; however, this has not been well studied and the results are not consistent across studies. Vittori, *et al*. did not find significant alterations in plasma iron levels or total iron binding capacity in rats exposed to 230 mg Al/kg/day as AL citrate in drinking water for 8 months; however, impaired iron uptake and decreased iron incorporation into heme were measured in bone marrow cells (Vittori, *et al.,* 1999).

But Farina, *et al*., found significant decreases in blood iron concentrations and no change in total iron binding capacity in rats exposed to 54.7 mg Al/kg/day as Al sulfate in a sodium citrate solution in drinking water for 18 months (Farina, *et al*., 2005). Florence, *et al*. reported decreases in serum iron levels, total iron binding capacity, and transferring saturation in rats exposed to 75 mg Al/kg/day as Al citrate in the diet for 6 months; however, the statistical significance of these findings was not reported (Florence *et al*., 1994).

Al might exert its toxic effects by using mechanisms which control iron homeostasis e.g. using transport proteins such as transferring, or interfering with iron homeostasis at the level of iron regulatory proteins (Ward, *et al*., 2001). Al induced anemia can be resulted from increasing the erythrocyte fragility, which may be due to Al oxidative effect (Sibmooth, *et al*., 2000).

Al has a direct effect on hematopoiesis (the development of blood cells) inducing microcytic anemia (resulting of hemoglobin synthesis failure or insufficiency (Becaria *et al.,* 2006).

2.2.2.4 Aluminum cookware leaching

Al pots leach Al into foods, with release depending on Al quality and food constituents used (Rao, & Rao, 1995). Besides the Al present in foods per se, humans

may also be exposed to additional AL contributed by cooking utensils and storage and packaging containers made of AL (Lione, 1983). Indian study indicates that utensils and packaging materials made of low quality AL are not safe for cooking and storage of acid foods (pH - 5.0). Furthermore, these utensils are not safe for use for cooking in geographical regions with F- rich water. However, utensils and packaging materials made of high quality Al are safe for cooking and storage of foods (Rao, & Rao, 1995).

Al-Juhaiman indicated that Al leaching depends on pH, solution composition and concentration, temperature, and Al alloy composition, and Using of Al cookware may leach significant amounts of Al into the diet, which raise the amounts of Al to high levels. This may exceed the allowed amounts by (WHO) and may be dangerous to the elderly and people with kidney problems (Al-Juhaiman, 2007).

During preparing and storage of foods, Al foil is often used fro warping heat-sensitive food for protection against direct heat, the results shows that some Al migrated from Al foil into food , this migration depends on several factors e.g. the duration and temperature of cooking, the PH value of foods, the presence of other substances (salts, citrus, spices) and complexing reactions that result in dissolution of the complexed metal, these amounts of Al didn't exceed the suggested provisional tolerable daily intake of 1 mg Al/kg per day , so the study suggested that no health risk in consuming foods prepared in Al foil(Ranau, *et al*., 2001).

Al migration from cans to tea was studied along time. Analyses of Al in the canned drinks were performed till the sell-by date, and, in seven months, Al migration was found to increase 0.6 mg L−1 in tea, Al migration into tea was found to be particularly severe and Al concentration in dented canned tea increased 9.6 mg L−1 in seven months(Marta, 2008).

Cooking foods in aluminum pots and pans or storing foods in aluminum foil or cans may increase the aluminum content in some foods since aluminum may dissolve when in contact with a salty, acidic, or alkaline food (Abercrombie, & Fowler, 1997).

Acidic foods, such as tomatoes, tomato sauce, and applesauce, especially when cooked for >15 minutes, tended to accumulate more Al than other foods, foods cooked in new AlC or AlC that had been treated to simulate use. In addition, the Al concentrations in the foods prepared in any AlC (old, new, or treated to simulate use) had higher Al concentrations than the same foods cooked in stainless steel cookware. (Greger, *et al*., 1985).

In evaluation of the effect of cooking on Al contents on meats (beef, water buffalo, mutton, chicken and turkey) baked in Al foil, its observed that, cooking increased the Al concentration of both the white and red meats, it was also found that raw chicken and turkey breast meat contained higher amounts of Al than the raw chicken and turkey leg meat, respectively. Regarding the suggested provisional tolerable daily intake of 1 mg Al/kg body weight per day of the FAO/WHO Expert Committee on Food Additives, there are no evident risks to the health of the consumer from using Al foil to cook meats. However, eating meals prepared in Al foil may carry a risk to the health by adding to other Al sources (Turha, 2006).

2.2.2.5 Detecting of Al

All people have small amounts of Al in their bodies. It can be measured in the blood, bones, feces, urine, hair, soft tissue and breast milk. A variety of analytical methods have been used to measure aluminum levels in biological materials, including atomic absorption spectrometry (Maitani, *et al.*, 1994), or chemical method by using spectrophotometer in wave length 495 nm (Ghori, & Yaqub,1999).

2.2.2.6Aluminum Serum Level

The Commission of the European Community (CEC) recommended that, the normal SAL is < 10 µg/L (0.37 µmol/L), while > 60 µg/L (2.22 µmol/L) considered as excessive accumulation of AL and if the SAL reach > 100 µg/L (3.70 µmol/L) it is a highly risk of toxicity in children, but if the SAL exceed 200 µg/L (7.41 µmol/L) urgent

action must be done in order to protect the children from a high of the toxicity of Al (CEC, 2006).

In Saudi study done at Riyadh City, the mean of Al concentration was 23.21 μg/L (range 5.98–206.93 μg/L) the samples collected form 533 female children (6–8 years old), the study founds that renal variables has no correlation with SAL, factors like drinking water , diet and use of AlC may have contributed to study results (Al-Saleh, & Shinwari, 1996).

Hawkins *et al.* study indicated that plasma aluminum concentrations in infants fed various formulas and breast milk, the mean plasma aluminum concentration of 8.6 μg/L was reported in breast fed infants; mean aluminum concentrations in plasma of infants fed various formulas ranged from 9.2 to 15.2 μg/L. Mean aluminum plasma concentrations of 9.9, 8.4, and 13.4 μg/L in breastfed infants at birth, 1 month, and 3 months of age, respectively(Hawkins et al, 1994). Infants on soy-based infant formulas, containing 1,600– 1,700 μg/L of Al, were reported to have mean Al plasma concentrations of 8.2–12.4, 7.6– 8.5, and 10.8–12.4 μg/L at birth, 1 month, and 3 months of age, respectively (Litov, *et al*., 1989).

Other researcher declared that the mean concentrations of SAL in healthy individuals may range up to 10 μ g/L (Minoia, et al., 1990), and may there for be an order of magnitude higher than some of the transition elements. Urinary levels may be in the upper part of this concentration range (Wang, *et al.,* 1991). Values are much higher in dialysis patients. Whereas values of 100 μ g/L are well tolerated by some patients, others develop symptoms that may be attributable to A1 at levels as low as 30 μ g/L, the "warning level" is generally 60 μ g/L (Day, 1990).

Ghori and Yaqb studied 40 normal healthy individuals in Pakistan, it was founded that SAL range was 92.9- 243.5 μg/ L, and 20% of individuals had SAL level in toxic level more than 100 μ g/L, without association with age or gender, also the study founded that using AlC and Al preparations to combat gastric acidity were the major cause of the toxicity (Ghori ,&Yaqb, 1999).

Chapter 3: Methodology

This chapter describes the study methodology, study design, type of study sample , study population and ethical issue considered, as well as , it presents the study instruments and its validity, data collection process, data processing and analysis . Finally, it presents selection criteria.

3.1 Study Design

A descriptive, quantitative, analytic, cross sectional design was chosen in order to explore the relation between anemia and using bad quality ALC ,and to achieve other research objectives. Cross sectional design w chosen because it is useful for descriptive and analytic purposes. It is less expensive than other designs and enables the researcher to meet the study objectives in short time. In this research, cross sectional design allows to provide an over all picture about the examined phenomenon by using the relationship among the variables and to compare differences among the study variable groups.

3.2. Study population

The target population of this study consisted of all children aged between 1 and 3 years old who registered and attending the UNRWA clinic at Gaza governorates. The children were attending to the well baby clinic, for immunization and growth monitoring, according to UNRWA registration records , in 2008 the registered refugees children aged between 1 and 3 years was (65,459) (UNRWA, 2009).

3.3. Period of the study

The study was conducted in March 2009 through February 2010, the researcher wrote the proposal through March to April. Then the researcher conducted the questionnaire in May. In June, ethical approval from Helsinki Committee was obtained. Piloting and data collection was done in October for 4 weeks, and the AL analysis was performed in November. Writing the research results and discussion were done in December.

3.4. Setting of the Study

Since the study was conducted in Gaza Strip, 5 primary health care were randomly chosen as described in sampling process to be the filed work in the UNRWA health centers , since which was the major sector that covering MCH services.

3.5 Sampling process

To select the clinics from where the sample was drawn, the researcher used multistage random sampling approach (figure 3.1).

- The first stage aimed to select randomly three governorates from the five governorates, North, Gaza, Middle zone, khanyons and Rafah. The selected governorates were, North, Gaza and khanyons .
- The second stage aimed to select large and small clinics according to UNRWA classification-randomly from each governorate, randomly five clinics were selected (three large and two small).

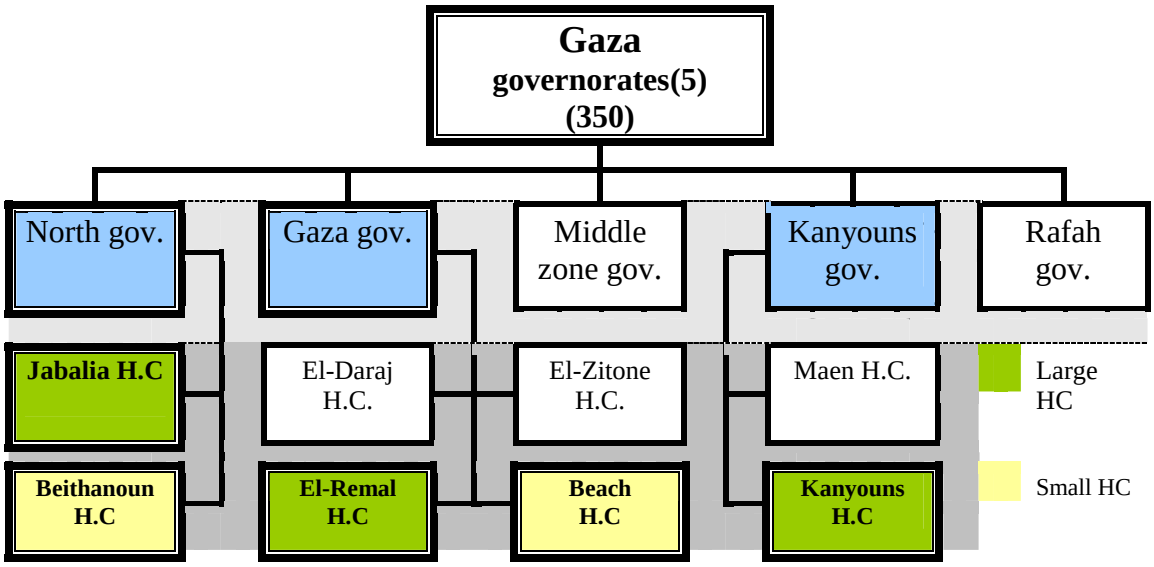

Figure (3.1): Description of sampling possess

To select subjects from clinics, the researcher calculate the average number of children aged 1-3 years attending to well baby clinic care services for vaccination or growth monitoring. Based on the calculated average and the calculated sample size , 350 clients were divided into 5 clinics in the 3 governorates, 80 participants was the proposed study sample in every large clinic and 40 in small clinic except khanyouns clinic 110 participants. Depending on the maximum capability of taking blood sample from the participants, only 20 participants from each clinic per day were selected.

3.6. Sample Size

By using Epi info statistic program, the study sample was calculated according to prevalence of anemia in children in the region (annex 3), which are about 54.7 % (UNRWA, 2007), and with 95% confidence interval. The sample was calculated 337 subjects and the researcher decided to take 350 subjects to compensate the non-responding subjects.

3.7 Eligibility Criteria

3.7.1 Inclusion criteria

The inclusion criteria for the study were

- Any refugee child age between 1to3years old, who reside in Gaza governorates and registered in the UNRWA health centers, and attending the well baby clinic for growth monitoring or vaccination
- His or her guardians (only females guardians, mother, grand mother, grand father, big sister, or others live at the same department) are willing to be interviewed, and accept to gave blood sample by the research team from the child.

3.7.2 Exclusion criteria

The exclusion criteria for the study were

- Child more than 3 years old or less than 1 year old

- Child were not resided in the Gaza Strip, or registered in the UNRWA health centers
- His or her guardians refused to be interviewed,
- Child suffering from liver or kidney problem, blood transfusion, and thalassemia or family history of Thalassemia.

3.8 Ethical Considerations

- Approval of Helsinki Committee in Gaza to conduct the study was obtained (annex 4)
- Approval of UNRWA Field Office/Gaza to carry out the study was obtained (annex5).
- The participants guardians was given an explanatory form both verbally and written about the study, this form includes the purpose of the study, confidentially of information and that partial and complete participation or withdrawal is fully voluntary,

  Signature is not requested from the participant because in Gaza it is not socially accepted to asked for signature and may led to suspicious and may be led to low response rate.

3.9 Data collection tool

I- The researcher used a structural closed ended questionnaire based on the literature review and filed observation with consultation of experts in the filed (annex 6).

The questionnaire was divided into three sections:

- **Section A**: comprised of socio-demographic data about child and the family that sought to obtain respondents age, parent's educational status, residency and average family income.
- **Section B**: sought to explorer the types and source of utensils which used in food processing and storage.

- **Section C**: was aimed at detects the knowledge of family about the hazard and the effect of using aluminum cookware.

II- Measuring the child's hemoglobin (Hb) concentration.

III- Measuring the child's serum aluminum level.

3.10pilot study

Piloting was done on 35 guardians with their children who were selected through a convenient sampling from one clinic in north Gaza. Such procedure was done to test recruitment, response rate, validity and sustainability of the questionnaire, and to check the blood sampling procedures, from the point of the time taken to complete the procedure, check the needed instruments, ensure infection control measurements, and availability of equipments and materials. Some revision and modifications were introduced because of the piloting process the pilot subjects were not included in the study sample.

3.11 Data collection

A face-to-face interviewed questionnaire was implemented for 350 Childs guardians (child age 1-3 years) in 5 health centers. After verifying the child's age from child file, and considered the inclusion and exclusion criteria, the researcher explained briefly the purpose of the study to each child guardians and confirm the right o accept or refuse the participation before filling the questionnaire. After obtained informed consent (annex7), child guardians were interviewed, and privacy and confidently was maintained all the time. After filling each questionnaire, the researcher reviewed it, and checks the completion of information. Additionally, the researcher checked child's files to check the nutrition status, and to confirm the information of the concerned child. After that, the researcher asked the child guardians to go to the clinic laboratory to complete blood sampling, blood sample was collected by a trained laboratory technician with a precise consideration of infection control measurements.

3.12 Blood sampling and processing

At clinic laboratory and after taking infection control measurements in accounts a 3 ml blood was taken from antecubital vein, then divided into two parts 20µl for Hb analysis and the rest in blank tube and allowed to clot for 30 minutes and serum was collected by centrifuging at 400 round per minute rpm for 5 minutes. The serum samples were labeled and transported to the laboratory and stored at -20°C till further analysis in Al Azhar university laboratories, Gaza.

