

Deanship of Graduate Studies  
Al-Quds University



Salinity of Drinking Water and Its Association with Renal  
Failure in the Southern Part in the Gaza Strip

Eman Seleman Mokhamer

MPH Thesis

Jerusalem-Palestine

1430/2009

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Salinity Of Drinking Water And Its Association With Renal Failure In The  
Southern Part In Gaza Strip

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Jerusalem-Palestine

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## **Dedication**

To my father soul

To my mother

To my husband, sons, daughter,

To my sisters, brothers, and their wives

For their patient, endless support, encouragement and love.

## **Declaration**

I certify that this thesis submitted for the degree of Master is the result of my own research, except where otherwise acknowledged, and that this thesis (or any part of the same) has been submitted for a higher degree to any other university or institution.

Signed\_\_\_\_\_

Iman Seleman Abedallah Mokhamer

Date:

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## **Abstract**

The environment in the Gaza Strip suffers considerable strain. In particular, the shortage and the pollution of resources, coupled with a high population growth and the insufficient job opportunities have created many environmental problems. Groundwater is the only source of water in the Gaza Strip. More than 90% of the households are connected to the municipal ground water wells. Water salinity is a major problem which threatens the ground water in the southern part of the Gaza Strip. There are two sources of water in the southern part of the Gaza Strip; the municipal wells are currently used for all domestic purposes, and the Israeli Water Company "Makorot" which serves the eastern villages in Khanyounes Governorate. The overall water quality of the Makorot source is acceptable compared with the World Health Organization (WHO) guidelines. The overall aim of this study was to determine the salinity of drinking water and its association with renal failure in the southern part of the Gaza Strip. Another aim was to explore the relationships between renal failure and the socio-economic and demographic variables.

Descriptive, analytic design was used which included interviewing a sample of patients with renal failure. Face to face interviewed questionnaire were implemented. The sample consisted from 194 subjects and the response rate was 70%. Reliability was assessed by Cronbach Alpha test and the validity were ensured by the content and face validity methods. Analysis of the quantitative data extracted four domains that reflected subjects' perceptions about the drinking water salinity level in their localities. All water chemical tests of the southern municipal domestic wells have been reviewed since 1987. The tests reviewed were fluoride, chloride, nitrate, total dissolve solid (TDS), and sodium levels in all groundwater wells, which reveal a general trend of increasing from north to south in the southern part.

The results showed that only 8% of the municipal wells were meeting the WHO drinking standards in chloride level. Chloride, nitrate, TDS, fluoride and sodium concentration ranges from 2 to 9 times the WHO standards in 92% of the southern wells. The study findings showed that there were no statistically significant associations between renal failure prevalence and chloride level, sodium level, TDS level and nitrate level. In contrary, there were strong statistically significant associations between renal failure and fluoride level. The study findings indicate that there is an urgent need to modify the mixing process of the water produced and distributed according to fluoride level, and to initiate public information and awareness programs about the fluoride health effects.

## Table of Content

	<b>Page</b>
1. Declaration	I
2. Acknowledgment	II
3. Abstract	III
4. Table of contents	IV
5. List of tables	V
6. List of figures	IX
7. List of annexes	X
8. List of abbreviations	XI

### Chapter 1 Introduction

Definition of terms	1
1.1 Research background	5
1.2 Research Problem	7
1.3 Justification of the study	8
1.4 Objectives of the study	8
1.4.1 General objective of the study	8
1.4.2 Specific objectives of the study	9
1.5 Research questions	9
1.6 Feasibility and cost	10
1.7 Context of the study	11
1.7.1 Demographic context	11
1.7.2 Socio-Economic context	12

### Chapter 2 Literature Review

2.1 Historical Review	13
2.2 Definitions	13
2.3 Renal failure epidemiological review	14
2.4 Classification of renal failure	17
2.5 Mechanism of Renal Failure	18
2.6 Causes of Renal Failure	19

2.7	Renal Failure Classification Variation by country	20
2.8	Renal failure incidence and prevalence variation by country	23
2.9	Renal failure etiology by country	26
2.10	Renal failure progress	28
2.11	Renal failure dialysis modalities & outcome	30
2.12	Water Salinity	33
2.13	World Health Organization standards for drinking water	35
2.14	Conceptual Framework	36
2.15	Factors affecting and affected water quality and level of salinity	37

### **Chapter 3 The Study Area**

3.1	location	39
3.2	Physical Settings	40
3.3	Hydrogeology	41
3.4	Historical comparison between the study area water quality and Gaza strip	42

### **Chapter 4: Methodology**

4.1	Study design	46
4.2	Study population	46
4.3	Period of the study	47
4.4	Place of the study	47
4.5	Sample size	47
4.6	Sampling method	47
4.7	Response rate	47
4.8	Ethical consideration and procedures	48
4.9	Construction of questionnaires	48
4.10	Pilot study	49
4.11	Data collection	50
4.12	Data entry	50
4.13	Data analysis	51
4.15	Validity	51
4.16	Reliability	52
4.17	Inclusion and exclusion criteria	52
4.18	Limitation of the study	53

## Chapter 5 Result and Discussion

A.5.1	Descriptive Part	54
A.5.1.1	Patients demographical variables	54
A.5.1.2	Distribution of patients by age group	55
A.5.1.3	Distribution of subjects by Demographical Data	56
A.5.1.4	Distribution of Subjects by Incidence Age Group	59
A.5.1.5	Distribution of Subject by etiological variables (Diseases)	60
A.5.1.6	Distribution of Patients by Cause of Renal Failure	61
A.5.1.7	Distribution of subjects by severity of the disease	62
A.5.1.8	Distribution of subject by relative's renal failure prevalence (heredity or family history)	64
A.5.1.9	Distribution of subject by domestic water source	65
A.5.1.10	Distribution of subjects by water consumption Pattern	67
A.5.2	Subjects Sub-scale domains	67
A5.2.1	Domestic water quality domains	68
A5.2.2	Practice and attitude	68
A.5.2. 3	Knowledge and awareness	69
A.5.2.4	Subjects Satisfaction	69
A.5.2.5	Over all domains	69
B.5	Descriptive Part	70
B.5.1	Ecological Variables (historical review)	70
B.5.2	Inferential statistic part	78
B.5.3	Subjects relationships Part	78
B.5.3.1	Demographic Characters for subjects	78
B.5.3.2	Domains differences by gender	78
B.5.3.3	Differences in domains by employment	79
B.5.3.4	Differences in domains by renal failure severity level	80
B.5.3.5	Differences of domain scores by subjects health status	81
B.5.3.6	Differences of domain scores regarding to water treatment	81
B.5.3.7	Differences of domain scores by water source	82
B.5.3.8	Differences of domain scores by residency	83
B.5.4	Distribution of Renal failure prevalence and water salinity level	84

	(during the period from 2005 -2009)	
B.5.4.1	Comparison between the distribution of Renal Failure prevalence and TDS level in the different areas	85
B.5.4.2	Comparison between the distribution of Renal Failure prevalence and Nitrate level in the different areas	86
B.5.4.3	Comparison between the distribution of Renal Failure prevalence and Chloride level in the different areas	89
B5.4.4	Comparison between the distribution of Renal Failure prevalence and Fluoride level in the different areas	90
B.5.4.5	Comparison between the distribution of Renal Failure prevalence and Sodium level in the different areas	94

### **Chapter 6 Conclusion and Recommendation**

6.1	Conclusion	97
6.2	Recommendations	100
6.3	Area for further researches	101
	References	102
	Annexes	113
	Summary in Arabic	121

## **List of Tables**

<b>No.</b>	<b>Table Name</b>	<b>Page</b>
Table 4.1	Sub- Scale reliability Subjects instrument	52
Table 5.1	Distribution of subjects by demographical data	58
Table 5.2	Distribution of subjects by etiological variables	61
Table 5.3	Distribution of patient by causes of renal failure	62
Table 5.4	Distribution of subjects by severity level of disease	63
Table 5.5	Distribution of subject relatives by renal failure prevalence (family history)	65
Table: 5.6	Distribution of subject by domestic water source	66
Table 5.7	Distribution of subjects by water consumption pattern	67
Table 5.8	Distribution of subject's domain by mean and percentage	68
Table 5.9	Water quality by time and localities in Khanyunis city and the eastern villages	73
Table 5.10	Domains differences by gender	79
Table 5.11	Domains differences by employment	79
Table 5.12	Domains differences by renal failure severity level	80
Table 5.13	Differences of domain scores by subject's health status	81
Table 5.14	Differences of domain scores regarding to water treatment	82
Table 5.15	Differences of domain by subjects water source	83
Table 5.16	Differences of domain scores by residency	84
Table 5.17	Distribution of renal failure prevalence by salinity parameters, TDS, sodium, fluoride, nitrate and chloride	85

## List of Figures

<b>No.</b>	<b>Figure Name</b>	<b>Page</b>
Figure 2.1	Conceptual framework	36
Figure 3.1	Geographic location of the Gaza Strip	42
Figure 3.2	Khanyounis map (PWA, 2007)	43
Figure 3.3	Contour map of chloride concentration for the year 2005 (PWA, 2005)	51
Figure 5.1	Distribution of renal failure patient by gender	55
Figure 5.2	distribution of renal failure patients by age group	56
Figure 5.3	Distribution of patient by incidence age group	59
Figure 5.4	Variation of TDS level by time and locality	75
Figure 5.5	Variation of nitrate level by time and locality	75
Figure 5.6	Variation of chloride level by time and locality	76
Figure 5.7	Variation of fluoride level by time and locality	76
Figure 5.8	Variation of sodium level by time and locality	77
Figure 5.9	Distribution of renal failure prevalence and TDS level.	86
Figure 5.10	Distribution of renal failure prevalence and nitrate level.	89
Figure 5.11	Distribution of renal failure prevalence and chloride level.	91
Figure 5.12	Distribution of renal failure prevalence and fluoride level	95
Figure 5.13	Distribution of renal failure prevalence and sodium level	97

## List of Annexes

<b>No.</b>	<b>Annex</b>	<b>Page</b>
Annex 1	Questionnaire for renal failure patients	114
Annex 2	Geographic location of the Gaza Strip	119
Annex 3	Khanyounis map	120
Annex 4	Contour map of chloride concentration for the year 2005	<b>121</b>

## List of abbreviations

AHA	American Heart Association
ANOVA	Analysis of Variance
ANZDAT	Australia and New Zealand Dialysis and Transplant
AOCRF	Acute On Chronic Renal Failure
ARF	Acute Renal Failure
CKD	Chronic Kidney Disease
EPA	U.S Environmental Protection Agency
ESRD	End- Stage Renal Disease
FAN	Fluoride Action Network
GRF	Glomerular Filtration Rate
JSPN	Japanese Society for Pediatric Nephrology
MOH	Ministry of Health
NAS	National Academy Of Science
NGOs	Non-Governmental Organizations
NKF-K/OQI	National Kidney Foundation Kidney Disease Outcome Quality Initiative
PHC	Primary Health Care
PLO	Palestinian Liberation Organization
PNA	Palestinian National Authority
PWA	Palestinian Water Authority
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
TDS	Total Dissolved Solid
UNICEF	United Nation Children's Fund
UNRWA	United Nations for Relief and Working Agency
USAID	United State Agency for International Development
USRDS	U.S Renal Data System
WHO	World Health Organization
GDP	Gross domestic product
RRT	renal replacement therapy
CAMP	Costal Aquifer Management Program.

## **Definition of terms**

**Pollution** is the term which carries with it a sense of an impurity, and can be defined as a chemical or physical agent in an inappropriate location or concentration (Beychok, 1967).

**Solid waste:** A simplified definition of solid waste would include garbage, trash, recyclable materials, yard waste, and waste from industrial and commercial sources. It does not include hazardous waste from businesses. Solid waste is any garbage, refuse, sludge, or other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations or from community activities (Wikipedia, 2006).

**Wastewater** is any water that has been adversely affected in quality by anthropogenic influence. It comprises liquid waste discharged by domestic residences, commercial properties, industry, and/or agriculture and can encompass a wide range of potential contaminants and concentrations. In the most common usage, it refers to the municipal wastewater that contains a broad spectrum of contaminants resulting from the mixing of wastewaters from different sources (Beychok, 1967).

**Biodiversity** Is a definition that is often used by ecologists is the "totality of genes, species, and ecosystems of a region". An advantage of this definition is that it seems to describe most circumstances and present a unified view of the traditional three levels at which biodiversity has been identified (Wikipedia, 2006).

**Natural resources** are naturally occurring substances that are considered valuable in their relatively unmodified (Wikipedia, 2006).

**Natural resources are classified into renewable and non-renewable resources:**

**Renewable resources** are generally living resources (fish, coffee, and forests, for example), which can restock (renew) themselves if they are not over harvested. Renewable resources can restock themselves and be used indefinitely if they are used sustain ably (Wikipedia, 2006).

- **Non-renewable resource** is a natural resource that cannot be re-made or re-grown. Often fossil fuels, such as coal, petroleum and natural gas are considered non-renewable resources, as they do not naturally re-form at a rate that makes the way we use them sustainable (Wikipedia, 2006).

**Renal failure** or **kidney failure** is a situation in which the kidneys fail to function adequately. It is divided into two categories the first is acute and the second is chronic forms; either form may be due to a large number of other medical problems. Biochemical, it is typically detected by an elevated serum creatinine. In the science of physiology, renal failure is described as a decrease in the glomerular filtration rate. When the kidneys malfunction, problems frequently encountered are abnormal fluid levels in the body, deranged acid levels, abnormal levels of potassium, calcium, phosphate, hematuria (blood in the urine) and (in the longer term) anemia. Long-term kidney problems have significant repercussions on other diseases, such as cardiovascular disease. Other factors which may help differentiate acute and chronic kidney disease include the presence of anemia and the kidney size on ultrasound. Chronic kidney disease generally leads to anemia and small kidney size (Wikipedia, 2006).

**Acute renal failure (ARF)** : As the name implies, a rapidly progressive loss of renal function, generally characterized by oliguria (decreased urine production, quantified as less than 400 mL per day in adults, less than 0.5 mL/kg/h in children or less than 1 mL/kg/h in infants); body water and body fluids disturbances; and electrolyte derangement. An underlying cause must be identified to arrest the progress, and dialysis may be necessary to bridge the time gap required for treating these fundamental causes. ARF can result from a large number of causes like diabetes, and hypertension (Wikipedia, 2006).

**Chronic kidney disease:** Stage Chronic Kidney Disease (CKD) can develop slowly and show few initial symptoms, be the long term result of irreversible acute disease or be part of a disease progression (Wikipedia, 2006).

**Acute on chronic renal failure: Acute renal failure:** can be present on top of chronic renal failure. This is called acute-on-chronic renal failure (AOCRF). The acute part of AOCRF may be reversible and the aim of treatment, as with ARF, is to return the patient to their baseline renal function, which is typically measured by serum creatinine. AOCRF, like ARF, can be difficult to distinguish from chronic renal failure, if the patient has not been monitored by a physician and no baseline (i.e., past) blood work is available for comparison. (Wikipedia, 2006).

**Salinity** is the increased accumulation of excessive salts in land and water at sufficient levels to impact on human and natural assets (plants, animals, aquatic ecosystems, water supplies, agriculture, or infrastructure). Primary salinity is where increases in salinity have occurred solely through natural processes and secondary or induced salinity is where increases have occurred due to land use changes made by human activity. Because salinity can be produced by a variety of distinctly different land management and ground water flow systems no one approach to managing salinity will work in all cases (Wikipedia, 2006).

**Saline water:** is a general term for water that contains a significant concentration of dissolved salts (NaCl). The concentration is usually expressed in parts per million (ppm) of salt (Wikipedia, 2006).

**Knowledge** is what is known. Also, knowledge an acquisition involves complex cognitive processes: perception, learning, communication, association, and reasoning. The term knowledge is also used to mean the confident understanding of a subject, potentially with the ability to use it for a specific purpose (Wikipedia, 2006).

**Awareness** describes a human or animal's perception and cognitive reaction to a condition or event. Awareness does not necessarily imply understanding, just an ability to be conscious of, feel or perceive (Wikipedia, 2006)

Awareness is a relative concept. An animal may be partially aware, may be subconsciously aware, or may be acutely aware of an event. Awareness may be focused on an internal state, such as a visceral feeling, or on external events by way of sensory perception. Also, awareness provides the raw material from which animals develop subjective ideas about their experience (Wikipedia, 2006).

## **Chapter One: Introduction**

### **1.1. Research Background**

Water is fundamental to all forms of life on earth. Without clean water, we cannot experience optimum health, or lead normal lives (WHO, 1993). All people whatever their stage of development and social and economic condition, have the right to have access to drinking water in quantities and of quality equal to their basic needs (UN, 1977). Water and sanitation is one of the primary drivers of public health. one often refer to it as "Health 101", which means that once we can secure access to clean water and to adequate sanitation facilities for all people irrespective of the difference in their living conditions, a huge battle against all kinds of diseases will be won." (WHO,1993). Escalating environmental degradation includes deforestation, desertification, and loss of biodiversity, ozone depletion, global climate change, and pollution and over consumption of natural resources which directly impact our ability to develop economically while at the same time sustaining the health of people as well as plants and animals (Kibert, 2000). Along with exponential population growth, these problems are especially significant in developing countries (Vadala, 2004). More than 10% people in the world (more than 900 million people) suffering from lack access to water that is safe for drinking and almost three times that (more than 2,5 billion people) live without adequate sanitation systems which lead many diseases. And as the population on earth increases so do these numbers (WHO, 1996). Adequate supply of good quality water is essential for public health (WHO, 1993). Drinking water should be free from pathogenic (disease-causing) organisms; fairly clear (low turbidity, little color); not saline (salty) not contain compounds that cause an offensive taste or smell; not contain chemicals, metals or radioactive compound in concentration that may have an adverse effect on human health; and not cause corrosion of water supply system, not nor stain clothes washed in it (WHO, 1993). Water of good chemical and physical quality is necessary from the point of view of its acceptability to the consumer, protection of consumer health, and conservation of water system. Situations are encountered in which offending

chemical substances have made a water source unacceptable to the public even though its bacteriological quality was excellent (WHO, 1993).

Palestinian environment is facing serious threats, such as: alarming population growth, limited land resources, long term isolation as a result of the regional political circumstance and the underdeveloped environmental protection system which caused serious deterioration, fast depletion and contamination of environmental resources that, in its turn, lead to health risk among citizen (UNEP, 2003). Palestine as a whole is a south Mediterranean country that suffers from shortage in quantity of fresh water available for use, in addition to decrease of water quality. This problem is more severe in Gaza Strip regarding available water quality to use, especially for drinking purposes (PWA, 2006).

Palestinian fresh ground water resources are currently being depleted due to over pumping of the aquifer, the fact that rates of salinization are increasing in areas of relatively good water quality implies that fresh water bodies are gradually becoming replaced with brackish and/or saline water. The time frame until all fresh water resources are exhausted will depend on continued pumping volumes and patterns, as well as the balance between aquifer inflows and out flows. Using a rate of aquifer depletion of 20 Mm<sup>3</sup>/y, it can be calculated that in theory, it will take about 20-30 years before all the fresh water in the Gaza coastal aquifer is replaced with higher salinity water (PWA, 2000).

Pollution of groundwater in Gaza strip is a major problem. Not only are there numerous source of pollution, but also the aquifer is highly vulnerable to pollution. Many years of over pumping have resulted in the seawater intrusion and upconing of saline ground water. Furthermore, human activities including agriculture and inadequate waste management have increased groundwater contamination level. The high nitrate content of the groundwater appears to be primarily induced by sewage and leachate of solid waste. The reason for drawing attention to nitrate pollution is its toxicity to humans, especially for babies and pregnant women by the so-called "blue babies" syndromes. Another factor which affects groundwater is the salinity content which has shown an obvious increase during the past 10 to 20 years, this may be the result of groundwater flow from the east, salinization of the surface, and seawater intrusion from the west (PWA, 1999).

Gaza Strip is characterized by its natural water resources scarcity. The main source of water in Gaza Strip is the groundwater aquifer. Over pumping and low rainfall have

limited the quantity of water available and have further contributed to the degradation of the water quality (CAMP, 2000). Ongoing deterioration of the water supply of Gaza poses a major challenge for water planners and the sustainable management of the coastal aquifer. The aquifer is presently being overexploited, with total pumping exceeding total recharge. In addition, anthropogenic sources of pollution threaten the water supplies in major urban centers. Many water quality parameters presently exceed the World Health Organization (WHO) drinking water standards. The major documented water quality problems are elevated chloride (salinity) and nitrate concentrations in the aquifer (PWA, 2000).

According to Abu Safieh (1994) demonstrated correlation between water salinity and mortality due to renal diseases. The researcher analyzes the mortality data gathered by Gaza Health Service Research Center and the water chemical composition from the Public Health Department. Gaza governorates with higher water salinity reported higher renal diseases mortality rates.

According to the above mentioned, it is important to highlight that the water resource and human public health in Gaza Strip are facing a real risk.

## **1.2. Research Problem**

Environmental quality is an important direct and indirect determinant of health, and deteriorating environmental conditions are major contributory factor to poor health. The research problem is to study if the existence of renal failure prevalence as outcome of water deterioration and salinity problem which threaten the public health. In the last 20 years the underground water which is the only source for drinking in Gaza Strip as well as in Khanyounis is facing a real problem due to concentrations of chemical pollutants, including Nitrate and Chloride have exceeded the standards recommended by WHO. About 63.5% of Gaza strip water wells sampled is chemically polluted and 15.8% are bacteriological contaminated (MOH, 2004). Groundwater quality especially in Khanyounis area is generally poor. Over-exploitation has resulted in saltwater intrusion and up-coning. In most areas of Khanyounis, a slow, continuing decline in groundwater levels has been observed since the mid-1970s. So, the coastal aquifer is over exploited and vulnerable to becoming unusable for drinking water and irrigation. Two main problems currently

challenge the groundwater resources in Khanyounis Governorate: a) Progressive salinity of water wells which exceeds WHO standards and b) Raising of nitrate levels in the drinking water (PWA, 2006).

According to the health report of MOH in Palestine renal failure is the seventh leading factor for death among the age group (5 – 19) and represented 1.1% from the total deaths in Gaza strip. The sixth leading factor for death among age group (20-59) and represented 3.1% in Gaza Strip. Leading cause for deaths among age group 60 and above represented 4% in Gaza Strip, 5.8% in West bank, and 5.1% in Palestine (MOH, 2005).

Unfortunately, the only research which links the relationship between renal failure mortality and water salinity is not documented as primary resource. On the other hand there are no studies carried out locally and nationally for the same reason.

### **1.3. Justifications of the study**

Groundwater quality in Khanyounis and the eastern villages in the southern area is a problem of great concern and groundwater quality is deteriorating very rapidly as a result of the continuous pumping, and bad sanitation system. Currently water supply for Khanyounis governorate is differing in many demographical areas within the governorate and the eastern villages which have another different source of water. Its main source of water supply is from Makorot Israeli Water Company. Its water meets the WHO standards. So it can be easy to compare the prevalence of renal failure in different areas with different level of salinity. For the above mentioned reasons Khanyounis city and the eastern villages (Khuza, Absan, Bunisuhila) have been selected for the study.

### **1.4 Objectives of the study:**

#### **1.4.1 General Objective of the study**

The overall aim of the research is to study association between salinity of drinking water and renal failure in the southern part in Gaza Strip.

#### **1.4.2. Specific Objectives of the study:**

- 1- Assessment of chemical quality of drinking water in the study area
- 2- To explore the relationship between renal failure and socio economic demographic variables such as age, gender, residential area, grade of education, job.
- 3- To identify renal failure etiological variables and severity level in the study area
- 4-To evaluate impact of saline water on subjects satisfactions
- 5-To highlight subject's awareness and knowledge on their health and ecological problems
- 6-To identify major salinity causes and variables which was or still existing in Khanyuns drinking or domestic water those may present health problems.
- 7-To compare renal failure prevalence in areas with different level of selected water quality parameters (nitrate, TDS, chloride, fluoride and sodium)

#### **1.5. Research Questions**

The main question addressed in this study:

Is there association between drinking water salinity and renal failure prevalence in different demographic areas with different water sources in Khanyunis city and the eastern villages?

This main question is divided into the following sub questions:

- Q1: Is there a relationship between renal failure and socio economic demographic variable (age, gender, marital status, educational level, residency, and job?)
- Q2: What are the causes, etiological variables, and medical history of renal failure in the study area?
- Q3: What is the level of renal failure severity?
- Q4: What are the previous and current differences in salinity levels in the different demographic areas?
- Q5: What is the subject level of satisfaction from domestic water supply?
- Q6: What is the level of subject's knowledge and awareness about water salinity management?
- Q7: what is the source of drinking water and treatment tool?

Q8: What is the historical level of salinity in Khanyunis and the eastern villages?

Q9: What are the most serious parameters of chemicals existing in Khanyuns drinking water that present a risk to human health which may cause renal failure?

Q10: Is there association between renal failure prevalence and chloride level in domestic water?

Q11: Is there association between renal failure prevalence and nitrate level in domestic water?

Q12: Is there association between renal failure prevalence and TDS level in domestic water?

Q13: Is there association between renal failure prevalence and fluoride level in domestic water?

Q14: Is there association between renal failure prevalence and sodium level in domestic water?

## **1.6. Feasibility and Cost**

This study was conducted at Nasser Hospital in Khanyunis governorate as requirement for study at the School of Public Health, Al-Quads University. Discussion and exchange of ideas with responsible persons from School of Public Health, Governmental Hospitals Director, General Primary Health care, and different specialties made the implementation of this study more feasible. This study was self funded; the researcher was responsible for all the needed cost. It is supervised by School of Public Health, and carried out with co-ordination between School of Public Health, artificial kidney department at Nasser hospital, Khanyunis Municipality, Water authority, Coastal Municipalities Water Utility, and Public Health laboratory, all the teams over the previous agencies provided the researcher with necessary research support such as access to study population, water data, chemical tests results, and ethical approval to conduct the study.

## **1.7 Context of the study**

The researcher provided some helpful background for the ecological and health problem and information that needed to be clear to facilitate understanding the nature of relationships. The information including geographical, physical, setting for Khanyunis, and renal failure patient situation can be influenced by many factors concerning the demographical, socio-economical and political circumstances. The current study conducted at Khanyunis Governorate in Palestine so some of the demographical, socio-economical and political factors were important to the study.

### **1.7.1 Demographic context:**

Palestine is a very small country, the total size approximately 27,000 Km<sup>2</sup>, has an important location in Western Asia, it is bordered from the west by the Mediterranean, from the east by Syria, and Jordan, from the north by Lebanon and on the south by the Sinai and the Gulf of Aqaba (MOH, 2006).

Palestine has a strategic location so many forces tried to occupy the country, now Palestine separated geographically into two parts, West Bank and Gaza Strip, the last is a highly populated area (MOH, 2006).

