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Analyzing Correlation Coefficients of the Concentrations of Trace Elements in Urinary Stones

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Abstract

The present study aims at deducing correlation coefficients between concentrations of trace elements and their metals, and determining the most important geochemical and environmental factors contributing to the formation of urinary stones. The researcher distributed 460 questionnaires to patients in different hospitals in Jordan, 282 of which were retrieved yielding a percentage of 61.3%. Seven groups were identified by using XRD namely calcium oxalate, oxalate/apatite, struvite/apatite, oxalate/uric acid, cholesterol, uric acid, and cystine. Urinary stones have been distributed as follows; gallbladder 65.3%, kidney 25.2%, ureter 8.1%, and bladder 1.4%. Males are found more likely to be infected with lithiasis about 51.1% with an average age of 50 years at (44.3%). Married people of both sexes make up to 87.2% of people infected. People with lower income (<100 JDs) are more likely to be infected with the disease by 46.9%; stones formation correlates inversely with socio-economic status. The daily amount of water a patient drinks ranges from 1 to 1.5 liters (40.4% of daily need) leading to high concentration of the nucleus of salts and formation of stones. The weekly average consumption of meat by patients was low (0-2 meals by 64.5%). It is obvious that eating more meat, green leaves, in addition to taking large quantities of milk, eggs, and dairy participate to the increase of calcium and phosphorous in the body leading to the formation of urinary stones that are made up of oxalate or phosphate.

Keywords: Medical Geochemistry, Urinary Stones, Kidney Stones, Gallbladder Stones.

1. Introduction

Urinary stones are one of the most widespread diseases in the world (Marshall and Ryall, 1981). In Jordan, however, over 40% of urinary disease cases are urinary stones (Malki, 2000; Al-Fawaz, 2006). It increases in people older than 30 years old (Scott, 1985; Mhailan, 1992; Malki, 2000). Its proportion in males is higher than in females (Malki, 2000; Al-Fawaz, 2006). Recent studies have attempted to explain its spread by exploring the reasons behind forming stones in the human body and explaining the environmental factors that play a major role in its creation.

More than 40 chemical elements in the human body affect the biological processes related to the health of body. These elements have different concentrations and functions. For example, a small presence of some trace elements negatively affects the biological processes in the body. Recently, attention has been paid to studying the concentration of trace elements in the body and their effects on such processes (Wandt and Underhill, 1988). These elements are often present in the body as contaminations (Feinendegen and Kasperek, 1980) and not as major constituents.

Hammarsten (1929) determined the effect of some trace elements on patients in forming urinary stones. Concentration of Co, Mg, and Ni affects Ca in the human body through the increase of dissolution of crystallized calcium oxalate stones. Meyer and Angino (1977) determined many of trace elements ions affecting the crystallization of urinary stones especially oxalate and phosphate stones. Furthermore, Levinson *et al.*, (1978) explained the effect of some trace elements on the dissolution and the crystallization of urinary stones.

Many studies try to put an account for the problem of urinary stones and its relation to the environmental and pathological factors. These studies also attempted to determine the mineralogical and chemical composition of stones (Abboud, 2008b). Joost and Tessadri (1987) indicated that the presence of stones in the human body is an old phenomenon, and apatite has been the first mineral to be discovered. Meyer and Angino (1977) have studied the role of trace elements in the growth of calcium oxalate and calcium phosphate. Donev *et al.*, (1977) explained that amount of some of heavy metals found in stones are higher than the amount found in the ordinary blood. However, Levinson *et al.*, (1978) studied concentration of some trace elements in the kidney, and found many of the concentrated elements in the oxalate stones. Furthermore, Wandt and Pougnet (1986); Joost and Tessadri (1987); Durak *et al.*, (1988); Wandt and Underhill (1988); Al-Maliki (1998); Al-Fawaz (2006); Abboud (2008a), among others conducted studies attempting to determine concentrations of heavy and trace elements. They tried to

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relate them to geochemical, environmental, and health factors. However, statistical studies have not dealt with the percentage of the spread of urinary stones and linking them to environmental factors.

Reviewing the medical records of those who went to the department of abdominal disease and surgery in Jordanian hospitals in the last 10 years, It was noticed that a great number of people suffer from urinary stones (ureter, bladder, kidney, and gallbladder). Also the number of people who check in the above–mentioned departments increases in summer.

Recently, statistical studies of geological and environmental information have become very important, and have developed applications. This study has been conducted by designing a questionnaire requesting some information and many specific questions. Some factors and the main reasons that play an important part in creating urinary stones have been predicted. Many medical and chemical analyses have been performed to 100 urinary stones collected using X-Ray fluorescence to determine their chemical constituents. X-ray diffraction has also been used to determine their minerals and organic constituents. Then results have been discussed by finding out relationships between such elements and their minerals.