3.12.1 Serum aluminum level analysis

Serum aluminum level was analysis by using spectrophotometer, at El Azhar university laboratories, Chemistry department. Aluminum analysis was done, after defreezing of the serum samples at room temperature in the following chemical steps:
For digestion, 0.5 g serum was boiled to dense fumes in 5 ml conc, HCL, 5 ml concentration, HNO3 and 7 ml perchloric acid. After that the sample was reboiled after addition of 30 ml water, then diluted to 100 ml and subjected to analysis and pH was adjusted to 2.5-3.0 with the help of 10% NaOH solution. Ten ml buffer complex solution (10 ml (Tioglycollic Acid) was added to 2.5% CaCO3 solution (dissolved in dd H_2O with the help of concentrated HCL and CO_2 was removed through boiling for 1-2 minutes), diluted to 400 ml and 14% sodium acetate (hydrated)to one liter , and 10 ml Alizarin Red S SOLN . Then added 1% to the digested solution , diluted to 100 ml , After that allowed to stand for 3 hours and absorbance noted at 495 nm using spectrophotometer (Ghori and Yaqub,1999).

3.12.2 Hemoglobin measurement

In each clinic, determination of Hb was done by Cyanmethemoglobin method. In this method by using 20µl of blood transferred with the help of a hemoglobine pipette to 5000 µl of Drabkin's solution (0.05g potassium cyanide ,0.02g potassium ferricyanide,1.00g sodium bicarbonate in 1Ldistilled water) in test tube mixed thoroughly

and the colure is measured in a photoelectric calorimeter at 540 nm. Standard curve was constructed by using the standard Cyanmethemoglobin solutions in different dilutions (UNRWA, 2005).

3.13 Response rate:

From among the sample size (350) subjects, only 286 children guardians (81.7%) responded.

3.14 Validity and Reliability

Many researchers have stressed on the importance of validity of an instrument. Validity defined as "The extent to which a measurement instrument measures what it is supposed to measure and measures it accurately "(Grinnell, 1990).

In this study content validity index (CVI) were used to rate the relevance of the questionnaire. The technique of measuring variables must be reliable as the reflects the extent to which an operational definition, questionnaire or other instruments is stable and consistent.

General measures of reliability and validity were implemented .

Reliability

- Standardization of data collection tools.
- Standardization of data collection methods.

Validity

- Systematic checking and follow up of data collected
- Data collection was done by the researcher himself
- Data cleaning and checking
- Using child record to validate the information

3.15 Data entry and Statistical analysis

After data, collection of the sample, the completed questionnaires and Hb level and Al level were entered by the researcher himself using the Statistical Package for Social Science (SPSS) version 15.

Descriptive and relevant inferential statistical test were used in the data analysis. The analysis of data was conducted as:

• Review of the filled questionnaire

• Coding the question

• Appropriate entry model

• Coding variables

• Data cleaning

• Frequency of the result

• Advanced statistical analysis

The Statistical significance was used depending on the nature of variables as follow:

- Chi-square test (X^2) was used to examine the relation between exposure to bad quality aluminum and anemia, with confidence interval (CI) of 95%.

- t test to explore the relation between anemia and Serum Al mean.

- Logistic regression was done examiner the relation between SAL and anemia and control of confounder.

The results in all the above-mentioned procedures were accepted as statistically significant when p-value is less than 5% ($P<0.05$).

3.16 Limitations of the study

- Time limitation
- Political situation during data collection Gaza Strip
- Lack of fund and the high cost of aluminum test and other material required for scientific investigation.
- Limitation in educational resource such as books and journals
- Lack of research in this filed in locally, regionally and internationally.
- The study sample was limited to UNRWA clients.

Chapter 4:

Results and Discussion

In this chapter, the results and findings of the study are described, and the analysis of the data are presented and discussed. The results describe information on the characteristics, and the distribution of the respondents of questionnaires from the five health centers included in the study concerning the relationship between anemias and using AlC, especially bad quality once among children 1-3 years old in Gaza governorates. In addition, the analysis provides relationship between some variables in regards to using AlC some findings were also compared with other studies' findings.

4.1 Descriptive statistics

4.1.1 Socio-demographic Characteristics

The represented sample of the children included in this study was 286, who were distributed in regards to selected socio-demographic characteristics of the children including, age, and gender, child's families life condition and parents characteristics.

4.1.1.1 Children age and gender

As shown in table (4.1). the mean age of the children participated in the study was 22.4 months, with stander divination (SD) ±7.4 months and the median was 22 months.. The researcher divided study population age into two main age groups; the first group aged 12- 24 months, while the second group aged 25-36 months.

The highest age group was among children aged 12-24months 55.2% followed by children aged 25-36 months 44.8%. This distribution of study population consistence with UNRWA report, found that the regular attendance rate in the first age group (72%) is higher than the second group 42% (UNRWA, 2009). A nutrition survey was performed in 1990 among children 6 - 35 months living in Palestinian refugee camps in Syria,

Jordan, the West Bank, Gaza Strip and Lebanon found that 66% of surveyed children were less than 2 years and 34% 24-36 months old **(**Hassan, *el al*., 1997**).**

Table 4.1: characteristics of children

characteristics	No.	%	mean	median	SD
child age groups					
12- 24 months	158	55.2	22,4	22	7.4
25-36 months	128	44.8			
Total	286	100			
Child gender					
female	147	51.4			
male	139	48.6			
total	286	100			

The explanation of these results is that, the immunization programs for children concentrated in the first and second year of life, in third years of life the families usually attended to for sick baby clinic, other nutrition programs (vitamin A supplementation), anemia follow up and growth monitoring. More effort must be done to increase the awareness about the importance of growth monitoring in children after 2 years old through health consultation and education at health centers level.

Regarding the distribution of participant's gender 51.4% of participants were females and 48.6% were males. This result consisted with Summour study, that the females was more prevalence than males in attending to well UNRWA baby clinics (Summour, 2010), and agree with Radi study 52% were females and 48% males(Radi, *et al*., 2009) , but not consisted with UNRWA report found that male female ratio 1.0 (UNRWA, 2009). The higher attendance among females maybe due to the higher prevalence of females malnutrition than males and therefore they need more follow-up and monitoring.

4.1.1.2 Characteristics related to family life condition

The distribution of study population among the three randomly selected localities as shown in table (4.2), were 35.3% from Gaza city followed by North Gaza 33.2% and 31.5% from khanyouns.

Regarding the distribution of participants living area results shows that 55.6% were living outside camps and 44.4% were living inside camps. In this study, two of the five selected clinics were outside the camp. This finding is consistent with other studies conducted in Gaza Strip, Al Najar found that more families residing outside camps 67.4% (Al Najar, 2008). Also consistent with UNRWA report, which indicates that, 46.1% of families living inside camps were, 53.9% living outside camps (UNRWA, 2009).

Regarding family type**,** the majority of study population lived in a nuclear family 63.3%, while the population lived in extended family represented only 36.7%. This finding is consistence with Al Majdalawi study and Mossleh study, showed that the majority of study population lived in nuclear family (Al Majdalawi, 2008: Mossleh, 2009). Also agree with PCBS survey 2007, indicated that the percentage of extended private households in Gaza Strip (24.5%) was lower (75.5%) than nuclear household (PCBS, 2008a).

These families have a house hold mean 7.7 persons, SD ± 3.9 persons and median 7 persons. The researcher divided the family size into three groups, the majority group between 6-9 persons sharing the same kitchen and bathroom which represents 43.7%, followed by group < 5 persons 33.6%, and the group > 10 persons (22.7%). These results did not consisted with PSCB reports, which revealed that average size of household in Gaza strip in 2007 was 6.5% (PSCB, 2008b), but consisted with Mossleh study, that 44.7% of families size were 6-10 persons, 30.2% less than 5, 25.1% more than 10 persons (Mossleh, 2009). This relatively large families increase the economical burden on the families, resulting in the limited choices of a good quality cookware.

Regarding housing units ownership, the percentage of participants family households that the ownership of the housing unit is for a family member is about 85.3%, while the percentage of households living in rented houses was 14.7%. This results consisted with PCBS survey 2007, indicates that majority of family households in Gaza Strip were ownership for a family member (93%) while the percentage of households living in rented houses in Gaza Strip 4.5 %(PCBS, 2008b).

Table (4.2): Characteristics related to family life condition

Characteristics	No.	%	mean	median	SD
Governorate					
Gaza	101	35.3			
North	95	33.2			
Khanyouns	90	31.5			
Total	286	100			
Residency					
Outside camp	159	55.6			
Inside camp	127	44.4			
Total	286	100			
Family type					
Nuclear	181	63.3			
Extended	105	36.7			
Total	286	100			
Household number					
Less than 5	96	33.6	7.7	7	3.9
6-9	125	43.7			
More than10	65	22.7			
Total	286	100			
Type of house owner					
ownership a family member	244	85.3			
Rent	42	14. 7			
Total	286	100			
Family income					
Extremely poor	162	56.6	1226	1000	759
Relatively poor	34	11.8			
Above poverty line	41	14.3			
Don’t know	49	17.1			
Total	286	100			
Drinking water source					
Out filtered	185	64.7			
Municipality	69	24.1			
Home filtered	20	7			
Well	12	4.2			
Total	286	100			
Water pipe types					
Plastic	106	37.1			
Don’t know	141	49.3			
Iron	39	13.6			
Total	286	100			

Regarding the family income about, 17.1% of guardians indicates that they don't know the monthly family income, but the others families 82.9% indicated that, the monthly income average was 1226 NIS, SD ±759 NIS and median 1000 NIS. The researcher divided the monthly income into three categories according to the PCBC classification, relative poverty line (1700- 2100 NIS), absolute poverty (<1700 NIS) and above poverty line (> 2100 NIS) (PCBC, 2006).

The finding reflects the poor economic situation among the population study. Unfortunately the majority of total sample (82.7 %) was below poverty line (>2100 NIS), they were classified into 2 groups, first group was extremely poverty(<1700 NIS) and consist the majority of the population (68.4%), while only 14.3% was relatively poor with average monthly income (1700- 2100 NIS), and the rest (17.3 %) were above the poverty line(>2100 NIS).

This result was similar to that of Abu Nahla results where the majority of families (79%) were below poverty line (Abu Nahla, 2006), also closely to Mossleh study where 70.6 % of families was below relatively poverty line and 14.6% was extremely poor (Mossleh,2009), and more worse than UNDP report shows that 70% households in the Gaza Strip live below the poverty line, Some 42% live in extreme poverty (UNDP, 2007).

PSBC in 2007 survey found that the poverty rate according to the income pattern was 79.4% percentage in Gaza stripe and according to consumption pattern for reference household consisted of two adult and 4 children was 51.8% in Gaza stripe (PSBC, 2008b).

These results reflected the bad economical situation of Palestinian society especially in Gaza Strip. The extended siege, boarders closure on Gaza, in addition to demolition of reproductive means of Gazans economy after the last war on Gaza, all these factors decreased family income to a tragedy level.

For most families, particularly poor families, what in side the pan is more important than the type of pan, therefore ALC is the popular utensils among the Gazans families because it is nicely and pricey, but unfortunately not healthy. Health education may play an important role to eliminate the adverse effect of using AlC, by educated the mothers how to protect their families from hazard of Al exposure.

It's not strange that half of child guardians (49.3%) did not know the type of water pipes used in their houses, because the child's entire guardian who involved the study was females and these details were out of their interest, but about 37.1% indicate that the water pipes were plastic, and only 13.6% iron pipes.

Regarding the drinking water, the most of the families (64.7%) used to buy filtered water from portable tanks, 24.1% drinking municipality water, only 7% have water filters in their houses, and 4.2% drinking from wells.

According to PCBS the majority of Gazans household (95%) receiving there water from public net work (PCBS, 2008b). Because of the poor quality of public net work water in Gaza Strip, the Gazans families tend to buy low price water for drinking purposes from portable tanks. It is worth to mentioned that, lake of controlling measurements ,supervision and regular analysis of this popular water type, put an inquiring marks on the source, production ,transportation and the quality of this type of water. The effective cooperation between MOH, municipalities and local community association, in order to supervised the production and transportation of water and put the regulations for regular analysis of water.

4.1.1.3 Characteristics related to child's parents

Table (4.3) shows the Characteristics of child's parents from age, education level and occupation status. Study population parents age was divided into three main age groups; figure (3.1) shows that the majority of fathers age group lies between 25-35years (62.6%) which represented approximately two third of population, followed by age group more than 35 years, which represented (26.6%) of population, and by age

group less than 25 years 10.8%. The mean age for Fathers was 31years, SD ±6.3 years with median of 32.7 years.

In contrast with mothers, they seem to be more younger than fathers, the majority of mothers age group less than 25 years (47.5%), followed by age group between 25-35years, which represented 41.3% of population, and by age group more than 35 years (11.2%).

The mean age for mothers was 26 years, SD ± 5.6 years and median of 27.1 years. This result is nearly similar to other studies where the majority of the participated women (84.7%) were aged 35 years or less (MARAM, 2004), and the mean age was similar to the mean age of 27.1 in the study done in West Bank and Gaza, but not consent with Mossleh study, shows that the majority of mothers age group was between 26-35 years 44% followed by age group less than 25 years 33.9% and age group more than 35 years 22.1% (Mossleh, 2009).

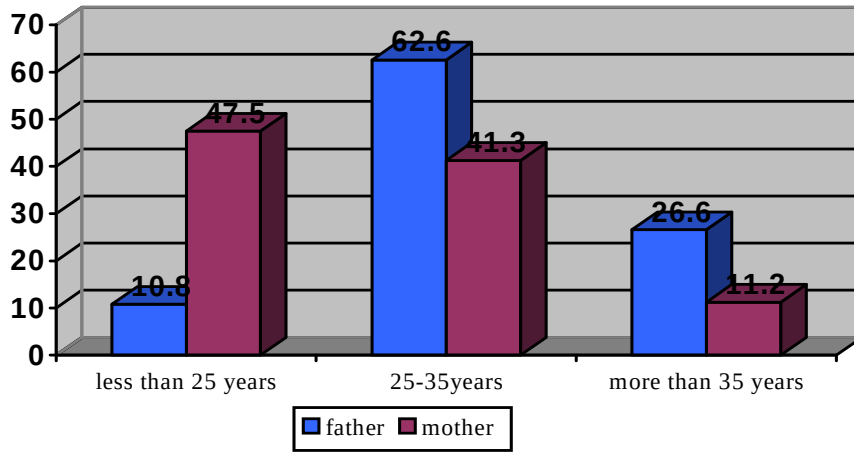

Figure (4.1): distributions of child's parent age

These results can be explained the difference between fathers and mothers age by the social phenomena in which, the marriage age of females is less than males (PCBS, 2005), the appropriate average age at first marriage for a young man is 24. 6 years, while the preferred age for marriage for girls is 19.4years (PCBS, 2008c).

Regarding parents educational level Figure (4.2) shows the distribution of child's fathers and mothers by educational levels. The majority of fathers and mothers were middle educational level (9-12 years) which represented approximately one half of the population (41.6% and 45.8% respectively), followed by low educational level (9-12 years) which represented approximately one third of the population (30.1% and 33.6% respectively), the population of high educational level(over 12 years) represented (28.3% and 20.6% respectively). The mean year of education was (12 and 11 years respectively), SD (± 3 and ± 2.8 respectively) with median of (11.4, and 11 respectively).

