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Salinity of drinking water and its association with renal failure in Gaza strip, Palestine

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Abstract: Gaza aquifer is the only natural water source for domestic, agricultural, and industrial purposes in Gaza Strip with a population of about 1.7 million. Current rates of the aquifer abstraction are unsustainable and deterioration of groundwater quality is documented in many parts of the Gaza Strip. The overall aim of this study was to determine salinity of drinking water and its association with renal failure in the southern part in Gaza Strip. Another aim was to explore the relationship between renal failure and socio-economic demographic variables. Descriptive, analytic design was used with survey samples from renal failure patients. A face to face questionnaire for renal failure patients was developed. The sample size for patients was 194subjects, with response rate of 70%. This rate was proportional with respect to its size. Reliability was approved by Cronbach alpha test, and validity was approved by content and face validity method. Analysis of the four quantitative extracted domains that reflected subjectsperception for drinking water salinity level in their localities. All water chemical tests of thesouthern municipal domestic wells have been reviewed since 1987. The tests were fluoride, chloride, nitrate, 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 show that only 8% of the municipal wells meet the WHO drinking standards in chloride level. Chloride, nitrate, TDS, fluoride and sodium concentration exceed 2-9 times the WHO standards in 92% of the southern wells. The study findings show that there was no association between renal failure prevalence and chloride level, sodium level, TDS level and nitrate level and showed only association with fluoride level, with which there was strong and positive association. There is an urgent need to modify the mixing process according to fluoride level, and initiate public information and awareness programs.

Keywords: Gaza Aquifer, Groundwater, Drinking Water Quality, Salinity, Renal Failure

1. Introduction

This study examined if there is a relationship between renal failure and drinking water salinity (domestic water) in Khan Yunis Governorate. In the following section the researcher intended to explore the relationship between demographical variables, etiological factors, and ecological indicators that affect the level of salinity, as well as to find the relationship between chronic renal failure prevalence and water salinity level, using a comparative study and some domain express some relations, in order to describe the relationship.

This paper presents the results of the statistical analysis of the data characteristic and distribution of the respondents. Itpresents some statistical tests to explore the relationships between the dependent variables and independent variables, and explores the distribution of the subjects' percentage according to the different variables that may have an effect on the renal function. It also describes and discusses the independent variables, demographical variables, water quality, and medical history variables; the historical data of the water resources and the access to it; and the ecological pattern and main salinity indicators that affect the water quality and may be related to increasing or decreasing the renal failure incidence in the southern part. Then statistical methods have been used to express the association and relation for the effect of the dependent variables on the independent variables, by using the independent t-test and one way ANOVA statistical tests, excel as well as other applications.

2. Study Area

The Khanyounis governorate is one of five governorates of the Gaza Strip. 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 (Figure 1). Where it forms a long and narrow rectangular area of about 365 km^2, with 45 km length, and between 5 and 12 km width. Nowadays, its five governorates are; Northern, Gaza, Middle, Khanyounis 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.

Figure 1: *Location of the Gaza Strip (Aish, 2004).*

The Gaza coastal aquifer is an important source of water to over 1.7 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 (Qahman and Larabi, 2006). It is densely populated, with population of more than one million in the year of 1998 and the population increased rapidly up to approximately 1.7 million now in 2013 which means that the environment in Gaza has been under great pressure and as a result most of the people there suffers severely now.In 2006, about 280 thousand inhabitants are living in Khanyounis. The Khanyounis governorate consists of six municipalities: Khanyounis, BaniSuhaila, Abasan El-Kabira, Abasan El-Saghira, Quarrara, Al Fakhari and the Khuza'a.

3. Methods

The study design is cross sectional, descriptive, analytical study. 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, Mekarout, Private wells) and registered in governmental health sector, as renal failure patient in (Nasser hospital). Their total number is 194 subjects conducted to treatment and registered.

Questionnaire data was collected by researcher only with some assistance and co-ordination 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, there 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. The process of 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.

Drinking water qualitydata was collected by the researcher from many agencies includes (municipalities, coastal water utility in the southern and Gaza region, public health laboratory, and Water Authority).

4. Results and Discussion

4.1. Descriptive Results

4.1.1. Demographical Variables

Regarding gender, the result shows the distribution of gender as male patient represented 58.1%, while female patient represented 41.9% of total sample. The majority of patients weremale;given that male the number is 1.4 times more than female. Characterization of the patient population with chronic kidney disease reveals that the incidence and prevalence rates are universally greater for males than for females. 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 males versus females. In fact, in the Italy Kid Project, males continue to predominate even after excluding patients with posterior urethral valves (Bradley A. Warady, 2007). The findings of the study correspond with the studies conducted by the department of nephrology at

Mercy Hospital in Kansas City, MO USA, and reveal that there is a gap between male and female patient percentage, the males being predominate.