The total Palestinian population residing in the Gaza Strip and the West Bank including Jerusalem was estimated to be 3,737,895 of where 1,6 million (43.8%) are registered refugees, more than one million of the Palestinians are living inside the green line "Palestine 1948" and the number of Palestinians who are living in Diaspora is estimated at 4,843,427 (MOH, 2006). The population number in Gaza was estimated by the year 2005 to be 1,389,789 with population density about, 3,808 inhabitants/Km<sup>2</sup> with 69% refugees (MOH, 2006). This large number in the small surface area with this density creates a worried health, environmental and economical problem. The most of Palestinian population is under age 15 years those represented 46.3% of the population in Palestine and the percentage of Palestinian who is older than 65 years is 2.8%. This made Palestinian young population which made an economical burden. The median age in Palestine is increased from 16.4 in 1997 to 16.7 years in 2004 (MOH, 2006).

The natural increase rate in Palestine at 3.3%, 3.8% were in Gaza. While the population natural increase rate estimated in Gaza as 3.1% (MOH, 2006).

### **1.7.2 Socio-economic context:**

Palestinian economy has been steady decline due to permanent strict closure and violence during the recent Intifada, as GDP were fallen to 30% it was contracted by 9% in the year 2006 to reach to 4.2% in the mid-year 2007 (World Bank, 2007a). In comparison to Israeli gross domestic product (GDP) at 2007, it reached to 8.7% while in EMERO country it is 7.5% (WHO, 2007). GDP levels have been maintained by government and private consumption funded by donor aid, while investment has fallen to low level. Employment, and particularly youth employment, must be the essence of any Palestinian economical strategy (World Bank, 2005a). Despite, large flow of aid, unemployment and poverty have continuo to raise (World Bank, 2007a). The number of Palestinian workers in Israel decreased from 135,000 in 1999 to 36,000 in 2005. The workers in Palestine also decreased from 453,000 in 1999 to 135,000 in 2005 (MOH, 2006). The World Bank reported that the unemployment rose from 9.5% in 1999 to nearly 16% in 2006 however it is higher in Gaza than West Bank (World Bank, 2007a). Increased scarcity of jobs has led to more part-time workers. Also the increase level of unemployment increased burden on Palestinian Authority by overstaff in its employee (World Bank, 2007a). This revealed sharply increasing the poverty rate in Palestine was 44% in 2005 (MOH, 2006). The poverty increases in 2006 at Gaza Strip to reach 51% (World Bank, 2007).

## **Chapter 2: Literature Review**

This chapter reviews the literature available about renal failure and salinity problem. It starts with historical review, definitions, types, and causes for both salinity and renal failure and some explanation of different variables are illustrated in the literature. In this part the researcher highlight on researches, paper was carried out in relation to both quality indicator and the prevalence of renal failure which may help to give a very simple idea.

### **2.1 Renal failure historical review**

Before the advancement of modern medicine, acute renal failure (ARF) might be referred to as uremic poisoning. Uremia was the term used to describe the contamination of the blood with urine. Starting around 1847 this term was used to describe reduced urine output, now known as oliguria , which was thought to be caused by the urine's mixing with the blood instead of being voided through the urethra. Acute renal failure due to acute tubular necrosis (ATN) was recognized in the 1940s in the United Kingdom, where crush victims during the Battle of Britain developed patchy necrosis of renal tubules, leading to a sudden decrease in renal function. During the Korean and Vietnam wars, the incidence of ARF decreased due to better acute management and intravenous infusion of fluids (Wikipedia, 2006).

### **2.2 Renal Failure Definitions:**

**2.2.1 Urinary system:** group of organs of the body concerned with excretion of urine, that is, water and the waste products of metabolism, also called excretory system or the genitourinary system that produces, stores, and eliminates urine. In humans it includes two kidneys, two ureters, the bladder, and the urethra. The analogous organ in invertebrates is the nephridium (Wikipedia, 2006).

**2.2.2 Kidneys:** Pair of organs that maintain water balance and expel metabolic wastes. Human kidneys are bean-shaped organs about 4 in. (10 cm) long, in the small of the back. They filter the entire 5-quart (about 4.5-liter) water content of the blood every 45 minutes. Glucose, minerals, and needed water are returned to the blood by reabsorption. The remaining fluid and wastes pass into collecting ducts, flowing to the ureter and bladder as urine. Each kidney has over 1 million functional units (nephrons) involved in the process of filtration and reabsorption. The kidneys also secrete renin, an enzyme involved in blood pressure regulation. Kidney disorders include kidney failure, kidney stones, and nephritis (Wikipedia, 2006).

**2.2.3 Nephrons:** Functional unit of the kidney that removes waste and excess substances from the blood to produce urine. Each of the million or so nephrons in each kidney is a tubule 1.2 – 2.2 in. (30 – 55 mm) long. At one end it is closed, expanded, and folded into a double-walled cuplike structure (Bowman's capsule) enclosing a cluster of capillaries (glomerulus). Fluid forced out of the blood through the capillary walls of the glomerulus into Bowman's capsule flows into the adjacent renal tubule, where water and nutrients are selectively reabsorbed from the fluid back into the blood, and electrolytes such as sodium and potassium are balanced in several distinct sections along its length. The final concentrated product is urine (Wikipedia, 2006).

### **2.3 Renal failure epidemiological review**

Unfortunately there is no national or local registry data for renal failure prevalence in Palestine, nearly all data are represented for other countries. Most epidemiological information on chronic kidney disease (CKD) originates from data available on end-stage renal disease (ESRD), the terminal stage of CKD when treatment with renal replacement therapy (dialysis or transplant) becomes necessary to sustain life. Little

information is available on the prevalence of earlier stages of CKD, as patients are often asymptomatic. The epidemiological studies that have been performed provide evidence that ESRD represents the “tip of the iceberg” of CKD and suggest that patients with earlier stages of disease are likely to exceed those reaching ESRD by as much as 50 times (Coresh J, Astor BC, Greene T, Eknoyan G, Levey AS, 2003). Worldwide, the number of patients with CKD is rising markedly, especially in adults, and CKD is now being recognized as a major public health problem that is threatening to reach epidemic proportions over the next decade (Lysaght MJ, 2002). The prevalence of chronic kidney disease in the United States population is rising significantly. A 1998 report of the National Health and Nutrition Examination Survey (NHANES. 1998) conducted from 1988 to 1994 estimated that 6.2 million individuals over age 12 years had reduced kidney function. Further, these data showed a higher prevalence of abnormal creatinine levels in older compared with younger individuals, in non-Hispanic blacks compared with whites or Mexican-Americans, and in men compared with women. In 1998, 86,000 patients began treatment for end-stage renal disease (ESRD), and in that same year there were more than 300,000 prevalent cases of ESRD. By 2010, these numbers are projected to be 172,667 incident and 661,330 prevalent cases of ESRD particular, renal disease in diabetes mellitus is a disproportion of the rising prevalence and incidence of new cases of progressive kidney disease in the United States (clinical practice guidelines for chronic kidney disease, 2002). In North America, up to 11% of the population (19 million) may have CKD (Coresh J, Astor BC, Greene T, Eknoyan G, Levey AS2003). Surveys in Australia, Europe, and Japan describe the prevalence of CKD to be 6–16% of their respective populations (El Nahas AM, Bello AK, 2005). In North America alone, more than 100,000 individuals entered ESRD programs in 2003 (adjusted incidence rate: 341 new cases per million population), with a prevalence count of more than 450,000 as of December 2003 prevalence rate: 1,509 per million population (U.S. renal data system, USRDS 2005).

Physicians in renal centers in Wales and in adjacent areas of England were asked to undertake a census of patients on renal replacement therapy on 30 June 2004 using an agreed protocol. Data were collated and analyzed in anonymous form. 2434 patients were on renal replacement therapy (RRT) in Wales at the census date. Median age of patients on RRT was 56 years, peritoneal dialysis 58 years, hemodialysis 66 years and transplantation 50 years. The three treatment modalities had

significantly different age-specific peak prevalence rates and distributions. RRT age-specific prevalence rates peaked at around 70 years (1790 pmp), transplantation at around 60 years (924 pmp), hem dialysis at around 80 years (1080 pmp) and peritoneal dialysis did not have a clear peak prevalence rate. Age-specific incidence of RRT peaked at a rate of 488 pmp at 79 years, as did incidence rates for hem dialysis, which peaked at the same age. Age had less effect on the initiation of peritoneal dialysis, which had a broad plateau between the early fifties and late seventies. Kidney transplantation rates were highest in the early fifties but were markedly absent in old age. Differences in the provision of RRT are evident, particularly in the very elderly, where the gender difference for hem dialysis is particularly marked. The study illustrates that grouping patients over 75 years into a single age-band may mask significant diversity within this age group. Significant numbers of very elderly patients who are currently not receiving RRT may wish to receive RRT as the elderly population increases, and as technology improves survival and quality of life on RRT. The study suggests that if technologies that are more effective were developed, and which had a lower impact on quality of life, there might be up to a 17% increase in demand for RRT in those aged over 75 years; around 90% of this increased demand would be for hem dialysis. Not surprisingly, the cost of treating patients with ESRD is substantial and poses a great financial challenge. The economic cost of North American ESRD programs reached \$25.2 billion in 2002, an 11.5% increase over the previous year, and is expected to reach \$29 billion by 2010 (Lysaght MJ,2002) Two factors, aging and the global epidemic of type-II diabetes mellitus, are primarily responsible for the increasing incidence of CKD in adults. In contrast, pediatric ESRD patients (<20 years of age) constitute a very small proportion of the total ESRD population. However, they pose unique challenges to providers and to the health care system, which must address not only the primary renal disorder but the many extra renal manifestations that affect growth and development as well. In North America, children younger than 20 years of age account for less than 2% of the total ESRD patient population, and the prevalence of patients aged 0–19 years has grown a modest 32% since 1990. This is in contrast to the 126% growth experienced by the entire ESRD population over the same time period (U.S. renal data system, USRDS 2005) Nonetheless, CKD in children is a devastating illness, and the mortality rate for children with ESRD receiving dialysis therapy is between 30 and 150 times that of the general pediatric population (U.S.

renal data system, USRDS 2004). In fact, the expected remaining lifetime for a child 0–14 years of age and on dialysis is only 20 years (McDonald SP, Craig JC, 2004). Therefore, the diagnostic and therapeutic approach to CKD must emphasize primary prevention, early detection, and aggressive management. Knowledge of the epidemiology of CKD and its associated clinical manifestations is a crucial component of this effort by helping to target key patient populations at risk, by quantifying the extent of the problem, and by facilitating an assessment of the impact of intervention.

## **2.4 Classification of renal failure**

Renal failure can broadly be divided into two categories: acute or chronic renal failure. The type of renal failure is determined by the trend in the serum creatinine. Other factors which may help differentiate acute and chronic kidney disease include the presence of anemia and the kidney size on ultrasound. Chronic kidney disease generally leads to anemia and small kidney size (Wikipedia, 2006).

### **2.4.1 Acute renal failure (ARF):**

Also known as acute kidney failure or acute kidney injury, is a rapid loss of renal function due to damage to the kidneys, resulting in retention of nitrogenous (urea and creatinine) and non-nitrogenous waste products that are normally excreted by the kidney. Depending on the severity and duration of the renal dysfunction, this accumulation is accompanied by metabolic disturbances, such as metabolic acidosis (acidification of the blood) and hyperkalaemia (elevated potassium levels), changes in body fluid balance, and effects on many other organ systems. It can be characterized by oliguria or anuria (decrease or cessation of urine production), although nonoliguric ARF may occur. It is a serious disease and treated as a medical emergency (Wikipedia, 2006).

#### **2.4.2 Chronic kidney disease (CKD):**

Also known as chronic renal disease is a progressive loss of renal function over a period of months or years. The symptoms of worsening kidney function are unspecific, and might include feeling generally unwell and experiencing a reduced appetite. Often, chronic kidney disease is diagnosed as a result of screening of people known to be at risk of kidney problems, such as those with high blood pressure or diabetes and those with a blood relative with chronic kidney disease. Chronic kidney disease may also be identified when it leads to one of its recognized complications, such as cardiovascular disease, anemia or pericarditis (Wikipedia, 2006).

#### **2.5 Mechanism of Renal Failure**

Acute kidney failure usually occurs as the result of a sudden interruption in the blood supply to the kidney, or as a result of a toxic overload of the kidneys. Some causes of acute failure include accidents, injuries or complications from surgery where the kidneys are deprived of normal blood flow for an extended period of time. Heart-bypass surgery is an example of a situation in which the kidneys receive reduced blood flow. Drug overdoses, whether accidental or from chemical overloads of drugs such as antibiotics or chemotherapy, may also cause the onset of acute kidney failure. Unlike in chronic kidney disease, however, the kidneys can often recover from acute failure, allowing the patient to resume a normal life. People suffering from acute failure require supportive treatment until their kidneys recover function, and they often remain at an increased risk of developing future kidney failure (National Kidney and Urologic Diseases Information Clearing House, 2007).

## 2.6. Causes of Renal Failure

The most common causes of CKD are diabetic nephropathy, hypertension, and glomerulonephritis. Together, these cause approximately 75% of all adult cases. Certain geographic areas have a high incidence of Human Immunity Virus HIV nephropathy. Historically, kidney disease has been classified according to the part of the renal anatomy that is involved as:

- Vascular, includes large vessel disease such as bilateral renal artery stenosis and small vessel disease such as ischemic nephropathy, hemolytic-uremic syndrome and vasculitis
- Glomerular, comprising a diverse group and sub classified into
  - Primary Glomerular disease such as focal segmental glomerulosclerosis and nephritis.
  - Secondary Glomerular disease such as diabetic nephropathy and lupus nephritis.
- Tubulointerstitial including polycystic kidney disease, drug and toxin-induced chronic tubulointerstitial nephritis and reflux nephropathy
- Obstructive such as with bilateral kidney stones and diseases of the prostate (Wikipedia, 2006).

## **2.7 Renal failure classification variation by country:**

There is limited information on the epidemiology of CKD in population. This is especially true for less advanced stages of renal impairment that are potentially more susceptible to therapeutic interventions aimed at changing the course of the disease and avoiding ESRD. As CKD is often asymptomatic in its early stages, it is both under diagnosed and, as expected, underreported. This is in part the result of the historical absence of a common definition of CKD and a well-defined classification of its severity. The current CKD classification system described by the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (NKF-K/DOQI) has helped remedy the situation. According to the K/DOQI scheme, CKD is characterized by stage one is mild disease, through stage 5 (ESRD) (National Kidney Foundation, 2002). By establishing a common nomenclature, staging has been helpful for patients, general health care providers, and nephrologists when discussing CKD and anticipating comorbidities and treatment plans. The classification system has, however, been subject to debate, as it is argued that stages 1 and 2 would be better defined by the associated abnormalities (e.g. proteinuria, hematuria, structural anomalies) rather being classified as CKD, whereas more advanced stages (3 and 4) should be characterized by the severity of the impaired renal solute clearance. Furthermore, and with particular reference to children, the normal level of glomerular filtration rate (GFR) varies with age, gender, and body size and increases with maturation from infancy, approaching adult mean values at approximately 2 years of age. In turn, GFR ranges that define the five CKD stages apply only to children 2 years of age and older. Finally, although the threshold of GFR reduction where chronic renal failure (CRF) and chronic renal insufficiency (CRI) begins is a matter of opinion, many registries have operationally defined this as a GFR below 75 mL/min per 1.73 m<sup>2</sup>. Hence, populations with CRI or CRF are now categorized as those that comprise CKD stages 2–4. Most of the existing data on the epidemiology of CKD during childhood concentrates on the late and more severe stages of renal impairment and are not population based in nature. In addition, some methodologically well-designed childhood CKD registries are limited by being restricted to small reference

populations. Finally, direct comparisons of the incidence and prevalence rate of childhood CKD in different geographical areas around the world is difficult due to methodological differences in study age group, characterization of the degree of renal insufficiency, and disease classification. In the United States, data is primarily available from two sources: the registry of the North American Pediatric Renal Trials and Collaborative Studies (NAPRTCS) organization with the United States Renal Data System (USRDS, 2005). NAPRTCS was established as a transplant registry in 1987 with a goal of gathering data from the majority of pediatric renal transplant centers in the United States, Canada, Mexico, and Costa Rica. Its registry was expanded in 1992 to include data from patients receiving maintenance dialysis, and in 1994, data was first collected from patients with CKD characterized by a Schwartz estimated creatinine clearance of  $\leq 75$  mL/min per  $1.73 \text{ m}^2$  (Schwartz GJ, Haycock GB, Edelmann CM Jr, Spitzer A, 1976). Participation in this registry is voluntary and mandates the involvement of pediatric nephrologists in the provision of care to those patients entered into the registry. As of December 2005, information had been collected on more than 6,400 patients who entered the registry with a diagnosis of CKD. In contrast to the NAPRTCS, which only receives data voluntarily submitted by pediatric nephrology centers, the USRDS is a national data system that collects, analyzes, and distributes information about all patients with ESRD in the United States. Thus, USRDS data includes information on both adults and children with stage 5 CKD, which is published as an Annual Data Report (ADR) (U.S. renal data system, USRDS 2005, 2004). This source of information is particularly important from an epidemiological perspective, as approximately one third of children and adolescents with ESRD requiring dialysis or transplantation in the United States are cared for in facilities that primarily serve adults, and thus, they are not included in the NAPRTCS database (Furth SL, Powe NR, Hwang W, Neu AM, Fivush BA, 1997). The recently published data from the ItalKid Project is by far the most comprehensive data on the epidemiology of CKD in children. The ItalKid Project is a prospective, population-based registry that was started in 1990 and includes all incident and prevalent cases of CKD ( $C_{Cr} < 75$  mL/min per  $1.73 \text{ m}^2$ ) in children (<20 years) from throughout Italy (total population base: 16.8 million children) (Ardissino G, Dacco V, Edefonti A, Sereni F, 2003).

The European Dialysis and Transplant Association (EDTA) was established in 1964 to record demographic data and treatment details of patients receiving renal replacement therapy (RRT), including dialysis and renal transplantation. Historically, the EDTA registry gathered data on RRT in children from individual renal units by means of center and patient questionnaires, a process that was subject to underreporting. At the turn of the century, the EDTA office moved to Amsterdam and began collecting data on RRT entirely through national and regional registries and recently reported data on RRT in children from 12 registries located in Europe (Van der Heijden BJ, van Dijk PC, Verrier-Jones K, Jager KJ, Briggs JD, 2004). Other regional societies, such as the Japanese Society for Pediatric Nephrology (JSPN), have also provided useful epidemiological information. In Japan, children are screened annually by urinalysis in a nationwide program, an approach that has provided invaluable epidemiological information and the opportunity for establishing clinical trials focusing on early detection and intervention. Epidemiological data is also available from Australia and New Zealand (Australia and New Zealand Dialysis and Transplant Registry). In contrast, epidemiological information from Asia, where 57% of the world's population resides and a geographic region characterized by a very high proportion of children, is very scant and is primarily based on patients referred to tertiary medical centers (Gulati S, Mittal S, Gupta RK, 1999) The situation in central and southern Africa or in the Arab countries of North Africa and the Middle East is even more unfortunate, as there are no regional pediatric nephrology societies in place to collect and publish any valid epidemiological data.

## 2.8 Renal failure incidence and prevalence variation by country:

Large population-based studies, such as the Third National Health and Nutrition Examination Survey (NHANES III), have made it possible to estimate the incidence and prevalence of CKD in the adult population (Coresh J, Astor BC, Greene T, Eknoyan G, Levey AS, 2003) According to this report, the prevalence of patients with early stages of CKD (stages 1–4; 10.8%) is approximately 50 times greater than the prevalence of ESRD (stage 5; 0.2%). There is no comparable information available in the United States on the prevalence of the earlier stages of CKD in children and its relationship to ESRD. This is, in large part, due to differences in disease etiology for children and adults. Furthermore, the relationship between the prevalence of earlier stages of CKD and the subsequent development of more severe CKD/ESRD is determined in part by factors unrelated to disease etiology, as was recently shown in a comparison between adult patients in Norway and the United States (Coresh J, Astor BC, Asberg A, Powe NR, 2006) Data that do exist on the epidemiology of CKD in children come from a variety of sources. Population-based data from Italy (ItaKid Project) has reported a mean incidence of preterminal CKD ( $C_{Cr} < 75$  mL/min per  $1.73$  m<sup>2</sup>) of 12.1 cases per year per million of the age-related population (MARF), with a point prevalence of 74.7 per MARF in children younger than 20 years of age. Similarly, the incidence rate of severe pre-terminal CKD in Lorraine (France) has been estimated as 7.5 per MARF in children younger than 16 years; the prevalence rate ranged from 29.4 to 54 per MARF (Deleau J, Andre JL, Briancon S, Musse JP, 1994). In Latin America, the (Chilean survey, 1996) reported incidence and prevalence rates of 5.7 and 42.5 per MARF, respectively, in children younger than 18 years of age with  $C_{Cr} < 30$  mL/min/ $1.73$  m<sup>2</sup>, including patients with (Lagomarsimo E, Valenzuela A, Cavagnaro F, Solar E, 1999) ESRD there are 81.2 million children in the United States younger than 20 years of age (USRDS, 2005) but no data on the incidence or prevalence of preterminal CKD is available.

Due to a lack of national registries, any semblance of incidence and prevalence data from developing countries primarily originates as reports from major tertiary care referral centers (Anochie I, Eke F, 2003). The nature of the data depends on local referral practices and accessibility to hospital care. The Jordan University Hospital has estimated the annual incidence and prevalence of severe CKD ( $C_{Cr} < 30$  mL/min per  $1.73$  m<sup>2</sup>) to be 10.7 and 51 per MARF, respectively, based on their hospital

admission rate. A 15-year review of admissions from a university teaching hospital in Nigeria estimated the median annual incidence of severe CKD ( $C_{Cr} < 30$  mL/min per  $1.73 \text{ m}^2$ ) to be 3.0 per MARP, with a prevalence of 15 patients per million children (Anochie I, Eke F, 2003). In a recent report, data from a major tertiary hospital in India revealed that approximately 12% of patients ( $n = 305$ ) seen by the pediatric nephrology service over a 7-year period had moderate to severe CKD ( $C_{Cr} < 50$  mL/min per  $1.73 \text{ m}^2$ ), and one quarter of these patients had already developed ESRD, highlighting the late diagnosis and referral pattern (Hari P, Singla IK, Mantan M, Batra B, Bagga A, 2003). Similar data was reported from another tertiary hospital in India where 50% of 48 patients presenting with CRF over a 1-year period had ESRD (Gulati S, Mittal S, Gupta RK, 1999). Finally, data from a major Iranian hospital collected over 7 years (1991–1998) reported that 11% of pediatric nephrology admissions ( $n = 298$ ) were due to severe CKD ( $C_{Cr} < 30$  mL/min per  $1.73 \text{ m}^2$ ), and one half of the patients advanced to ESRD (Madani K, Otoukesh H, Rastegar A, Why SV, 2001). The incidence rate of ESRD, adjusted for race and gender, is much higher among adults than among children. Data from the USRDS revealed that in pediatric patients younger than 20 years of age, the annual incidence of ESRD increased marginally from 13 per MARP in the 1988 cohort to 15 per MARP in the 2003 cohort (U.S. renal data system, USRDS 2005). This is in contrast to the adult incidence rate of 119 per MARP for patients 20–44 years of age and 518 per MARP for those 45–64 years old in the 2003 cohort (U.S. renal data system, USRDS 2005). As in adults, a higher incidence rate with older patients was also found across the 5-year age groups within the pediatric cohort. The incidence rate was nearly twice as high among children 15–19 years of age (28 per MARP) compared with children 10–14 years of age (14 per MARP), and nearly three times higher than the rate for children 0–4 years of age (9 per MARP). The point prevalence for pediatric patients (adjusted for age, race, and gender) was 82 per million populations during 2002–2003 (U.S. renal data system, USRDS 2005). The EDTA registry recently reported its cumulative data on 3,184 patients (<20 years of age) with ESRD who initiated RRT between 1980 and 2000 in 12 European countries (Van der Heijden BJ, van Dijk PC, Verrier-Jones K, Jager KJ, Briggs JD, 2004). With a total of 18.8 million children between 0–19 years in the countries surveyed, data revealed that the incidence of ESRD rose modestly from 7.1 per MARP in the 1980–1984 cohort to 9.9 per MARP over the next 15 years. In contrast, the prevalence of patients receiving RRT increased from 22.9 per MARP

in 1980 to 62.1 per MARP in 2000, providing evidence of improved long-term survival. As in the United States, the incidence of ESRD was highest in the 15–19 year age group, with the exception of the 0- to 4-year age group in Finland who experienced a high incidence of ESRD (15.5 per MARP) secondary to the large number of infants in that country with congenital nephritic syndrome. The incidence of ESRD in children (<20 years age) from Australia and New Zealand has remained fairly constant at around 8–10 per million population over the past 25 years, whereas the prevalence of treated ESRD has steadily increased since 1980, from approximately 25 to 50 patients per million population (Australia and New Zealand Dialysis and Transplant Registry). In 1998, Japanese National Registry data reported comparatively lower ESRD incidence and prevalence rates of 4 and 22 per MARP, respectively, for children 0–19 years of age (Hattori S, Yosioka K, Honda M, Ito H, 2002) for reasons that are as yet unexplained. However, as in other countries, the prevalence rate of treated ESRD patients among patients aged 15–19 years of age was not only high (34 per million), but seven times higher than that of patients 0–4 years of age (5 per million). In the 2005 from the USRDS, data regarding the incidence and prevalence of ESRD in children was simultaneously published from 37 countries to corroborate the information above and to facilitate international comparisons (U.S. renal data system, USRDS, 2005) The highest incidence rates for children were reported from the United States, New Zealand, and Austria, at 14.8, 13.6, and 12.4 per million population, respectively. As mentioned earlier (*vide supra*), Japan's rate for pediatric patients was, in contrast, one of the lowest, even though Japan ranks fourth highest in the world for the incidence of ESRD in adults. The prevalence rate for pediatric ESRD patients was reported to be highest in Italy, at 258 patients per million populations; however, this may be partially related to the addition of data from patients ages 20–24 to the prevalent group. The second highest prevalence rate for children was reported from Finland, with a rate only 40% of that in Italy but greater than the rates from the United States and Hungary, where they were reported to be 82 and 81 patients per million populations, respectively (U.S. renal data system, USRDS 2005).