Table 4.3 Characteristics related to child's parents

Characteristics	No.	%	Mean	median	SD
Mother age group					
Less than 25 years	136	47.5	26	27.1	5.6
From 25 to 35 Yrs	118	41.3			
More than 35 Yrs	32	11.2			
Total	286	100			
Mother occupation status					
Not working	235	82.2			
Working	51	17.8			
Total	286	100			
Mother education status					
Less than 9 years	96	33.6	11	11	2.8
9-12 years	131	45.8			
More than 12	59	20.6			
Total	286	100			
father age group					
Less than 25 years	31	10.8	31	**32.7**	**6.3**
From 25 to 35 Yrs	179	62.6			
More than 35 Yrs	76	26.6			
Total	286	100			
father occupation status					
Professional	105	36.7			
Skilled worker	50	17.5			
Not Skilled worker	37	12.9			
Not working	94	32.9			
Total	286	100			
Father educational level					
Less than 9 years	86	30.1	12	**11.4**	**3**
9-12 years	119	41.6			
More than 12	81	28.3			
total	286	100			

These findings are nearly similar to findings in other studies with very few differences. The mean educational years of the women and their husbands were 11.5 and 12.0 years respectively. The median was 12.0 years for both and the (SD) was ± 3.3 and ± 4.1 respectively (Abu Nahla, 2006). Also closely to Mousleh study were the mean year of education for women and their husbands were (11.4 and 12 years respectively) and (SD) was (± 2.92 and ± 3.1 respectively) ((Mousleh, 2009).

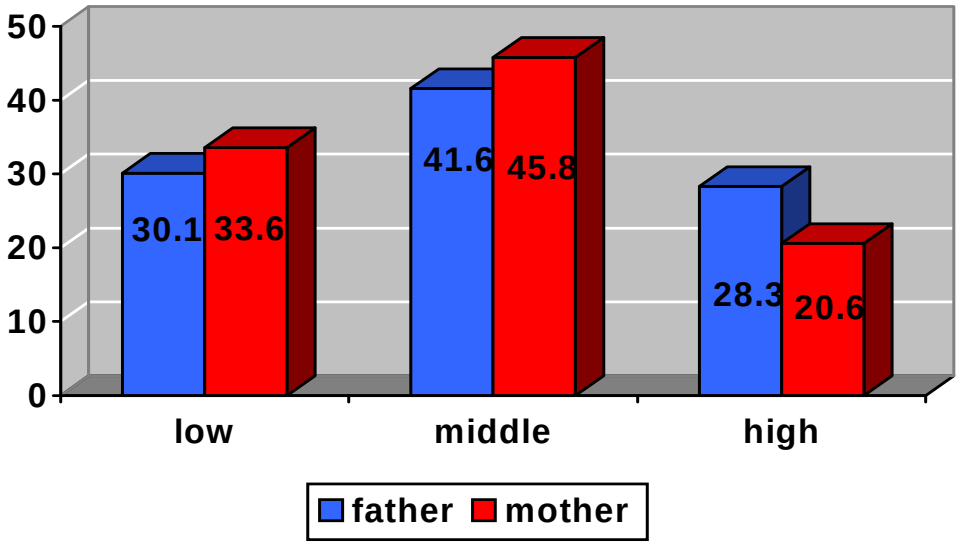

Figure (4.2): distribution of child's parents education level

Regarding employment status of children's fathers and mothers, 32.9% are not working fathers, while the rest of them are working (67.1%) and divided into three categories, professional working represents 36.7%, skilled working represents 17.5% and not skilled working represents 12.9%. In contrast of this finding the majority of mothers was not work which represented 82.2% of total mothers and only 17.8 % are were working mothers.

This results was consistent with World Bank results, showed that unemployment rate was 29, 8% in Gaza during the year 2008 (World Bank, 2008), and similar to finding from Mousleh study where the percentage of employed women was 17.3 %(

(Mousleh , 2009) ,but not consistent with This finding is similar to finding from MARAM study where the percentage of employed women was 7.9%, and different from the MOH findings which was 4.4% (MARAM, 2004; MOH, 2005).

4.1.2. Child nutrition profile

The study shows (table 4.4) that, the majority of the children (83.6%) were normal weight, while underweight among children were 13.3% and only 3.1% were overweight. This results were more than the growth failure rate of children under 3 years in Gaza 7.8% (UNRWA, 2008) , also more than PCBS 2006 survey that only 2.4% of Gazans children less than 5 years were underweight (PCBS,2008b) , and less than Radi study that 31.4% of children less than 2 year attending primary health care were under weight (Radi et all, 2009), but this study consistent with Summour study results that 12.3% of children less than 2 years were underweight (Summour, 2010).

The measurements used in this study were according to UNRWA standers (weight by age) which using percentage scale. The high prevalence of underweight children indicate the miserable economic and health situation in Gaza strip specially after the last Israeli war against Gaza in January 2009 .

Because of the study sample of this study were between 1-3 years old, the majority of children (61.5%)were completely weaned, were 36.4% were on mixed feeding (regular family food and breast feeding), and only 2.1% were exclusive breastfeeding EBF.

The majority of mothers started to add food to child nutrition regime before 6 months age (69.2%), while 30.8% add food after 6 months age, with mean 6.14 months, SD 1.8 and median 6 months.

In recent study in UNRWA health centers the percentage of infant breastfeed (not exclusive breast feeding) for one year was 65% (UNRWA, 2008). According to the MOH report 2004 , the EBF rate in Gaza was 23.5% (MOH, 2004) , Summour study indicate that the majority of children(94.7%) were EBF tell7month age and mothers start to add

food after that age(Summour, 2010), while the study at Ard El Insan found that 71.2% of mothers used EBF for 6 months (Abo Hasan, 2008), in contrast with Radi study 27% of study population were EBF until 6 months age and one third of them were (32%) artificially feed and 41% were mixed feed (Radi et all, 2009).

The majority of the children were feed on cooked food (81.5%), while the children who feed on not cooked foods like cereal and fruits and others type of foods represents only18.5%, out of the 81.9% children, the majority of cooked food (98.3%) were regular family food, and only 1.7% with special food .

These results indicate that, the majority of children exposed to the same factors affected other family members particularly the exposure to Al from using bad quality AlC.

Table 4.4 :Demonstration of child medical and nutrition profile

Characteristics	**No.**	**%**	**Mean**	**median**	**SD**
child recent weight					
normal weight	239	83.6			
under weight	38	13.3			
over weight	9	3.1			
Total	286	100			
child feeding type					
Weaned	176	61.5			
Mixed	104	36.4			
Exclusive breast feeding	6	2.1			
Total	286	100.			
Age of adding food					
After 6 months	198	69.2			
Before 6 months	88	30.8	**6.14**	**6**	**1.8**
Total	286	100			
type of water used in preparing food					
Out home filtered water	177	61.9			
municipality	89	31.1			
home filter	12	4.2			
well	8	2.8			
Total	286	100			

Regarding source of water used in cooking, 61.9% of Gazans families were using out home filtered water in preparing foods followed by municipality water 31%, home filtered water4.2%, and only 2.8% using wells water.

More families depending on municipality water for cooking than drinking; this may be due to the economical situation and the lake of knowledge about some pollutant and heavy metals that can be harmful even after boiling water and cooking such as mercury, lead and AL. For that, health education and increasing the awareness is the corner stone in prevention and protection such hazard.

4.1.3 Child Hemoglobin status and its related factors

Table (4.5) shows that, the prevalence of anemia among the study population was 48.3%, and 51. 7% were not anemic, with mean 10.4 g/dl, SD 1.09 g/dl, and median 10.8 g/dl. This results not consistent with UNRWA results, revealed that anemia prevalence among children less than 3 years in 2004 was 54.7% (UNRWA, 2008), also Radi found that the prevalence of anemia among children who were less than 2 years of age was 72.8%, with mean 10.2 g/dl (Radi, 2009) and a nutritional survey for Palestinian refuge aged 6-36 months held in 1997 found that anemia prevalence in Gaza was 72% (Hassan et al., 1997). But NECC talked about 40% as prevalence of anemia (NECC, 2009). These variations in anemia prevalence are questionable, and it may be due to the variation of measuring tools and the differences of the study population, more surveys in this filed is needed.

Regarding the iron supplementation results, table(4,5) shows that, 54.5% of mothers received and gave iron supplementation for their children, while 45.5% did not, from those who received iron supplementation 48.1%declared that child hemoglobin was improved, while 33.3% said that child hemoglobin did not improved, and 18.6% did not know what happened with child hemoglobin .

In spit the UNRWA strategy for treatment anemia among children, the compliance for iron supplementation still low, little done to explore the compliance for iron supplementation among children, but different researches done about compliance for iron supplementation among antenatal and postnatal for women, one study indicated that compliance rate of among women during postnatal period was 46.7%, (Mousleh,2009).

This result can explain the low prevalence of receiving and taking iron supplementation among children.

One of the important factors affecting anemia is the tea consumption specially in children, about one third of study children (30.4%) used to drink tea while 69.6% didn't have this habit, the mean times of drinking tea was 2 times per day, median (2.1) with SD ±1.1 times per day. Children drinking tea two and less times per day represented 72.4%, while children drinking tea more than two times per day represented (27.6%).

Hassan et al study found that tea consumption in not an important factor in anemia among children (Hassan et al, 1997). Tea consumption can inhibit iron absorption; therefore, efforts must be directed to increase the awareness about this bad habit in the Palestinian society.

Table (4.5): child Hemoglobin status and its related factors

Characteristics	**No.**	**%**	**Mean**	**median**	**SD**
Anemia in category					
anemic	134	48.3	10.4	10.8	1.09
Not anemic	152	51.7			
Total	286	100			
Did the child reserved iron supplementation during the past 3 months					
Yes	156	54.5			
No	130	45.5			
Total	286	100			
Did his hemoglobin improved					
Yes	75	48.1			
No	52	33.3			
don know	29	18.6			
Total	156	100			
Dose your child drink tea?					
Yes	87	30.4			
No	199	69.6			
Total	286	100			
How many times did the child drink tea					
2 times daily	63	72.4	2	2.1	1.1
More than two time	24	27.6			
Total	87	100			

Iron supplementation is the most important factor in prevention and treatment of anemia, different factors affecting the intakes and absorption of iron such as tea consumption and the high level of Al in food due to using bad quality AlC. Health education and increase the awareness about the nutritional bad habits and the role of tea consumption in developing anemia is critical and need more effort from all sectors.

4.1.4 Family hemoglobin status

Table (4.6) shows that, 36.7% of mothers were anemic, and 53.5% were not anemic, while 9.8% of the mothers didn't know their Hb status. These results consisted with the PCBS report, that the prevalence of anemia among women in Gaza strip was 36.4% (PCBS, 2004).

Concerning about the child's brothers, 44.1% of them was anemic, and 55.9% were not anemic. From those anemic 46.8% received iron supplementation and 53.6% didn't receive. Out of those received iron supplementation only 37.3% were improved their anemia condition as declared by mothers, while 33.9% did not improved and 28.8% did not know.

Table (4.6): demonstrate Family hemoglobin status

Characteristics	No.	%
Mother hemoglobin		
anemic	105	36.7
non anemic	153	53.5
don't know	28	9.8
Total	286	100
Child brothers or sister have been suffered from anemia		
yes	126	44.1
no	160	55.9
Total	286	100
Iron supplementation receiving		
yes	59	46.8
no	67	53.2
Total	126	100
Hemoglobin level improvement		
yes	22	37.3
no	20	33.9
don't know	17	28.8
Total	59	100

These results indicated that, anemia is widespread phenomena in the Gazans families, different factors contribute on anemia occurrence and all the family members facing these factors, some of these factors which play an important role are some unhealthy nutritional practice, lake of knowledge about the importance of iron supplementation. On of the factors which may be contribute with the absorption and utilizing iron is elevated of SAL (Tesleem, & Amal, 1999).

4.1.5 Characteristics of family cookware

4.1.5.1 Availability of different kinds of cookware

Table (4.7) shows that the distribution of different types of cookware among Gaza families, world wide different types of cookware are available in the markets with different quality, also in our society different kinds of cookware available in the Gazans kitchens, most of families have AlC in their kitchen (89.2%), also they have stainless steel (27.6%), other kinds like non-stick (Tefal), glass and coated iron also existed in the same houses with percent (23.4%, 9.1%, 4.2% retrospectively).

Table (4.7): distribution of different kind of utensils used in preparing food

	Aluminum		Stainless-steel		(non-stick) Tefal		Glass		Coated-iron	
	No	%	No	%	No	%	No	%	No	%
The available cookware in Palestinian kitchen*	**255**	**89.2**	**79**	**27.6**	**67**	**23.4**	**26**	**9.1**	**12**	**4.2**
The most available cookware in Palestinian kitchen	**233**	**81.5**	**34**	**11.9**	**19**	**6.6**				
Cookware used in preparing food in Palestinian kitchen*	**238**	**83.2**	**73**	**25.5**	**59**	**20.6**	**19**	**6.6**	**9**	**3.1**
The most used cookware in preparing food in Palestinian kitchen	**226**	**79**	**38**	**13.3**	**22**	**7.7**				

*More than one type could be available

Regarding to the most available cookware in each house, Al was the most available type (81.5%), followed by stainless steel (11.9%), and non-stick (6.6%).

Usually different kinds of cookware available in the same house according to family income and other factors, but there were some kind more current than other. In addition to that, families used different kinds of cookware in preparing foods, but there were some kind used kinds in regular base while other kinds used in special occasions.

Because of the physical and economical characteristics, AlC is the most available and used kind of cookware in Gazans houses; also AlC is the most common kind available in the local markets, some of that cookware are bad quality one, so wide range of the community exposed to Al risk.

Figure (4.3) shows the percents of different kinds of cookware used in preparing food. AlC used in the most of Gaza families (83.2%), while Stainless steel used in 25.5%, other kinds non- stick, glass and coated iron (20.6%, 6.6%, 3.1% retrospectively).

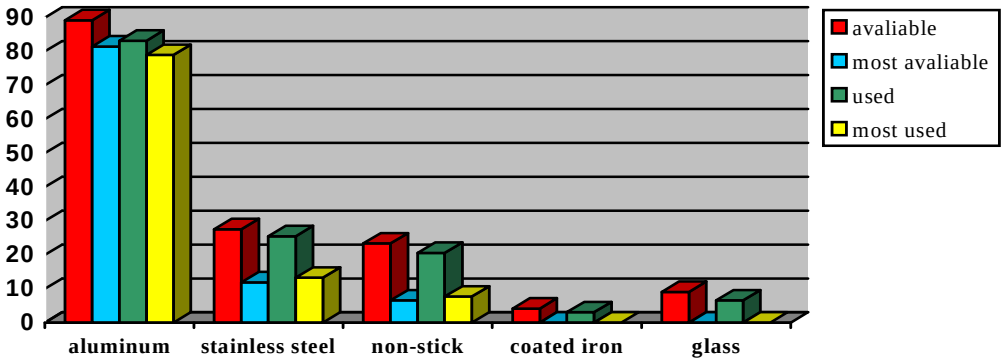

Figure 4.3: distribution of different kind of cookware available and used for preparing food

For most of Gaza families AlC stay the most kind in preparing food (79%), followed by Stainless steal (13.3%), and non-stick (7.7%). From that, AlC considered as the most abundant metallic cookware in Gazans kitchen, and used from the most of Gazans families for preparing food, so it is a public health concern issue, which need more attention from a decision makers. It is of grate value to explain for public about the hazard of exposure to Al by health education.

Table (4.8): distribution of different kind of utensils used in saving food

	plastic		aluminum		Stainless steel		non-stick		glass		Coated-iron	
	No	%	No	%	No	%	No	%	No	%	No	%
Cookware used in saving food in Palestinian kitchen*	196	68.5	178	62.2	59	20.6	42	14.7	20	7	6	2.1
The most used cookware in saving in Palestinian kitchen	123	43	114	39.9	24	8.4	12	4.2	9	3.1	4	1.4

*More than one type could be available

Another use for cookware is saving foods, (table 4.8) shows that 68.5% of families used plastic utensils in saving food, and 62.2% of families have Al utensils for saving food, the other kinds Stainless steel, non-stick, Glass, Coated iron (20.6%, 14.7%, 7%, 2.1% retrospectively).