4.1.2. Distribution of Patient by Age Group

Regarding patient age, the patients are distributed according to their age and within four age groups.The lowest age group was 0-19 years as it is only 8.8% of the total sample, while the other two age groups of 20-39 and 40-59 years were equal to 30.1%.The fourth age group is from 60+ years and higher, and this group was a little bit higher than the second and the third group with a percent of 30.9%, with (mean 46.01, mode 60, median 47.50). The majority ofpatients are older than 19 years. The study finding corresponds to the study conducted by all three Units of Medicine of Allied and District Headquarters at Allied Hospital Punjab Medical College, (PMC), Faisalabad, a comparative study. The period is January of 1995 to the end ofMay; 1997.The mean age for the study was 58 years.

4.1.3. Distribution of Subjects by Demographical Data

The patients' residences were distributed throughout eight demographic areas within the KhanYounis governorate and the eastern villages in the southern area of Gaza Strip(KhanYounis city, KhanYounis camp, Kuza, Abassan, Banisuhila, Qizan an Najar, Maen, Qarara), according to the demographical localities and according to the study variable when needed.Table (1) shows the distribution of subjects according to locality, the highest percent was being in KhanYunis city as represented with 52.9%. Thethe highest midyear population during 2006 was KhanYunis camp and Baniseihlawith a percent of 11%. KhanYunis camp is 3.7 times BunSuhila by the Mid year population of 2006 Maen, represented with 7.4%, and the lower percentages were found in Kuza, Abassan, Qizan, and Qarara, as each area represented only 4.4% of the sample. The majority of subjects were living in KhanYunis city. The majorities of subjects were married and represent 64.7%. The level of education represented in the table shows that the majority of the subjects' education level is less than Tawjehi (secondary), and more than half of the sample the rest percent distributed between, Tawjehi level with 30%, Diploma 5.9%, Bachelor 4.4%.

Current occupations presented in table (1) show that currently about 89.7% are unemployed due to the political and economical situation in the country, and only 10.3% are currently working.Outof the working percent, agriculture represents 28.5% of the total workers, construction represents 14.2% of the total workers, and all other jobs which include physicans, administrative workers, nurses, managers, teachers, pharmacists, lab technicians, hair dressers, finance professionals, and policemen comprise 57%. Each job represents a percentage of about 7% of the total jobs.Agriculture and construction have the highest and percentages, as well as previous employment presented in the table which show that 63.9% were previously unemployed. Only 36.02 % were previously employed, and out of the total employed 36.7% were in agriculture, 22.4% were in construction , and 40.8% were in all other jobs that were previously mentioned with percentages not exceeding 5% for each job. The majority of employed subjects either were or still are working in the agriculture sector, and the second largest job category is construction. The study findings correspond with discussed paper by (HenkdeZeeuw, 2000).

Table 1: *Distribution of subjects by demographical data*

Variable		Frequency	Percent
Residency place	Khan Yunis city	72	52.9%
	KhanYunis Camp	15	11%
	Khuza	6	4.4%
	Abasan	6	4.4%
	Bani Suheila	15	11%
	Qiza an Najjar	6	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%

Regarding the family type of the subjects, 72.1% of the subjects represented nuclear family and 27.9% represented extended. The first type is most common.

4.2. Distribution of Subject by Medical Data (Variables)

4.2.1. Distribution of Subjects by Incidence Age Group

Regarding patient age, the incidence age group for the renal failure patients vary in percent. The patients are distributed within four age groups, and the highest age groups for incidence were the third age group of 40-59 with percent 37.5% of the total sample; the second age group of 20-39 years with a percent of 28.7%; and the third, ages 0-19, with a percent of 20.6%.The lowest is 60+ with percent 13.2%. The majority of renal failure incidence occurs at the age 40-59. Figure (2) shows the distribution of renal failure incidence age.

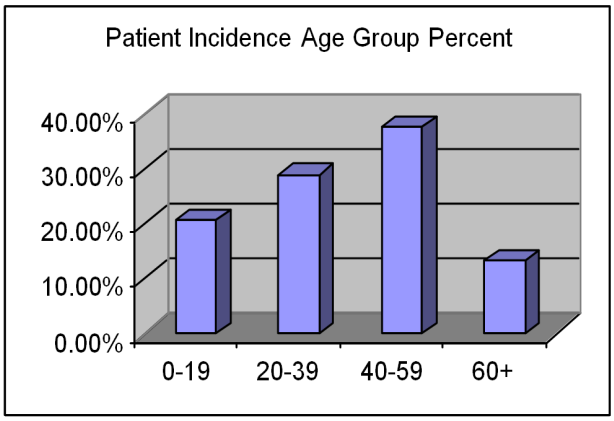

Figure 2: *Distribution of Subjects by incidence age group*

4.2.2. Distribution of Subject by Etiological Variables (Diseases)

The medical history for the subjects is represented in table 2 below. The table shows that only 20.6% of the total subjects do not suffer from chronic disease, but the majority of subject are suffering from chronic diseases as represented by 79.4% of the subjects.The major diseases are diabetes (40.7%), hypertension (33%), congenital disorder (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 (7.4%), gland disorder (3.7%), and the minority suffering from both diabetes and hypertension and they (3.8%). Two studies (K. Amin and Tufai Muhammad, 2000)and (Arrigo et al, 2000) showed the prevalence of diabetes to be 25%35%respectively.