A number of factors influence incidence and prevalence rate variability of ESRD. Factors such as racial and ethnic distribution, type of prevalent renal disease, and quality of medical care available for preterminal CKD patients have a significant impact on patient outcome. As the vast majority of treated ESRD patients come from

more-developed countries, which can afford the cost of renal replacement therapy, the huge disparity in the prevalence of ESRD between the more- and less-developed countries probably stems, in large part, from the inadequacy of health-care resource allocation to programs providing renal replacement therapy in underdeveloped countries (De Vecchi AF, Dratwa M, Wiedmann ME, 1999). Finally, characterization of the patient population with CKD (both preterminal CRF and treated ESRD) reveals that the incidence and prevalence rates are universally greater for boys than for girls (Gulati S, Mittal S, Gupta RK, 1999) Two thirds of patients in the NAPRTCS CRI registry and in the database of the ItalKid Project are males. This gender distribution reflects the higher incidence of congenital disorders, including obstructive uropathy, renal dysplasia, and prune belly syndrome, in boys versus girls. In fact, in the ItalKid Project, males continue to predominate (male: female ratio 1.72) even after excluding patients with posterior urethral valves, As for race, the incidence rate for ESRD in black children in North America is two to three times higher than for white children, irrespective of gender (U.S. renal data system, USRDS 2001 ) Likewise, the incidence rate of ESRD for the indigenous people of Australia (Aborigines) and New Zealand (Maoris) is disproportionately higher than that experienced by the remainder of the population (Hoy WE,1996)

## **2.9. Renal failure etiology by country:**

Unlike adults in whom diabetes and hypertension are responsible for the majority of CKD, congenital causes are responsible for the greatest percentage of all cases of CKD seen in children. However, whereas this is the most common reported etiology from developed countries where CKD is diagnosed in its earlier stages, infectious or acquired causes predominate in developing countries, where patients are referred in the later stages of CKD. These generalizations apart, certain disorders giving rise to CKD are, indeed, more common in some countries than in others. In the CRI registry arm of NAPRTCS, almost one half of the cases are accounted for by patients with the diagnoses of obstructive uropathy (22%), aplasia/hypoplasia/dysplasia (18%), and reflux nephropathy (8%). Whereas structural causes predominate in the younger patients, the incidence of glomerulonephritis (GN) increases in those older than 12 years. Among the individual glomerular causes, only focal segmental glomerulosclerosis (FSGS) accounts for a significant percentage of patients (8.7%),

whereas all other glomerulonephritides combined contribute less than 10% of the causes of childhood CKD. For reasons that are as yet not clear, FSGS is three times more common in blacks than in whites (18% vs. 6%) and is particularly common among black adolescents with CKD (NAPRTCS, 2005).

Data from the ItalKid Project revealed that hypoplasia with or without urological malformations accounts for as many as 57.6% of all cases of CKD in Italy, whereas glomerular diseases account for as few as 6.8% of cases of CKD in children. Interestingly, when the analysis was restricted to the patient population that had reached ESRD, the relative percentage of glomerular diseases increased from 6.8% to 15.2%, whereas that of hypoplasia decreased from 57.6% to 39.5%, underscoring the discrepancy between the rates of progression of these two entities. Observations from this study have also prompted questions regarding the commonly accepted cause-effect relationship between vesicoureteral reflux (VUR) and kidney disease (reflux nephropathy) and support the hypothesis that both hypoplasia and VUR may be related to similar developmental factors causing congenital disorders of the kidney and urinary tract (Pope JC IV, Brock JW III, Adams MC, Stephens FD, Ichikawa I, 1999). In the ESRD population reported by the EDTA registry, hypoplasia/dysplasia and hereditary diseases were the most common causes for ESRD in the 0- to 4-year age group, whereas GN and pyelonephritis became progressively more common with increasing age in the majority of reporting countries (Van der Heijden BJ, van Dijk PC, Verrier-Jones K, Jager KJ, Briggs JD, 2004). The exception is Finland, where congenital nephrosis (Finnish type) remains the most common cause of ESRD in children younger than 15 years of age (Finnish Registry for Kidney Diseases 1999). Somewhat different is the data reported by the Japanese National Registry, which reflects a very high proportion (34%) of cases secondary to GN [FSGS 60% and immunoglobulin A (IgA) nephropathy 17%] in their pediatric ESRD population (Hattori S, Yosioka K, Japanese Society for Pediatric Nephrology (2002). Similarly, the Australia and New Zealand Dialysis and Transplant (ANZDATA, 2005) registry reported GN to be the most common cause of ESRD in children and adolescents from Australia and New Zealand (42%) (Australia and New Zealand Dialysis and Transplant Registry. The 28<sup>th</sup> annual report. 2005 report). Comprehensive information on the etiology of ESRD from many less-developed countries is unavailable owing to poor data collection and the absence of renal registries. In addition and in contrast to the experience within developed countries, many of these

countries continue to suffer from the burden of infectious diseases such as hepatitis C, malaria, schistosomiasis, and tuberculosis, with resultant infection-related GN. One such example is Nigeria, from which a publication on pediatric CKD reported various glomerulopathies as the cause of renal failure in one half of their patients, a third of whom also had nephritic syndrome (Anochie I, Eke F, 2003) Human-immunodeficiency-virus (HIV)-associated nephropathy in children is another entity that is underreported, and it is a disorder that is likely to increase along with the increasing incidence of HIV in Africa and Asia. Familial Mediterranean fever leading to amyloidosis has been found to be responsible for up to 10% of cases of CKD in Turkish children ( $n=459$ ) (Sirin A, Emre S, Alpay H, Nayir A, Bilge I, Tanman F,1995). Hereditary disorders are more prevalent in countries where consanguinity is common. One third of Jordanian children with CKD have been diagnosed with hereditary renal disorders such as polycystic kidney disease, primary hyperoxaluria, and congenital nephrotic syndrome (Hamed RMA, 2002) Similarly, one fifth of Iranian children with CKD have been reported to have hereditary disorders such as cystinosis, cystic kidney disease, Alport syndrome, and primary hyperoxaluria (Madani K, Otoukesh H, Rastegar A, Why SV, 2001)

## **2.10 Renal failure progress:**

Although the stages of CKD are now reasonably well defined, the natural history of the early stages is variable and often unpredictable. However, most available data demonstrates a slower progression toward ESRD in patients with congenital renal disorders compared with patients with glomerular disease. For this reason, and as alluded to previously, the relative proportion of glomerular diseases increases in groups of patients with more advanced stages of CKD. The progression of established CKD is also influenced by a variety of risk factors, some of which (e.g., obesity, hypertension, and proteinuria) may be modifiable (Remuzzi G, Bertani T,1998) whereas others, including genetics, race, age, and gender, are not. Obesity is associated with hypertension, albuminuria, and dyslipidemia, all of which can potentially influence the progression of CKD. The incidence of certain glomerulonephritides, such as FSGS, is higher in obese than in lean individuals (Verani RR,1992). Hypertension together with proteinuria has been shown to be an

important risk factor for progression of primary renal disease in children and adults (Mitsnefes M, Ho PL, McEnery PT,2003) and the renoprotective efficacy of renin angiotensin system (RAS) antagonists, which is in part independent of blood pressure, has been clearly demonstrated in animal models and adults with acquired nephropathies (Kamper AL, Strandgaard S, Leyssac P,1992). Whereas both angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers have been shown to reduce proteinuria in children with CKD, the renoprotective efficacy of these medications in children and their potential impact on the epidemiology of CKD still needs to be better delineated, as is currently being addressed by the Effect of Strict Blood Pressure Control and ACE Inhibition on the Progression of Chronic Renal Failure in Pediatric Patients (ESCAPE) trial (Ellis D, Vats A, Moritz M, Janosky JE, 2003). The clustering of CKD in families is strongly suggestive of a genetic or familial predisposition in some cases (Bergman S, Key BO, Kirk KA, Warnock DG, Rostant SG,1996). Studies have suggested the presence of links between CKD and various alterations or polymorphisms of candidate genes encoding putative mediators, including the renin-angiotensin system. Additionally, racial factors may play a role in susceptibility to CKD, as there is a strong concordance of renal disease in the families of African Americans with hypertensive ESRD (Bergman S, Key BO, Kirk KA, Warnock DG, Rostant SG,1996). Not only may there be an increased susceptibility to disease, but there is evidence that the rate of progression of CKD is faster among African American males (Hsu CY, Lin F, Vittinghoff E, Shlipak MG, 2003). Low birth weight in some ethnic communities might be associated with a reduction in the number of nephrons and a subsequent predisposition to hypertension and renal disease in later life (Brenner BM, Chertow GM,1994). Irrespective of the underlying kidney disease or presence of additional risk factors, it is clear that the risk of progression to ESRD in childhood is inversely proportional to the baseline creatinine clearance (North American Pediatric Renal Transplant Cooperative Study (NAPRTCS, 2005). Additionally, regardless of the initial level of renal insufficiency, puberty seems to be a critical stage for patients with renal impairment, as a steep decline in renal function often occurs during puberty and the early postpuberty period (Ardissino G, Dacco V, Testa S, Sereni F,2003)Whereas the specific reasons are yet to be determined, it is speculated that this pattern of progression may be attributable to an adolescent-specific pathophysiological mechanism, possibly related to sex hormones and/or the

imbalance between residual nephron mass and the rapidly growing body size. Data collected by NAPRTCS has also revealed that patients whose baseline serum albumin was below 4 g/dl, inorganic phosphorus above 5.5 mg/dl, calcium below 9.5 mg/dl, blood urea nitrogen (BUN) above 20 mg/dl, or hematocrit below 33% had a significantly higher risk of reaching ESRD ( $p < 0.001$ ) North American Pediatric Renal Transplant Cooperative Study (NAPRTCS,2005). Data pertaining to a variety of risk factors potentially associated with the progression of CKD, including those noted above, is being collected by the Chronic Kidney Disease in Children Study (CKiD), a prospective, multicenter initiative funded by the National Institutes of Health designed to follow the course of 540 children with CKD for 2–4 years (Furth SL, Cole SR, Schwartz G, Wong C, Warady BA, 2006)

### **2.11. Renal failure dialysis modalities & outcome**

The outcome with severe CKD is highly dependent upon the economy and availability of health care resources. Approximately 90% of treated ESRD patients come from developed countries that can afford the cost of RRT (De Vecchi AF, Dratwa M, Wiedmann ME, 1999) despite comparable incidence rates, high mortality in countries that lack resources for RRT results in a low prevalence of CKD patients in those countries. In one of the tertiary care hospitals in India, for example, up to 40% of the ESRD patients opted out of further therapy because of a lack of financial resources (Gulati S, Mittal S, Gupta RK,1999) and of the 91 patients with ESRD in another hospital, only 15 underwent renal transplantation, 63 received hemodialysis, and the remainder opted out of dialysis or transplantation care secondary to financial constraints with ESRD were accepted by an “Assessment Committee” for RRT as part of a rationing program (Moosa MR, Kidd M, 2006). In countries where RRT is readily available, the most favored renal replacement modality is transplantation in all pediatric age groups. Sixteen percent of children newly diagnosed with ESRD in North America receive a preemptive transplant, and three fourth of children receive a transplant within 3 years of RRT initiation (U.S. renal data system, USRDS,2005). Similar figures are reported by the ANZDATA registry (Australia and New Zealand Dialysis and Transplant Registry, 2005). Among Western countries, Spain/Catalonia has the highest pediatric transplant rate, reaching 15 patients per million population, followed by a rate of 12 patients per million population in the United States and

Finland U.S. renal data system, USRDS 2005). In the United States, white pediatric patients are more likely to receive a renal transplant than are patients from other racial groups. The distribution of dialysis modalities varies among countries (U.S. renal data system, USRDS 2005). Peritoneal dialysis (PD) in children is highest in Finland, New Zealand, and Scotland, accounting for 73%, 71%, and 67% of prevalent dialysis patients, respectively. Whereas PD is still the favored mode of dialysis in young children, there has been an increase in hemodialysis (HD) utilization since the early 1990s, and HD is now the most common form of dialysis overall for prevalent patients <19 years of age ( U.S. renal data system, USRDS, 2005). In the United States, PD is the most frequently used dialysis modality (60% of dialysis patients) according to the NAPRTCS registry (North American Pediatric Renal Transplant Cooperative Study (NAPRTCS,2005) whereas HD is more common according to data collected by the USRDS (U.S. renal data system, USRDS,2005). Once again, this discrepancy reflects in part the fact that many adolescent patients are cared for in adult dialysis units where there is often a preference for HD (Furth SL, Powe NR, Hwang W, Neu AM, Fivush BA ,1997). Whereas automated PD (APD) is the most frequently used PD modality in children (Warady BA, Alexander SR, Balfe JW, Harvey V,2000) continuous ambulatory PD (CAPD) is commonly used in countries that lack finances and technical support, as reflected in the recent report of the Turkish Pediatric Peritoneal Dialysis (TUPEPD) registry, (Bakkaloglu SA, Ekim M, Sever L, Noyan A, 2005). Mortality rates remain significantly lower in pediatric patients with ESRD compared with their adult counterparts. Nevertheless, an assessment of the causes of death reflect the excess risk of cardiac and vascular disease and the high prevalence of left ventricular hypertrophy and dyslipidemia among children treated with RRT (Bakkaloglu SA, Ekim M, Tumer N, Soylu K, 2000). Pediatric patients with glomerulonephritis or those with cystic/hereditary/congenital disease have the greatest probability of surviving 5 years, in contrast to patients who have developed ESRD as a result of secondary GN or vasculitis ( U.S. renal data system, USRDS 2005 (2005). Infants on dialysis have a higher mortality rate than do older children, which is likely, at least in part, to be a result of coexisting morbidities (Wood EG, Hand M, Briscoe DM, Warady BA, Ellis EN 2001). Although substantial improvement has occurred in the long-term survival of children and adolescents with ESRD over the past 40 years, the overall (dialysis and transplantation) 10-year survival remains at only 80%, and the age-specific

mortality rate is still 30–150 times higher than among children without ESRD (McDonald SP, Craig JC,2004). It is noteworthy that dialysis is associated with an appreciably higher risk of death compared with renal transplantation; therefore, patients who experience a longer wait for transplantation are more likely to have a worse overall outcome. Not only is the benefit of transplantation evident when one compares transplant recipients to patients deemed “medically unsuitable” for transplantation, it has also been substantiated in a recent longitudinal study of 5,961 patients  $\leq 18$  years of age, all of whom were placed on the kidney transplant waiting list in the United States (Gillen DL, Smith J, Stehman-Breen CO, Brandt JR, Wong CS ,2006). In that study, transplanted children had a lower estimated mortality rate (13.1 deaths/1,000 patient years) compared with patients on the waiting list (17.6 deaths/1,000 patient years). Similarly, the 2005 ADR reported that approximately 92% of children initiating therapy with a transplant survive 5 years compared with 81% of those receiving HD or PD U.S. renal data system, USRDS 2005. Finally, the expected remaining lifetime for children 0–14 years of age and on dialysis is only 18.3 years, whereas the prevalent transplant population of the same age has an expected remaining lifetime of 50 years (U.S. renal data system, USRDS, 2005).

## **2.12 Water Salinity**

### **2.12.1 Salinity historical review**

Salinity is an ecological factor of considerable importance, influencing the types of organisms that live in a body of water. As well, salinity influences the kinds of plants that will grow either in a water body, or on land fed by water (or by a groundwater). A plant adapted to saline conditions is called a halophyte. Organisms (mostly bacteria) that can live in very salty conditions are classified as extremophiles, halophiles specifically. An organism that can withstand a wide range of salinities is euryhaline. Salt is expensive to remove from water, and salt content is an important factor in water use (such as potability). The technical term for saltiness in the ocean is halinity, from the fact that halides - chloride specifically - are the most abundant anions in the mix of dissolved elements. In oceanography, it has been traditional to express salinity not as percent, but as parts per thousand (ppt or ‰), which is approximately grams of salt per liter of solution. Other disciplines use chemical analyses of solutions, and thus salinity is frequently reported in mg/L or ppm (parts per million). Prior to 1978, salinity or halinity was expressed as ‰ usually based on the electrical conductivity ratio of the sample to "Copenhagen water", artificial sea water manufactured to serve as a world "standard". In 1978, oceanographers redefined salinity in the Practical Salinity Scale (**PSS**) as the conductivity ratio of a sea water sample to a standard KCl solution. Ratios have no units, so it is not the case that a salinity of 35 exactly equals 35 grams of salt per liter of solution (Wikipedia, 2006).

### **2.12.2 Salinity definitions and concept:**

Salinity is the increased accumulation of excessive salts in land and water at sufficient levels to impact on human and natural assets (plants, animals, aquatic ecosystems, water supplies, agriculture, or infrastructure). Primary salinity is where increases in salinity have occurred solely through natural processes and secondary or induced

salinity is where increases have occurred due to land use changes made by human activity. Because salinity can be produced by a variety of distinctly different land management and ground water flow systems no one approach to managing salinity will work in all cases (Wikipedia, 2006). Salinity is the saltiness or dissolved salt content of a body of water. 35 g dissolved salt / kg sea water = 35 ppt = 35 o/oo = 3.5% = 35,000 ppm. Salinity in drinking water - 100 ppm, restriction on drinking water - 500 ppm , limit drinking water - 1000 ppm, limit agriculture irrigation - 2000 ppm, brackish water - 500 - 30,000 ppm , sea water - 30,000 - 50,000 ppm brine > 50.000 ppm . Saline water is a general term for water that contains a significant concentration of dissolved salts (NaCl). The concentration is usually expressed in parts per million (ppm) of salt (Wikipedia, 2006). The salinity concentration level used by United States Geological Survey classifies saline water in three categories. Slightly saline water contains around 1,000 to 3,000 ppm. Moderately saline water contains roughly 3,000 to 10,000 ppm. Highly saline water has around 10,000 to 35,000 ppm of salt. Seawater has a salinity of roughly 35,000 ppm, equivalent to 35 g/L. Because of scarcity of fresh water in some areas of the world, saline water is used by desalinating it. For example, in Colorado, water having up to 2,500 ppm of salt is used for irrigating crops. Saline water, known as saline, is also used in medicine as a sterile solution. Normally, moderately or highly salinated water is of little use to humans. Humans cannot drink salinated water directly, nor is it suitable for irrigating crops. (Wikipedia, 2006).

<b>Water salinity based on dissolved salts in parts per thousand (ppt)</b>			
<b>Fresh water</b>	<b>Brackish water</b>	<b>Saline water</b>	<b>Brine</b>
<b>&lt; 0.5</b>	<b>0.5 – 30</b>	<b>30 – 50</b>	<b>&gt; 50</b>

### **2.13. World Health Organization standards for drinking water**

Freshwater is a word that refers to bodies of water such as ponds, lakes, rivers and streams containing low concentrations of dissolved salts and other total dissolved solids. In other words, the term excludes seawater and brackish water. Freshwater can also be the output of desalinated seawater. Freshwater is an important renewable resource, necessary for the survival of most terrestrial organisms, and is required by humans for drinking and agriculture, among many uses. The World Health Organization apply safe drinking water standard parameter these are the most important parameters determining safe drinking water, chloride is 250 mg/l , fluoride 1.5 mg/l, sodium 160 mg/l, nitrate 50mg/l, and TDS 600mg/l. (WHO,1999).

## 2.14. Conceptual Framework

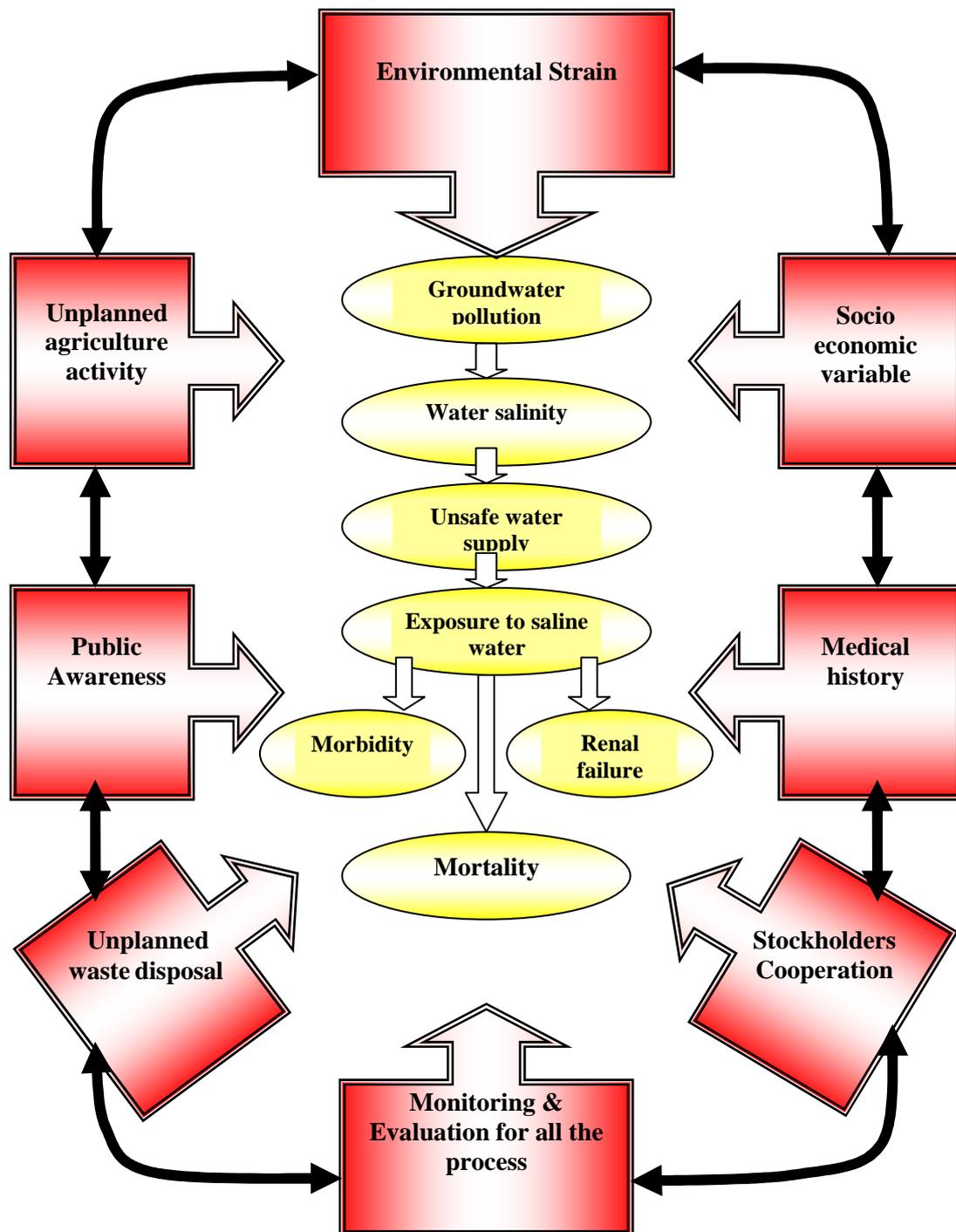


Figure: 2.1: Conceptual framework

## **Introduction**

In this part of the chapter, the factors that affect and affected by water quality will be illustrated using a brief summary figure (2.1) shows the conceptual framework adopted, by the researcher, which was the Cause-effect framework model which behave with renal failure disease as an outcome from exposure to saline polluted water.

### **2.15 Factors affecting and affected water quality and level of salinity**

The diagram (Figure 2.1) presents indicators related to environmental quality as an important direct and indirect determinant of human health. Deteriorating environmental conditions are major contributory factor to poor health. Through the cause-effect model represents water as a major driving force for health, and renal failure as effect and outcome of exposure to saline water. The frame will include the factors affect and affected by water salinity.

#### **2.15.1 Driving force: Water pollution and deterioration**

There are two major indicators affected the water salinity and pollution the first are naturally occurring which refer to the physical setting of the area were the aquifer is located in and level of annual rainfall as the area is semi arid with very average annual rainfall 279 mm per year. These indicators assist in pressing to water deterioration, on the other hand the human activities that stress water deterioration which include population dynamics, urbanization as cities generate considerable waste and pollution, poverty, technical and scientific development, poorly and unplanned water source management, unplanned agriculture activity, economic development, consumption and production pattern as increase consumption and production depletes the natural resources and produces waste, which have sever effect

on the environment and human health. Science and technology have played and will continue to play a significant role in the search for new knowledge and more efficient means of agricultural and industrial production as well as technology development can be polluting and wasteful and may create serious risk to environment and health.

#### **2.15.2 Pressure:**

High pressure from water pollution as a driving force will lead high percentage of household without safe drinking water supply access which have negative impact both on the consumer health and satisfaction.

#### **2.15.3 State:**

Saline water with high level chloride, fluoride, TDS, sodium, and nitrate. These indicators will lead to direct or indirect health effect.

#### **2.15.4 Exposure:**

High percentage of population at risk, due to environmental deterioration from human activities.

#### **2.15.5 Effect:**

Morbidity and may mortality from diarrhea, renal failure, and other diseases due to natural resource mismanaged, poorly planned or inadequately regulations, peoples vulnerability to environmental health risk increase.

## **Chapter 3: The Study Area**

This chapter addresses issue relating to the study area these issue will give a simple explanation for salinity level in the study area this chapter include historical review of water quality in the country, location, physical setting, land use hydrogeology, and water quality in the study area.

### **3.1 location**

Gaza Strip is located in an arid area with scarce water resources. It is a part of the Palestinian coastal plain in the south west of Palestine as shown in annex (2), where it forms a long and narrow rectangular area of about 365 km<sup>2</sup>, with 45 km length, and between 5 and 12 km width. Nowadays, its five governorates are; Northern, Gaza, Middle, Khanyunis and Rafah. It is located on the south-eastern coast of the Mediterranean Sea, between longitudes 34° 2'' and 34° 25'' east, and latitudes 31° 16'' and 31° 45'' north. The Gaza Strip is confined between the Mediterranean Sea in the west, Egypt in the south. Before 1948, it was part of Palestine under the British Mandate. From 1948 to 1967, it was under the Egyptian administration. From 1967 until 1994, the Gaza Strip was under Israel occupation. According to the peace agreement between Israel and the Palestinian, the Gaza Strip has been under the Palestinian Authority control since May, 1994 (Qahman, 2004).

Gaza coastal aquifer is an important source of water to over 1.5 million residents in Gaza Strip. It is utilized extensively to satisfy agricultural, domestic, and industrial water demands. The extraction of groundwater currently exceeds the aquifer recharge rate. Today, the Gaza Strip is a land under great pressure. It is densely populated, with population of more than one million in the year of 1998 and the population increased rapidly up to approximately 1.5 million now in 2007, which means that the environment in Gaza has been under great pressure and as a result most of the people there suffers severely now (Qahman and Zhou, 2001). Khanyounis Governorate is located in the southern part of Gaza Strip as shown in annex (3). Its district capital is Khanyounis city. In 2006, about 280 thousand inhabitants are living in Khanyounis. The Khanyounis governorate consists of six municipalities: Khanyounis, Bani Suhaila, Abasan El-Kabira, Abasan El-Saghira, Quarrara, Al Fakhari and the Khuza'a.