Figure (4.4) shows the percents of the most kinds of utensils used in saving food, plastic utensils occupied the first position, that 43%, followed by Al (39.9%), and Stainless steel, non-stick,Glass, Coated iron (8.4%, 4.2%, 3.1% , 1.4 % retrospectively).

Some families used Al utensils in saving foods which increase the interaction between food ingredients and the Al, resulting in more leaching from utensil into food, so adverse effects may results such as anemia.

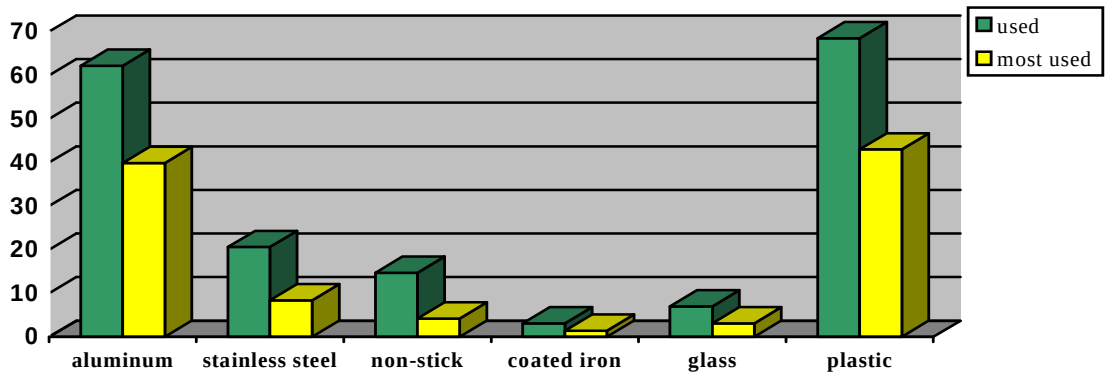

Figure (4.4): distribution of different kind of utensils used saving food

4.1.5.2 Characteristics of Aluminum Cookware

4.1.5.2.1 Availability of Aluminum Cookware

Figure (4.5) shows that; the majority of Gazean families have AlC in their houses (89.2 %), while only 10.8% don't have AlC. From that, AlC considered as the most popular cookware in Gazans houses, this may be due to its price, availability in markets and its physical characteristics.

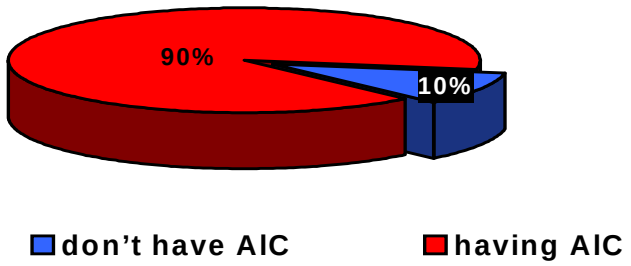

Figure (4.5): Availability of Aluminum Cookware

4.1.5.2.2 Factors related to availability of aluminum cookware

Regarding the circumstances of choosing AlC table (4.9) shows that, from those indicated that they have AlC in their houses, 64.8% said that they brought their AlC from local markets, while 10.8% aboard, and 24.3% don't know the source of their AlC.

The siege and closure of border for more than two years make the local market the main source of any goods in Gaza strip.

When the researcher asked the familie participants about the AlC manufacturing place, the majority (40.9 %) didn't know the made place of their own AlC, while 37.8% in Gaza, in Egypt and other places (19.3%, 1.9% retrospectively), also 42.2% of participants clamed that they didn't know the reasons of choosing their own AlC, only 34.7% said that it is the only cookware available in local markets, and 23.1% because it's cheap.

Table (4.9): Factors related to availability of Aluminum Cookware

Characteristics	No	%
Source of Aluminum cookware		
local market	168	64.8
out borders	28	10.8
don't know	63	24.3
Total	259	100
Place of aluminum cookware manufacturing		
Gaza	98	37.8
Egypt	50	19.3
don't know	106	40.9
Others	5	1.9
Total	259	100
The reason of aluminum cookware chosen		
the only available one in the markets	90	34.7
Cheep	60	23.1
don't know	109	42.2
Total	259	100

As a results insufficient awareness about the importance of the effect of cooking utensils on human health, the majority of participants do not know neither the manufacturing place, nor the source of it. More attention must be directed toward this issue through the effort of ministry of economics and consumers protection associations.

4.1.5.2.3 Factors related to the Quality of aluminum cookware

Table (4.10) shows about two third (61.1%) of families who have AlC in their houses, said that it is a bad quality one, while only 38.9% said it is a good quality and they have not any problem with it.

Regarding the observations about bad quality AlC, the researcher emphasized on four issues, changes on utensils after regular use in preparing and saving food, changes on food during processing and saving food, changes in utensils during rising , and the effect of such foods and substance on ALC.

Table (4.10): Factors related to the Quality of Aluminum Cookware

Characteristics	No	%
The quality of aluminum cookware		
Good quality	101	38.9
Bad quality	158	61.1
Total	259	100
Observation of aluminum cookware badness		
Color change	39	24.6
difficult in cleaning	24	15.1
Leaching	21	13.2
Loss of aluminum utensils hardness	16	10.1
Mixed	58	36.7
Total	158	100
Changing in food during preparing foods in aluminum cookware		
there are changes	126	79.7
there aren't any changes	32	20.3
Total	158	100
Change elements in food during preparing foods in aluminum cookware		
Color	54	42.8
Teats	30	23.8
Texture	7	5.5
Mixed	35	27.7
Total	126	100
Changing in aluminum cookware during washing and rising		
there are changes	142	89.8
there aren't any changes	16	10.2
Total	158	100
Change elements in aluminum cookware during washing and rising		
Change in color	85	59.8
Change in surface smoothness	25	17.6
Change in hardness	6	4.2
Mixed	26	18.3
Total	142	100
Observation the effect of such foods on the aluminum cookware		
Yes	99	62.6
No	59	37.3
Total	158	100
Kinds of foods		
tomato and acids	38	38.3
boiling water	17	17.1
Frying	9	9
Mixed	35	35.3
Total	99	100

Figure (4.6) shows the changes on utensils after regular use in preparing and saving food, 24.6% said that they noticed utensils color changes, loss of its brightness, and the color tuned to dark color, difficulty in cleaning 15.1% , leaching into food 13.2% , hardness loss 10.1% and mixed changes 36.7% .

Different studies examined the relationship between foods and AlC and there were consensus that, the longer the food is cooked or stored in Al vessels, the greater the amount dissolved in food, and leafy vegetables and acidic foods (such as tomatoes and citrus products) aid in the release of Al most readily (BVSDE, 2009).

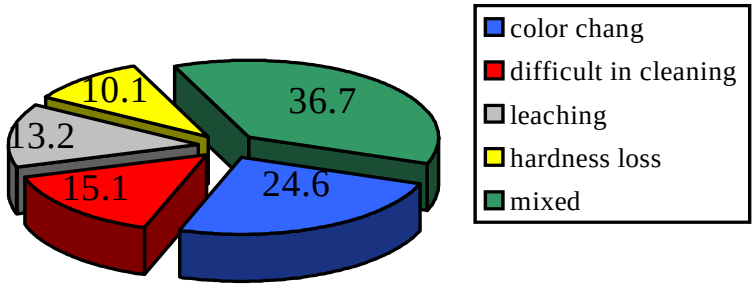

Figure (4.6): Changes on bad quality Aluminum utensils

4.1.6 Serum aluminum level

Table (4, 11) demonstrated that, the mean of SAL among children was 38.5 µg/ L, SD ±19.2 µg/ L, median 35 µg/ L, and the range was 10-80 µg/ L. The researcher divided the results into three categories, <20 µg/ L (normal range), 20-60 µg/ L (moderate elevation) and >60 µg/ L (high level).

Table (4, 11): Distribution of Serum Aluminum Level

Serum aluminum level	No	%	mean	median	SD
< 20 µg/ L(normal)	78	27.3	**38.5**	**35**	**19.2**
20-60 µg/ L(moderate)	136	47.6			
>60 µg/ L(high level)	72	25.2			
Total	286	100			

This classification depend on the recommendation of the commission of the European community, which considered SAL >60 µg/ L as excessive accumulation and harmful, and below 10 µg/ L as normal rang but other references indicated that 20 µg/ L can be tolerateable from normal individuals (CEC, 2006).

Figure (4, 7) shows that the majority of participants (47.6%) have moderate elevation of SAL 20-60 µg/ L, followed by <20 µg/ L and>60 µg/ L (27.3%, 25.2% retrospectively).

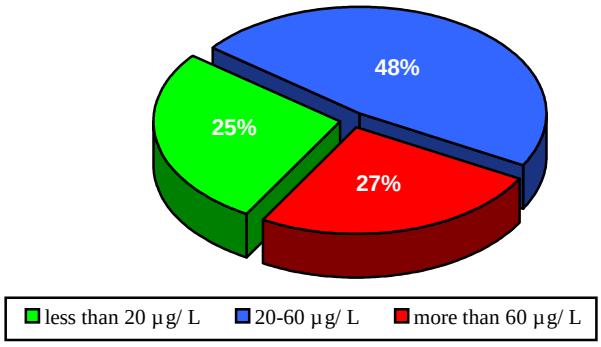

Figure (4, 7): distribution of Serum aluminum level

Unfortunately, SAL mean among children were higher than the accepted international level (<20 µg/ L), but the majority of children still under SAL dangerous level, at this level (moderate level) normal children with good renal function can be tolerated. The main route of Al intake was oral, and the main source of that may be the using of bad quality AlC.

This level more than the level of Saudi student 6-8 years were the Aluminum mean value was 23.2 µg/ L and SD 15.2.(Al. Saleh, & Shinwari, 1996), But less than the level found in Pakistanis adult , that the range was 92.9- 243.5 µg/ L(Ghori&Yaqub, 1999).

Controlling of markets, increase the awareness about the hazard of using bad quality AlC playing an important role in prevention and controlling the hazard of Al and anemia.

4.1.7 Knowledge regarding Aluminum hazard

The researcher examined the degree of child guardians knowledge about the hazard of exposure to Al from using AlC by a number of questions classified into three groups, first group deals with the exposure and the adverse effect of Al, the second group deals with the kinds of foods and products which contains Al, and the third group deals with the factors which affecting the AlC corrosion.

Table (4, 12) Distribution of knowledge about hazard of exposure to aluminum according to questions groups

Items	**percentage**		
	yes	**NO**	**DK**
All uptake due to using AlC in food processing	29.7	39.5	30.8
All uptake due to using AlC in food saving	26.6	40.6	32.9
adverse effect that can be results from exposure to Al	24.1	42.7	33.2
adverse effects due to Al over doses exposure			
anemia	17.1	38.5	44.4
bone disease	16.1	36.7	47.2
neurorgenic disease	22.4	32.2	45.5
Foods and products contain Al			
tooth brush	12.6	34.3	53.1
anti acids	19.2	28	52.8
deodorants	13.6	33.9	52.4
baking powder	11.2	42	46.9
cosmetics	10.8	39.5	49.7
Factors affecting AlC corrosion			
food type can	37.1	23.8	39.2
food processing	33.9	25.9	40.2
quality of cookware's	42.7	23.8	33.6

Knowledge was composed of 14 questions about the first group deals with the exposure , the adverse effect of all, foods and products contain AL, and the third the factors affecting the AlC corrosion. The correct answer was given one score, incorrect and do not know answer was given 0 score. The total score was 0-14. The knowledge score was classified into 3 groups: good level (>70%) of total score, middle level (51- 70%), and low level (≤ 50%).

Only 29.7% of guardians knew that Al can enter our body due to using AlC during food processing , while 26.6% of them knew that the same thing can happened when foods saved in AlC, but only 24.1% of them knew that exposure to aluminum can cause adverse effect on human health. Of the respondents, 17.1% understood that exposure to Al has a relationship with anemia, 16.1% with bone disease, and 22.4% with neurorgenic disorders.

Among the respondents 12.6 %, have knowledge that toothbrush contain Al, while19.2%, of respondents have knowledge that anti acids contain Al, 13.6% have knowledge that deodorants contain Al, 11.2% for baking powder, and 10.8%for cosmetics.

Table (4, 13): The overall knowledge score related to the exposure to AL and it adverse effects

Score	**frequency**	**percentage**
low level (≤ 50)	238	83.2
middle level (51- 70)	33	11.5
good level (>70)	15	5.2

The over all knowledge regarding Al exposure was extremely weak. As shown in table (4.13) the majority of knowledge scores (83.2%) for the women groups were less than 50% which reflect low knowledge among populations study, only 5.2% of women scored more than 70%, while 11.5% scored between 51-70 %, so more effort must do to elevate the level of knowledge by health education through media and other channels.

4.2 Inferential statistics

4. 2.1 Using Aluminum Cookware and selected sociodemographic variables.

4.2.1.1 Using Aluminum Cookware and family life condition

Table (4.14) demonstrates that, there were statistically significant differences between the residency of the family with respect to AlC quality (X^2 =6; P value <0.04). The percent of bad quality AlC inside camp (59.1%) was higher than outside camp (52.2%). The percent of families who have not AlC outside camp (13.2%) was higher than inside camp (4.7%). These differences may be due to the bad economical situation inside camps, which make the ability of the families to choose good quality cookware extremely limited.

Table (4, 14): Using Aluminum Cookware and family life condition variables

Variables	Don't have		Good quality		Bad quality		X^2	P value
	No	%	No	%	No	%		
Governorate								
north	6	6.3	32	33.7	57	60	4.4	0.34
Gaza	14	13.9	37	36.6	50	49.4		
khannuns	7	7.8	32	35.6	51	56.7		
Area of residency								
inside camp	6	4.7	46	36.2	75	59.1	6	**0.04***
out side camp	21	13.2	55	34.2	83	52.2		
House owner								
owner	22	9.0	88	36.1	134	54.9	0.6	0.7
Rent	5	11.9	13	31	24	57.1		
Type of family								
nuclear	18	9.9	61	33.7	102	56.4	0.6	0.7
extended	9	8.6	40	38.1	56	53.3		
Household family								
Less than5	13	13.5	30	31.3	53	55.2	3.8	0.4
6-9 person	8	6.4	46	36.8	71	56.8		
more than 10	6	9.2	25	38.5	34	52.3		
Family income								
absolute poverty	9	5.1	65	37.1	101	57.7	34	**0.001***
relative poor	12	38.7	6	19.4	13	41.9		
above poverty line	8	34.8	7	30.4	8	34.8		
Don't know	2	3.5	19	33.3	36	63.2		

* Statistically significant

Also results show statistically significant differences between AlC quality and family income, there were highly statistically significant differences between the family income and the using of bad quality AlC (X^2 =34; p value <0.001). The percent of using bad quality AlC from absolute poor families (57.7%) was higher than in families above the poverty line (34.8%). In addition to that, (34.8%) of families above the poverty line do not AlC in their houses, in compare with (5.1%) of absolute poor families.
As the results of this study show that there were no statistically significant differences between governorates, or hose owner, or type of family (p value 0.3, 07, 0.7, respectively) with using AlC.

Family income is the major determents for choosing the cookware among the Gazans families, even if they know that AlC. Speared the knowledge and awareness about the hazard of using bad quality AlC may help the customers to choose the healthy utensils according to family income.