Table 2: *The medical history for the subjects.*

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

Mellitus is a quite significant risk factor in the people of our area. 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 factors in chronic renal failure. The study corresponds with another study conducted by Allied Hospital Punjab Medical College, (PMC), Faisalabad. 25 patients out of a total 300 patients, i.e. 8.33%, were having hypertensive nephropathy.

Table 3: *The cause of renal failure*

Variables		Frequency	Percent
Cause of renal failure	Glomerulonephritis	58	42.6%
	Renal atrophy	56	41.2%
	Renal stone	22	16.%
Type of stone	Calcium	12	52.2%
	Exalate	11	47.8%

4.2.3. Distribution of Patient by Cause of Renalfailure

The majority of subjects who responded to the study suffer from glomerulonenephritis represented by 42.6% out of the total subjects, and 41.2% of the subjects have renal atrophy. The rest (16.2%) developed renal stone, while 52.2% developed calcium stones.The others (47.8%) developed exalate type of stone.Table 3 represented the cause of renal failure.

4.2.4. Distribution of Subjects by Severity of Disease

As presented in table 4, all the subjects in the study were suffering from chronic renal failure and 59.6% are still severe but don't need to conduct hem dialysis.The rest of the subjects (40.4%) are at the highest level of severity and conduct hemi dialysis.The majority of these subjects (52.7%) 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%) need four sessions per week, with an average of 14 hours per week. Seven subjects (5.2% of the total subjects) previously conducted renal transplantation; five out of seven with (3.7% of the total subjects) conducted transplantation once, and two subjects (1.5%) conducted transplantation twice.

Table 4: *Distribution of subjects by severity 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 session per week dialysis	1 session	3	5.5%
	2 sessions	29	52.7%
	3 sessions	22	40%
	Four sessions	1	1.8%
Renal transplantation	No	129	94.8%
	Yes	7	5.2%
Repeat ion of transplantation	once	5	3.7%
	twice	2	1.5%

The cost of medical treatment for most of the acquired kidney disease has been expensive. Renal transplantation is limited because of the shortage of donors not only in Palestine but worldwide.

4.2.5. Distribution of Subject Relatives by Renal Failure Prevalence (History)

The majority of the subjects(76.5%) do not have relatives suffering from RF, and 23.5% do have relatives suffering from RF.For the previous percent, the researcher notices that some of the subjects answer with no even if they have a relative visiting the hospital 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 their relative, 43.8% of the subjects with a «yes» answer knew that one of their relatives were affected by Renal Failure; 37.5% knew that two of their relatives were; 12.5% knew that three relatives were; 3.1% knew of five relatives; and 3.1% knew six relativesthat were suffering from renal failure.

The majority of affected relatives were first degree with 59.4%; 28.1% of their relatives were second degree, and the minority had both first and second degree relatives affected by RF. Regarding their relatives' residency, 62.5% are living in the same demographical area (city, camp).The majority of relatives had the same source of water, but the rest of relatives (28%)lived in the same governorate but maybe did not share the source of water. Twenty nine relatives out of thirty two are living in KhanYunis governorate or the eastern villages with a percent of 90.6% of the whole relatives, and only 9.3% are living outside the governorate. Table 5 shows the distribution of subject relatives.

Table 5: *Distribution of subject relatives by renal failure prevalence (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%

4.2.6. Distribution of Subject by Domestic Water Source

The subjects have access to domestic water through one of the four suppliers in the governorate.The majority have municipal access (77.9% of the total subjects) 13.2% have access to private well , 7.4% have Makarout access and 1.5% only have UNRWA access as shown in table 6.

There is a wide range of differences between previous and current domestic water treatment before ten years.Only 2.9% of the total subjects treated domestic water before using for drinking purpose, but recently only 7.4% of the subjects didn't treat domestic water before using it for drinking purposes.Many do not treat because they have access to Mekarout water, which has WHO approval for drinking water.Sometimes this water has a lesser chloride level than the WHO standard, meaning that 92.6% of the total subjects don't use domestic water without treatment.

Table 6: *Distribution of subject by domestic water source*

Variables		Frequency	Percent
Domestic water source	Municipality	106	77.9%
	UNRWA	2	1.5%
	Macarout	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%
	Mekarout	22	17.5%
Treatment time	Before incidence	32	25%
	After incidence	94	75%

This could be reflectedby the Gaza strip society as all have the same access for the saline ground water with different level of salinity. The majority (52.4%) of subjects who treat water buy water from desalination stations a using home filter, while the rest take water from Mekarout recently as they have access. 75% of the subjects treated water after renal failure incidence while the other 25% only treated water before renal failure incidence.