## **3.2 Physical Settings**

### **3.2.1 Climate**

Khanyounis is a part of Gaza Strip has a characteristically semi-arid climate and is located in the transitional zone between a temperate Mediterranean climate in the west and north, and an arid desert climate of the Sinai Peninsula in the east and south. Regarding the rainfall data and measurements of Khanyounis governorate, the wet season starts in October and extends to April while the dry season occurs between May to September ( PWA, 2000).

### **3.2.2 Temperature**

For the period lasting from 1970 until 2000 temperature gradually changes throughout the year, reaches its maximum in August (summer) and its minimum in January (winter), average of the monthly maximum temperature range from about 17.6 C° for January to 29.4 C° for August. The average of the monthly minimum temperature for January is about 9.6 C° and 22.7 for August ( CAMP, 2000)

### **3.2.3 Rainfall**

The rainfall data of the Khanyounis is based on the data collected from the main two rain stations located in Khanyounis city and Khuza'a. Average rainfall in Khanyounis governorate from 2000 to 2005 was 279.17 (mm/year) as an annual precipitation (PWA,2004).

### **3.2.4 Topography and Soil**

The Khanyounis topography is characterized by elongated ridges and depression parallel to the coastline, dry streambeds and shifting sand dunes. They are narrow and consist of "Kurkar" sandstone. The major depressions are filled with alluvial sediments from storm water. Land surface elevations range from mean sea level (MSL) near the coastline to about 100 meters above the mean sea level at the eastern areas ( PWA, 2006).

### **3.2.5 Land Use**

The land is scarce and the pressure on it is increasing rapidly for all kinds of uses; urban, industrial, and agricultural uses. Agricultural land occupies about 72 km<sup>2</sup>, which is about to 65% of the total area of the Khanyounis governorate. It is expected that future expansion will be for the urban use only. (PCBS, 2006).

## **3.3 Hydrogeology**

### **3.3.1 Description of the coastal aquifer**

The coastal aquifer of the Gaza Strip (included Khanyounis governorate) is part of a regional groundwater aquifer system that extends north up to Haifa, and south into Sinai coast of Egypt. The coastal aquifer consists primarily of Pleistocene age Kurkar Group deposits including calcareous and silty sandstones, silts, clays, unconsolidated sands, and conglomerates. The coastal aquifer is generally 10-15 kilometers wide; the Kurkar group forms a seaward sloping plain, which ranges in thickness from 0 m in the east, and about 100 m at the shore in the south, and about 200 m near Gaza city. At the eastern Gaza border, the saturated thickness is about 60-70 m in the north, and only a few meters in the south near Rafah. Near the coast, coastal clay layers extend about 2-5 km inland, and divide the main aquifer into three sub-aquifers. The base of the aquifer is marked by the top of Saqiya formation (Tertiary age), it is a thick sequence of marls, clay stones and shale that slopes towards the sea, with low permeability and approximately 400-1000 m thick wedge beneath the Gaza Strip (PWA, 2000).

### **3.3.2 Groundwater Flow and Water Levels**

Under natural conditions, groundwater flow in the Khanyounis governorate is towards the Mediterranean Sea, where fresh groundwater discharges to the sea. However, natural flow patterns have been significantly disturbed by increasing population and over pumping in the past 40 years (PWA, 2000). Within the Khanyounis governorate, large cone of depression has formed over large area. Water levels are presently below

mean sea level in many places, inducing a hydraulic gradient from the Mediterranean Sea towards the major pumping centers and municipal supply wells. In Khanyounis, water levels range from about 10 meters above sea level near the eastern border to mean sea level along the shore. In some places, flow directions have been reversed as a result of over-pumping.

### **3.3.3 Study area water quality**

The researcher reviewed the historical data of water quality for the southern municipals wells and summaries the historical salinity level in Khanyunis and the eastern villages the data **illustrated in chapter 5, Ecological Variables**, The study finding showed that Khanyunis water is generally poor and magnitude and attitude of groundwater quality change with time depends mainly on many factors such as; well location, and pumping rate. Generally, most of the wells show significant water salinity increase as indication of groundwater salinization. The results show that only 8% of the municipal wells meet the WHO standards for drinking in chloride level. Chloride, nitrate, TDS, fluoride and sodium concentration exceed 2-9 times the WHO standards in 92% of the municipal southern wells. Localized salinity impacts are observed near Khanyunis. Chloride concentrations in municipal wells have risen steadily from about 100 or 500 mg/l in the 1970 to almost 1000 in 1997. Groundwater salinity is considered to be one of the most pressing problems of the water supply system. A generalized contour map of chloride concentration for the year 2005 is shown in annex (4). The chloride concentration of the Khanyunis municipality is in the range of 350-1250 mg/l.

### **3.4 Historical comparison between the study area water quality and Gaza strip**

Water balance is the relation between the flows into and out of the aquifer at a given time or under a given set of hydrologic conditions. At present, there is a net negative balance between inflows and outflows because the rate at which ground water is being extracted is higher than the rate at which it is being replenished. There is significant uncertainty around historical pumping in Gaza, it is believed that large-scale abstraction started in early 1960, when agricultural development of the Gaza Strip

began. Continuous decrease in water level since 1970 with a flattening of or slight recovery in the wet year 1991/1992. Most of the responses are observed in the southern parts of Gaza. The initial water level rise is believed to be natural response to 1991/1992 wet year when rainfall in the region was about 150% of the long-term average. Continuous water level declines are observed primarily in the southern part of Gaza near Khanyunis. In broad terms, the total measured changes in water levels (i.e., storage) across the Gaza Strip between 1970 and 1993 observed water levels dropped in average but mostly in the south (PWA, 2000). The negative balance is reflected in decreasing water levels in many parts of the aquifer system as well as gradual and/or sudden increase in aquifer salinity. Water imbalance causes depletion of Gaza fresh ground water resources. It has resulted in seawater intrusion and upcoming of brines. Ongoing deterioration of Gaza water is a major challenge for water planners and sustainable management of the costal aquifer. The aquifer is presently being overexploited, with total pumping exceeding total recharge. In addition, anthropogenic sources of pollution threaten the water supplies in major urban centers. Many water quality parameters presently exceed World Health Organization (WHO) drinking water standard. Magnitude and attitude of groundwater quality change with time depends mainly on many factors such as; well location, total penetrated depth, saturated thickness and duration and pumping rate. Generally, most of the wells show significant water salinity increase as indication of groundwater salinization due to saline water upward leakage from the underneath water formations. While the magnitude of water quality changes in the wells that are located in the fresh groundwater is more or less stable with time, but that is not mean that the aquifer is not affected by salinization but it is not noticed at the moment due to the thickness of the fresh water aquifer. Actually and based on the geophysical survey that have been conducted before through the Costal aquifer management program (CAMP) project in year, 2000 it was clear the saline water interface is very close to the yielding zone and its impact on the groundwater quality will be noticed suddenly with continuous pumping after short period (PWA, 2007 ). The major documented water quality problems are elevated chloride (salinity) and nitrate concentration in the aquifer. The extent to which the aquifer may be impacted by other pollutants such as organic chemicals, metals, and pesticides. Screening of total petroleum hydrocarbons and organic chlorine pesticides from 130 wells was conducted during the CAMP project. None of the wells had total petroleum hydrocarbons level exceeding 1 mg /l. Even

though floating oil product has been observed in several agricultural wells. Low level of organ chlorine pesticides were found in 5 agricultural wells and 8 municipal wells, primarily in Khanyounis and Rafah areas. None of the pesticides levels exceeded the US Environmental Protection Agency or the WHO standards. In different parts of the aquifer while some of the chloride may be occurring naturally (as lateral inflow from Israel or water rock interaction). Ground water quality in the Khanyounis aquifer is generally poor. Over-exploitation has resulted in saltwater intrusion and up-coning. In most areas of Khanyounis, a slow, continuing decline in groundwater levels has been observed since the mid-1970s. So, the coastal aquifer is over exploited and vulnerable to becoming unusable for drinking water and irrigation. Two main problems currently challenge the groundwater resources in Khan younis Governorate, progressive salinity of water wells which exceeds WHO standards and, raising of nitrate levels in the drinking water. The WHO drinking water standards for chloride is 250 mg/L and 50 mg/L for nitrate. The WHO drinking water standard for chloride of 250mg/l is generally only met in the Gaza and Northern Governorates which mean that underground water in Khanyounis doesn't meet the standard level. This was confirmed by the sampling of 130 municipal and agricultural wells conducted as part of the CAMP during the November and December 1999. Chloride concentration is highest along the Gaza border in the middle and south areas with concentrations exceeding 1000 mg/l. Few wells in Gaza remain unaffected by high nitrate levels and only about 10% of the municipal water supply remains below the WHO drinking water standard of 50 mg/l. In the most wells and areas, nitrate concentration increasing, in some cases rapidly, at rates of up to 10 mg/l per year. The main sources of the nitrates are believed to be fertilizers and domestic sewage effluent. Relative impacts of agricultural practices and sewage (PWA, 1999). Within the city of Khan younis, chloride values are about 500 mg /l in the early 1970s to almost 1000 mg/l in 1997. Localized salinity impacts are observed near Khanyounis (PWA, 2000). Palestinian fresh ground water resources are currently being depleted due to over pumping of the aquifer, the fact that rates of salinization are increasing in areas of relatively good water quality implies that fresh water bodies are gradually becoming replaced with brackish and/or saline water. The time frame until all fresh water resources are exhausted will depend on continued pumping volumes and patterns, as well as the balance between aquifer inflows and out flows. Using a rate of aquifer depletion of 20 Mm<sup>3</sup>/y, it can be calculated that in theory, it will take about 20-30

years before all the fresh water in the Gaza coastal aquifer is replaced with higher salinity water (PWA, 2000). Pollution of groundwater in Gaza strip is a major problem. Not only are there numerous source of pollution, but also the aquifer is highly vulnerable to pollution. Furthermore, human activities including agriculture and inadequate waste management have increased groundwater contamination level. The high nitrate content of the groundwater appears to be primarily induced by sewage and leachate of solid waste. The reason for drawing attention to nitrate pollution is its toxicity to humans, especially for babies and pregnant women by the so-called "blue babies" syndromes. Another factor which affects groundwater is the salinity content which has shown an obvious increase during the past 10 to 20 years, this may be the result of groundwater flow to the east, Stalinization of the surface, and seawater intrusion from the west (CAMP, 2000). Gaza Strip is characterized by its natural water resources scarcity. The main source of water in the Gaza Strip is the groundwater aquifer. Over pumping and low rainfall have limited the quantity of water available and have further contributed to the degradation of the water quality (PWA, 2003). Ongoing deterioration of the water supply of Gaza poses a major challenge for water planners and the sustainable management of the costal aquifer.

## **Chapter 4: Methodology**

This chapter addresses issue relating to methodology used to answer the research questions. The chapter included the study design, the study population, period and place of the study, sample size, sampling method and method of conducting the study. Additionally construction of the questionnaires, as well piloting, ethical consideration, was also included. Then, it presents the ethical consideration and procedure, data collection, data cleaning, and data analysis. Also it illustrates the validity and reliability of the study instruments. The final step was the eligibility criteria and the limitations of the study.

### **4.1 Study design**

The study design is cross sectional, descriptive, analytical study. Cross section design is a research design that involves observation of some subset of a population of items all at the same point of time (Trochim, 2006). Usually cheaper, fast in term of time in relatively to other design (Gerard, 1999).

### **4.2 Study population**

The study population consists of one group:

- The target group is the total population of renal failure patient in the acute or chronic stage treated or followed by artificial kidney department doctors in Nasser hospital and previously or currently having access to domestic and drinking water from the resources available in Khanyounis Governorate (Municipal, UNRWA, Makorot, Private wells) and registered in governmental health sector, as renal failure patient in (Nasser hospital). Their total number was 194 subjects conducted to treatment and registered.

### **4.3 Period of the study**

The study was started in Nov. 2008, after approval from Director General of primary health care sector was got. The pilot study was conduct in Nov. 2008. Data collection started in Jan. 2009 to Feb. 2009. It takes all that's period because of the political status in the country was unsafe during December2008 and January 2009, the war on Gaza was an obstacles for data collection. Data entry and cleaning of data was conducted on Feb. 2009, data analysis, reviewing of literature and writing the report continued till the 30th of April 2009.

### **4.4 Place of the study**

The study conducted at Nasser Hospital, artificial kidney department, in Khanyunis Governorate.

### **4.5 Sample size**

The researcher used cross sectional survey method:

- Survey by including all the renal failure population in the acute or chronic stage for their small size, there was 194 patients.

### **4.6 Sampling method**

The researcher used survey technique for all the patients. Names were taken from Nasser Hospital directory, screening and registering of new list name for all renal failure patients (old, new, chronic, and acute) was carried out by the artificial kidney department in Nasser Hospital.

### **4.7 Response rate**

The number of respondent from patient is 136, out of 194 represented 70 % as response rate.

#### **4.8 Ethical consideration**

- An official letter was obtained from the Director General of primary health care centers (Annex, 2).
- An official letter was obtained from the Director General of governmental hospitals (Annex, 3 )
- Explanatory letter were attached to the questionnaire and provided to participants who were conducted to the study which included the study title, aim, objectives, and other information needed to make clarification to participants.
- In the face interview questionnaire privacy were kept to the patients.
- The right to participate or not, confidentiality, anonymity was maintained into the explanatory letter
- No participant would have experienced a sense of coercion; a sense of fear of not answering.
- Helesnky approval was obtained, and the researcher didn't have a copy due to health worker strike.

#### **4.9 Construction of questionnaire**

The researcher developed the questionnaires related to study by herself. Draft of questionnaire was done by the researcher, then final modifications was done with supervisor. The questionnaire designed to be clear with no complex terms, double parallel questions were avoided. It was translated into Arabic language where it was filled to the study subjects to facilitate understanding and to ensure credibility of answers.

The questionnaires were sent to expert and a pilot sample was collected to do the required modifications.

The researcher made one questionnaire for patient, which included three parts of questions, the first part included items related to personal information ( gender, age,

residency area ), social and economic information ( marital status, level of education , employment, previous job, current job, and family type ), medical history information ( type of chronic diseases, age of renal failure incidence, causes and etiological variables of renal failure, genetic and family history of the disease, residency of affected relatives, disease level of severity, hem dialysis, or renal transplantation ). The second part includes water sources (type of water source, water treatment history and tools, and water consumption pattern).

The third part include likert scale, divided into four groups each group contain different number of questions, the first domain is water quality and continuity which reflect the impact of salinity problem on the physical characterizes of water from the subjects point of view. The second domain is subject's knowledge and awareness about water salinity problem and if salinity affect public health status. The third domain is practice and attitude and this reflect subject's ability to save safe drinking water access during twenty four hours daily. The fourth domain is subject's satisfaction from water quality and quantity. The Likert scale used in the questionnaire was contained the following items, 1= strongly disagree, 2= disagree, 3= don't know, 4= agree, 5= strongly agree.

#### **4.10 Pilot study**

A pilot study done before data collection, and after experts evaluation done, pilot sample provide the study with many purpose. It gives an idea about response rate, and difficulty or vague questions.

Ten participant were included, they were all from different, gender, age, education levels, and residency there response rate was 90%.

All of them were provided a clear explanation about the study and it objective before application and after pilot an individual meeting done to ask the subjects about difficulties and their opinion in questionnaire. Some changes done after that a face questionnaire interview was administered for the pilot sample. The pilot questionnaires were included in the study.

#### **4.11 Data collection**

Questionnaire data was collected by researcher only with some assistance and coordination from the team worker in the artificial kidney department. The patient questionnaire was face interviewed questionnaire. The interview was started by giving the patient explanation about study and its objectives and their importance in giving true answers, a face interview questionnaire was conducted by researcher to the patient, because some of them were illiterate. They were given a complete instruction about the study and how they included in it, their privacy and safety during interview were maintained as the interview was done in the place of work, taking into consideration not to interrupt the work, during the interview. Data collection last about 25 full working days. Patient data for prevalence calculation was obtained and audited by the researcher as there were repletion of cases, the researched apply all the old and new cases on excel sheet and remove the repeated cases.

Water data was collected by the researcher by having hard copies of the chemical tests which was carried out by public health lab for all domestic municipal wells in Khanyunis governorate since 1987. The water quantity data was obtained from many agencies includes (municipalities, coastal water utility in the southern and Gaza region, and Water Authority).

#### **4.12 Data entry**

Data entry was done by using SPSS entry model. The questionnaire was coded and entered by researcher, data cleaned by reentered 20% of data randomly and through frequency table.

#### **4.13 Data analysis**

- Data analysis was done by using SPSS program and excel. Starting after data collection.
- Frequency table for the study variable were conducted.
- Description, mean and standard deviation for numeric variable were done,
- Reliability and validity for instrument done.
- The researcher don't conduct factor analysis due to the domains was created as it wasn't mentioned before in the literature.

#### **4.15 Validity of the questionnaire**

##### **4.15.1 Face validity:**

It is important to make people to response more to the questionnaire, the researcher check the face validity twice time, the first during the pilot study as the participants were asked about the structure of the questions, it's shape, and typing clearance. The second check was through expert persons who give their opinion in the face validity of questionnaires.

##### **4.15.2 Content validity:**

Content validity is subjective estimation of measurement based on judgment rather than statistical analysis. In order to validate the instrument used. It was done before data collection; by sent the questionnaires with covering letter and paper contain instruction about the study, over all aim, objective, field of study and other relevant information.

The researcher sent to eleven experts from different backgrounds including doctors, expert in management, experts in environment university educationist, and researchers. They were asked to estimate the questionnaires in relation to study, clarity, and completeness of each item. Feedback was obtained from 9 experts and

modification accordingly was done with the researcher supervisor, their opinion was taken in consideration.

The questionnaire was written in Arabic by the researcher and assessed by Arabic language expert who gave advices and modifications.

#### 4.16 Reliability

The statistical test used for the internal consistency was Cronbachs, alpha coefficient. The reliability for patient questionnaire as a whole was 0.712. Cronbachs Alpha was computed for the instruments subscales. Table (4.1) Shows the reliability estimated of the derived factors.

**Table 4.1:** Sub- Scale reliability subjects instrument

Factor No.	Factor name	Cronbach' Alpha
1-	Water quality	.69123
2-	Practice and attitude	.6430
3-	Knowledge and awareness	.7471
4-	Subjects satisfaction	.7206

#### 4.17 Inclusion and exclusion criteria

##### 4.17.1 Inclusion criteria:

- All renal failure patients who were treating in Nasser hospital and living in Khanyunis governorate and available at the study period.
- The patient who were interviewed during the pilot study

#### **4.17.2 Exclusion criteria:**

- Patient none available at the time of study, having treatment outside, or visitors.

#### **4.18 Limitation of the study**

- Under reporting was the major problem for the researcher to get data.
- Limited resource like, literature, books and magazine.
- Political situation was an obstacle, during the last war on Gaza 27<sup>th</sup> Dec. to 29<sup>th</sup> Jan.
- Limited information, insufficient and inappropriate data registry, and segmentation of data in many different stick holder.

## **Chapter 5: Results and Discussion**

The study examined if there is association between drinking water salinity (independent variable , exposure) and renal failure ( dependent variable, outcome ) and link the nature of the association in Khan yunis Governorate as well as to explore the relationships between demographical variables, etiological variables, and ecological variables (salinity variables) and renal failure prevalence.

This chapter presents the result of the statistical analysis of the data characteristic and distribution of the respondents. Then it presents statistical tests to explore the relationships between the dependent variables, and independent variables, and to explore the distribution of the subject's percentage according to the different variable. Then statistical method have been used to express the association and relation for the effect of the dependent variables on the independent variables, by using independent t-test and one way ANOVA statistical tests,

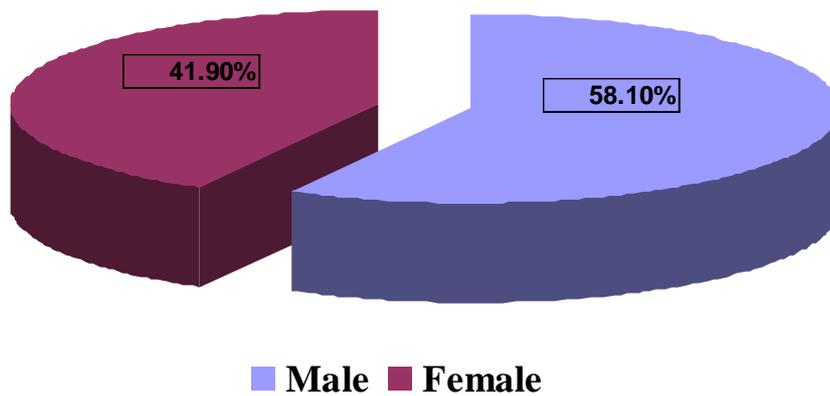
### **A.5.1 Descriptive Part**

#### **A.5.1.1 Socio demographical characteristics of the study sample:**

Regarding renal failure patient's gender, figure (5.1) showed the distribution of patient by gender as male patient represented 58.1%, while female patient represented 41.9% of total sample. The study finding reveals that gender distribution reflect higher male prevalence than female in Khan yunis governorate and correspond with the following studies carried out in the U.S.A reveal that population with chronic kidney disease incidence and prevalence rates are universally greater for boys than for girls, and corresponds with the study which reveals that two thirds of patients in the NAPRTCS CRI registry and in the database of the ItalKid Project are males. This gender distribution reflects the higher incidence of congenital disorders, including obstructive uropathy, renal dysplasia, and prune belly syndrome, in boys versus girls. In fact, in the Italy Kid Project, males continue to predominate even after excluding patients

with posterior urethral valves (Bradley A. Warady, 2007). The finding of the study is corresponding with the studies conducted by the section of nephrology, Mercy Hospital Kansas city MO USA and reveal that there is a gap between male and female patient percentage the male are predominate.

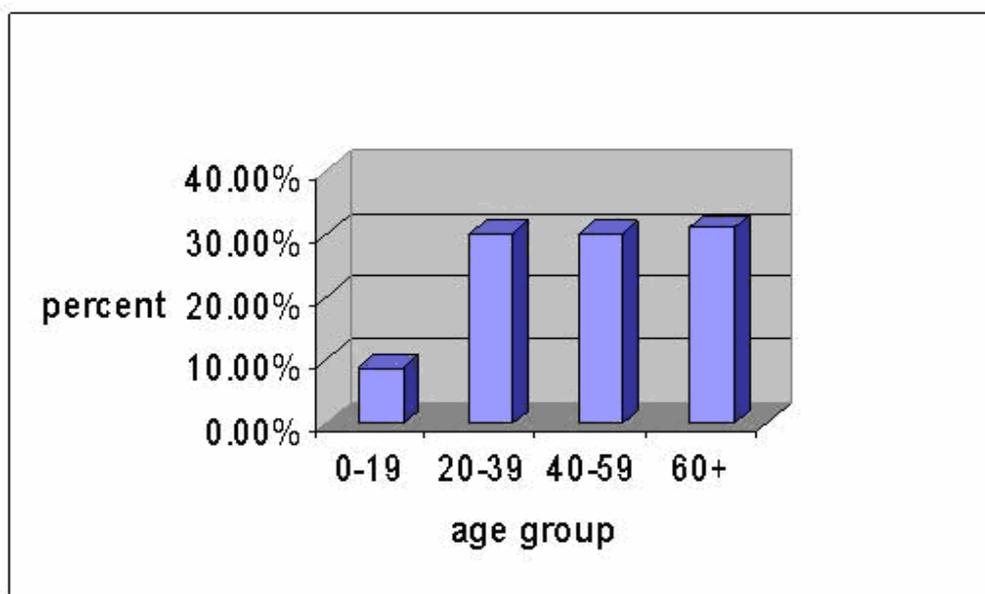
Figure 5.1: Distribution of renal failure patient by gender



#### A.5.1.2 Distribution of patients by age group

Regarding patient age, the patient distributed according to their age within four age groups, the lowest age group were 0-19 as it is only 8.8% of the total subjects, while the other two age groups were 20-39 and 40-59 were equal and represented 30.1% the fourth age group from 60+ and higher, the group was a little bit higher than the second and the third group with percent 30.9%, with (**mean 46.01, mode 60, median 47.50**) The majority of patient are older than 19 year. The study finding is corresponding to the study conducted "All the three Units of Medicine of Allied and District Headquarters, Allied Hospital Punjab Medical College, (PMC), Faisalabad a comparative study. Period Its January, 1995 to end of May 1997, the mean age for the study was 58 years. Figure (5.2) show the distribution of patient by age group.

Figure 5.2: distribution of renal failure patients by age group



#### A.5.1.3: Distribution of subjects by Demographical Data

The patient residency place were distributed to eight demographical areas within Khanyunis governorate and the eastern villages in the southern area of Gaza Strip (Khanyunis city, Khanyunis camp, Kuza, Abassan, Banisuhila, Qizan al Najar, Maen, Qarara) according to the demographical localities and according to the study variable when needed .Table (5.1) shows the distribution of subject according to locality the highest percent was founded in Khanyunis city as represented 52.9%, with the highest mid year population during 2006, Khanyunis camp and BunSuhila represented equal percent 11%, even Khan yunis camp is 3.7 times than BunSuhila by the Mid year population 2006 Maen represented 7.4%, and the lower percent were founded in (Kuza, Abassan, Qizan, and Qarara) as each area represented only 4.4% of the sample. The majorities of subjects were living in Khan yunis city. The majorities of subjects was married and represent 64.7%. The level of education represented in the table shows that the majority of the subject education level is less than Tawjihi, and

consider more than the half of the sample the rest percent distributed between, Tawjehi level with 30%, Diploma 5.9%, Bachelor 4.4%.

Regarding patients current occupations 89.7% are unemployed due to the political and economical situation in the country, and only 10.3% are currently working, And out of the working percent agricultural jobs represent 28.5% of the total employed, construction represents 14.2% of the total employed, all other jobs which include, physician, administrative, nurses, managers, teachers, pharmacist, lab technician, hair dressers, finance, policemen, all compromise 57% , each job represent a percent about 7% of the total job is agriculture, and construction has the highest percentages, as well as previous employment presented in the table which show that 63.9% was previously unemployed. And only 36.02 % were previously employed, out of the total employed 36.7% their main job was agriculture, 22.4% there main job was construction , and 40.8% all other jobs was previously mentioned with percent not exceeding 5% for each job. The majority of employed subject either were or still working in agriculture sector and the second job category is construction. The study finding is corresponding with discussed paper by (Henk de Zeeuw September, 2000) .Urban agriculture provides various potential exposure pathways to agrochemicals including occupational and environmental exposure and consumption. The intensive use of agrochemicals (fertilizers, pesticides, fungicides) may lead to residues of agrochemicals in crops or groundwater, and negative effects on the health of agricultural workers. Because of differences in usage, the level of risk of crop or groundwater pollution due to agrochemicals is higher in intensive commercial horticulture, especially for vegetables, than in traditional and subsistence farming (WHO Commission on Health and Environment 1992). Acute poisoning due to agrochemicals can cause a range of symptoms which are often not correctly diagnosed (e.g. dizziness, diarrhea, headache, memory impairment, convulsions, coma, liver and kidney impairment and lung fibrosis). Agrochemicals are also a major source of suicide worldwide.