4.2.1.2 Using aluminum cookware and parents characteristics variables

As illustrated in table (4.15), the relationship between father education level and using AlC. There were statistically significant differences between using AlC and father education level (X^2 =12.8; p value < 0.01). It is illustrated that the higher user of bad quality AlC was among middle education level 9-12 years (63%) and low education level less than 9 years (59.3%), while the lowest user of bad quality AlC was the higher education more than 12 years (39.5%). The percent of good quality AlC among educated fathers (46.9%) was high than meddle and lower educated fathers (27.7%, 34.9 retrospectively).

In addition to that there were statistically significant differences between using AlC and mother education level (X^2 =12.1; p value < 0.01), it is illustrated that the higher user of bad quality AlC was among low education level less than 9 year (65.6%), and middle education level 9-12 years (55%), while the lowest was among higher education

more than 12 years (39%). Also the percent of good quality AlC among educated mothers (44.1%) was high than middle and lower educated fathers (36.6%, 28.1 retrospectively). The interpretation of these results is that, in addition to the level of education among the parents, which enable them to know about the hazards of using bad quality AlC, family income plays the major role that highly educated seems to have more and fixed family income which enable theme to chose the healthy and good quality cookware.

Table (4, 15): Using Aluminum Cookware and parents characteristics variables

Variables	**Don't have**		**Good quality**		**Bad quality**		X^2	**P value**
	No	**%**	**No**	**%**	**No**	**%**		
Father age								
Less than 25 years	4	12.9	10	32.3	17	54.8	1.7	0.7
25-35 years	1	8.4	61	34.1	103	57.5		
more than 35 years	8	10.5	30	39.5	38	50.0		
father education								
Low education	5	5.8	30	34.9	51	59.3	12.8	**0.01***
middle education	11	9.2	33	27.7	75	63.0		
High education	1	13.6	38	46.9	32	39.5		
Father occupation								
working	24	12.5	74	38.5	94	49	11.6	**0.003***
not working	3	3.2	27	28.7	64	68.1		
mother age								
Less than 25 years	14	10.3	45	33.1	77	56.6	3.6	0.4
25-35 years	9	7.6	41	34.7	68	57.6		
more than 35 years	4	12.5	15	46.9	13	40.6		
Mothers education								
Low education	6	6.3	27	28.1	63	65.6	12.1	**0.01***
middle education	11	8.4	48	36.6	72	55		
High education	10	16.9	26	44.1	23	39		
Mother occupation								
working	6	11.8	29	56.9	16	31.4	14.9	**0.001***
not working	21	8.9	72	30.6	142	60.4		

* Statistically significant

The results of the study illustrated that there were differences between parents occupational status and using AlC. Related to father occupational status, the higher user of bad quality AlC was among not working fathers (68.1%), and the lower among working fathers (49%), while the percent of working fathers (38.5%) within good quality

AlC was higher than not working fathers (28.7%). These differences reach the statistically significant level (X^2 =11.6; p value < 0.003).

Regarding the to mothers occupational status, the higher percent of bad quality AlC was among not working mothers (60.4%), and the lower among working mothers (31.4 %). While the percent of working mothers using good quality AlC (56.9%) was higher than not working mothers (30.6%).

These differences reach the statistically significant level (X^2 =14.9; < 0.001). These results consisted with the above-mentioned results, that the family income is the most important determent of choosing the healthy and safety cookware in spite of its coast.

4.2.2 Quality of Aluminum Cookware and it is source

It has been observed from table (4.16) that, a significant statistical differences between AlC quality and its source and manufacturing place. There were statistically significant differences between AlC quality and its source (X^2 =322; p value < 0.001), the percent of bad quality AlC among local markets (73.2%) was higher than Aboard markets (25%) and who don't know the source of it (44.4%). In contrast with the percent of good quality among aboard markets, (75%) it was higher than local markets (26.8%).

The extended siege and blocking of borders for more than two years, and recently the uncontrolled smuggles through the borders with Egypt, over lauded the local markets with bad quality utensils, especially AlC.

Supervision from the local authority, municipality and ministry of national economy ministry on the markets can control the messy situating in our markets, in addition to the role of the NGOs like Consumer Protection association in increasing the awareness of community about the quality of utensils and in controlling the markets.

Concerning the manufacturing place, there were statistical significant difference between the quality of AlC with respect to place of manufacturing (X^2 =303; p value < 0.001). the

highest percent of bad quality AlC (74.5%) was manufactured in Gaza strip, while the lowest (20%) was manufactured in places other than Gaza or Egypt, while 57.5% of bad quality AlC manufactured in unknown places and 46% in Egypt.

Table (4, 16): Aluminum Cookware quality and it source

variables	Good quality		Bad quality		Total		X^2	P value
	No	%	No	%	No	%		
The source of aluminum cookware								
Local markets	45	26.8	123	73.2	168	100	322	**0.001***
Aboard markets	21	75	7	25	28	100		
Don't know	35	55.6	28	44.4	63	100		
Manufacturing place of aluminum cookware								
Gaza	25	25.5	73	74.5	98	100	303	**0.001***
Egypt	27	54	23	46	50	100		
Others	4	80	1	20	5	100		
Don't know	45	42.5	61	57.5	106	100		

* Statistically significant

This result reflects the bad impact of the extended siege on all economical fields especially the industrial filed. Demolitions of the remaining manufactures during the last Israeli war against Gaza increase for adobe dabble. The siege and boarders closure results in depleted of industrial row material, which open the door wildly for using low quality material for AlC production. More over the quality of Egyptian AlC was not in good quality, this may be due. Also it is noticed that half of the participants don't know the manufacture place or the source of their utensils, effort must be done to and increase the awareness of the hazard of using bad quality AlC by health education. The responsibility of this mission lying on the burden of local community organization, media and the national authority represented by ministry of health and the national ministry of economy.

4.2.3 Factors related to the level of serum aluminum

4.2.3.1 Serum aluminum level and family life condition variables.

As shown in table (4.17), there were statistically significant differences between the family income and the SAL (X^2 =28.2; p value < 0.001), from the results it is clear that, the percent of children with high and risky level of SAL(>60 µg/ L) among

absolutely poor families (28%) was higher than families above the poverty line (4.3%), also the percent of children with normal SAL(<20 µg/ L) among absolutely poor families (21.7%) was lower than families above the poverty line (69.6%).

The results of this study shows that, no statistically significant differences between participants governorates, nor area of residency, nor hose owner, nor type of family, nor father and mother age (p value 0.1, 05, 0.9, 0.1, 0.7, 0.8 retrospectively). Also no statistically significant differences with type of drinking water and type of water used in preparing food (p value 0.3, 0.5 retrospectively).

Table (4.17) :Serum Aluminum Level and family life condition variables.

variables	Normal		Moderate		High		X^2	P value
	No	%	No	%	No	%		
Governorate								
North	28	29.5	38	40	29	30.5	7	0.1
Gaza	31	30.7	52	51.5	18	17.8		
Khanyouns	19	21.1	46	51.1	25	27.8		
Area of residency								
Inside camp	38	29.9	56	44.1	33	26	1.2	0.5
Out side camp	40	25.2	80	50.3	39	24.5		
House owner								
Owner	67	27.5	115	47.1	62	25.4	0.12	0.9
Rent	11	26.2	21	50	10	23.8		
Family type								
Nuclear	48	26.5	81	44.8	52	28.7	3.3	0.1
Extended	30	28.6	55	52.4	20	19		
Family income								
Absolutely poor	38	21.7	88	50.3	49	28	28.2	**0.001***
Relatively poor	11	35.5	16	51.6	4	12.9		
Above poverty line	16	69.6	6	26.1	1	4.3		
Don't know	13	22.8	26	45.6	18	31.6		
Type of drinking water								
Filleted out side home	51	27.6	88	47.6	46	24.9	6.9	0.32
home Filleted water	7	35	11	55	2	10		
municipality	17	24.6	34	49.3	18	26.1		
Well	3	25	3	35	6	50		
Type of water used in preparing food								
Filleted out side home	52	29.4	84	47.5	41	23.2	5.2	0.5
home Filleted water	3	25	8	66.7	1	23.2		
municipality	22	24.7	40	44.9	27	30.3		
Well	1	12.5	4	50	3	37.5		

* Statistically significant

The poorest families are more exposed to high levels of environmental Al than the other families regarding the economical situation. One of the important sources of this exposure is bad quality AlC, which are the most frequent and available for this category of population in Gaza strip, other sources are drinking water but in this case and because of the wide using of filtered water this source has not significant effect. The bad economical and environmental situation in Gaza strip deletes any differences between area of residency or type of family. Dissemination of awareness and knowledge about hazard of exposure to Al specially AlC through all population groups, and educates them about the way of protection even if they can not pay more money for buying utensils.

Saudi study found that there were statistically significant differences between SAL and area of residency (Al Salleh, & Shinwari, 1996).

4.2.3.2 Serum Aluminum Level and parents characteristics.

Considering the education level of the children parents, table (4.18) shows that, there were statistically significant differences between SLA and father education level (X^2 =11.9; p value < 0.01). It is illustrated that, among high SLA (>60 µg/ L), the percent of high education level >12 years was lower (18.5%) than education level <9 years (24.4%). while percent of normal SLA< 20 µg/ L was higher (40.7%) in education level > 12 years than low education level (20.9%) and moderate level education (22.7%).

Among the relation with mother education level, there were a differences between SAL and mother education level and this differences reach the statistically significant level (X^2 =18.9; p value < 0.01). It is obvious that, among high SLA (>60 µg/ L), the percent of low education level <9 years was (35.4%) higher than education level >12 years (16.6%). while percent of normal SLA< 20 µg/ L was higher (39%) in education level > 12 years than low education level (12.5%) and moderate level education (32.8%).

Table (4, 18): Serum Aluminum Level and selected socio-demographic variables

variables	Normal		Moderate		high		X^2	P value
	No	%	No	%	No	%		
Father age								
Less than 25 years	8	25.8	17	54.8	6	19.4	2	0.7
From 25 to 35 Yrs	50	27.9	86	48	43	24		
More than 35 Yrs	20	26.3	33	43.4	23	30.3		
Father education level								
Less than 9 years	18	20.9	47	54.7	21	24.4	11.9	**0.01***
9-12 years	27	22.7	56	47.1	36	30.3		
More than 12	33	40.7	33	40.7	15	18.5		
Father occupation status								
Working	65	33.9	89	46.4	38	19.8	16.1	**0.001***
Not working	13	13	47	50	34	36.2		
Mother age								
Less than 25 years	36	26.5	63	46.3	37	27.2	1.5	0.8
From 25 to 35 Yrs	31	26.3	58	49.2	29	24.6		
More than 35 Yrs	11	34.4	15	46.9	6	18.8		
Mother education level								
Less than 9 years	12	12.5	50	52.1	34	35.4	18.9	**0.001***
9-12 years	43	32.8	61	46.6	27	20.6		
More than 12	23	39	25	42.4	11	16.6		
mother occupation status								
Working	21	41.2	21	41.2	9	17.6	6.3	**0.04***
Not working	57	24.3	115	48.9	63	26.8		

* Statistically significant

Concerning to the relationship between father and mother occupational status and child's SAL. There were statistically significant differences between child's SAL and father and mother occupational status (X^2 =16.1; p value < 0.01, X^2 =6.3 p value <0.04 retrospectively).

It was noticed that the percent of not working fathers and mothers for the high SAL >60 µg/ L were (36.2%, 26.8% retrospectively) and it were higher than working father and mother (19.8%, 17.6 %). While the percent of working fathers and mothers for the normal SAL < 20 µg/ L were (33.9%, 41.2% retrospectively) and it were higher than not working father and mother (13%, 24.3 %)

This relation between education level and occupation status of parents and children SAL may be as a result of the relation between using bad quality AlC and education level and occupation status of parents.

4.2.3.3 Serum Aluminum Level and children characteristics.

Table (4, 19) shows that, there were statistically significant differences between SAL and child age (X^2 =7.6; p value < 0.02). The percent of children aged 25-36 months regarding high SAL >60 µg/ L was higher (32.8%) than children aged 12-24 months (19%). And the percent of children aged 12-24 months regarding high SAL < 20 µg/ L was higher (31%) than children aged 12-24 months (22.7%). While there were no statistically difference between SAL and gender.

With child age advancement, child expoused more and more to the surrounding hazard such as to exposure to Al mainly for ALC More age, more exposure to Al, increasing the SAL. More over, the children aged 25-24 months, usually feeds on regular family foods, which prepared in AlC and, and as consequences of these factors, there was difference between the two groups. But Pakistan's study found that there was no relation between adult age and SAL (Ghori,& Yaqb, 1999).

Table (4, 19) Serum Aluminum Level and children characteristics

variables	Normal		Moderate		high		X^2	P value
	No	%	No	%	No	%		
Child gender								
Male	34	24.5	66	47.5	39	28.1	1.6	0.4
female	44	29.9	70	47.6	33	22.4		
Child age								
12-24 months	49	31	79	50	30	19	7.6	**0.02***
25-36 months	29	22.7	57	44.5	42	32.8		
Child recent weight								
Under weight	1	2.6	22	57.9	15	39.5	20.2	**0.001***
Normal weight	71	29.7	112	46.9	56	23.4		
over weight	6	66.7	2	22.2	1	11.1		
Age of adding food								
Less than 6 months	25	28.4	41	46.6	22	25	.08	0.9
More than 6 months	53	26.8	95	48	50	25.3		

* Statistically significant

In the other hand the same level of exposure upon male and females, erase the difference with gender. This results consistent with Saudi study, found that there were no statistical differences between primary school pupils SAL and gender (Al Salleh, & Shinwari, 1996).

Regarding the relationship between child recent weight and SAL, there were statistically significant differences between normal weight, underweight and over weight children with high SAL (X^2 =20.2; p value < 0.001). Under weight children were the majority (39.5%) of children with SAL >60 µg/ L, and their percent were higher than normal weight (23.4%) and over weight children (11.1%). While over weight children constrict the majority (66.7%) of children with normal SAL < 20 µg/ L and under weight the minority (2.6%).

Regarding to these results, it's clear that, there were a consistent relation between food and SAL which may be reflected the relation between SAL and using AlC especially bad quality one in cooking foods.

The relation between SAL and children recent weight, may be reflect the relation of anemia resulted form elevated SAL and malnutrition among children, this relation opened the eyes on a suspected relation between malnutrition and SAL elevation and may be with using bad quality AlC.

4.2.3.4 Serum Aluminum Level and anemia

Table (4, 20) shows that, there were highly statistically significant differences between Serum Al mean and Hb status among children (t =9.8; p value < 0.001). Within anemic children, Serum Al mean was higher (48.85µg/ L) than not anemic children (29.45µg/ L), and SD among anemic children was 16.43 µg/ L, and it was16.92 µg/ L for not anemic children.

Table (4, 20): Serum Aluminum Level and anemia

Variable	number	mean	SD	Mean differences	t	P value
Anemic	134	48.85	16.43	19.3	**9.8**	**0.001***
Not anemic	152	29.45	16.92			

- Statistically significant

These results supported by the regression test, which examines the correlation between SAL as independent factor and Hb level as dependent factor. The findings indicated that there was negative correlation between SAL and Hb level (F = 168.9, < P value 0.001) as shown in figure (4. 8). The regression equation which represent the correlation between the two variables was Y= 11.82+ (-0.035) X, where Y represents the HB level and X represents the SAL.

This equation reflects that the increase 1% of SAL in blood leads to decrease 0.035 mg/dl of Hb in blood.