Table 7: *Distribution of subjects by water consumption pattern*

Variables		Frequency	Percent
Total amount consumed for drinking per day	Less than three liter	102	75%
	Three liter	0	0
	More than three liter	24	17.4
	uncertain	10	7.4%
Using treated water for cooking	Yes	104	76.5%
	No	32	23.5%

As shown in table 7, regarding the total consumed drinking water by subjects, 75% of the total subjects consumed less than three liters per day, 17.4% drink more than three liters, 7.4% don't know the total daily amount, and none drink exactly three liters per day. Most of the subjects (76.5%) used treated water for cooking, but 23.5% still use untreated domestic water for cooking.

4.2.7. Subjects Sub-Scale Domains

It was difficult for the researcher to study each item of the Likert scale presented in the questionnaires alone. The researcher classified the items into four domains through the questionnaire to make it easy and applicable for analysis.The first domain is domestic water quality, the second concerns practices and attitudesaccess to safe drinking water, the third knowledge and awareness, and the fourth satisfaction.

Table 8: *Distribution of subject's domain by mean and percentage*

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

The overall domain is the summation of all factors. The highest mean was for the water quality and the lowest mean was subjects' practice.Table 8 shows the distribution of all subjects by domains of mean and percentage

4.2.7.1. Domestic Water Quality Domain

The subjects perceive this domain as the highest positive (72.4%), more so than other domains. This could be explained by the fact that the majority of subjects that have access to saline water, not pure, have changeable characteristics like color, odor, and poor even for cooking. This meets the study finding that more than 90% percent have another source of drinking and cooking water through either a home filter or by buying desalinate water.

4.2.7.2. Practice and Attitude

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

4.2.7.3. Knowledge and Awareness

This domain reflects the subject's knowledge and awareness about both the salinity problem and the renal failure problem; if there is direct link or effect between the two; if there is any relation between salinity and renal failure; and if they have attended any workshops or awareness sessions. The percentage of this domain reported 58.5%, which is considered moderate in between other domains. On the other hand, the majority of subjects agree about the positive role of knowledge and awarenessin decreasing the prevalence of renal failure.Eventhough the majority did not join any session (T test statistically significt with this domain for female),there is a need to focus on both health and environmental awareness for the public.This may assist health improvement.

4.2.7.4. 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 cant even used for cooking. This correspond with the subjects agreement to change the source of domestic water, the use water treatment tools at home,and access to clean water.Nearly all subjects in all areas accept this domain positively except (Kuza an Absan) as all subjects in this area are satisfied and don't agree to change domestic water.

4.2.7.5. Overalldomains

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

4.3. 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 Khanyounis Governorate and the eastern villages since 1987and distribute subjects living areas according to water quality in each area.

The mathematical method 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 a major change occured with nitrate levels, which increased 20% -25% in the spring test in eastern villages and Al Qarara , but in other areas nitrate level increased from 10-15%, and the level came down from 20-15% during autumn test). During the same period the well number doesn't changed.The changing amount of produced water from each well doesn't exceed 10%.The average for each well water quality during the period has been calculated by summation of the all tests carried divided by the number of tests, then the average multiply by the production percent for each well (the level for each area is the summation of the well's production percent for supply water for the area).This calculation has been done for each well within the four separate periods. As example figure 3 shows the variation of TDS level by time and locality.

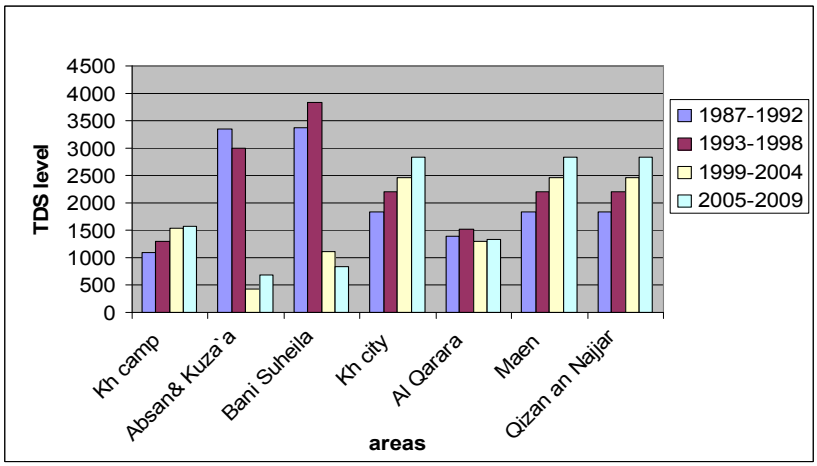

Figure 3: *Variation of TDS level by time and locality*

The following were observed:

1. There are different levels of water quality as well as salinity; the main sources of water is Municipal wells since 1987, Private Wells that are owned by the Municipality, and the UNRWA wells. There are 22 wells that save all the domestic water supply for KhanYnis city, and KhanYuniscamp.Six of the wells have worked since 1987, and others were drilled since 1991-2000.
2. KhanYunis Camp water supply conducted by nine wells with total amount produced at 290190 per month.Different percentages of water production to the camp were (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%).
3. KhanYunis city water supply conducted by thirteen different wells for the city with total amount 329560 m3 per month.Even the mid year population for KanYunis city is three times than the camp. (Al Janoby 10.7%, New Janoby 9.5%, Aya 20. % , Al Shargy7% , Al Madina Al Ryadia 10% . Al satar al shamaly 2.9%, Al Najar 16%, Maen 6.5%, Al Markaz Al Thagafy 10%, Al Bahar Al Jadied 1.7%, Al satar al Jadid 5.7% ,).
4. During1987 there was only one well suppling water for Qarara and owned by its municipality, but another well was producing during the period from1991-1998 and has been closed due to elevated nitrate level.The third well was drilled in1998, and now the two wells are supplying water for Qarara (with equal percent).
5. Since 1987 to 2001, the eastern villages (Khuza, Abasan, BaniSuhila) were getting water from the 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 supplying water for Bunsuhial in summer if there is shortage of water.This happened because BuniSuhila need larger amount of water than both Khuza and Absan. But after 2001, both Absan and Khuza are having directly from Mekarout and Merage three (which met the WHO standard for drinking), but Banisuhila has from the same source and another covers about 30% of Bunisuhiala daily supply. The other well is owned by Eastern villages municipality, so Banisuhila is having 14 hours/day only from the same source and the other ten hours/day having mixed water from Merage and another well (Al Najar for eastern villages).

During the period from 87-92 and by comparing the TDS, Nitrate, Chloride, Fluoride and sodium BaniSuhila is the highest level (for all the fifth elements,) then (Kuza and Absan), Maen and KhanYunis city , Qarara (is highest with fluoride level), and KhanYunis camp. Within 1993-1998 the highest level found for the fifth parameters is BuniSuhialla , Khuza and Absan, KanYunis city an Maen, Qarara(only higher with fluoride level), Khan Yunis Camp. During 1999-2004 the highest level for all except fluoride wasKhanYunis city and Maen, Qarara , BuniSuhila ,and both Khuza and Absan met the WHO standard for drinking water. Between 1999-2004 the highest level found for the fifth parameters wasMaen, KhanYunis city, KhanYunis Camp, Qarara, BuniSuhila, Kuza andAbsan met the WHO standard for TDS, Chloride, Fluoride, Sodium, but higher with Nitrate level. According to the data, all wells within theKhanYounis governorate exceed the WHO standard (TDS, Nitrate, Chloride, Fluoride, and Sodium) for drinking water within the period from 87-2008, but only the eastern villages Absan and Kuza met or fell below WHO standard (TDS, Cl, Nitrate and sodium), but fluoride is a little bit higher during the period 99-2004 .

The researcher noticed that tests are carried out during the spring and autumn seasons, but not for all wells, and some wells are tested more than twice a year, and fluoride level is not measured in all tests. A noticeable elevation of the nitrate level fromautumn to spring in the same year may be explained byfertilizers or manure storage, which are

common causes for nitrate pollution for underground water in the 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 seawater intrusion.

5. Inferential Statistic Parts

This part discuss the relationship between the dependent and independent variables for subjects by using some 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.Theindependentvariable is demographical data such as gender, residency place, marital status, main job, and level of education.

5.1. Subjects Relationships Part

5.1.1. Demographic Characters for Subjects

Age, marital status, and level of education all showed no statistically significant differences in the overall domains.

5.1.2. Differences in Domains by Gender

Gender comparison with domains was done by using an independent t test. Table (9) 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 femaleshad more positive perception than male for the domain (statistical significancewasobserved between the two groups).

Table 9: *Differences in domains by gender*

Dependent variable *" Domain"*	Ind. var. *"Gender"*	N	Mean	SD	t	Sig.
Satisfaction	Female	57	3.02	.517	2.257	.448
	male	79	2.83	.462	2.216	
Practice	F	57	2.85	.787	.343	.471
	M	79	2.90	.853	.347	
Knowledge	F	57	3.02	.355	2.530	.007*
	M	79	2.82	.530	2.692	
Water quality	F	57	3.64	.601	.331	
	M	79	3.60	.507	.332	.374
Over all	F	57	3.13	.316	1.661	.802
	M	79	3.04	.334	1.667	

(*) Statistically significant

5.1.3. Differences in Domains by Employment

Employment comparison with domains (Table 10) show that unemployment and employment had nosignificantstatistical differences in the mean scores in overall domains (P= .123) similarly all sub-scale domains hadno statistical significant differences except in water quality domain. The test shows that unemployed subjects have more positive response to water quality domain than the employed.