Regarding to the family type the majority of subjects represented 72.1% of the total subjects living in a nuclear family and 27.9% living in an extended. The first type is most common.

Table 5.1: Distribution of subjects by demographical data

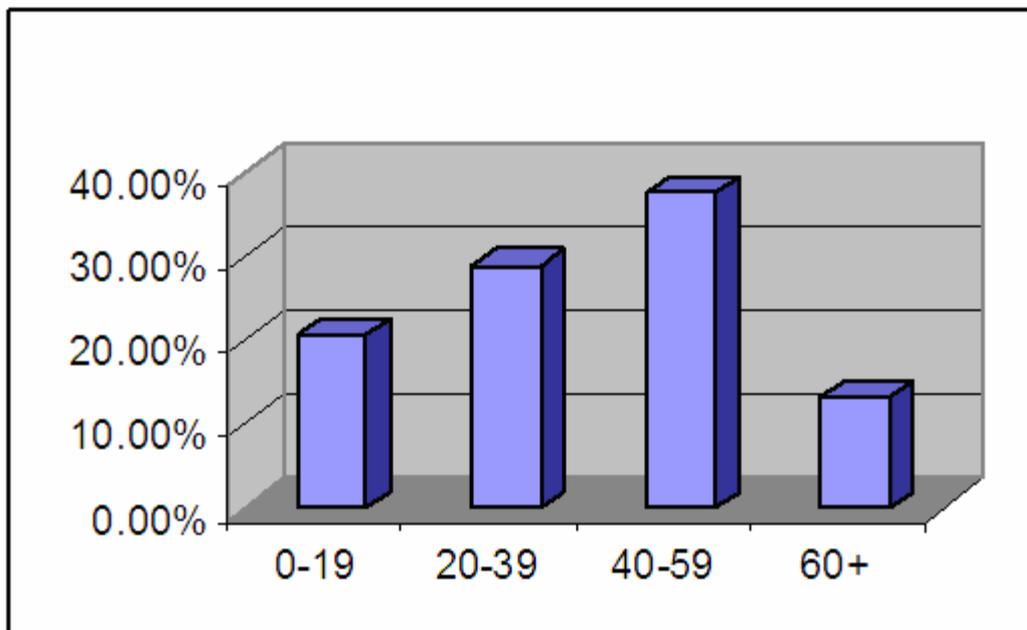
Variable		Frequency	Percent
Residency place	Khanyunis city	73	52.9%
	Khan yunis Camp	15	11%
	Khuza	6	4.4%
	Abasan	6	4.4%
	Bani Suheila	15	11%
	Qiza an Najjar	5	4.4%
	Maen	10	7.4%
	Al Qarara	6	4.4%
Marital Status	Single	34	25%
	Married	88	64.7%
	Widow	12	8.8%
	Divorce	2	1.5%
Academic certificate	Less than Tawjehi	80	58.8%
	Tawjehi	42	30.9%
	Diploma	8	5.9%
	Bachelor	6	4.4%
Current Employment	Unemployed	122	89.7%
	Employed	14	10.3%
Current job	Agriculture	4	28.5%
	Construction	2	14.2%
	Others	8	57.1%
Previous Employment	Unemployed	87	63.9%
	Employed	49	36.02%
Previous job	Agriculture	18	36.7%
	Construction	11	22.4%
	Others	20	40.8%
Family Type	Nuclear	98	72.1%
	Extended	38	27.9%

**Distribution of subject by medical history data (variables):**

**A.5.1.4 Distribution of Subjects by Incidence Age Group**

Regarding patient age, the incidence age group for the renal failure patient vary in percent, the patient distributed within four age groups, the highest age group for incidence were the third age group 40-59 represented 37.5% of the total sample, the second age group follow 20-39 represented 28.7%, the third is 0-19 represented 20.6% and the lowest is 60+ represented 13.2%. The highest renal failure incidence occurs at the age 40-59. Figure (5.3) show the distribution of renal failure incidence by age groups.

Figure 5.3: Distribution of patient by incidence age group



#### **A.5.1.5 Distribution of Subject by etiological variables (Diseases):**

The medical history for the subjects is represented in the table (5.2) show that only 20.6% of the total subject don't suffer from chronic disease but the majority of subject are suffering from chronic diseases represented 79.4% of the subjects, and the major disease is diabetes mellitus represented 40.7%, hypertension represented 33%, congenital disorder represented 13% ( five of the subjects who are suffering from congenital disorder having only one kidney, two of them having right kidney and three having left kidney), heart disease represented 7.4%, gland disorder represented 3.7%, and the minority suffering from both diabetes and hypertension and they represented 3.8% out of the total subjects who are suffering from chronic disease. .

The study finding is corresponding to the study conducted by "All the three Units of Medicine of Allied and District Headquarters, Allied Hospital Punjab Medical College, (PMC), Faisalabad a comparative study. Period Its January, 1995 to end of may 1997, 35.66%. Diabetes mellitus was seen in 83 patients, (27.66%). Essential hypertension was present. In USA the prevalence of diabetes was 34%<sup>20</sup>. In an Indian study the prevalence rate of diabetes in patients of chronic renal failure was 26.27%<sup>19</sup>. Two studies showed the prevalence of diabetes to be 25%<sup>1</sup> 35%<sup>15</sup> respectively. From the results, it is quite obvious that diabetes mellitus is a quite significant risk factor in the people of our area as well as in European countries and USA. The high prevalence of diabetes in patients of chronic renal failure was due to poor glycemic control and lack of knowledge about the hazardous effects of diabetes.

Hypertension is also one of the important risk factor in chronic renal failure. The study is corresponding with another study conducted by Allied Hospital Punjab Medical College, (PMC), Faisalabad, 25 patients out of total 300 patients i.e. 8.33% were having hypertensive nephropathy. In European dialysis and transplantation association study it was 10% of 17 patients while in Australia and New Zealand dialysis and transplant association study revealed the prevalence of hypertensive nephropathy in 9% of patients<sup>21</sup>. In a study done in India the prevalence of hypertension was 12.06%. In John Walls study the prevalence was 10%. So as the other studies prevalence of hypertension in chronic renal failure patients, showed significant prevalence (Coresh J, Astor BC, Greene T, Eknoyan G, Levey AS , 2003). The best that we can do at present is to concentrate our efforts on the prevention of

the progression of renal diseases. We should redouble our efforts to remind the public on the need to pay attention to maintain their blood sugar and blood pressure at the normal level. Prevention through a “healthy lifestyle” plays a major role to reduce if not totally control the epidemic of renal failure and this could be achieved through proper education, with that, we will be able to help decrease or at least slow down the increase in statistics of patients suffering from kidney problems.

Table 5.2: Distribution of subjects by etiological variables

Variable		Frequency	Percent
Chronic Disease	Suffering from chronic disease	108	79.4%
	Don't suffer from chronic disease	28	20.6%
Type of disease	Diabetes	44	40.7%
	Hypertension	35	32.4%
	Hypertension and Diabetes	3	2.8%
	Heart disease	8	7.4%
	Congenital disorder ( five subjects having only one kidney)	14	13%
	Gland disorder	4	3.7%

#### **A.5.1.6 Distribution of patients by cause of renal failure**

The majority of subjects who respond to the study were suffering from glomerulonephritis that represented 42.6% out of the total subjects, and 41.2% of the subject having renal atrophy, and the rest 16.2% developed renal stone , 52.2% of the patient who developed stones developed calcium stones type but the others 47.8% developed oxalate stones type, the study finding is corresponding with the study conducted by " All the three Units of Medicine of Allied and District Headquarters , Allied Hospital Punjab Medical College,(PMC), Faisalabad a comparative study 35.66% were found to have glomerulonephritis as confirmed by history, physical examination and laboratory investigations. In the study conducted by European dialysis and transplantation association, glomerulonephritis was recorded in 25% of

patients. In the study done by Australia and New Zealand dialysis and transplant association, the prevalence of glomerulonephritis in Australia was 38%. In the study conducted in India the prevalence of chronic glomerulonephritis was 38%. Similarly in the study done in Albania by Khan (1996) glomerulonephritis was found the most common cause of chronic renal failure in 26% of patients. In another study was conducted by the Australia and New Zealand medical centre the prevalence of glomerulonephritis was 25%<sup>2</sup>. So as the other studies revealed the significant prevalence of glomerulonephritis in chronic renal failure patients our study also showed significant prevalence. Overall the incidence of glomerulonephritis appears higher in China., India, South-East Asia, Africa and South America, when compared to Europe and United States. This may reflect socioeconomic differences and the higher prevalence of glomerulonephritis caused or exacerbated by infections. (The amendment of The Professional Medical Journal). Table (5.3) represents the cause of renal failure.

Table 5.3 Distribution of patient by causes of renal failure

<b>Variables</b>		<b>Frequency</b>	<b>Percent</b>
<b>Cause of renal failure</b>	Glomerulonephritis	58	42.6%
	Renal atrophy	56	41.2%
	Renal stone	22	16.2%
<b>Type of stone</b>	Calcium	12	52.2%
	Oxalate	11	47.8%

#### **A.5.1.7 Distribution of subjects by severity of the disease:**

All the subjects who have been conducted to the study was suffering from chronic renal failure and 59.6% are classified sever but don't need to conduct hemodialysis, but the rest of the subjects 40.4% are at the highest level of servility and conducted to hemodialysis, the majority of these subjects 52.7% of the subjects who conducted hemodialysis need 2 sessions per week and around 3-4 hours per session. These subjects stay around seven hours per week in the department of artificial kidney in the hospital for treatment, the second highest group represented 40% needs three sessions per week with average treatment 10.5 hours per week, the third group represented 5.5% need one session per week with average 3.5 hours, the fourth group represented 1.8% and need four session per week. These patients are the most severe cases, with

treatment time average 14 hours per week. Seven subjects presented 5.2% of the subjects previously conducted renal transplantation; five out of seven with percent 3.7% of the total subjects conducted transplantation once and two subjects represented 1.5% conducted transplantation twice a week. The cost of medical treatment for most of the acquired kidney disease has been so expensive. Renal transplantation is limited because of the shortage of donors not only in Palestine but worldwide. This is correspond to the article " preventing end stage of renal disease NDT Nephro Dialysis Treatment 2003 " There is a clear, direct relationship between gross national product (GNP) and availability of Renal Replacement Treatment ( RRT). Dialysis treatment absorbs 0.7 to 1.8% of the health care budget in European countries, while the dialysis population represents 0.02 to 0.05% of the whole population. In the Eastern European countries, the so-called former Soviet block, the prevalence rate of RRT is half or less than in countries of the European Union; also the average GNP in those countries is half or less than in Western Europe. It is hard to believe that the epidemiology of renal diseases differs that much in the two areas of Europe (Coresh J, Astor BC, Greene T, Eknoyan G, Levey AS, 2003). Table (5.4 ) shows the distribution of subjects by severity of the disease.

Table 5.4 Distribution of subjects by severity level of disease

Variables		Frequency	Percent
Level of servility	Chronic and Conducted hem dialysis	55	40.4%
	Chronic Not conducting hem dialysis	81	59.6%
Frequencies of hemi dialysis session per week	1 session	3	5.5%
	2 sessions	29	52.7%
	3 sessions	22	40%
	4 sessions	1	1.8%
Renal transplantation	No	129	94.8%
	Yes	7	5.2%
Repeation of transplantation	Once	5	3.7%
	Twice	2	1.5%

#### **A.5.1.8 Distribution of subject by relative's renal failure prevalence (heredity or family history):**

The majority of the subjects don't have family history or relative suffering from RF. They represented 76.5% of the total responded subjects, and 23.5% having relative suffering from RF, but for the previous percent the researcher notice that some of the subjects answers that they haven't family history or relatives affected by RF even their relative are visiting the hospitals and suffering from RF this may refer to the nuclear type of family, or because of weak relationships within the extended family, so the percent may be a little higher than the mentioned percent, regarding to their relative. 43.8% of the subjects having family history are having only one of their relative affected by Renal Failure, 37.5% having two of their relative, 12.5% having three relatives, 3.1% having five relatives, and 3.1% having six relative are suffering from renal failure. The majority of subjects relatives is first degree relationship represents 59.4%, and 28.1% of the subjects having relatives from the second degree of relationship, but the minority having first and second degree relatives affected by RF. Regarding to their relative residency 62.5% of their relatives are living in the same demographical area ( city, camp). The majority of relatives having the same source of water, but the rest of relatives 28% are living in the same governorate but may not share the same water source. For the whole relatives twenty nine of them out of thirty two are living in Khanyunis governorate or in the eastern villages with percent 90.6%, of the whole relatives, and only 9.3% are living out side the governorate. Table (5.5) shows the distribution of subjects relatives by renal failure prevalence.

Table 5.5: Distribution of subject relatives by renal failure prevalence (family history)

Variables		Frequency	Percent
Relative history RF	Yes	32	23.5%
	No	104	76.5%
Number of relatives	1	14	43.8%
	2	12	37.5%
	3	4	12.5%
	5	1	3.1%
	6	1	3.1%
Level of relation	First degree	19	59.4%
	Second degree	9	28.1%
	Both first and second degree	4	12.5%
Relative Residency	Living in the same area (district)	20	62.5%
	Live in the same governorate but not in the district	9	28%
	Outside the governorate	3	9.3%

#### A.5.1.9 Distribution of subject by domestic water source:

The subjects have water supply from one of the four sources in the governorate, the majority have municipal access with percent 77.9% out of the total subjects, 13.2% have access to private wells, 7.4% have Makorot access and 1.5% only have UNRWA access. There is a wide range of differences between previous and current domestic water treatment before ten years. Only 2.9% of the total subject treated domestic

water before using for drinking purpose, but recently only 7.4% of the subjects don't treat domestic water before use for drinking purposes and they don't treat because they have access to Makorot access which met WHO standard for drinking in chloride, sodium, and sometimes lower in chloride level than the WHO standard. That's mean 92.6% of the total subjects use domestic water after treatment, and this could be reflected to the Gaza strip society as whose have the same access for the saline ground water with different level of salinity. The majority of subjects buys water from desalination stations and represented 52.4% of the subjects while 30% are using home filter, and the rest take water from Makorot. Recently 75% of the subject treats their water after renal failure incidence while the other 25% only treat their water before renal failure incidence. Table 5.6 shows the distribution of subjects by domestic water source.

Table: 5.6 Distribution of subject by domestic water source

Variables		Frequency	Percent
Domestic water source	Municipality	106	77.9%
	UNRWA	2	1.5%
	Makorot	10	7.4%
	Private wells	18	13.2%
Previous domestic water treatment (since the last 10 years)	No	132	97.1%
	Yes	4	2.9%
Treatment tool	Home filter	4	100%
Current domestic water treatment	Yes	126	92.6%
	No	10	7.4%
Current treatment tool	Desalinate(Sold water)	66	52.4%
	Home filter	38	30%
	Makorot	22	17.5%
Treatment time	Before incidence	32	25%
	After incidence	94	75%

#### **A.5.1.10 Distribution of subjects by water consumption Pattern:**

Regarding to the total consumed drinking water amount, the majority of subjects consumed less than three liter per day and represented 75% of the total subjects, 17.4% drink more than three liter ( most of those subjects are diabetic ), 7.4% don't know the total amount consumed daily. The majority of the subjects used treated water for cooking represented 76.5% out of the total subjects but only 23.5% still using domestic water directly for cooking without treatment. Table (5.7) shows the subject's distribution by water consumption pattern.

Table 5.7: Distribution of subjects by water consumption pattern

<b>Variables</b>		<b>Frequency</b>	<b>Percent</b>
Total amount consumed for drinking per day	Less than three liter	102	75%
	Three liter	0	0
	More than three liter	24	17.5%
	Uncertain	10	7.5%
Using treated water for cooking	Yes	104	76.5%
	No	32	23.5%

#### **A.5.2 Subjects Sub-scale domains**

It was difficult for researcher to study each items of the likert scale presented in the questionnaires alone. The researcher classify the items into four domains through questionnaire to make it easy and applicable for analysis, the first domain is domestic water quality, the second satisfaction, the third domain subjects knowledge and awareness, and the fourth is the subjects practice and attitude to keep continuity of drinking water all the day. The over all domain is the summation of all factors. The highest mean was for the water quality and the lowest mean was subjects practice. Table (5.8) shows the distribution of subjects by domains mean and percentage.

Table 5.8: Distribution of subject's domain by mean and percentage

Domain	Mean	Percentage
Domestic water quality (Physical characteristics, level of salinity)	3.62	72.4%
Practice " keeping acces to safe drinking water all the day)	2.88	58%
Knowledge about salinity problem	2.91	58.5%
satisfaction " domestic water"	2.91	58.5%
Over all domains	3.08	62%

#### **A5.2.1 Domestic water quality domains:**

Reflect the subjects perceive this domain as the highest positive than other domains, its represents 72.4%. This could be explained that majority of subject having access to saline water, not pure, having changeable characteristic like color, odor, and poor even for cooking. This meet the study finding that more than 90% percent are having another access for drinking and cooking by having either home filter or buy desalinate water.

#### **A5.2.2 Practice and attitude:**

It is reflect the ability of subject to keep a continuous access to safe water twenty for hours per day for drinking and cooking. Those subjects represented 58% from the whole and 42% percent are not able to keep continuity of safe drinking water. So it is expected that the last have higher prevalence of water disease than the others, as access to safe water is very vital and critical for public health, there should be serious thought and effort to supply the citizen by infrastructure access for safe water. This will reduce diarrhea, typhoid, skin sepsis, ulcers.

### **A.5.2. 3 Knowledge and awareness**

This domain reflects the subject knowledge and awareness about both salinity problem and renal failure problem and if there is direct link or effect, if there is any relation between salinity and renal failure and if they attend any workshops or awareness session. The percentage of this domain reported 58.5% which is considered moderate in between other domains. In other hand the majority of subjects agree about the positive role of knowledge and awareness to decrease the prevalence of renal failure even the majority didn't join any session.

### **A.5.2.4 Subjects Satisfaction**

These items included subject's level of satisfaction due to their usage of saline domestic water, this domain represented 58.5%. The majority of subjects absolutely agree that domestic water is very poor and can not even use for cooking. This corresponds with the subject's agreement to change their water source. This correspond with the study finding that the majority of subjects conduct water treatment tool at home or have access to clean water nearly in most areas accept this domain positively as all subjects in most areas aren't satisfied and agree to change domestic water source.

### **A.5.2.5 Over all domains**

Refer to summation of the four domains. The percentage of overall perception of domain was 62%, and its mean 3.08.

## **B.5. Descriptive Part**

### **B .5.1 Ecological Variables (historical review)**

The researcher goes deeply into the history of water quality and review all the tests was carried out by the Public Health lab for all the wells in khanyunis Governorate and the eastern villages since 1987, then subjects distributed by localities according to water quality in each area , the mathematical method conducted for calculation. Table (5.9) shows water quality by time and localities, figure 5.4, figure 5.5, figure5.6, figure 5.7, figure 5.8 show variations of TDS level, nitrate level, chloride level, fluoride level, and sodium level by time and localities.

**The mathematical Model is used to calculate the average for each well within the following periods** (1987-1992, 1993-1998, 1999-2004, and 2005-2009) each of the previous periods have been studied separately (within the same period the major change occur with nitrate level which increased 20% -25% in spring test in eastern villages and Al Qarara, but in other areas nitrate level increased from 10-15%. The level of nitrate comes down from 20-15% during autumn test, wells number and production percent doesn't changed or the changing percent didn't exceed 10% during the same period. The following calculation was applied:

- 1- The average for each well during the period has been calculated by summation of the all tests carried divided by the number of tests, then the average multiply with the production percent for each well, the level for each area is estimated by summation of the wells production percent which supply water for the area. This calculation has been done for each well within the four separate periods.
- 2- Wells percent calculated by the well production amount divided by the total amount produced multiply 100.

**The following were observed:-**

- The results show that only 8% of the municipal wells meet the WHO standards for drinking in chloride and nitrate level. Chloride, nitrate, TDS, fluoride and sodium concentration exceed 2-9 times the WHO standards in 92% of the southern wells.
- There are different levels of water quality as well as salinity; the main source of water is municipal wells since 1987, private wells that are owned by the municipalities and UNRWA wells and managed by the municipality. There are 22 wells save all the domestic water supply for Khanynis city, and Khan yunis camp, six of the wells was working since 1987, and others were drilled since 1991-2000.
- **KhanYonis Camp:** water supply conducted by nine wells with total amount produced 290190 cubic meters per month with different percent of water production to the camp. The percentages for the wells are (Al Sada well 11.3% , Al Ahrash 14.2%, Al Amal 11.9%, Al Amal Al Jaded 24.5%, Rashwan B 10.4%, Al Tahady Al Jadied 8.6% , Istad El Ryady 13.8% , Al Wakalla Al Shamaly 2.4%, Al Wakalla Al Janoby 2.5% )
- **KhanYonis city:** water supply conducted by thirteen different wells for the city with total amount 329560 cubic meter per month even the mid year population for Kanyunis city is 1.5 times more than the camp Mid year population. ( Al Janoby 10.7%, New Janoby 9.5%, Aya 20. % , Al Shargy7% , Al Madina Al Ryadia 10% . Al satar al shamaly 2.9%, Al Najjar 16%, Maen 6.5%, Al Markaz Al Thagafy 10%, Al Bahar Al Jadied 1.7%, Al satar al Jadid 5.7% , ).
- Mean water supply by two wells with different level of water quality (with unequal percentage).
- During the year 1987 there were only one well supply water for Qarara and owned by its municipality. Another well were producing during the period from 91-98 and have been closed due to elevated nitrate level. The third well were drilled since 98, now the two wells are supply water for Qarara.
- Since 1987 to 2001 the eastern villages ( Khuza, Abasan, BuniSuhila), were having different wells ( Khuza and ABsan from one source but BuniSuhila

from another source, the wells were closed and not being used for Khuza and Abasan, but one of the closed wells is still supply water for Bunsuhiala in summer if there is shortage of water needed for the village, and during impairment and maintenance for the other source. This happened because BuniSuhila need larger amount of water than both Khuza and Absan. After 2001, both Absan and Khuza are having directly from Makorot and Merage three (which meet the WHO standard for drinking in chloride level), Banisuhila have the same source in addition to another one cover about 30% of daily supply by another well owned by Eastern villages municipality, so Banisuhila is having 14 hours/ day only from the same source and the other ten hours/ day having mix water from Merage and another well (Al Najar for eastern villages).

- 1- During the period from 87-92 and by comparing the TDS, Nitrate, Chloride, Fluoride and Sodium concentration, BaniSuhila have the highest level (for all the five elements,) then (Kuza and Absan ), Maen and Khanyunis city , Qarara ( is highest with fluoride level ), and Khanyunis camp.
- 2- During 1993-1998 the highest level is found for the five parameters is BunSuhial , Khuza and Absan, Kanyunis city and Maen, Qarara only higher with fluoride level, Khan yunis Camp.
- 3- During 1999-2004 the highest level for all except fluoride is found in Khanyunis city and Maen, Qarara , BuniSuhila. Both Khuza and Absan water quality meet the WHO for drinking purpose.
- 4- During 1999-2004, the highest level is found for the five parameters in Maen, Khanyunis city, Khanyunis Camp, Qarara, BuniSuhila, Kuza and absan they met the WHO standard for TDS, Chloride, Fluoride, Sodium, and higher in Nitrate levels. According to the data represented all wells within KhanYounis governorate are exceeding the WHO standard (TDS , Nitrate, Chloride, Fluoride, and Sodium) for drinking within the period from 87-2008, but only the eastern villages Absan and Kuza met or less than WHO standard ( TDS, Cl, Nitrate and sodium), but fluoride is a little bit higher during the period 99-2004 . The researcher notices that water tests are carried out twice a year during spring and Autumn seasons, but not for all wells. Some wells have the chance of more than twice a year, fluoride level is not measured in all tests, noticeable elevation of the nitrate level during Spring (specially in Bunisuhila , Kuza, Absan, and Qarara )

than Autumn in the same year this may be explained that fertilizers or manure storage are common cause for nitrate pollution for underground water in Khanyounis area and eastern villages. Chloride is an indicator ion that if found in elevated concentration, points to potential contamination from septic systems, fertilizer, landfills, or road salt. And another sort for chloride is the sea intrusion. Fluoride Excessive levels causes fluorosis and a mottling of the surface of the teeth. During data collection mottling of the teeth surface was notice especially with subjects from the eastern village) so the prevalence of teeth molting in the eastern villages ( in the last ten years ) and Qarara may be higher than other area in Khanyounis Governorate.

The main concern with high levels of nitrate in groundwater is the increased incidence of methemoglobinemia. Also known as blue-baby disease, it causes the child to develop a bluish or grayish tint around the extremities. If left untreated the baby will not receive enough oxygen through the blood and could die. This problem arises primarily in rural areas where nitrate levels are not well monitored.