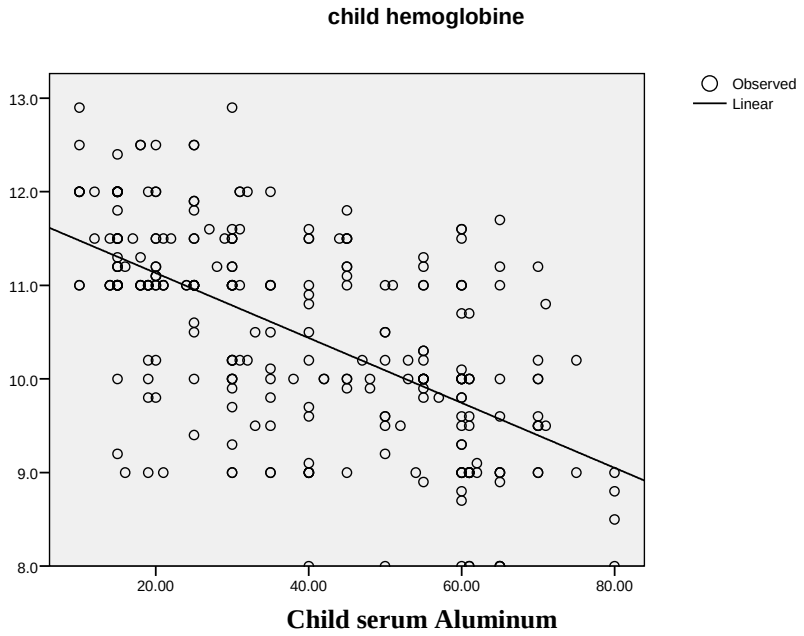

Figure (4, 8): Scatter graph demonstrates the relationship between serum aluminum level and hemoglobin level.

4.2.4 Anemia and using Aluminum Cookware

Table (4, 21) demonstrated the differences between anemia and exposure to AlC. There were differences between the percent of using bad quality AlC, good quality AlC with anemia. The majority of anemic children their families used bad quality AlC (70.3%) and this percent was higher than good quality AlC (17.8%), but there were no differences between good quality AlC and who don't have AlC. While the majority of not anemic children (82.2%) their families used good quality good quality AlC or don't have AlC (81.5%), while 29% used bad quality good quality AlC. These differences reach the statistically significant level (X^2= 77.6, p value <0.001).

Table (4, 21) relationship between anemia and using bad quality Aluminum Cookware

Variables	Anemic		Not anemic		X^2	P Value
	No	%	No	%		
Exposure to Aluminum cookware according to its quality						
Don't have	5	18.5	22	81.5	77.6	**0.001***
Good quality	18	17.8	83	82.2		
Bad quality	111	70.3	47	29.7		

* Statistically significant

These results consistent with other observations and studies, which indicate that Al is responsible of microcytic anemia by interfering with iron absorption and synthesis of Erythropioten (Tesleem, & Amal, 1999; Vittori, *et al*., 1999; Grutzmacher, 1991; Sibmooth, *et al*., 2000; Becaria, *et al*., 2006).

4.2.5 Controlling confounders among the study population

The current studies regarded one of the studies in which many confounders could affect the reliability of the results e.g. Socio- demographic and parent characteristics variables. However, Bivariate logistic regression was performed using logistic regression, and the researcher divided the variables into groups (socio demographic, SAL), then combined the socio demographic factors in one model to reach the final factors.

Table (4, 22) showed the child and family factors that remained statistically significant among all the other significant factors related to anemia when all entered the logistic regression model. However, strength of association was clear with, SAL, mother education, family income and father education.

Table (4, 22) logistic regression of family and child variables

variables	Odds ratio	95% confidence interval	P value
Serum aluminum level	.94	.926 - .955	**.000**
Father education	1.08	1.003-1.17	**.042**
Mother education	1.178	1.079-1.286	**.000**
Family income	1.001	1 - 1.001	**.003**

When combined with in one model, as shown in table (4, 23) the only significant factor was SAL (OR=0.939, CI= 0.921 - 0.957, P= 0.000). So the only important independent factor with anemia among children was SAL.

Table (4.23) logistic regression of combined variables

variables	Odds ratio	95% confidence interval	P value
Serum aluminum level	.939	.921 - .957	**.000**
Father education	.979	.878 - 1.091	.699
Mother education	1.076	.954 - 1.212	.232
Family income	1.000	.999 - 1.000	.635

The researcher believed that, more research in this filed is needed to uncover the ambiguity of the relationship between using bad quality AlC and anemia and other adverse health effects.

Chapter 5:

Conclusion and Recommendations

This chapter explains the study conclusions that are drown from the study and the recommendations made to protect the community from exposure to Al hazard.

5.1 Main conclusions

In spite of different campaigns of iron and foliate supplementation, anemia prevalence among Palestinian population is still very high especially in women and children. During processing of foods and storage in AlC and a considerable amount of Al leached into food. Al considered as a potential toxic metal and the over dos of Al may lead to three serious types of disorders: Al- induced bone disease, microcytic anemia and encephalopathy. Yet a little known about the relationship between anemia and using AlC especially bad quality one.

The study was conducted to assess the relationship between anemia, and using AlC, especially bad quality AlC, among children 1-3 years old, in Gaza governorates. It is also conducted in order to assess other relation affected the level of serum Al.

A descriptive, quantitative, analytic, cross sectional design was conducted; three stages stratified random sampling approach used in this study, the first stage aimed to select randomly three governorates from the five governorates. The second stage aimed to select large and small clinics according to UNRWA classification-randomly from each governorate. Finally, from each health center being randomly selected the participants were randomly selected from a sampling frame. The sample consisted of 350 children comprising those who attended the wall baby clinic and who met the inclusion criteria.

A face-to-face interviewed questionnaire was introduced for 350 Childs guardians in the well baby clinic of which child age 12-36 month. A structural closed ended questionnaire was used as the data collection instrument, in addition to measuring the

child's hemoglobin concentration and child's serum Al level. A data collection analysis of data was done using SPSS.

The study results showed that, 48.3% of children were anemic (Hb <11 g/dl), Hb mean was 10.4 g/dl, median 10.8 g/dl and SD 1.09 g/dl. The mean of serum AL was 38.5 µg/ L, median 35 µg/ L, SD 19.2 µg/ L. About 25.2% of children have SAL at dangers level (> 60 µg/ L), while 47.6% have moderate elevation of SAL 20-60 µg/ L, but 27.3% was in normal level(<20 µg/ L). The significant factors associated SAL were child age (X^2 =7.6; p value = 0.02), recent type of child food (X^2 =9.3; p value = 0.009). While gender and age of adding food has not any statistically differences. In the other hand, family income, educational and employment status of the parents were statistically different, but area of residency, house owner, and father and mother age has not statistically significant differences.

The researcher found that, there were highly statistically significant differences between differences between Serum Al mean and Hb status among children (t =9.8; p value < 0.001). Within anemic children, Serum Al mean was higher (48.85µg/ L) than not anemic children (29.45µg/ L). This relation expressed by the negative correlation between SAL and Hb concentration (F = 168.9, < P value 0.001). The equation reflects that the increase 1% of SAL in blood leads to decrease 0.035 mg/dl of Hb in blood.

Also there were positive relation between anemia prevalence and using bad quality AlC(X^2= 77.6; p value <0.001), The majority of anemic children their families used bad quality ALC (70.3%) and this percent was higher than good quality AlC (17.8%), but there were no differences between good quality AlC and who don't have AlC.

Bivariate analysis was carried out using logistic regression in order to control the confounders, the child and family factors that remained statistically significant among all other significant factors related to anemia when all entered the logistic regression model were SAL, mother education, family income and father education, When combined with

in one model the only significant factor was SAL (OR=0.939, CI= 0.921 - 0.957, P= 0.001).

Results indicate that, most of families have AlC in their kitchen (89.2%), stainless steel (27.6%), non- stick (23.4%), glass (9.1%), and coated iron (4.2%) also existed in the same houses , the most available kind for preparing foods was Al (81.5%), followed by stainless steel 11.9%, and non- stick 6.6%. For saving foods 68.5% of families used plastic utensils, and 62.2% have AL utensils, the other kinds Stainless steel, non- stick, Glass, Coated iron (20.6%, 14.7%, 7%, 2.1% retrospectively), the most kinds of utensils used in saving food was plastic utensils (43%), followed by AL (39.9%), and Stainless steel, non- stick ,Glass, Coated iron (8.4%, 4.2%, 3.1% , 1.4 % retrospectively). About 61.1% of families declared that AlC was in bad quality, while only 38.9% said it is a good quality.

Also results show statistically significant differences between AlC quality and family income, (X^2 =34; p value <0.001), and father education level (X^2 =12.8; p value < 0.01), father occupational status(X^2 =11.6; p value < 0.003), mother education level (X^2 =12.1; p value < 0.01) mothers occupational status(X^2 =14.9; < 0.001)**.** While the results shows no statistically significant differences between governorates, or hose owner, or type of family.

Family income is the major determents for choosing the cookware among the Gazans families, even if they know that AlC.

It has been observed that, there were statistically significant differences between AlC quality and its source that the higher percent of quality AlC was among the local markets (X^2 =322; p value < 0.001). Concerning the manufacturing place, there were statistical significant difference between the quality of AlC with respect to place of manufacturing (X^2 =303; p value < 0.001). The highest percent of bad quality AlC was manufactured in Gaza strip.

The results showed that, the changes on utensils after regular use in preparing and saving food were, 24.6% colure changes, loss of its brightness, and the colure tuned to dark

colure, 15.1% difficulty in cleaning, 13.2% leaching into food, 10.1% hardness loss and 36.7% mixed changes.

The majority of knowledge scores were less than 50%, which reflect low knowledge among populations study groups. Only (29.7%) of guardians knew that Al can enter our body due to using AlC during food processing , while (26.6%) of them knew that the same thing can happened when foods saved in AlC, but only (24.1%) of them knew that exposure to aluminum can cause adverse effect on human health. Of the respondents, (17.1%) understood that exposure to Al has a relationship with anemia, (16.1%) with bone disease, and 22.4% with neurorgenic disorders. Among the respondents (12.6 %, 19.2%, and 11.2%) have knowledge that toothbrush contain AL, while of respondents have knowledge that anti acids contain AL, deodorants, baking powder, 10.8% cosmetics.

5.2 Recommendation

Protection children from anemia occupied an important position in national priorities; greater efforts done in this filed from different health sectors, but unfortunately anemia still in its high prevalence. The relationship between anemia and using AlC which had been observed in this study increased the necessity of more effort for protection children from Al hazard.

In this chapter, the researcher suggested some recommendations that could be helpful in improving children nutritional status and protect them from Al hazard.

- Coordination and co-operation between different governmental authorities (ministry of economic, municipalities) and NGOs (local committees, customer's protection association) in monitoring the local markets regarding the bad quality AlC.

- Development of roles and regulations from the local authorities for monitoring and supervision of the local manufactures, which aimed to protect the customers from commercial cheating and from AlC hazard.

- Empowerment the participation role of NGOs like Customer protection association and local organizations in monitoring the local markets, in order to protect the customers.

- Policy and commitment from decision-makers with definite protocol and sufficient budget allocation for food fortification that improve the overall health and nutrition status of all Palestinian population specially children.

- Development of the Iron supplementation programs among children, in order to increase the compliance rate of taking iron supplementation, more over new and innovative strategies are needed, particularly those that improve the overall health and nutrition status of children.

- Parents should be provided with minimum and easily understandable information towards increasing parent's awareness and influence their perceptions about the benefits of iron supplements to their children .

- Training of trainers, on counseling skills, identification and utilization of effective communication tools (channel and messages) to create awareness among the Al hazards.

- Because of the low level of knowledge about the Al exposure and its adverse effects, a wide-scale education programmers should be targeted to all family members specially house wife's ; these programmers should be carried out in schools, in the community and through the mass media.

Recommendation for future studies

- According to the limited time and recourses of the study, the researcher studied one side of adverse effect of exposure to AL, so the researcher recommend for other comprehensive studies to explore these other relations.
- Experimental research to examine the effect of Al on human body.
- To carry out much larger multicenter studies to define the risk factors related to exposure to Al.
- Using more advanced technology like atomic absorption in detection in Al detection among different groups of population.