Table 10: *Differences in domains by employment*

Dependent variable	Independent"employment"	N	Mean	Std. Deviat ion	t	Significance
Satisfaction	Unemployed	122	2.90	0.491	0.745	
	Employed	14	3.00	0.491	0.708	0.469
Water quality	Unemployed	122	3.66	0.502	2.442	
	Employed	14	3.29	0.790	1.714	0.002*
Practice	Unemployed	122	2.87	0.840	0.653	0.063
	Employed	14	3.00	0.667	0.677	
Knowledge &awareness	Unemployed	122	2.91	0.478	0.168	0.976
	Employed	14	2.89	0.455	0.174	
Overall	Unemployed	122	3.08	0.339	0.423	0.123
	Employed	14	3.04	0.222	0.589	

5.1.4. Differences in Domains by Level of Severity

By comparing level of severity with domains by using an independent t test Table (11) shows that subjects who conduct hem dialysis and subjects who don't conduct hem dialysis have a small variation in the mean scores in overall domains. The results show no statistical significance between the two groups within the four domains and the overall domain (p=.903)

Table 11: *differences in domains by level of severity*

Dependent variable	Conduct dialysis or not	N	Mean	SD	T	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	.787
Practiceandattitude	Yes					.817
	No	55	2.91	.823	.311	
Knowledgeawarness	Yes	81	2.86	.828	.312	
	No	55	2.85	.460	.190	
	Yes	81	2.95	.482	.201	
Over all	No	55	3.08	.329	.075	.903
	Yes	81	3.08	.331	.075	

5.1.5. Differences of Domain Scores Regarding to Water Treatment

By comparing subjects who treat water before drinking and who don't treat with response to domains shows that subjects who treat water before drinking and subjects who don't treat water before drinking had no statistical significant differences in the mean scores in 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.

5.1.6. Differences of Domainscores by Watersource

One way anova used the water source of participant shows that there were differences in theoverall perceptions of domains with significant statistical difference (P=.007). The respondents show different statistical significance in satisfaction, water quality, and practice. No significant statistical differences shown in knowledge and awareness. Scheffe test shows that the subject who has Municipal access had more positive perception, than subjects who have UN, and Private well, and Mekarout. (Ascending quality arrangement)

5.1.7. Differences of Domainscores by Residency

One way anova used to the residency of participant shows that there were differences in the overall perceptions of domains with statistical significant difference (P=.000). The respondents shows 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.

Age group, marital status, and academic certificate all show no statistical significance in overall domains with some variation in the subscale domain.

5.2. Distribution of Renal Failure Prevalence and Water Salinity Level (from 2005 -2009)

The total population of the renal failure patients registered in Nasser Hospital have been classified according to their water source area (salinity level).The classification was done by the artificial kidney staff.Upon the researcher's request the old and new cases were included, and 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" except Man the Mid year population for 2006, which was obtained from KhanYunisMunicipality, Absan include (Absan Al Jadida , Absan Al Kabira, Kuza`a). A comparison between renal failure prevalence and level of salinity including , TDS level , Nitrate level, Chloride level , Fluoride level and sodium level during the period from 2005-2009, shows that the highest prevalence for renal failure is found in Qezan An Najjar representing 1.28 renal failure patients per 1000 in Qizan an Najjar , then Maenwith 92 renal failure patients per, then KhanYunis City with75 renal failure, then Bunisuhila , Absan and Kuza ,and KhanYunis camp.

5.2.1. Comparison between the Distribution of Renal Failure prevalence (Dependent Variable) and TDS Level (Independent Variable) in the Different Areas

All areas haveTDS levels higher than the level recommended by the WHO standard (1000mg/l) for drinking water except Kuza,Absan&Bunisuhila. Figure 4

links the relationship between TDS and the prevalence of renal failure.The study findings show that when the TDS increased, the renal failure prevalence increased in one and in another decreased.The highest TDS level were in Maen but the highest prevalence was in Qizan andNajjar. The lowest TDS levels were in Kuza&Absan while the lowest prevalence was in KanYunis Camp. Thepeak of TDS level was not in the area with the peak prevalence or off peak so there is no association between TDS level and renalfailure prevalence.The study findings show 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 the negative effect of TDS on public health as well as taste and odor. The life of home hot water heaters decreases by approximately one year for each additional 200 mg/l of TDS in water above the typical household level of 220 mg/l.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).