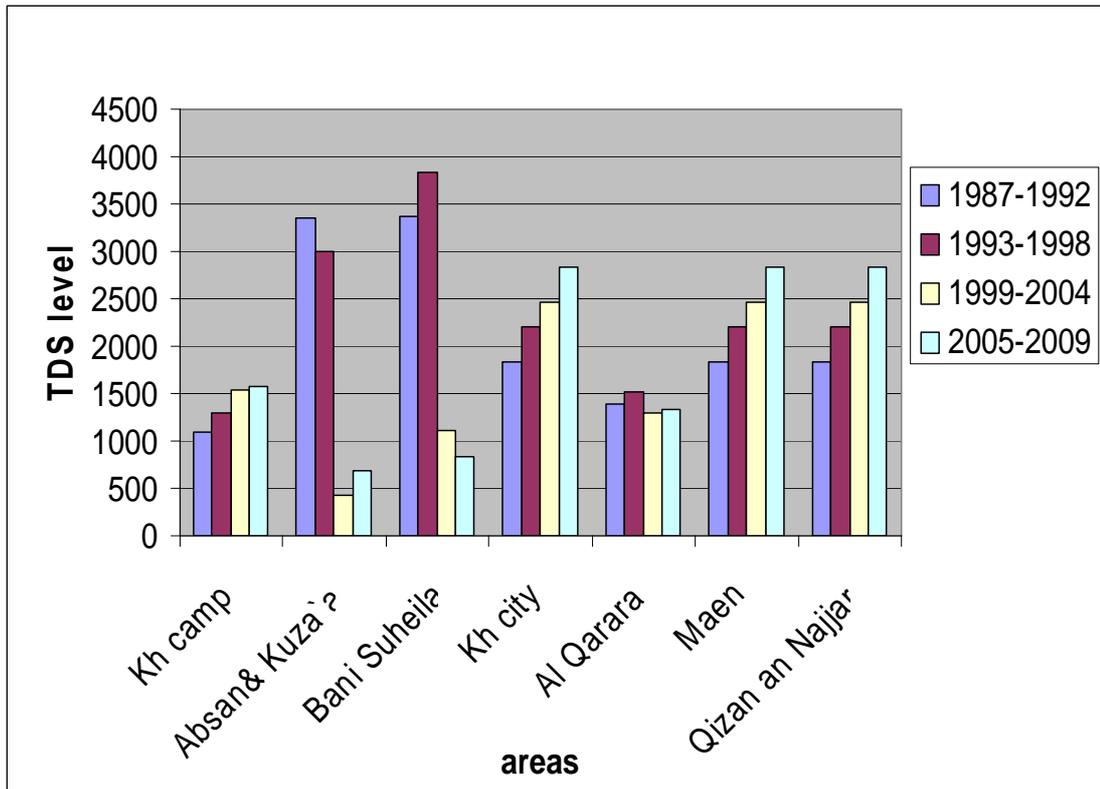
Table 5.9: Chemical water quality by time and localities in Khanyounis city and the eastern villages

Region	Period	TDS	Nitrate	Chloride	Fluoride	Sodium
Khanyounis Camp	1987-1992	1100	110	382	1.215	233
	1993-1998	1305	199	430	1.253	281
	1999-2004	1546	258	515	1.2	431
	2005-2008	1573	228	784	1.6	439
Khan younis city	19987-1993	1832	116	633	2.28	496
	1994-1998	2197	160	730	2.3	574
	1999-2004	2456	271	814	2.44	673
	2005-2009	2826	223	949	2.8	681
Eastern villages (Khuza, Absan)	1987-1992	3353	110	1104	3.3	900
	1993-1998	3000	300	862	3.2	740
New source (Makorot)	1999-2004	431	16.5	160	1.9	145

	2005-2009	676	65	221	2	170
BuniSuhila	87-92	3362	117	1288	3.4	1110
	93-98	3840	245	1580	3.7	960
The first source ( Makorot)	99-2004	431	16.5	160	1.9	145
The second source( 30% of daily use, and during	99-2004	2691	65	945	3.2	440
The first source( Makorot)	2005-2009	676	65	221	2	170
The second source	2005-2009	1200	133	1011	3.4	820
Qarara	87-92	1398	126	368	4	402
	93-98	1521	90	427	3.8	350
	99-2004	1291	66	427	3.4	400
	2005-2008	1339	88	438	3.2	440
Maen ( the previous period sharing source with Khanyunis city)	2005-2008	2858	117	1083	3.6	980
Qezan area ( share with Khanyunis city until 2004 with the same source)	2005-2008	2551	156	779	4.1	660

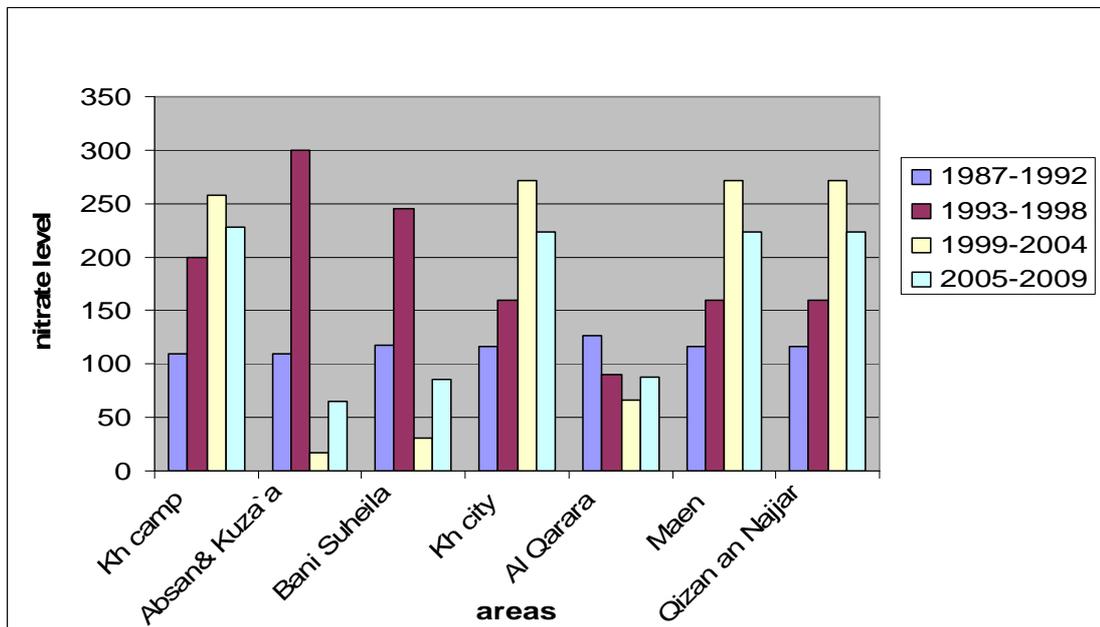
(The tests obtained from the public health lab, and Khanyunis, and eastern villages Municipality, and Coast Municipality Utility)

Figure 5.4: Variation of TDS level by time and locality



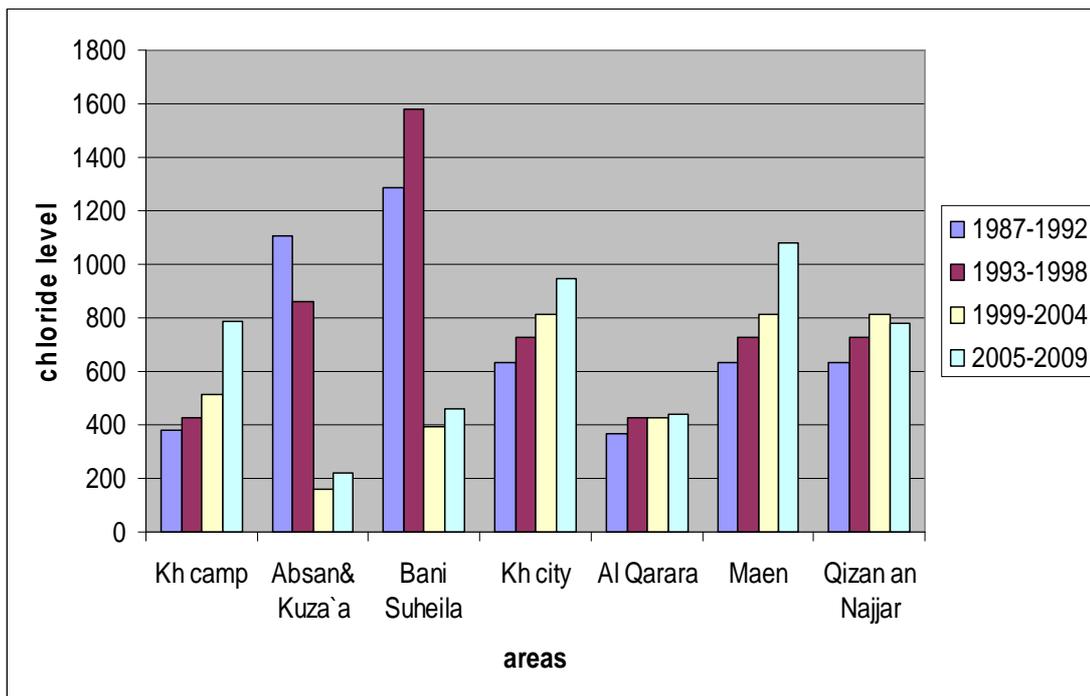
Kh ( Khanyunis )

Figure 5.5: Variation of nitrate level by time and locality



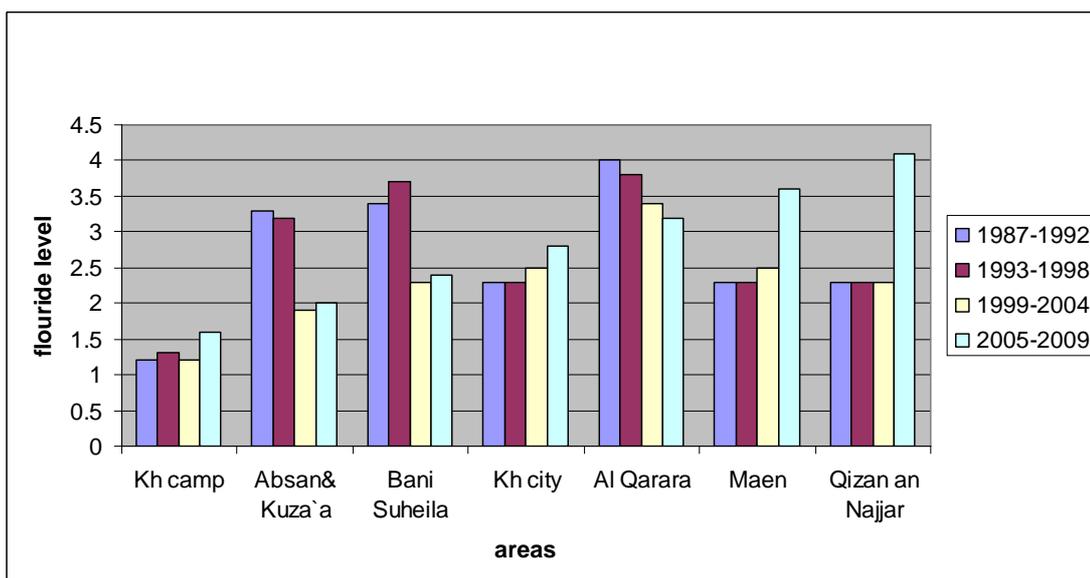
Kh ( Khanyunis )

Figure 5.6: Variation of chloride level by time and locality



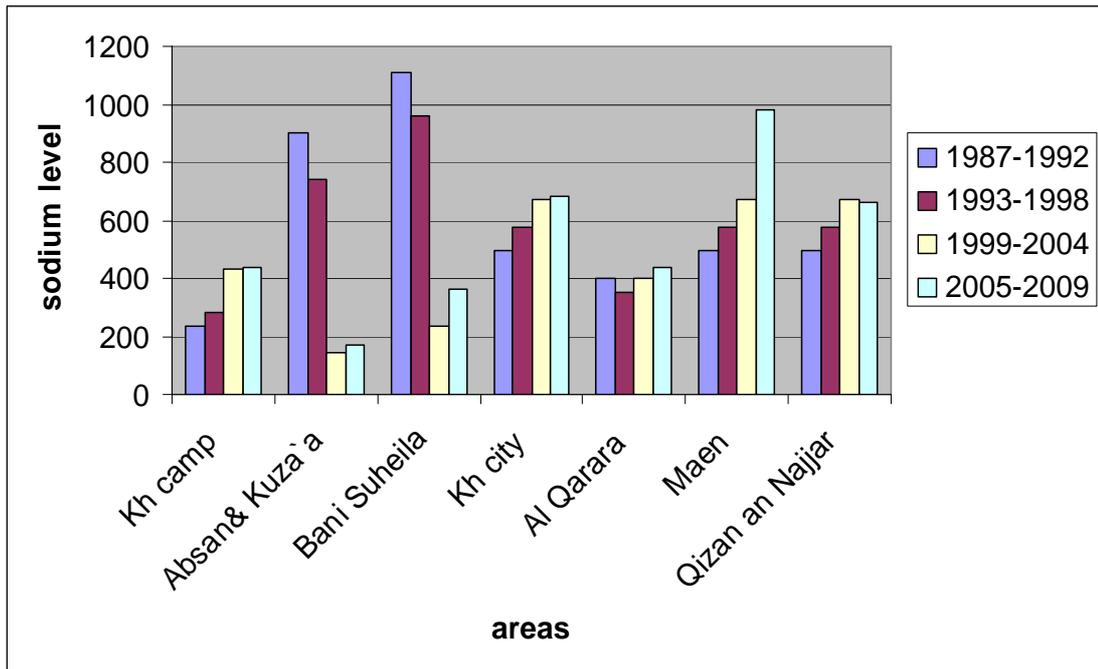
Kh ( Khanyunis )

Figure 5.7: Variation of fluoride level by time and locality



Kh ( Khanyunis )

Figure 5.8: Variation of sodium level by time and locality



Kh ( Khanyunis )

### **B.5.2 Inferential statistic part**

This part discuss the relationship between the dependent and independent variables for subjects by using some of statistical tests, and the researcher provides an explanation and opinion regarding the findings of this study. The dependent variable is the subject's domains to explore the relation between domain and subject acceptance the independent variable for is demographical data such as, gender, residency place, marital status, main job, level of education.

### **B.5.3 Subjects relationships Part:**

#### **B.5.3.1. Demographic Characters for subjects:**

Regarding age groups, marital status, level of educations all showed no statistically significant differences in the all domains.

#### **B.5.3.2 Domains differences by gender**

Gender comparison with domains by using an independent t test. Table (5.10) shows that males and females had no statistical significant differences variation in the mean scores in overall domains ( $P = .802$ ). Through knowledge and awareness only female were more positive perception than male for the domain (statistically significant were observed between the two group). Table 5.10 shows domains differences by gender.

Table 5.10: Domains differences by gender

Dependent variable " Domain"	Ind. var. "Gender"	No.	Mean	SD	T- value	Sig.
Satisfaction	Female	57	3.02	.517	2.257	.448
	Male	79	2.83	.462		
Practice	F	57	2.85	.787	.343	.471
	M	79	2.90	.853		
Knowledge	F	57	3.02	.355	2.530	.007*
	M	79	2.82	.530		
Water quality	F	57	3.64	.601	.331	.374
	M	79	3.60	.507		
Over all	F	57	3.13	.316	1.661	.802
	M	79	3.04	.334		

- Statistically significant

### B.5.3.3 Differences in domains by employment

Employment comparison with domains (Table 5.11) shows that unemployed and employed had no statistical significant differences variation in the mean scores in overall domains (P= .123) similarly all sub-scale domains have no statistical significant differences except water quality domain. The test shows that unemployed subjects have more positive response to water quality domain than the employed.

Table 5.11: Domains differences by employment

Dependent variable	Independent employment	No	Mean	SD	t-value	Sig
Satisfaction	Unemployed	122	2.90	.491	.745	.469
	Employed	14	3.00	.523	.708	
Water quality	Unemployed	122	3.66	.502	2.442	.002*
	Employed	14	3.29	.790	1.714	
Practice	Unemployed	122	2.87	.840	.653	.063
	Employed	14	3.00	.667	.677	
Knowledge & awareness	Unemployed	122	2.91	.478	.168	.976
	Employed	14	2.89	.455	.174	
Overall	Unemployed	122	3.08	.339	.423	.123
	Employed	14	3.04	.222	.589	

\* Statistically significant

#### B.5.3.4. Differences in domains by renal failure severity level

Comparing patient level of severity with domains by using an independent t test. Table (5.12) shows that subjects who conduct hem dialysis and subjects don't conduct hem dialysis, have small variation in the mean scores in overall domains. The results show no statistically significance between the two groups within the four domains and the overall domain ( $p=.903$ )

Table 5.12 Domains differences by renal failure severity level

Dependent variable	Conduct dialysis or not	N	Mean	SD	T-value	sig
Satisfaction	Yes	55	2.96	.501	.988	.955
	No	81	2.87	.488	.983	
Water quality	Yes	55	3.61	.599	.150	.392
	No	81	3.62	.513	.145	
Practice and attitude	Yes	55	2.91	.823	.311	.787
	No	81	2.86	.828	.312	
Knowledge awareness	Yes	55	2.85	.460	.190	.817
	No	81	2.95	.482	.201	
Over all	Yes	55	3.08	.329	.075	.903
	No	81	3.08	.331	.075	

### B.5.3.5. Differences of domain scores by subjects health status

By comparing subjects having chronic disease and who don't have with domains perception (table 5.13) shows that subjects having chronic disease and subjects don't have chronic disease had statistical significant differences variations in the mean scores in all domains (P= .013) similarly satisfaction domain, but the other domains wasn't statistically significant.

Table 5.13: Differences of domain scores by subject's health status

Dependent variable	Independent variable suffer from chronic disease or not	No	Mean	Std. Deviation	T	Sig
		Satisfaction	Yes	108	2.90	.513
	No	28	2.95	.413	.621	
Water quality	Yes	108	3.60	.529	.855	.835
	No	28	3.70	.614	.783	
practiseandattitude	Yes	108	2.82	.833	1.809	.122
	No	28	3.13	.744	1.933	
Knowledge awareness	Yes	108	2.89	.486	.820	.859
	No	28	2.97	.428	.884	
Over all	Yes	108	3.05	.344	2.001	.013*
	No	28	3.19	.235	2.493	

\* Statistically significant

### B.5.3.6 Differences of domain scores regarding to water treatment

By comparing subject who treat water before drinking and who don't treat with response to domains ( table 5.14) shows that subjects who treat water before drinking and subjects don't treat water before drinking had no statistical significant differences variations in the mean scores in over all domains (P= .213) similarly

practice, knowledge , except satisfaction, and water quality. The study shows that subjects who treat water before drinking had more positive perception to satisfaction and water quality domains than subjects who don't treat water before drinking.

Table 5.14: Differences of domain scores regarding to water treatment

Dependent variable	Independent variable ( water treatment)	No.	Mean	SD	T-value	Sag
Satisfaction	Yes	126	2.88	.500	2.441	.000*
	No	10	3.27	.141	6.172	
Water quality	Yes	126	3.73	.357	11.579	.006*
	No	10	2.25	.687	6.722	
Practise and attitude	Yes	126	2.84	.802	2.092	.474
	No	10	3.40	.953	1.804	
Knowledge awareness	Yes	126	2.94	.442	2.739	.133
	No	10	2.52	.688	1.885	
Over all	Yes	126	3.10	.314	2.220	.213
	No	10	2.86	.441	1.660	

\* Statistically significant

### B.5.3.7 Differences of domain scores by water source

One way ANOVA test conducted to compare subjects perception for domain regarding their water source table (5.15) shows that there were differences in the overall perceptions of domains with statistical significant difference (P=.007). The respondents show different statistical significance in satisfaction, water quality, and practice. No statistical significant differences in knowledge and awareness. Post hock (Scheffe) test shows that subject who has municipal access had more positive perception, then subjects who have UN, private well, and Makorot. (Ascending quality arrangement).

Table 5.15: Differences of domain by subjects water source

Dependent variable	Independent " water source"	Sum of Squares	Df	Mean Square	F	Sig.
Satisfaction	Between Groups	2.983	3	.994	4.399	.006*
	Within Groups	29.837	132	.226		
	Total	32.820	135			
Water quality	Between Groups	31.194	3	10.398	149.623	.000*
	Within Groups	9.173	132	.069		
	Total	40.368	135			
practiseandattitude	Between Groups	9.636	3	3.212	5.182	.002*
	Within Groups	81.815	132	.620		
	Total	91.451	135			
Knowledge awareness	Between Groups	.586	3	.195	.868	.460
	Within Groups	29.729	132	.225		
	Total	30.315	135			
Over all	Between Groups	1.281	3	.427	4.234	.007*
	Within Groups	13.317	132	.101		
	Total	14.599	135			

\* Statistically significant

### B.5.3.8 Differences of domain scores by residency

One way ANOVA test applied table (5.16) shows that there were differences in the overall perceptions of domains with statistical significant difference ( $P=.000$ ). The respondents show different statistical significance in satisfaction, characteristics and knowledge. No statistical significant in practice and attitude. Scheffe test shows that Khanyunis city subjects had more positive perception.

Regarding age group, marital status, and academic certificate all shows no statistically significant in overall domains with some variation in the subscale domain.

Table 5.16: Differences of domain scores by residency

Dependent variable	Independent "residency"	Sum of Squares	df	Mean Square	F	Sig.
Satisfaction	Between Groups	5.205	7	.744	3.447	.002*
	Within Groups	27.615	128	.216		
	Total	32.820	135			
Water quality	Between Groups	15.213	7	2.173	11.059	.000*
	Within Groups	25.155	128	.197		
	Total	40.368	135			
Practice and attitude	Between Groups	7.146	7	1.021	1.550	.156
	Within Groups	84.305	128	.659		
	Total	91.451	135			
Knowledge awareness	Between Groups	7.818	7	1.117	6.354	.000*
	Within Groups	22.498	128	.176		
	Total	30.315	135			
Overall	Between Groups	3.711	7	.530	6.232	.000*
	Within Groups	10.888	128	.085		
	Total	14.599	135			

\* Statistically significant

#### B.5.4 Distribution of Renal failure prevalence and water salinity level (during the period from 2005 -2009)

The total population of the renal failure patients which registered in Nasser Hospital have been classified according to their water quality (salinity level) the classification done by the artificial kidney staff upon the researcher request the old and new cases were included, the prevalence of each area has been calculated (Prevalence per thousand = old and new

cases/Mid year population \*1000). The Mid year population for all areas have been conducted from (Palestinian Central Bureau of Statistics, 2006 multiply the annual increase rate to calculate the expected population number at year 2009) except Maen the Mid year population for 2006 was obtained from Khanyunis municipality and Absan include (Absan Al Jadida, Absan Al Kabira, Kuza`a). A comparison between renal failure prevalence and level of salinity including, TDS, Nitrate, Chloride, Fluoride and sodium level during the period from 2005-2009. The highest prevalence for renal failure is found in Qezan An Najjar represented (1.27) renal failure Patient per 1000, then Maen (.91), then Khanyunis city (.74), then Bunisuhila , Absan and Kuza ,and Khanyunis camp. Table (5.17) shows the distribution of renal failure prevalence and salinity parameters which include TDS, sodium, fluoride, nitrate and chloride.

Table 5.17: Distribution of renal failure prevalence by salinity parameters, TDS, sodium, fluoride, nitrate and chloride

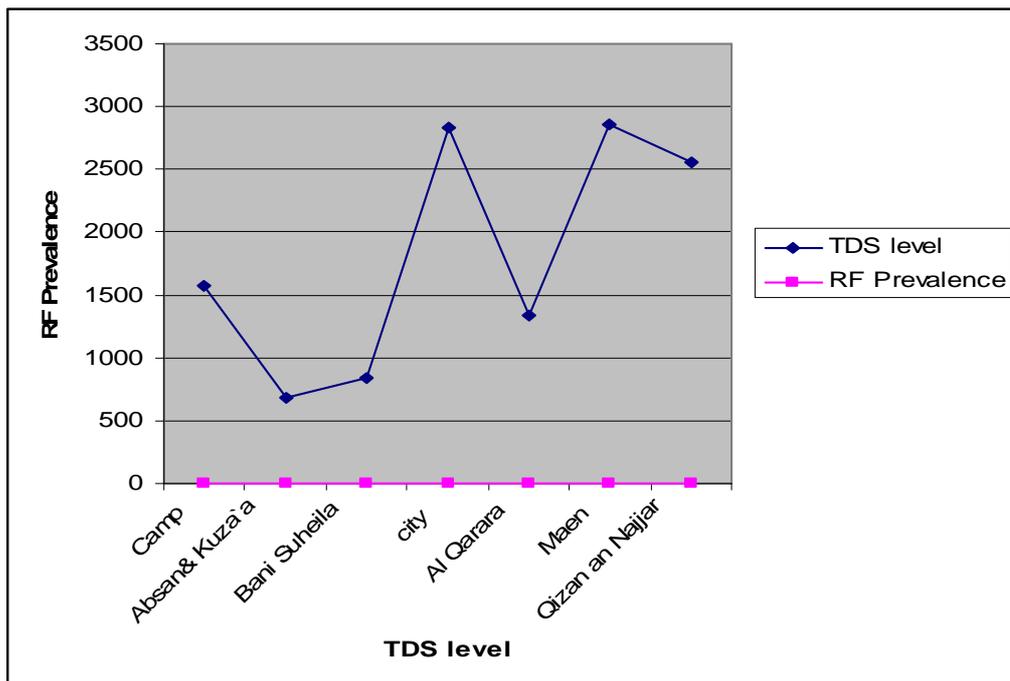
Region	TDS	Nitrate	Chloride	Fluoride	Sodium	Cases no.	Mid population	Prevalence Per1000 person
Khan Yunis city	2826	223	949	2.8	681	98	132987	.74
Khanyunis Camp	1573	228	784	1.6	439	20	50661	.40
Absan , Kuza	676	65	221	2	170	20	34880	.57
Bunsuhila	833	85	458	2.4	365	22	32993	.66
Al Qarara	1339	88	438	3.2	440	15	17818	.87
Maen	2858	117	1083	3.6	980	13	14370	.91
Qezan an Najjar	2551	156	779	4.1	660	5	4267	1.27

#### **B.5.4.1 Comparison between the distribution of Renal Failure prevalence and TDS level in the different areas:-**

Figure (5.9) shows the distribution of renal failure prevalence and TDS level. Most areas having TDS level higher than the level recommended by the WHO standard (1000mg/l) for drinking water except Khuza, Absan & Bunisuhila. The following diagram link the relationship between TDS, and the renal failure prevalence. The

study finding shows that when the TDS increased the renal failure prevalence once increased and another decreased the highest TDS level in Maen but the highest prevalence in Qizan an Najjar , and the lowest TDS level in Kuza & Absan while the lowest prevalence in Kanyunis Camp , Peak of TDS level is not in the area with the Prevalence peak or off peak so there is no association between TDS level and Renal failure prevalence. The study finding shows that more than 90% of the subjects don't accept domestic water before treatment due to high level of TDS, and 95% prefer to change domestic water source due to TDS negative effect on public health as well as taste and odor this finding correspond with the New Jersey Secondary drinking water law 1992 which confirm that Total Dissolved Solids (TDS) may have an influence on the acceptability of the water in general and, in addition, high TDS value may be an indication of the presence of excessive concentration of some specific substance, not included in the Safe Drinking Water Act, which would make the water aesthetically objectionable to the consumer. The secondary maximum contaminant level (SMCL) of 500 mg/l for TDS is reasonable because it represents an optimum value commensurate with the aesthetic level to be set as a desired water quality goal. (New Jersey secondary drinking water regulation, 1992).

Figure 5.9: Distribution of renal failure prevalence and TDS level.