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Annexes

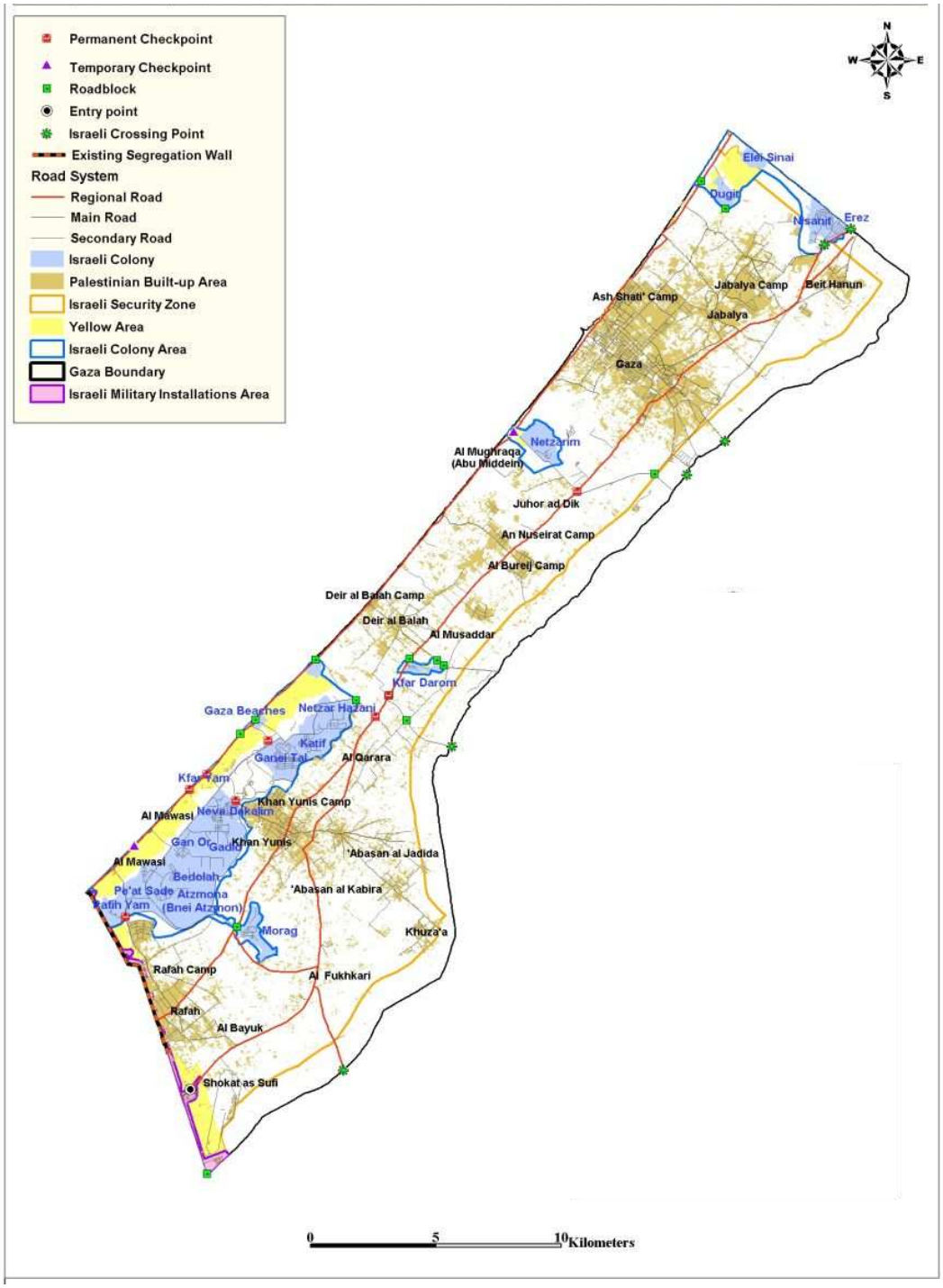
Annex 1

Map of Palestine

Source:PCBS

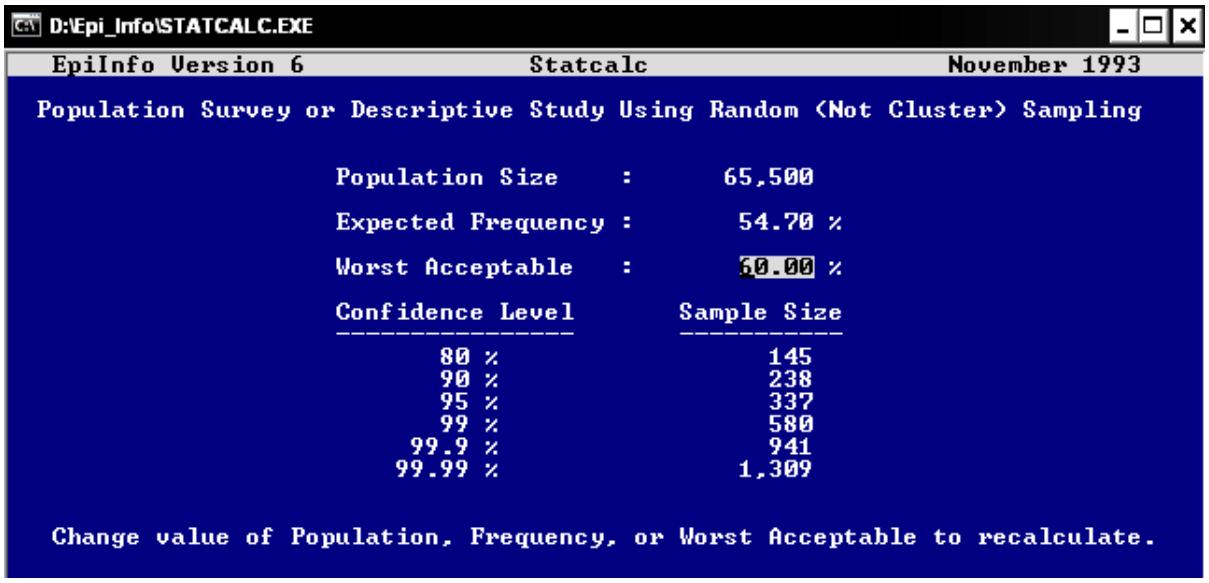
Annex 2

Map of Gaza Strip



Source:paldf.net

Annex: 3
Sample size by Epi -info



Annex: 4

Helsinki Committee approval

Palestinian National Authority
Ministry of Health
Helsinki Committee

السلطة الوطنية الفلسطينية
وزارة الصحة
لجنة هلسنكي

التاريخ2009/6/3

Name:

الاسم: كمال عيسى إسماعيل حمو

I would like to inform you that the committee has discussed your application about:

نفيدكم علماً بأن اللجنة قد ناقشت مقترح دراستكم حول:-

Relationship between Anemia and Aluminum Uptakes from Aluminum. Cookware among Palestinian Children in Gaza Governoratets,2009

In its meeting on June 2009
and decided the Following:-
To approve the above mention research study.

و ذلك في جلستها المنعقدة لشهر 6 2009
و قد قررت ما يلي:-
الموافقة على البحث المذكور عاليه.

Signature
توقيع

Member
عضو

Member
عضو

Chairperson

Ministry of Health Helsinki Committee

Conditions:-

- Valid for 2 years from the date of approval to start.
- It is necessary to notify the committee in any change in the admitted study protocol.
- The committee appreciate receiving one copy of your final research when it is completed.

Annex 5

UNRWA Field Office/Gaza permission letter

بسم الله الرحمن الرحيم

Al-Quds University
Jerusalem
School of Public Health

جامعة القدس
القدس
كلية الصحة العامة

التاريخ: ٢٠٠٩/٧/١٢

جضرة الاخ/ د.محمد المقادمة المحترم
مدير برامج الصحة بوكالة الغوث UNRWA
تحية طيبة و بعد ،،،،

الموضوع: مساعدة الطالب كمال عيسى حمو

وزعت على جميع العيادات

يقوم الطالب المذكور بعاليه باجراء بحث بعنوان :

Relationship between Anemia and Aluminum Uptake from Aluminum Cookware among Children in Gaza Governorates.

كمتطلب للحصول على درجة الماجستير في الصحة العامة – مسار وبائيات وعليه نرجو التكرم بالايعاز لمن ترونه مناسب لتسهيل مهمة الطالب في جمع البيانات اللازمة العيادات و المراكز الصحية التابعة لوكالة الغوث .
علما بان المعلومات ستكون لغرض البحث العلمي لدى الطالب و الجامعة فقط وسنطلعكم على النتائج في حينها..

شاكرين لكم حسن التعاون
و اقبلوا فائق الاحترام و التقدير

د. بسام أبو حمد
منسق عام برامج الصحة العامة

نسخة :
الملف

Jerusalem Branch/Telefax 02-2799234
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ص.ب. ٥١٠٠٠ القدس

Annex 6

School of Public Health
كلية الصحة العامة
جامعة القدس **القدس– فلسطين**

أخي /أختي المحكم/ة.....:

نشكر مشاركتك بوقتك الثمين في إبداء الرأي وتحكيم هذه الاستبانة، فهذه المشاركة ستساهم في إتمام دراستي في دراسة العلاقة بين فقر الدم عند الأطفال و الالومنيوم الذي يدخل للجسم من استخدام أواني الالومنيوم في محافظات غزة.

والتي ستقدم كأطروحة لنيل درجة الماجستير في الصحة العامة - وبائيات- التابع لجامعة القدس-.أبود يس الغرض من الدراسة.

و يهدف البحث لقياس العلاقة ما بين فقر دم الأطفال و الالومنيوم الذي يدخل الجسم من استخدام أواني الالومنيوم وذلك بهدف وضع بض التوصيات خاصة عند صناع القرار فيمل يعود بالنفع علي صحة الأطفال.

"Relationship between Anemia and Aluminum Uptake from Aluminum Cookware among Children in Gaza Governorates."

أهداف الدراسة:

1. To examine the relationship between anemia and serum aluminum.
2. To assess the relationship between anemia and using ALC in Gaza governorates.
3. To estimate the serum aluminum mean among the children1-3 years old.
4. To explore the prevalence of using ALC in Gaza governorates.
5. To assess the population knowledge about the ways of exposure to aluminum, and the hazard of aluminum uptake.
6. To conclude recommendations that could help protecting the Palestinian people from AL hazard.

الإجراءات:

1. تحليل مستوي الدم عند الأطفال
2. تحليل مستوي الالومنيوم في الدم عند الأطفال
3. استبانة تستخدم لمعرفة مدي تأثير استخدام الأواني المصنوعة من الالومنيوم علي صحة الأطفال و مدي المعرفة لدي الأسرة بمخاطر الالومنيوم

ولكم جزيل الشكر

كمال حمو

Annex:7

Consent Form

Number: ----------

Date: 1 / 9 / 2009

Relationship between Anemia and Aluminum Uptake from Aluminum Cookware among Children in Gaza Governorates.

Dear participant,

Kindly I would like to inform you that your child have been selected to be part of my research study "**Relationship between Anemia and Aluminum Uptake from Aluminum Cookware among Children in Gaza Governorates.** as part of the requirement for Master degree Program organized by Al-Quds University- Public health Program. Your facility has been thoroughly selected as a source of data by filling a well and comprehensive questionnaire, and taking blood sample for that purpose. All the information given from your side and the result from your sample are top confidential and will be used to asses the Relationship between aluminum uptakes from aluminum cookware, and anemia in Gaza governorates, 2009. Participation is greatly appreciated and no information given would be used against you whatsoever.

For more information and follow up the results you can contact with

Mobil 0599717282

e-mail kmalhamo@hotmail.com

Thanking you in advance for your cooperation.

Best Regards.

The researcher

Kamal Hamo

Annex :8

Questionnaire
Interview questionnaire form

I- sociodemographic data

1- Date / / 2009

2- Serial number _____

3- Child age_____months

4- Date of birth / /

5- Name_____

6- Gender ☐ 1-male ☐ 2- female

7- Governorate ☐ 1- North ☐ 2- Gaza ☐ 3-Midle zone

☐ 4- khanyons ☐ 5- Rafah

8- Clinic name :_____

9- Area of residency ☐ 1-Inside camp ☐ 2-Outside camp

10- Type of house owner ☐ 1-rent ☐ 2- personal owned

☐ 3- family owned ☐ 4-others

11- If other specify_____

12- Source of water for drinking ☐ 1- well ☐ 2-municipality ☐ 3- out filter ☐ 4- home filter

13- Type of water pipes used in your home ☐ iron ☐ aluminum ☐ plastics ☐ Don't know

14- Family type ☐ 1- nuclear ☐ 2- Extended

39

15- Father age :_____year

16- Father education _____ years

17- Father Occupation ☐ 1- employee ☐ 2-skiled worker ☐ 3-not skilled worker ☐ 4- not working

18- Mother age _____year

19- Mother education _____year

20- Mother work status ☐ 1-Working ☐ 2-Not working

21- Child order in the family _____

22- 20- monthly family income _____NIS

II child health status

23 Birth weight ☐ 1- LBW ☐ 2- Normal ☐ 3- over weight

24- Gestational age ☐ 1- premature ☐ 1-Full term ☐ 2- post term

25- Child recent weight

☐ 1-Normal ☐ 2-underweight ☐ 3-Over weight

26- Type of feeding ☐ 1- weaned ☐ 2-mixed ☐ 3-Brest feeding

27- Age of adding food _____month

28- Type of added food ☐ 1-cereal ☐ 2-cooked foods

☐ 3-Not cooked

29- If cooked food ,child food is ☐ 1-Family food ☐ 2-Special food

30- If special , specify it _____

31- Type of water used in child food processing

☐ 1- well ☐ 2-municipality ☐ 3- home filter

☐ 4-out filter ☐ 5-bottles ☐ 6- others

32- If others specify _____

33- Child hemoglobin _____ g/dl

34- Child serum aluminum _____ μ g/L

35- During the last 3 months, did your child received any iron supplementation?

☐ 1- Yes ☐ 2-No

36- If the answer yes, did the hemoglobin improved with iron supplementation?

☐ 1- Yes ☐ 2-no ☐ Don't know

37- Did your child suffered from any chronic disease?

☐ 1- yes ☐ 2-No

38- If yes specify_____

39- Did your child take any medications continuously in the past one month ?

☐ 1- Yes ☐ 2-No

40- If yes specify_____

41- Dose your child drink tea? ☐ 1- Yes ☐ 2-No

42- If yes ,how many time daily? _____

43- Mother hemoglobin ☐ Anemic ☐ Not anemic

44- Any brothers or sister have been suffered from anemia?

☐ 1- Yes ☐ 2-No

(if no skip to question 47)

45- If yes , how much they _____

46- Did they receive iron supplementation?

☐ 1- Yes ☐ 2-No

47- If yes, Did there hemoglobin level improved?

☐ 1- yes ☐ 2-No ☐ 3-Don't know

III The types and source of utensils which used in food processing and saving.

48- Do you have following cookware in your kitchen?

type	Yes	No
Glass		
Iron		
Cooper		
Tefal		
aluminum		
Stainless Steel		

49- What is the most available type of cookware in your kitchen?

☐ 1-Glass ☐ 2- iron ☐ 3-Cooper

☐ 4- tefal ☐ 5 aluminum ☐ 6- Stainless Steel

50- Do you use following cookware(if available) in proceeding food in your kitchen?

type	Yes	No
Glass		
Iron		
Cooper		
Tefal		
aluminum		
Stainless Steel		

51- What is the most type of cookware you use in food cooking?

☐ 1-Glass ☐ 2- iron ☐ 3-Cooper

☐ 4- tefal ☐ 5 aluminum - ☐ 6- Stainless Steel

52- Do you use following cookware(if available) in saving food?

type	Yes	No
Glass		
Iron		
Cooper		
Tefal		
aluminum		
Stainless Steel		
plastic		

53- What is the most type of cookware you use in saving foods?

☐ 1-Glass ☐ 2- iron ☐ 3-Cooper

☐ 4- Tefal ☐ 5- aluminum ☐ 6- Stainless Steel

☐ 7- plastic

(if you have not aluminum cookware in your kitchen, skip to question 69)

54- What is the source of the aluminum utensils?

☐ 1-Local market ☐ 2-out boarders ☐ 3-don't know

55- your aluminum utensils made in

☐ 1-Gaza ☐ 2-Egypt ☐ 3-don't know

☐ Others

56- If answer other specify _____

57- Why do you choose aluminum utensils?

☐ 1-The only available one in the market

☐ 2- cheap ☐ 3-Don't know

58- Do you think your aluminum utensils are good quality?

☐ 1- yes ☐ 2-no

(if yes ,skip to question 69)

59- How do you decide that your utensils are in bad quality?

☐ 1- Color change ☐ 2- leaching

☐ 3- difficult in cleaning ☐ 4- mixed

☐ 5- loss its hardness ☐ 6- others

60- Why do you think that your utensils are in bad quality?

☐ 1-absence of governmental monitoring ☐ 2-seag

☐ 3- commercial cheating ☐ 4-Don't know

61- Do you notice any change in food during preparing foods in aluminum utensils?

☐ 1- Yes ☐ 2-No

62- If yes. Where did you notice that?

☐ 1-color ☐ 2- taste ☐ 3- texture

☐ 4-mixed ☐ 5- others

63- If other , specify_____

64- During washing and rinsing aluminum utensils, do you notice any change in the utensils?

☐ 1- Yes ☐ 2-No

65- If yes. Where did you notice that?

☐ 1-Colo ☐ 2- surface ☐ 3- mixed

☐ 4- others

66- If other , specify_____

67- During preparing food, did you notice any extra effect foods on aluminum utensils?

☐ 1- Yes ☐ 2-No

68- If yes. What kinds of foods?

☐ 1-Tomato ☐ 2-Boiling water ☐ 3- Frying

☐ 4- mixed ☐ 5- others ☐

69- If other , specify_____

70- type of utensils for preparing child foods

☐ 1- special utensils ☐ 2- family utensils

71- if special ones specify the type_____

72- Type of utensils for saving child foods

☐ 1- special utensils ☐ 2- family utensils

73- if special ones specify the type_____

43

III- The knowledge of family about the hazard and the effect of using aluminum cookware, especially locally manufactured ones.

74- Do you think that using aluminum cookware in food processing can enter your body?

☐ 1- Yes ☐ 2- No 3- Don't know

75- Do you think that using aluminum cookware in food saving can enter your body?

☐ 1- Yes ☐ 2-No ☐ 3- Don't know

76- Do you think that exposure to over doses of aluminum from aluminum cookware has adverse effect on health?

☐ 1- Yes ☐ 2-No ☐ 3- Don't know

77- Can exposure to over doses of aluminum from aluminum cookware cause the following adverse effect on health?