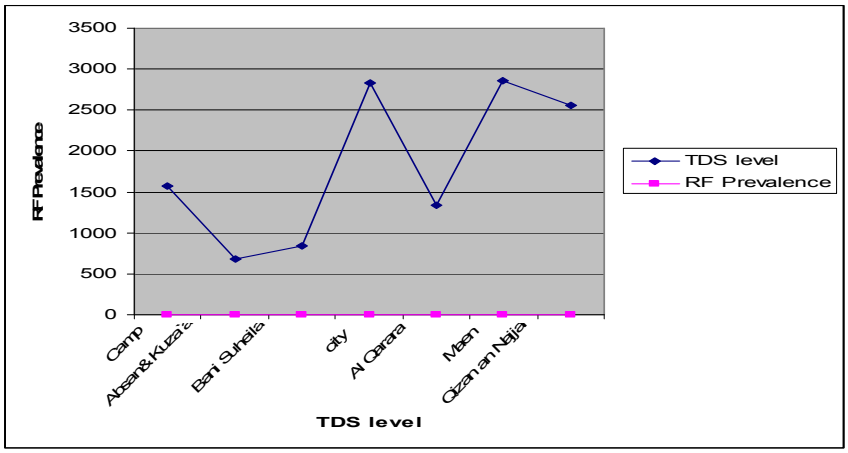

Figure 4: *Distribution of renal failure prevalence and TDS level*

5.2.2. Comparison between the Distribution of Renal Failure Prevalence (Dependent Variable) and Nitrate Level (Independent Variable) in the Different Areas

All areas haveNitrate levels higher than the level recommended by the WHO standard for drinking water (50mg/l). Figure 5 links the relationship between Nitrate, and the prevalence of renal failure. The study findings show that when the Nitrate level increased, the renal failure prevalence once increased and another decreased.The highest Nitrate level was found in KhanYunis camp and the lowest Nitrate level in Kuza&Absan.The peak 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 findings show that the peak nitrate level is during spring, and the highest increase occurred in Kuza, Absan, BuniSuhila, and Al Qrara. This could be due to soil washing in these agricultural areas during winter and excessive unplanned used offertilizers and manure.

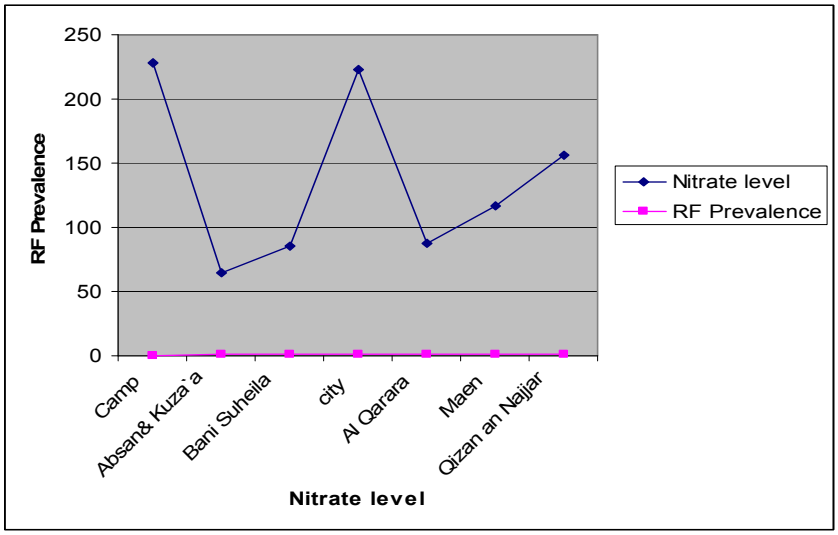

Figure 5: *Distribution of renal failure prevalence and nitrate level*

5.2.3. Comparison between the Distribution of Renal Failure Prevalence (Dependent Variable) and Chloride Level (Independent Variable) in the Different Areas

All areas havechloride levels higher than the level recommended by the WHO standard (250mg/l) for drinking water except Kuzaand Absan which have chloride level less than the WHO standard for drinking water. Figure 6 links the relationship between chloride level, and the prevalence of renal failure. The study findings show that when the chloride increased the renal failure prevalence once increased and another decreased.The highest chloride level was in KhanYunis city but the highest prevalence was in QizanaNajjar. The lowest chloride level was in Kuza&Absan(moderate) while the lowest prevalence was in KanYunis Camp. Thepeak of chloride level was 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 findings show 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 findings correspond to the Federal safe drinking water which confirmed that if chloride levels exceed 250mg/l the SMCL for chloride is the level above which the taste of the water may become objectionable to the consumer.

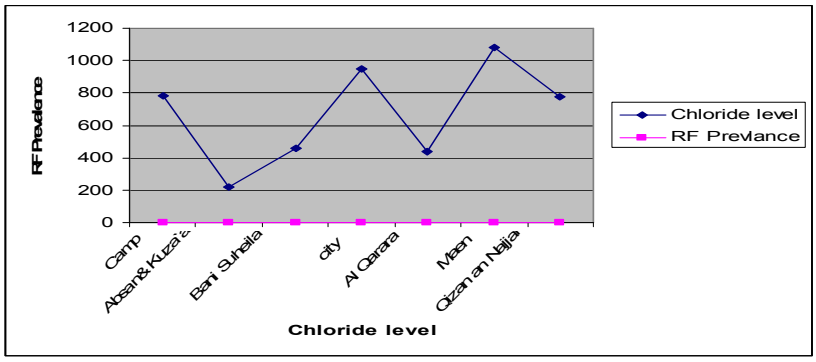

Figure 6: *Distribution of renal failure prevalence and chloride level*

5.2.4. Comparison between the Distribution of Renal Failure Prevalence (Dependent Variable) and Fluoride Level (Independent Variable) in the Different Areas