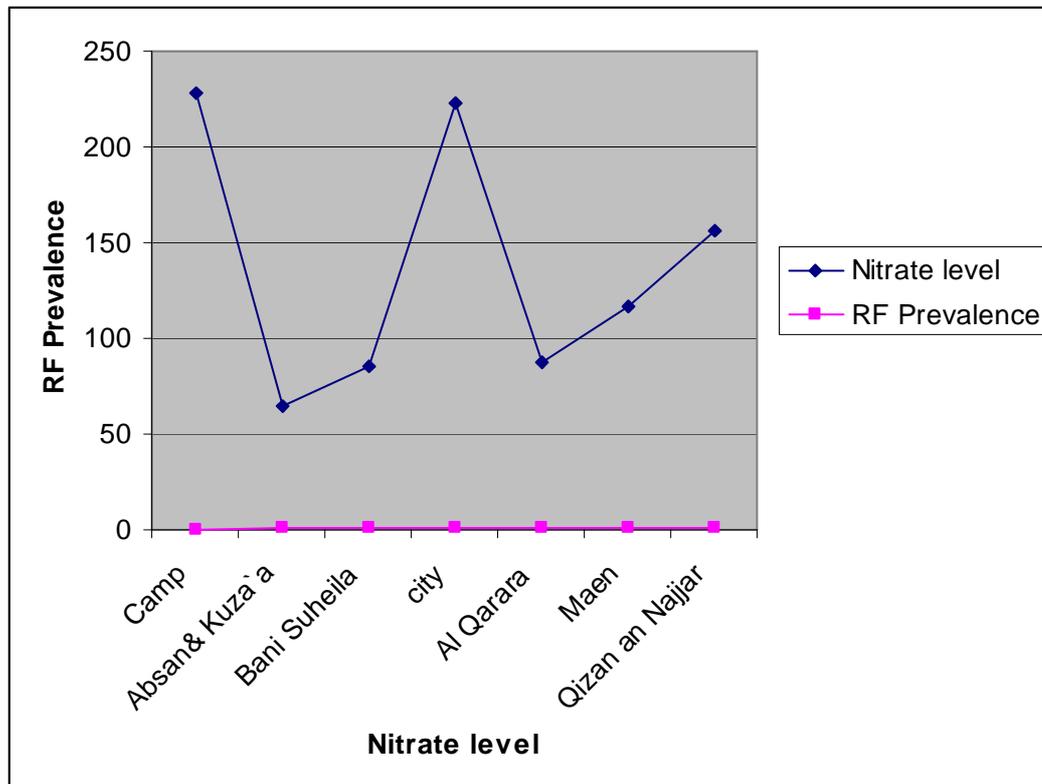
Each area represents the prevalence rate per 1000 population

#### **B.5.4.2 Comparison between the distribution of renal failure prevalence and Nitrate level in the different areas:-**

Figure (5.10) shows distribution of renal failure prevalence and nitrate level. Most areas having Nitrate level higher than the level recommended by the WHO standard for drinking water (50mg/l). The following diagram link the relationship between Nitrate, and the renal failure prevalence , the study finding shows that when Nitrate level increased the renal failure prevalence once increased and another decreased the highest Nitrate level in Khanyunis camp but the lowest but its not systemic change , and the lowest Nitrate level in Kuza & Absan while the prevalence is neither the highest , Peak of nitrate level is not in the area with the Prevalence peak or off peak , so there is no association between nitrate level and Renal failure prevalence. The study finding shows that the peak nitrate level is during spring test for the wells in all areas but the highest increase occur in Kuza, Absan, BuniSuhila, and Al Qrara , this could be due to soil washing in this agricultural areas during winter and excessive unplanned used for fertilizers and manure . The study finding correspond to the Federal Safe Drinking Water Act (SDWA, 93) (P.L. 93-523) was signed into law in 1974 and confirmed that nitrate is the more stable oxidized form of combined nitrogen in most environmental media. Most nitrogenous materials in natural waters tend to be converted to nitrate, and, therefore, all sources of combined nitrogen (particularly organic nitrogen and ammonia) should be considered as potential nitrate sources. Nitrates occur naturally in mineral deposits (generally sodium or potassium nitrate), in soils, seawater, freshwater systems, the atmosphere, and in biota. Lakes and other static water bodies usually have less than 1.0 ug/l of nitrate/nitrogen. Groundwater levels of nitrate/nitrogen may range up to 20 ug/l or more, with higher levels characteristically occurring in shallow aquifers beneath areas of extensive development. Major sources of nitrates and nitrite in drinking water include fertilizer, sewage, and feedlots. The toxicity of nitrate in humans is due to the body's reduction of nitrate to nitrite. This reaction takes place in saliva of humans at all ages and in the gastrointestinal tract of infants during the first three months of life. The toxicity of nitrite is demonstrated by vasodilators/cardiovascular effects at high dose levels and methemoglobinemia at lower dose levels. Methemoglobinemia,"Blue-Baby Disease,"

is an effect in which hemoglobin is oxidized to meet hemoglobin, resulting in asphyxia. Infants up to three months of age are the most susceptible subpopulation with regard to nitrate. This is due to the fact that in the adult and child, about 10 percent of ingested nitrate is transformed to nitrite, while 100 percent of ingested nitrate can be transformed to nitrite in the infant. The effects of methemoglobinemia are rapidly reversible, and there are, therefore, no accumulative effects. Nitrate/ nitrite have been classified in EPA's Group D (not classifiable), based upon inadequate data in animals and humans. Nitrate compounds have demonstrated adverse toxic effects in infants. Due to potential toxicity and widespread occurrence in water, it is regulated. This could be controlled by taxes for nitrogen fertilizers, construction of linear lagoon for manure saving, and awareness for farmer about the health impact for excessive fertilizers usage.

Figure 5.10: Distribution of renal failure prevalence and nitrate level.

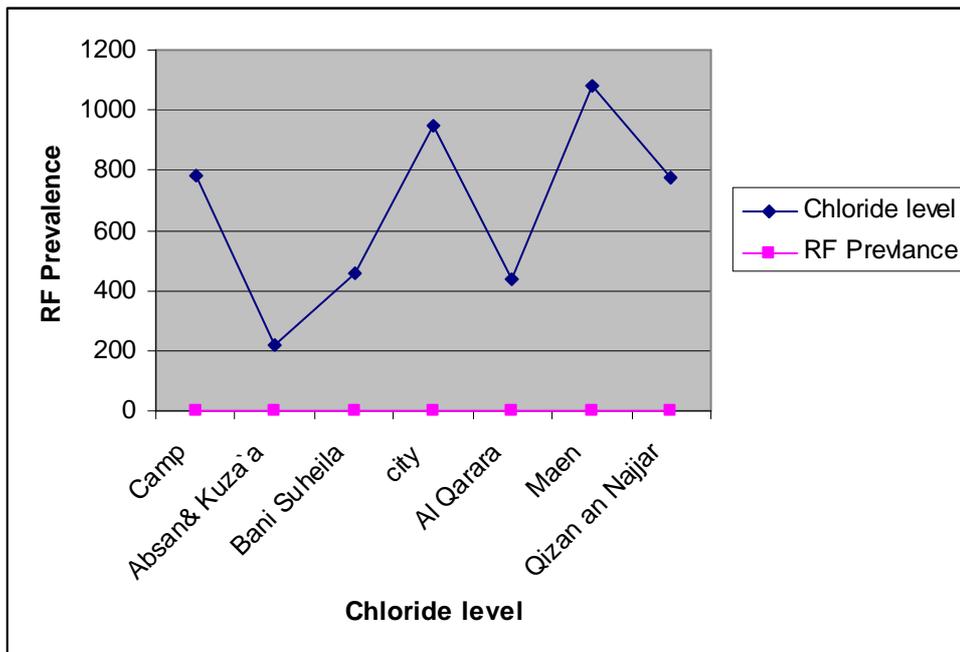


Each area represents the prevalence rate per 1000 population

### **B.5.4.3 Comparison between the distribution of Renal Failure prevalence and Chloride level in the different areas:-**

Figure (5.11) shows distribution of renal failure prevalence and chloride level. Most areas having chloride level higher than the level recommended by the WHO standard (250mg/l) for drinking water except Khuza, Absan which have chloride level less than the WHO standard for drinking water. The following diagram links the relationship between chloride level, and the renal failure prevalence. The study finding shows that when the chloride increased the renal failure prevalence once increased and another decreased the highest chloride level in Khanyunis city but the highest prevalence in Qizan an Najjar , and the lowest chloride level in Kuza & Absan ( moderate ) while the lowest prevalence in Kanyunis Camp , Peak of chloride level is not in the area with the Prevalence peak or off peak so there is no association between chloride level and Renal failure prevalence . The study finding shows that more than 90% of the subjects don't accept domestic water taste without treatment even for cooking but Kuza and Absan accept water taste without treatment and 90% of the subjects in these areas don't treat water, and the same percent refused to change domestic water source. The study finding correspond to the( New Jersey Federal safe drinking water,1998) which confirmed that if chloride level exceed 250mg/l the SMCL for chloride is the level above which the taste of the water may become objectionable to the consumer. In addition to the adverse taste effects, high chloride concentration levels in the water contribute to the deterioration of domestic plumbing, water heaters, and municipal waterworks equipment. High chloride concentrations in the water may also be associated with the presence of sodium in drinking water. Elevated concentration levels of sodium may have an adverse health effect on normal, healthy persons. In addition, a small segment of the population may be on severely restricted diets requiring limitation of their sodium intake. For the preceding reasons, the SMCL for chloride represents a desirable and reasonable level for protection of the public well.

Figure (5.11) Distribution of renal failure prevalence and chloride level.



Each area represents the prevalence rate per 1000 population

#### B5.4.4 Comparison between the distribution of Renal Failure prevalence and Fluoride level in the different areas:-

Figure (5.12) shows distribution of renal failure prevalence and fluoride level. Most areas having fluoride level higher than the level recommended by the WHO standard for drinking water (1.5 mg/l). The following diagram links the relationship between Fluoride, and the renal failure prevalence. The study finding shows that when fluoride level increased the renal failure prevalence increased. The highest fluoride level is in Qezan an Najjar and the highest prevalence in the same area. The lowest fluoride level is in Khanyunis camp and the lowest RF prevalence in the same area. In all areas when the fluoride level increase the RF prevalence increased, so there is a positive association between the fluoride level and renal failure with correlation coefficient equal (.987), and the diagram links a semi liner relationship. The study finding the study finding correspond with A new study, to be published in the journal *Environmental Research*, adds further support to recent conclusions on fluoride toxicity by the National Academy of Sciences (NAS). The study, conducted by a team of researchers at Tongji Medical College in China, suggests that fluoride exposure – at levels currently deemed safe by the US Environmental Protection Agency (EPA) –

can damage both kidney and liver function in children (1). Earlier this year, an NAS panel concluded that EPA's safe drinking water standard for fluoride – currently set at 1mg/l - “should be lowered” due to evidence linking fluoride exposure at this level to multiple adverse effects on human health (2). A new study from China, meanwhile, has detected evidence of kidney and liver disturbances in children drinking water with as little as 2 ppm fluoride — half the level of fluoride currently deemed safe by the EPA. According to the authors, “our results suggest that drinking water fluoride levels over 2.0 mg/L (ppm) can cause damage to liver and kidney function in children. The authors arrived at this conclusion after studying a group of 210 children living in areas with varying levels of fluoride in water (from 0.61 to 5.69 ppm). Among this group, the children drinking water with more than 2 ppm fluoride – particularly those with dental fluorosis - were found to have increased levels of lactic dehydrogenase in their blood (an indicator of liver damage) and increased levels of NAG enzyme and  $\gamma$ -GT enzyme in their urine (two markers of kidney damage). While definitive conclusions about the risks of fluoride exposure to kidney and liver function can not be drawn from this single study, it bears noting that several animal studies have previously found evidence of fluoride-related kidney damage at levels as low as 1 ppm in rats, and 5 ppm in monkeys. Furthermore, the possibility that fluoride can damage the kidney is boosted by the fact that, of all soft tissues, the kidney is exposed to the highest levels of fluoride (with the possible exception of the pineal gland). According, for instance, to the recent NAS report: “Human kidneys... concentrate fluoride as much as 50-fold from plasma to urine. Portions of the renal system may therefore be at higher risk of fluoride toxicity than most soft tissues.” Unfortunately, 60 years after water fluoridation began; there remains a scarcity of research investigating the effect of fluoridated water on kidney, or liver, function. As noted by the NAS, “Early water fluoridation studies did not carefully assess changes in renal function.” This fact was not lost on the authors of the current study. As they note in the introduction: “Surprisingly, few studies have examined the effects of fluoride on the functions of human liver and kidney and the possible dose–effect relationship between fluoride levels and damage to human liver and kidney functions.” In fact, because of the scarcity of such research, the recent NAS report had actually specifically recommended that: “The effect of low doses of fluoride on kidney and liver enzyme functions in humans needs to be carefully documented in communities exposed to different concentrations of fluoride in drinking water.” In light of this NAS

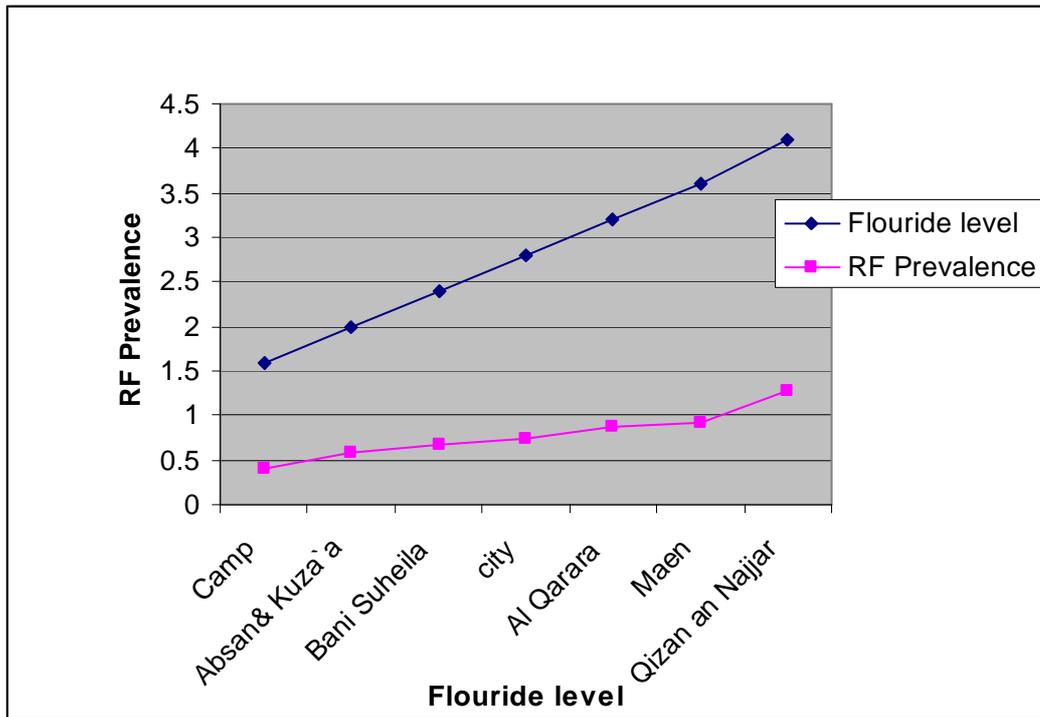
recommendation, the new findings from China raise a serious red flag that shouldn't be ignored (Fluoride Action Network, 2007). **The study finding correspond to the study of which express that Kidney Patients at Increased Risk of Fluoride Poisoning:** "[A] fairly substantial body of research indicates that patients with chronic renal insufficiency are at an increased risk of chronic fluoride toxicity. Patients with reduced glomerular filtration rates have a decreased ability to excrete fluoride in the urine. These patients may develop skeletal fluorosis even at 1 ppm fluoride in the drinking water... The National Kidney Foundation in its 'Position Paper on Fluoride 1980' as well as the Kidney Health Australia expresses concern about fluoride retention in kidney patients. They caution physicians to monitor the fluoride intake of patients with advanced stages of kidney diseases. However, a number of reasons will account for the failure to monitor fluoride intake in patients with stages 4 and 5 of chronic kidney diseases and to detect early effects of fluoride retention on kidneys and bone. The safety margin for exposure to fluoride by renal patients is unknown, measurements of fluoride levels are not routine, the onset of skeletal fluorosis is slow and insidious, clinical symptoms of this skeletal disorder are vague, progression of renal functional decline is multifactor and physicians are unaware of side effects of fluoride on kidneys or bone (Schiffl H. 2008). Fluoridation of drinking water and chronic kidney disease: absence of evidence is not evidence of absence.

Nephrology Dialysis Transplantation. Another study express that "Individuals with kidney disease have decreased ability to excrete fluoride in urine and are at risk of developing fluorosis even at normal recommended limit of 0.7 to 1.2 mg/l. (Bansal R, Tiwari SC, 2006). Back pain in chronic renal failure. Nephrology Dialysis Transplantation. Another study express that "Persons with renal failure can have a four fold increase in skeletal fluoride content, are at more risk of spontaneous bone fractures, and akin to skeletal fluorosis even at 1.0 ppm fluoride in drinking water. (Ayoob S, Gupta AK, 2006).

Fluoride in Drinking Water, a review on the Status and Stress Effects. Critical Reviews in Environmental Science and Technology "In patients with reduced renal function, the potential for fluoride accumulation in the skeleton is increased. It has been known for many years that people with renal insufficiency have elevated plasma fluoride concentrations compared with normal healthy persons and are at a higher risk of developing skeletal fluorosis, (National Research Council, 2006). Fluoride in Drinking Water: A Scientific Review of EPA's Standards. National Academies Press,

Washington D.C. p140 . "Skeletal fluorosis seems possible, especially in hot climates or with renal compromise, from drinking excessive quantities of instant or bottled teas. Our observations support the need for better understanding of the amounts and systemic effects of fluoride in teas. (Whyte M, 2006). Fluoride levels in bottled teas. American Journal of Medicine "We hypothesize that elevated serum F levels might contribute to the disturbances in mineral ion homeostasis that are observed in patients with CRI (Chronic Renal Insufficiency). This is of particular concern since the incidence of dental fluorosis has increased due to increased F<sup>-</sup> uptake from multiple fluoridated sources. The ubiquitous presence of F in food and beverage products regardless of the degree of water fluoridation suggests that the overall F exposure in individuals with CRI may need to be more closely monitored. (Mathias RS, et al, 2000). Increased fluoride content in the femur growth plate and cortical bone of uremic rats. Pediatric Nephrology. Federal regulations require that fluoride, which occurs naturally in your water supply, not exceed a concentration of 4.0 mg/l in drinking water. This MCL has been established to protect public health. Exposure to drinking water levels above 4.0 mg/l for many years may result in some cases of crippling skeletal fluorosis, which is a serious bone disorder. Fluoride in children's drinking water at levels of approximately 1 mg/l reduces the number of dental cavities 60-65 percent below rates in communities with little or no fluoride. However, some children exposed to levels of fluoride greater than about 2.0 mg/l may develop dental fluorosis. Dental fluorosis, in its moderate and severe forms, is a brown staining and/or pitting of the permanent teeth. Because dental fluorosis occurs only when developing teeth (before they erupt from the gums) are exposed to elevated fluoride levels, households without children are not expected to be affected by this level of fluoride. Federal law also requires that notification take place when monitoring indicates that the fluoride exceeds 2.0 mg/l. This is intended to alert families about dental problems that might affect children under nine years of age. Families with children under the age of nine with fluoride exceeding 2.0 mg/l are encouraged to seek other sources of drinking water for their children to avoid the possibility of staining and pitting.

Figure (5.12) Distribution of renal failure prevalence and fluoride level



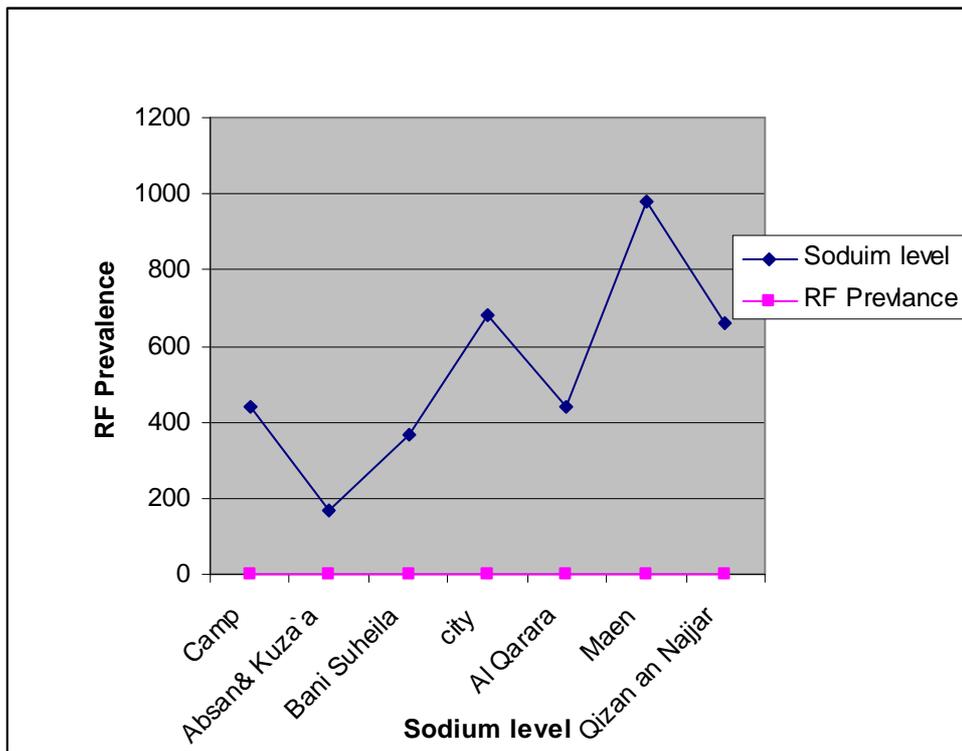
Each area represents the prevalence rate per 1000 population

**B.5.4.5 Comparison between the distribution of renal failure prevalence and Sodium level in the different areas:-**

Figure (5.13) shows distribution of renal failure prevalence and sodium level. Most areas having Sodium level higher than the level recommended by the WHO standard (200 mg/l) for drinking water except Khuza, Absan which have sodium level less than the WHO standard for drinking water. The following diagram link the relationship between sodium level, and the renal failure prevalence. The study finding shows that when the sodium level increased the renal failure prevalence once increased and another decreased the highest sodium level in Maen but the highest prevalence in Qizan an Najjar , and the lowest sodium level in Kuza & Absan (moderate ) while the lowest prevalence in Kanyunis Camp , Peak of sodium level is not in the area with the Prevalence peak or off peak so there is no association between sodium level and Renal failure prevalence. The study finding shows that more than 90% of the subjects don't accept domestic water taste without treatment even for cooking but Kuza and

Absan accept water taste without treatment and 90% of the subjects in these areas don't treat water, and the same percent refused to change domestic water source. The study finding corresponds to the Federal safe drinking water which confirmed SODIUM SMCL 50 mg/l, Sodium is the principal cation in the hydrosphere. It is derived geologically from the leaching of surface and underground deposits of salts (e.g., sodium chloride) and from the decomposition of sodium aluminum silicates and similar minerals. The sodium ion is a major constituent of natural waters. Human activities also contribute sodium to water supplies, primarily through the use of sodium chloride as a deicing agent, and the use of washing products. Based on the available studies, it appears that insufficient evidence is available to conclude whether or not sodium in drinking water causes an elevation of blood pressure in the general population. It has been estimated that food accounts for approximately 90 percent of the daily intake of sodium, whereas drinking water contributes up to the remaining 10 percent. In order to afford protection to a segment of the U.S. population on a sodium-restricted diet, in 1968, the (American Heart Association (AHA).1968) recommended a level of 5 mg of sodium per 8 ounces of water or 20 mg/l. USEPA is suggesting a guidance level for sodium of 20 mg/l in drinking water for the high-risk population as recommended by the AHA. When it is necessary to know the precise amount of sodium present in a water supply, a laboratory analysis should be made. When home water softeners utilizing the ion-exchange method are used, the amount of sodium will be increased. For this reason, water that has been softened should be analyzed for sodium when a precise record of individual sodium intake is needed. For healthy persons, the sodium content of water is unimportant because the intake from salt is so much greater, but for persons placed on a low-sodium diet because of heart, kidney, circulatory ailments, or complications in pregnancy, sodium in water must be considered. The researcher expectations was that people with high sodium level will developed renal failure more but this expectation don't correspond to the study finding .

Figure (5.13) Distribution of renal failure prevalence and sodium level



Each area represents the prevalence rate per 1000 population

## Chapter 6

### Conclusion and Recommendations

#### 6.1 Conclusion

In order to explore the association between water salinity and renal failure in the southern part of Gaza Strip (Khanyunis Governorate) a descriptive analytical cross sectional survey was conducted at Nasser Hospital. The entire renal failure patient were invited to participate in the study. Questionnaire tool was used, hospital registry and files were reviewed, water chemical tests were obtained, and wells network and distribution maps were conducted. The response rate of patients was 70%, this rate is considered high. The study result might help to improve the current status of renal failure patient by giving alert or warning for the current situation or in answering some questions. The study findings showed that male participant and prevalence are higher than female participant and prevalence. This finding correspond to the male and female ratio in other studies. The majority of patient's ages were between 40 years to 60+ years old. All respondent were lived in Khanyunis city and the eastern villages. The majority of respondents are married. Majority of respondent don't complete the basic education. The majority of subjects are unemployed. Agriculture and construction occupies the highest percentage which was 36.7% for agriculture and 22.4% for construction. The majority conducted to the study having nuclear families. The highest incidence age group is 40-59 which represented 37.5% of the incidence.

The major diseases that causes renal failure in arrangement are diabetes mellitus represented 40.7% of all subjects , hypertension represented 33%,congenital disorder, heart disease, gland disorder, and both diabetes and hypertension. The main causes for renal failure in arrangement are Glomerulnephritis, renal atrophy and renal stone. More than the half developed calcium stones. Most of renal failure was chronic with different level of severity the most sever and conducted to hemodialysis represented 40% with treatment session range from one to four treatment session. Only 5.2% conducted to renal replacement therapy due to high cost and shortage of donors.

The majority of subject don't have family history of RF they represented 76.5% of the total respondent and only 23.5% are having RF family history, the majority of

subjects who have RF family history having only one relative affected by RF represent 43.8% of the total subjects who having RF family history prevalence, and 37% are having two relatives, 12.5% having three relatives, 3.1% having five relatives, 3.1% having six relatives suffering from RF.

The majority of subjects having RF family history or relatives affected by RF their relatives were first degree relation, they represented 59.4%, the others having RF family prevalence their relatives were second degree and represented 28.1%, the rest 12.5% are having relatives from both first and second degree.

According to RF relatives residency the majority of their relatives are living in the same district or city which mean that both subjects and RF relatives are sharing with the same water sources they represented 62.5%, the other part don't live in the same district but in the same Governorate and represented 28%, the rest are living outside the governorate and represented 9.3% of the total relatives.