Effect	Yes	No	Don't know
anemia			
Bone disease			
neurogenic			

78- According to your knowledge, dose the following foods and products contain aluminum

Product	Yes	No	Don't know
Tooth brush			
Antacids drugs			
deodorant			
baking powder			
Cosmetics			

79- According to your knowledge, what is the factor affecting the corrosion of aluminum

Factor	Yes	No	Don't know
Food type			
Food processing			
Quality of pots			

Thanks for your cooperation

Annex:9

استبانه

معلومات عامة

1- التاريخ / / 2009

2- الرقم المتسلسل _____

3- عمر الطفل _____شهر

4- تاريخ الميلاد / /

5- الاسم _____

6- الجنس ☐ 1- ذكر ☐ 2- أنثي

7- المحافظة ☐ 1- الشمال ☐ 2- غزة ☐ 3- الوسطي

☐ 4- خان يونس ☐ 5- رفح

8- اسم العيادة _____

9- مكان السكن ☐ 1- داخل المخيم ☐ 2- خارج المخيم

10- نوع المنزل ☐ 1- إيجار ☐ 2- ملكية خاصة

☐ 3- ملكية عائلية ☐ 4- أخري

11- إذا كانت الإجابة أخري و حدد/ي_____

12- مصدر مياه الشرب ☐ 1- بئر ☐ 2- بلدية

☐ 3- مفاترة من خارج المنزل ☐ 4- مفلترة في المنزل

13- نوع أنابيب المياه المستخدمة في المنزل ☐ 1- حديد ☐ 2- الومنيوم

☐ 3- بلاستيك ☐ 4- لا اعلم

14- نوع الأسرة ☐ 1- نووية ☐ 2- ممتدة

15- عمر الأب _____سنة

16- عدد سنوات تعليم الأب _____سنة

17- عمل الأب ☐ 1- موظف ☐ 2- عامل حرفي

☐ 3- عامل غير حرفي ☐ 4- لا يعمل

18- عمر الأم _____ سنة

19- عدد سنوات تعليم الأم _____سنة

20- عمل الأم ☐ 1- تعمل ☐ 2- لا تعمل

21- ترتيب الطفل بالأسرة _____

22- دخل الأسرة الشهري _____ شيكل

I- حالة الطفل الصحية

23- الوزن عند الولادة ☐ 1- ناقص الوزن ☐ 2- طبيعي ☐ 3- زائد الوزن

24- العمر الحملي ☐ 1- خديج ☐ 2- طبيعي ☐ 3- متأخر عن الموعد

25- وزن الطفل الحالي ☐ 1- ناقص الوزن ☐ 2- طبيعي ☐ 3- زائد الوزن

26- طبيعة غذاء الطفل ☐ 1- مفطوم كليا ☐ 2- مختلطة ☐ 3- رضاعة

27- عمر إضافة الغذاء الخارجي _____

28- الغذاء المضاف هو ☐ 1- حبوب ☐ 2- مطبوخ ☐ 3- غير مطبوخ

29- إذا كان الطعام مطبوخ فهل طعام الطفل من ☐ 1- طعام العائلة ☐ 2- طعام خاص

30- إذا كان خاص و حدد/ى_____

31- نوع الماء المستخدم في إعداد طعام الطفل

☐ 1- بئر ☐ 2 - بلدية ☐ 3- مفلترة في المنزل

☐ 3- مفلترة خارج المنزل ☐ 5- زجاجة معدنية ☐ 6- أخري

32- إذا كان اخري و حدد/ى_____

33- خضاب الطفل _____غرام/100 مل

34- مستوي الالومنيوم في مصل الطفل_____ مبكرو غرام /ليتر

35- خلال الثلاثة الشهر السابقة و هل تناول الطفل جرعات من الحديد الداعم؟

☐ 1- نعم ☐ 2- لا

36- إذا كانت الإجابة نعم, هل تحسن مستوي الخضاب عند الطفل؟

☐ 1- نعم ☐ 2- لا ☐ 3- لا اعلم

37- هل عاني طفلك من أي أمراض مزمنة؟ ☐ 1- نعم ☐ 2- لا

38- إذا كانت الإجابة نعم, حدد/ي_____

39- هل تناول طفلك أي دواء بشكل متواصل خلال الشهر الفائت ؟

☐ 1- نعم ☐ 2- لا

40- إذا كانت الإجابة نعم, حدد/ي_____

41- هل يتناول طفلك الشاي؟ ☐ 1- نعم ☐ 2- لا

42- إذا كانت الإجابة نعم, فكم مرة يوميا؟_____

43- خضاب الأم ☐ 1- فقر دم ☐ 2- طبيعي

44- هل عاني أي من إخوان الطفل من فقر الدم؟ ☐ 1- نعم ☐ 2- لا

(إذا كانت الإجابة لا, اقفز/ى لسؤال 47)

45- إذا كانت الإجابة نعم, حدد/ي العدد_____

46- هل تناولوا الحديد ☐ 1- نعم ☐ 2- لا

47- إذا كانت الإجابة نعم, هل تحسن مستوي الخضاب لديهم؟

☐ 1- نعم ☐ 2- لا ☐ 3- لا اعلم

II- نوع و مصدر الأواني المستخدمة في تحضير و حفظ الطعام

48- هل يوجد لديك الأواني التالية في مطبخك؟

نوع الآنية	نعم	لا
زجاج		
حديد		
نحاس		
تيفال		
الومنيوم		
ستنالس ستيل		

49- ما هو نوع الآنية الأكثر شيوعا في مطبخك؟(اختر نوع واحد فقط)

☐ 1-زجاج ☐ 2- حديد ☐ 3 -نحاس

☐ 4- تيفال ☐ 5 - الومنيوم ☐ 6- ستنالس ستيل

50- هل تستخدمين الآنية التالية (إذا توفرت في مطبخك) في إعداد الطعام ؟

نوع الآنية	نعم	لا
زجاج		
حديد		
نحاس		
تيفال		
الومنيوم		
ستنالس ستيل		

51- ما هو نو ع الآنية الأكثر استخداما في مطبخك لإعداد الطعام؟

☐ 1-زجاج ☐ 2-حديد ☐ 3-نحاس

☐ 4- تيفال ☐ 5 - الومنيوم ☐ 6- ستنالس ستيل

52- هل تستخدمين الآنية التالية (إذا توفرت في مطبخك) في حفظ الطعام ؟

نوع الآنية	نعم	لا
زجاج		
حديد		
نحاس		
تيفال		
الومنيوم		
ستنالس ستيل		
اليلاستيك		

53- ما هو نو ع الآنية الأكثر استخداما في مطبخك لحفظ الطعام؟

☐ 1- زجاج ☐ 2- حديد ☐ 3- نحاس

☐ 4- تيفال ☐ 5 - الومنيوم ☐ 6- ستنالس ستيل

☐ 7- اليلاستيك

(إذا لم يكن لديك انية الومنيوم و اقفز/ي لسؤال69)

54- ما هو مصدر آنية الالومنيوم في منزلك؟

☐ 1- السوق المحلي ☐ 2-من خارج البلاد ☐ 3-لا اعلم

55- آنية الالومنيوم لديك مصنعة في ؟

☐ 1- غزة ☐ 2- مصر ☐ 3- لا اعلم

☐ 4- أخري

56- إذا كانت الإجابة -أخري حدد/ي_____

57- لماذا اخترت أدوات الالومنيوم؟

☐ 1-الوحيدة المتوفرة ☐ 2- رخيصة ☐ 3-لا اعلم

58- هل تعتقد/ين أن آنية الالومنيوم خاصتك ذات نوعية جيدة؟

☐ 1- نعم ☐ 2-لا

(إذا كانت الإجابة نعم اقفز للسؤال رقم 60)

59- كيف قررت أن آنية الالومنيوم ذات نوعية سيئة؟

☐ 1- بعد الاستعمال تفقد لمعانها ☐ 2-تغير لونها

☐ 3- صعوبة تنظيفها ☐ 4- يحدث انحلال في الطعام

☐ 5- تفقد صلابتها ☐ 6- أخري

60- في اعتقادك, لماذا الآنية سيئة النوعية ؟

☐ 1-غياب الرقابة الحكومية علي التصنيع و الاستيراد ☐ 2- الحصار

☐ 3- غش تجاري ☐ 4- لا اعلم

61- أثناء إعداد الطعام في آنية الالومنيوم,هل لاحظت أي تغير في الطعام؟

☐ 1- نعم ☐ 2- لا

62- إذا كانت الإجابة نعم , أين لاحظت التغير ؟

☐ 1- في اللون ☐ 2- في المذاق ☐ 3- القوام

☐ 4- مختلط ☐ 5- أخري

63- إذا كانت الإجابة -أخري حدد/ي_____

64- أثناء تنظيف آنية الالومنيوم,هل لاحظت أي تغير ؟

☐ 1- نعم ☐ 2- لا

65- إذا كانت الإجابة نعم , أين لاحظت التغير ؟

☐ 1- اللون ☐ 2- نعومة السطح ☐ 3- الصلابة

☐ 4- مختلط ☐ 5- أخري

66- إذا كانت الإجابة -أخري حدد/ي_____

67- هل لاحظت أثناء إعداد الطعام زيادة في تأثير بعض المواد الغذائية علي أواني الالومنيوم ؟

☐ 1- نعم ☐ 2- لا

68- إذا كانت الإجابة نعم, ما هي هذه الأطعمة؟

☐ 1- بندورة ☐ 2- غلي الماء ☐ 3- الأحماض

☐ 4-البهارات ☐ 5- مختلط ☐ 6- اخري

69- إذا كانت الإجابة -أخري حدد/ي_____

70- ما هي نوع الآنية المستخدمة في إعداد طعام الطفل؟

☐ 1-آنية المنزل ☐ 2- آنية خاصة

71- إذا كانت خاصة و حدد/ى_____

72- ما هو نوع الآنية المستخدمة في حفظ طعام الطفل؟

☐ 1-آنية المنزل ☐ 2-آنية خاصة

73- إذا كانت خاصة و حدد/ى_____

III معرفة الأسرة عن مخاطر استخدام أواني الالومنيوم و تأثيره السلبي علي صحة الإنسان

74- هل تعتقد أن استخدام أواني الالومنيوم في إعدادا الطعام قد يؤدي إلي دخول الالومنيوم للجسم ؟

☐ 1- نعم ☐ 2- لا

75- هل تعتقد أن استخدام أواني الالومنيوم في حفظ الطعام قد يؤدي إلي دخول الالومنيوم للجسم ؟

☐ 1- نعم ☐ 2- لا

76- هل تعتقد أن التعرض لكميات كبيرة من الالومنيوم قد يعرض الإنسان للخطر لصحي؟

☐ 1- نعم ☐ 2- لا

77- إذا كانت الإجابة نعم, فأي تأثير ممكن أن يحدث؟

التأثير	نعم	لا	لا اعلم
فقر دم			
أمراض عظام			
تأثيرات عصبية			

78- هل تعتقد أن المواد التالية تحتوي علي كميات من الالومنيوم

المادة	نعم	لا	لا اعلم
معجون الأسنان			
مضادات الحموضة(مالوكس)			
مزيل العرق			
المواد الرافعة للعجين(بيكنج باودر)			
مواد التجميل			

79- بناء علي معرفتك, ما هي العوامل التي توثر علي انحلال الالومنيوم في الطعام؟

العامل	نعم	لا	لا اعلم
طبيعة الطعام			
طريقة إعداد الطعام			
نوعية الآنية			

شكرا لتعاونك معنا

ملخص الدراسة

يعتبر فقر الدم من أكثر الأمراض الغذائية انتشارا في العالم، بالغم من الحملات المتكررة بتزويد الأطفال و النساء أقراص الحديد و حمض الفوليك، إلا أن معدل انتشار فقر الدم مازال مرتفعا بشدة. يعتبر عنصر الالومنيوم من أكثر العناصر انتشارا في قشرة الأرض، و هو يستعمل بكثرة في صناعة الأواني المنزلية و في تغليف الأطعمة بسب خصائصه الفيزيائية ولرخص ثمنه نسبيا. يعتبر الالومنيوم من العناصر السامة للإنسان و الجرعات العالية منه قد تسبب العديد من الأمراض للإنسان من هذه الأمراض، أمراض العظام مثل لين العظام ، فقر الدم و الاعتلال الدماغي.

هدفت هذه الدراسة إلي تقييم العلاقة بين فقر الدم و استخدام أواني طهي الطعام المصنعة من الالومنيوم – خصوصا سيئة الصنع – عند الأطفال بعمر 1-3 سنوات في مراكز الرعاية الأولية التابعة لوكالة الغوث و تشغيل اللاجئين في محافظات غزة، و ذلك بهدف توفير المعلومات التي يمكن أن تساعد في تدعيم الحالة الغذائية للأطفال.

هذه الدراسة هي دراسة وصفية تحليلية قطعية، نفذت بالاختيار العشوائي ل 350 طفل من 5 مراكز صحية تابعة لوكالة الغوث و تشغيل اللاجئين بمحافظات غزة و ذلك باستخدام طريقة اختيار العينات المتعدد الطبقات، حيث تم عمل مقابلة شخصية مع الشخص الوصي علي الطفل في عيادة الأطفال الأصحاء وذلك عبر تعبئة استبيان تم إعداده بواسطة الباحث، وقد كان معدل الاستجابة 81.7%، بالإضافة إلي ذلك تم سحب عينة دم من كل طفل لعمل فحص نسبة الخضاب في الدم و نسبة الالومنيوم بالدم.

أظهرت نتائج الدراسة أن معدل انتشار الأطفال المصابين بفقر الدم بلغ 48.3% (نسبة الخضاب< 11 غرام /100مل)، و معدل تركيز الإلومنيوم بالدم كان 38.5 ميكروغرام /ليتر،و كانت نسبة الأطفال الذين بلغ عندهم تركيز الالومنيوم إلي الحد الخطر(>60 ميكروغرام/ليتر)25.2% . من العوامل المؤثرة في معدل تركيز الإلومنيوم في الدم معدل دخل الأسرة، درجة تعليم الوالدين والحالة الوظيفية للوالدين، بالإضافة عمر الطفل ،وزن الطفل الحالي و نوعية غذاء الطفل.

كما وأظهرت الدراسة و جود علاقة ايجابية بين معدل انتشار فقر الدم لدي الأطفال و مستوي تركيز *الالومنيوم* في الدم و قد اتضحت هذه العلاقة في العلاقة السلبية بين مستوي الخضاب و مستوي تركيز الإلومنيوم في الدم. كذلك الأمر في العلاقة بين معدل انتشار فقر الدم واستخدام مستوي تركيز الإلومنيوم سيئة الصنع، وقد استخدم الباحث تحليل الانحدار اللوجستي ثنائي المتغيرين بهدف لضبط عامل الالتباس وقد أظهرت النتائج أن مستوي تركيز الإلومنيوم هو العمل الوحيد المؤثر.

كما بينت الدراسة أن أكثر أواني الطهي انتشارا في المجتمع الغزي هي أوني الطهي المصنعة من *الالومنيوم(81.3%) ، وقد بلغت نسبة النوعيات السيئة 61.1%*، العوامل المؤثرة في اختيار هذه النوعية في إعدادا و حفظ الطعام مكان السكن، دخل الأسرة، مستوي تعليم الوالدين و الحالة الوظيفية للوالدين. إن غالبية المشتركين في الدراسة لديهم مستوي متدني جدا من المعرفة بخصوص الطرق التعرض للالومنيوم و النتائج الصحية السلبية المترتبة عن التعرض له.

و قد اقترحت الدراسة إن نشر الوعي و المعرفة والمعلومات عن مخاطر التعرض للالونيوم عن طريق استخدام أواني الالومنيوم سيئة الصنع قد يساهم في حماية المجتمع الغزي من هذه المخاطر، التأكيد علي المراقبة الفعالة و تدعيم الرقابة علي الأسواق المحلية و المصانع المحلية ، تعزيز فوائد استخدام الحديد لدي الأطفال.