All areas hadfluoride levels higher than the level recommended by the WHO standard for drinking water (1.5 mg/l). Figure 7 links the relationship between Fluoride, and the prevalence of renal failure. The study findings show that when fluoride level increased the prevalence of renal failure increased.The highest fluoride level was inQezanaNajjar and the highest prevalence was in the same area. The lowest fluoride level wasKhanYunis camp and the lowest prevalence was in the same area.In all areas when the fluoride level increased the prevalence increased so there is a positive association between the fluoride level and renal failure.The diagram links a semi linear relationship.The study findings correspond with a new study, to be published in the journal Environmental Research, and adds further support to recent conclusions on fluoride toxicity by the National Academy of Sciences (NAS).

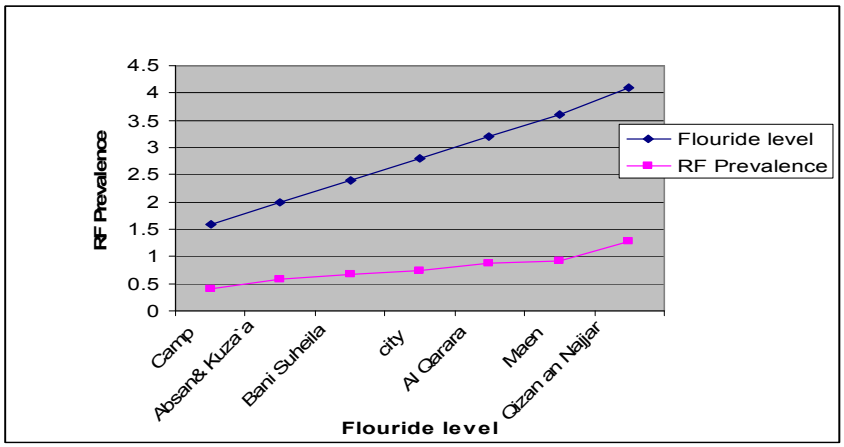

Figure 7: *Distribution of renal failure prevalence and fluoride level*

5.2.5. Comparison between the Distribution of Renal Failure Prevalence (Dependent Variable) and Sodium Level (Independent Variable) in the Different Areas

All areas hadSodium levels higher than the level recommended by the WHO standard (200mg/l) for drinking water except Kuzaand Absan which have sodium level less than the WHO standard for drinking water. Figure 8 links the relationship between sodium level, and the prevalence of renal failure. The study findings show that when the sodium level increased the renal failure prevalence once increased and another decreased.The highest sodium level was in Maen but the highest prevalence was in QizanaNajjar, and the lowest sodium level was in Kuza&Absan(moderate) while the lowest prevalence was in KanYunis Camp. Thepeak sodium level was not in the area with the prevalence peak or off peak so there is no association between sodium level and renal failure prevalence.

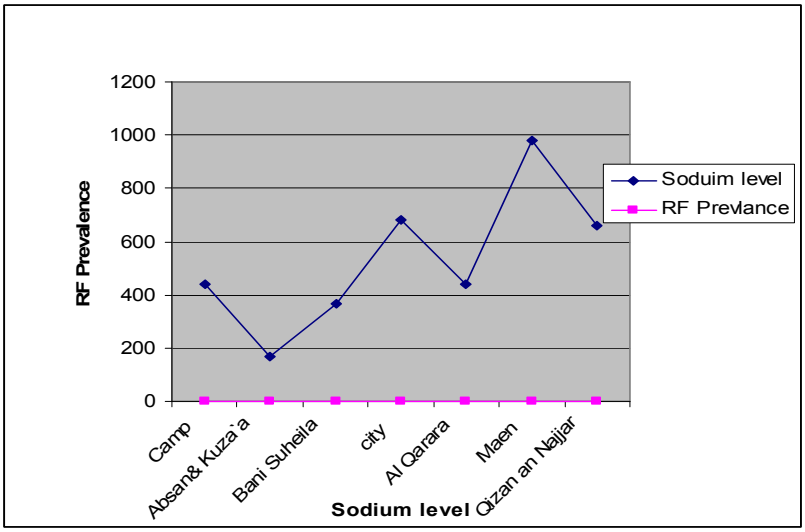

Figure 8: *Distribution of renal failure prevalence and sodium level*

6. Conclusions

1. 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 that nearly all subject having one access which fit their needs & requirement for domestic and drinking.
2. 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 these subjects has direct access to mirage storage tank.
3. The results showed 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 southern wells.
4. The study findings showed that there was no association between renal failure prevalence and chloride level, sodium level, TDS level and nitrate level and showed only association with fluoride level, there was strong and positive association.

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