According to their water supply source subjects have been classified within four major groups, the first group which represented the majority with 77.9% of the total subjects, in this group subjects are having water from municipals wells , the second group are having water supply from private wells and owned by their municipalities and represented 13.2% of the subjects, the third are having water supply makorot within this group subjects connected to large tanks are called mirage where distribution for water supply from this large storage for eastern villages only ( Khuza, Absan, Banisuhila ). This storage has been started water distribution since 2001. Bansuhila subjects are having only 70% of their water needs from this storage but the 30% is served from private well owned by eastern village's municipality. The rest of subjects are having water supply from UNRWA wells and managed by Khanyunis municipality. Before ten years the majority of subjects used domestic water access for drinking directly without treatment and these represented 97.1% of the total subjects. That's mean nearly all subjects are having one access which fit their needs and requirement for domestic use and drinking. At present time majority of subjects treating domestic water before drinking these presented 92.6% of the total subject, and only 7.4% don't treat domestic water before drinking those subjects has direct access to mirage storage tank. The major drinking water treatment access for subject is desalinated water. This access represented 52.4% of the total subject's access, then home filter represented 30%, Makorot access represented 17.5%. The majority of subjects treat their water after renal failure incidence. Those represented 75%, but the

minority treats their water before renal failure incidence and represents 25% of the total subjects. The majority of subjects drink less than three liter per day. They represented 75%, and others drink more than three liters and represented 17.5% and only 7.4 don't know how much water they drink per day.

Four domains were created by the researcher including water quality, subjects practice and attitude, knowledge and awareness, and subject's satisfaction. The over all domain is the summation of the four domains. The second major part of the study is description and analysis for all water data and chemical tests since 1987 for the all different demographical areas by application of the mathematical model to calculate the level of salinity which include TDS, Nitrate, Chloride, Fluoride and sodium level as exposure. The study findings showed variation in salinity levels by time and locality. The study finding showed that water supply from 90% of the wells in the governorate don't meet the WHO standard for drinking since 1987 in all areas, which means the majority of citizen in the governorate have access to unsafe drinking water since along time, as well as subjects are exposed to high water salinity level for along period ( high chloride, nitrate, fluoride, TDS ,and sodium level) but only subjects in Khuza and Absan who have drinking water access from Mirage storage tanks met the WHO for drinking water in TDS, Nitrate, chloride, and sodium level during the period from 1999-2004, and the same area met the standard for chloride and sodium level during the period from 2005-2009 those subjects represented only 8.8% of the total subjects. The study finding shows that more than 90% of the people in the governorate are suffering to unsafe and unclean drinking water access.

Some demographical variables showed statistical significant differences effect on subjects domains and showed the effect on subject's perception to the domains. Gender showed that female perceived more positively to knowledge and awareness domain than male. Subjects were positively perceived the domains with differences in some domains, and they agreed on the importance of knowledge and awareness for improving the both health and environmental situation.

Renal failure has been classified to the same water sources areas in order to link and study the association of each salinity variable level on the prevalence. Five graphs have been applied to show variation of renal failure prevalence by sodium, chloride, fluoride, nitrate and TDS level differences. The study findings showed a scatter diagram link the relationship between TDS level and the prevalence in all areas which mean that there is no association between TDS level and renal failure prevalence. The

study finding shows a scatter diagram link the relationship between nitrate level and renal failure prevalence in all areas and this mean that there is no association between nitrate level and renal failure prevalence.

For chloride a scatter diagram link the relationship between chloride level and renal failure prevalence and meaning that there is no association between chloride level and renal failure prevalence.

For sodium a scatter diagram link the relationship between sodium level in all areas and renal failure prevalence.

Only fluoride a semi linear diagram link the relationship between fluoride level and renal failure which means that there is a strong direct proportion between fluoride level and renal failure with correlation coefficient equal (.987). This finding correspond with the minority of new finding about fluoride which is still not generalized but the majority of the studies which are generalized reveal the effect of fluoride on both teeth and bone.

## **6.2 Recommendation**

The opportunity was given to the researcher by the study finding to conclude the following recommendations:-

1. The best that we can do at present is to concentrate our effort on the prevention of the progression of renal disease and redouble our effort to remind the public on the need to pay attention to maintain their blood sugar and blood pressure at the normal level and by initiating an urgent public awareness program about fluoride health effect.
2. Prevention through a healthy lifestyle which plays a major role to reduce if not totally control the renal failure and this could be achieved through proper education, with that, we will be able to help decrease or at least slow down the increase in statistics of patient suffering from kidney problems.
3. The need to pay attention for prevention from fluoride exposure risk from water food and drinks in order to maintain good kidney function.
4. Setting up ground water monitoring and database management system, for monitoring and regulating the process of groundwater abstractions from all types of wells

5. Minimizing water consumptions and losses through well licensing and registration, implementation of well and protection plan, and reorganizing and redeveloping new criteria for licensing private existing and new desalination plants
6. Reducing the aquifer over pumping by reducing the loss in the irrigation water through using new and reliable irrigation methods
7. Closing all types and unnecessary illegal production wells
8. Implementation of land use planning including protection of ground water protection zones
9. Setting up public information and awareness programs
10. Communication and public participation through awareness programs on the fluoride health effect.
11. Control the use of pesticides and fertilizers by awareness and imposing taxes.
12. Setting up systematic criteria for laboratory tests, by giving wells equal opportunity and change for all parameters determining salinity level (nitrate, fluoride, sodium, chloride and TDS levels).

### **6.3 Area for further research**

- Further study is needed to explore the association between fluoride level and liver damage
- The prevalence of chronic fluoride toxicity
- The prevalence of crippling skeletal fluorosis
- The association between water quality, and chemical composition of kidney and urinary tracts stones.

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## بسم الله الرحمن الرحيم

### عزيزي المشارك/ة

أنا الطالبة إيمان سليمان مخيمر ادرس بكلية الصحة العامة في جامعة القدس - أبو ديس أقوم بإعداد بحث بعنوان " العلاقة بين ملوحة مياه الشرب والفشل الكلوي في المنطقة الجنوبية من قطاع غزة محافظة خانينوس " باعتباره متطلب للتخرج والحصول على درجة الماجستير وتم اختيارك/ي بناء لمطابقتك لشروط العينة.

تهدف هذه الدراسة إلى تحديد العلاقة بين ملوحة مياه الشرب والإصابة بالفشل الكلوي في محافظة خانينوس والخروج بتوصيات للحد من الإصابة بمرض الفشل الكلوي.

نشكر لك مشاركتك في هذه الدراسة بالإجابة على بعض الأسئلة خلال المقابلة مع العلم أن المقابلة لن تستغرق أكثر من 20 دقيقة تقريبا، في حال أن الوقت غير مناسب الرجاء تحديد موعد آخر يناسبكم.

مشاركاتكم تطوعية يمكنكم رفض الإجابة على أي سؤال وارغب أن أؤكد لكم أن المعلومات التي تذكرونها ستكون سرية وستستخدم فقط لغرض البحث العلمي وبدون ذكر أسماء ولذا أرجو أن تكون الإجابات دقيقة.

قبل البدء في المقابلة هل تودي/ن الاستفسار حول أي شيء عن الدراسة وهل من الممكن أن نبدأ المقابلة؟

( ) نعم ( ) لا

نشكر لكم حسن تعاونكم

## إستبانة

حول علاقة ملوحة مياه الشرب بالفشل الكلوي في محافظة خانيونس

الرقم: \_\_\_\_\_ التاريخ: \_\_\_\_\_  
الاسم: \_\_\_\_\_ اسم المشفى: \_\_\_\_\_  
رقم الهاتف: \_\_\_\_\_

### معلومات شخصية:

1. الجنس:  أنثى  ذكر
2. الحالة المدنية  مواطن  لاجيء
3. العمر:  سنة
4. المنطقة السكنية  خانيونس المدينة  المخيم  خزاعة  عيسان  
 بنى سهيلا  قيزان  معن  القرارة

### المعلومات الاجتماعية والاقتصادية:-

5. الحالة الاجتماعية:  أعزب  متزوج  مطلق  أرمل
6. آخر شهادة حصلت عليها:  أقل من توجيهي  توجيهي  دبلوم
- بكالوريوس  ماجستير  دكتوراه
7. المهنة:  لا يعمل  يعمل
- 8: طبيعة العمل الحالي: \_\_\_\_\_
9. طبيعة العمل السابق: \_\_\_\_\_
10. نوع العائلة التي تعيش فيها  عائلة نووية  عائلة ممتدة  حمولة

التاريخ الطبي :-

11. هل تعاني من امراض مزمنة ( غير الفشل الكلوي ) اخرى  نعم  لا
12. إذا كانت الإجابة نعم حدد/ي؟  أمراض القلب  سكري  ضغط الدم   
 أمراض صدرية  وراثية
13. متى أصبت بمرض الفشل الكلوي؟ عند عمر \_\_\_\_\_ سنة
14. سبب الفشل الكلوي هو؟  التهاب في الكلى  حصيات  ضمور
15. نوع الحصى؟  كالسيوم  اكسالات
16. الفشل الكلوي لديك في  الكلى اليمنى  الكلى اليسرى  كلاهما
17. هل يعاني احد اقربائك من مرض الفشل الكلوي؟  نعم  لا
18. إذا كانت الإجابة نعم حدد/ي عدد المصابين؟ \_\_\_\_\_
19. إذا كانت الإجابة نعم حدد/ي نوع القرابة؟  درجة اولى  درجة ثانية  غير ذلك
20. هل يسكن في نفس المنطقة؟  نعم  لا
21. المنطقة السكنية  خانيونس المدينة  المخيم  خزاة  عيسان   
 بنى سهيلا  قيزان  معن  القرارة
22. هل تقومين بغسل الكلى؟  نعم  لا
23. إذا كانت الإجابة نعم حدد/ي عدد مرات الغسل اسبوعيا؟ \_\_\_\_\_
24. هل قمت/ي بعملية زراعة كلى  نعم  لا
25. إذا كانت الإجابة نعم فما هي عدد مرات الزراعة \_\_\_\_\_

مصادر المياه :-

26. ما هو مصدر مياه الشرب؟  بلدية  وكالة غوث  شركة ماكروت الاسرائيلية  مباحة

بئر خاص

27. هل كانت المياه تعالج منذ عشر سنوات  نعم  لا

28. اذا كانت الاجابة نعم ماهي الوسيلة المستخدمة سابقا؟

29. منذ متى بدأت معالجة المياه  قبل اكتشاف المرض  بعد الاكتشاف للمرض

30. هل يتم حاليا معالجة مياه الشرب في المنزل قبل استعمال  نعم  لا

31. اذا كانت الاجابة نعم ماهي الوسيلة المستخدمة حاليا؟

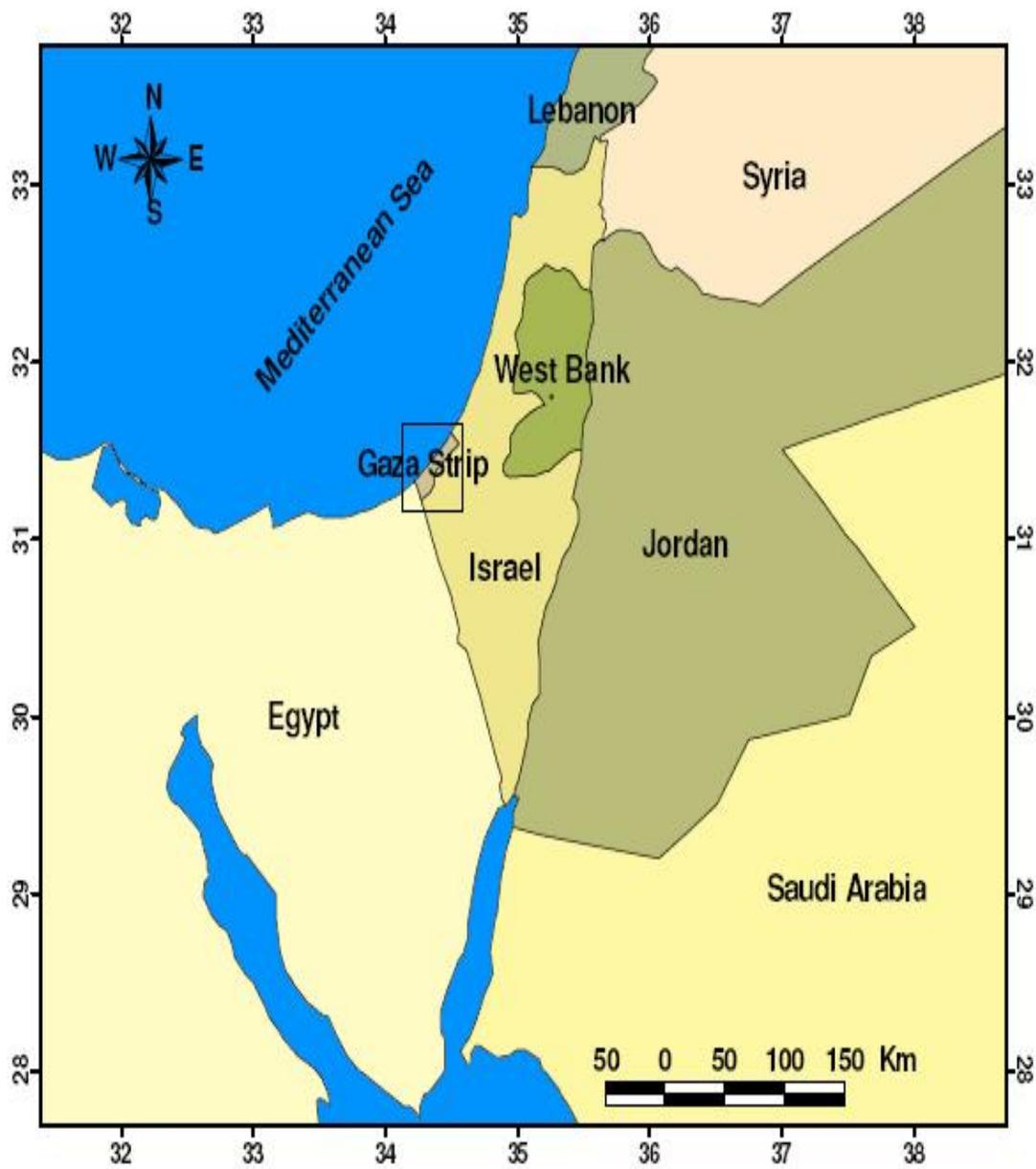
302. هل يتم استعمال مياه الشرب في الطبخ  نعم  لا

33. ما هو متوسط المياه التي تشربها يوميا؟  اقل من 3 لتر  اكثر من 3 لتر  لا ادري

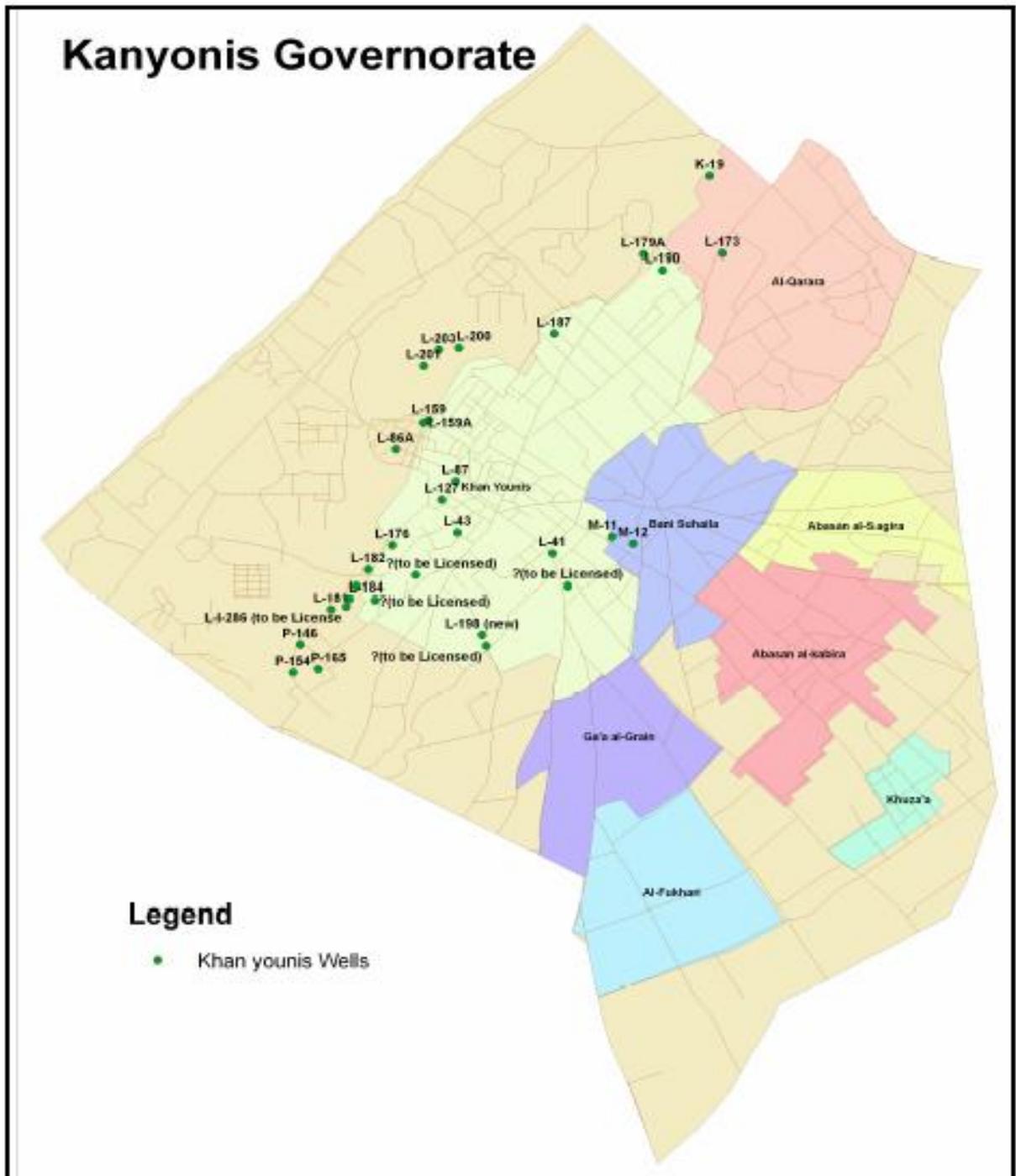
م.	البنود	لا أوافق مطلقاً	لا أوافق	لا أدري	أوافق	أوافق مطلقاً
34.	مياه الشرب مالحة الطعم					
35.	مياه الشرب نقية وشفافة					
36.	مياه الشرب المنزلية لها صفات متغيرة ( الرائحة )					
37.	المياه المنزلية ليست جيدة للطبخ					
38.	يمكن السيطرة على ملوحة المياه في المنزل (باستخدام وسائل تنقيه)					
39.	يمكن تحسين صفات وجودة المياه في المنزل من حيث النقاء والشفافية باستخدام وسائل تنقيه)					
40.	يمكن الحفاظ على استمرارية وجود مياه نقية للشرب طوال اليوم					
41.	يوجد علاقة مباشرة بين الفشل الكلوي وملوحة المياه					
42.	شرب المياه المالحة ليس السبب الوحيد في الفشل الكلوي					
43.	للتثقيف الصحي دور فعال للحد من مرض الفشل الكلوي					
44.	هل حضرت دورات او ندوات عن مشكلة ملوحة المياه					
45.	هل يمكن السيطرة على مرض الفشل الكلوي بالسيطرة على ملوحة المياه					
46.	المياه المالحة عامل مؤثر سلبي على الصحة العامة					
47.	المياه التي تصل إلى المنزل جيدة من حيث النوعية لكافة					
48.	المياه التي تصل إلى المنزل كافية من حيث الكمية لكافة					
49.	ترغبين بتغيير مصدر مياه الشرب في منزلك					

شكراً لتعاونكم،،،

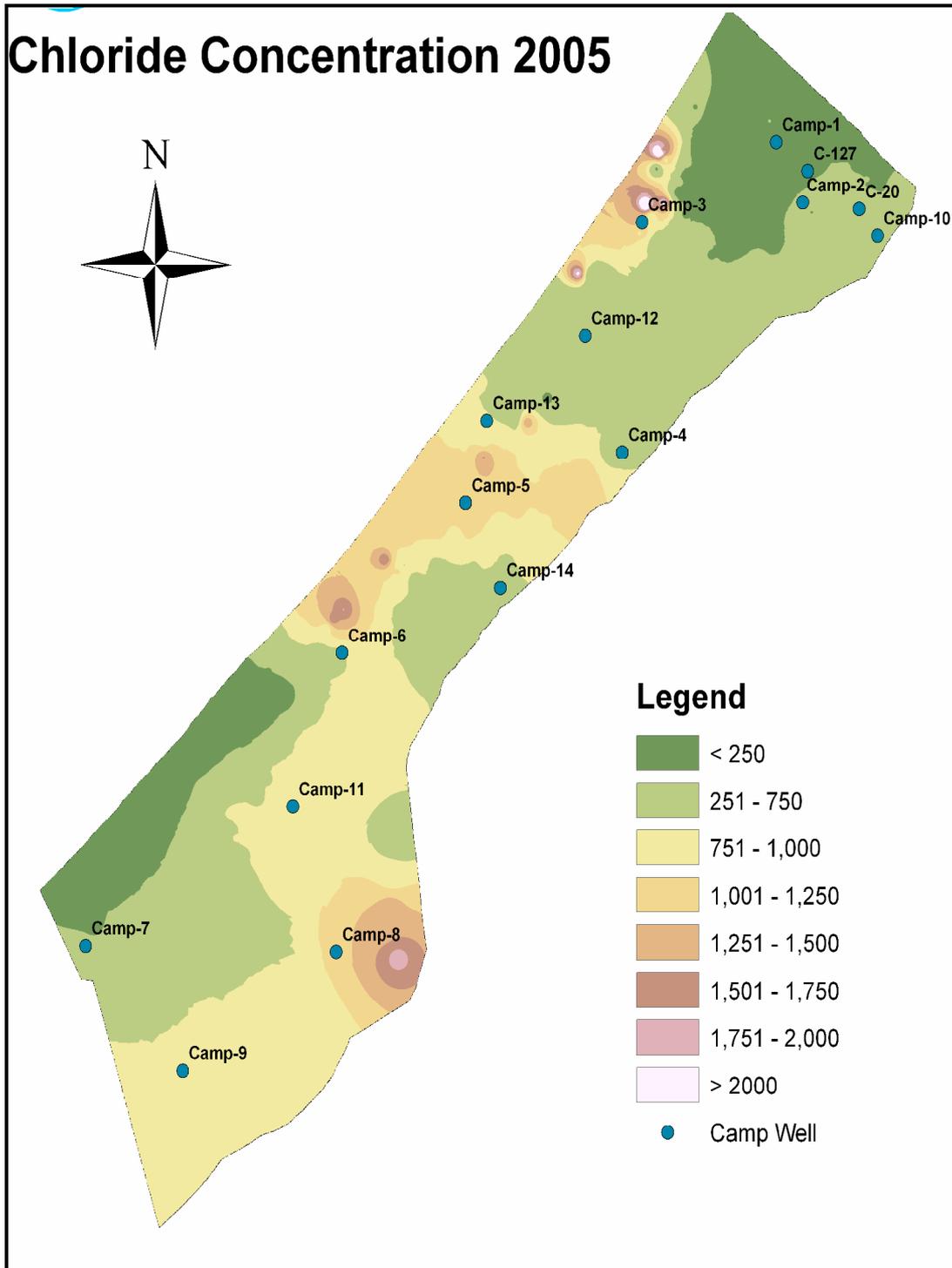
**Annex (2) Geographic location of the Gaza Strip (Aish, 2004)**



Annex (3) Khanyounis map (PWA, 2007)



**Annex (4):** Contour map of chloride concentration for the year 2005 (PWA, 2005)



## ملخص الدراسة

### العلاقة بين ملوحة مياه الشرب والفشل الكلوي في الجزء الجنوبي من قطاع غزة

تواجه البيئة في قطاع غزة مشاكل جوهريّة، خصوصاً قلة وتلوث الموارد، بالإضافة إلى زيادة عدد السكان و قلة فرص العمل مما خلق مشاكل بيئية عديدة. المياه الجوفية هي المصدر الوحيد للمياه في قطاع غزة وفي الجزء الجنوبي من قطاع غزة أكثر من 90% من سكان المنطقة الجنوبية في قطاع غزة يحصلون على المياه من الآبار الجوفية التابعة لبلدياتهم وتستخدم مياه الآبار الجوفية حالياً لجميع أغراض الاستخدام المنزلي.

ملوحة المياه هي مشكلة أساسية تهدد المياه الجوفية في الجزء الجنوبي من قطاع غزة وهناك جزء آخر من سكان القرى الشرقية في محافظة خان يونس يعتمدون على مصدر مياه للشرب من شركة ماكوروت الإسرائيلية والتي تتمتع نوعية المياه من هذا المصدر بمطابقتها لمعايير منظمة الصحة العالمية.

الهدف العام هو دراسة العلاقة بين ملوحة مياه الشرب ونسبة مرض الفشل الكلوي في الجزء الجنوبي من قطاع غزة. هذه الدراسة وصفية تحليلية. وقد استهدفت جميع مرضى الفشل الكلوي في الجزء الجنوبي من قطاع غزة. تم جمع البيانات من خلال إستبانة تحتوي على مجموعة من المعطيات الشخصية، التاريخ الطبي للمرض، مصادر المياه بالإضافة إلى طرق معالجة مياه الشرب. ومن الجدير بالذكر أنه تم الاتصال مع كافة مرضى الفشل الكلوي في المنطقة الجنوبية من قطاع غزة والذي بلغ عددهم 194 مريض و المسجلين لدى مستشفى ناصر وقد كانت نسبة الاستجابة 70%. تم تحليل كافة البيانات الخاصة بفحوصات المياه الكيميائية لكافة الآبار التي تشمل عنصر الكلورايد، الفلورايد، الصوديوم، مجموع الأملاح الذائبة، والنترات لما لها دور في تحديد مستوى ملوحة المياه منذ عام 1987، وربط نسبة كل عنصر مع نسبة المرض في نفس المنطقة السكانية. تم استخدام البرنامج الإحصائي "SPSS" و تم اختبار النتائج باستخدام اختبارات إحصائية مثل اختبار "T-test" و إختبار "ANOVA". أوضحت هذه الدراسة أن نسبة 8% فقط من آبار المياه الجوفية في المنطقة الجنوبية تطابق مواصفات منظمة الصحة العالمية لمياه الشرب في تركيز الكلورايد والنترات، وأن نسبة 92% من آبار الشرب تحتوي على تركيز يتراوح ما بين 2 – 9 مرة من مواصفات منظمة الصحة العالمية لمياه الشرب لكل من الفلورايد، الصوديوم، الكلورايد، النترات و مجموع الأملاح الذائبة. كما أوضحت الدراسة أنه لا يوجد علاقة أو ارتباط بين نسبة مرض الفشل الكلوي مع عنصر الكلورايد، النترات، مجموع الأملاح الذائبة والصوديوم و يوجد ارتباط قوي وإيجابي بين نسبة مرض الفشل الكلوي و عنصر الفلورايد.