2. Methodology of the Study

This study focuses on patients suffering from urinary stones who checked into Al-Basheer, Al–Zarqa, Al-Mafraq, King Abdullah, and Princess Basma hospitals from 1/5/2001 until 31/12/2005. The present study is based on the computerized records of patients who checked in the above mentioned hospitals during the study. The computerized data has been ordered and categorized based on the type of the questionnaire. One hundred urinary stones have been collected from both males and females of all ages. The stones have been stored in polyethylene bottles. The organic materials have been removed by H_2O_2, then dried, after that grinded, and finally made into a homogeneous mix. XRD was used for mineralogical and organic constituents, and XRF was used to determine the major and trace elements of the metals of such stones. The correlation coefficients between the elements and the minerals have been calculated using SPSS software. Finally, the study explained the environmental and health factors that play an important role in creating the urinary stones in humans and their affect on human health.

A statistical questionnaire was designed and distributed to patients. The questionnaire contained a mechanism of distributing stones in the body according to age, sex, weight, nutrition culture, and other variables related to the concentration and distribution of such stones. Next, distribution, concentration, and percentages of each point mentioned in the questionnaire have been calculated. Then, the SPSS was used to examine data in order to determine the effect of each factor.

3. Results and Discussion of the Mineralogical and Chemical Analysis

Two hundred eighty two urinary stones have been collected of which the mineralogy of 100 samples have been determined. The samples have been distributed to 7 mineral and organic families (Table 1). As shown in Table 2, the researcher depends on both positive and negative variables to explain relations.

Table 1: Composition percentage of investigated urinary stones analysis by X-ray diffraction collected from adult patients.

Components: Sample type, XRD	No. and % of Stones & No. of Patients
1- Oxalate Stones:	22
a. Calcium Carbonate Oxalate hydrate + Whewellite	5
b. Calcium Oxalate: Weddellite + Whewellite	10
c. Calcium Oxalate: Whewellite	7
2- Oxalate/Phosphate Stones:	17
a. Oxalate/Apatite	
3- Phosphate Stones:	20
a. Struvite /Apatite	
4- Oxalate/Uric Acid Stones:	25
a. Calcium Oxalate (Whewellite)/Uric Acid	14
b. Oxalate/Uric Acid	11
5- Cholesten Stones:	6
a. Cholesten/ Oxalate /Uric Acid	4
b. Cholesten/ Oxalate /Uric Acid/Phosphate	2
6- Urate (Uric Acid) Stones:	7
a. Uric Acid/Uricite	
7- Cystine Stones:	3
a. Cystine	1
b. Cystine /Cholesten /Phosphate	2
	100 %

Table 2 shows that Ca has a strong positive correlation with whewellite and weddellite minerals in the urinary stones. This is because Ca is the fundamental element of whewellite and weddellite which form calcium oxalate. The high percentage of Ca in urinary stones is due to eating foods rich with Ca such as red meat and green leaves, in addition to eggs and milk. Another reason is drinking so much hard water that contains ions of Ca^{2+}. This is due to extraction of proud water from carbonate aquifers.

Table 2 shows the relationship between Sr and Zn (r=0.88). Sr competes with Ca to enter the crystals of whewellite, weddellite, vaterite minerals ($CaCO_3$), and in apatite (Wandt and Underhill, 1988 in Sobel *et al.,* 1949). Sr resembles Ca and processes of metabolism, and accompanies it with the precipitated salt in the urine. Sr's mechanism of exchange with Ca increases intake in crystal structure when its percent increases (Neuman and Neuman, 1953). The positive correlation between apatite content and Sr (r=0.89), and between P and Sr (r=0.84) in oxalate/apatite stones supports that Sr doesn't play an important role in forming urinary stones in the body (Wandt and Underhill, 1988).

Zn accumulations with apatite supports the relationship between Zn and apatite (r=0.77) and between Zn and P (r=0.72) in the urinary stones. Schneider *et al.,* (1970); and Wandt and Underhill (1988) supported the result that Zn exchanges with Ca (r=0.67) in calcium phosphate, or that it makes a main percent from phosphate as its presence in hopeite mineral.

Table 2: Correlation Coefficients between the components and their trace elements.

	Na	Mg	Al	P	S	K	Ca	Ni	Mo	Co	Mn	Fe	Zn	Sr	Ba	Cr	As	Whe	Wed	UA	Lau	Vat	APA	STR
Na	1																							
Mg	.63	1																						
Al	.79	.33	1																					
P	.79	.62	.78	1																				
S	-.18	-.29	28	23	1																			
K	.93	.52	.68	.48	.11	1																		
Ca	.69	.18	-.23	21	29	.38	1																	
Ni	29	-.42	-.24	.72	-.20	-.28	.12	1																
Mo	21	.72	29	.54	-.55	-.14	.09	-.21	1															
Co	.09	-.07	-.04	.38	-.16	22	-.11	.12	.39	1														
Mn	.19	-.21	-.48	27	-.44	27	.14	.48	-.47	-.01	1													
Fe	.15	-.18	.19	-.08	.38	.55	.34	25	.77	-.13	.58	1												
Zn	.92	24	.93	.72	.95	.93	.67	-.20	-.54	-.35	-.05	-.38	1											
Sr	.84	.62	.38	.84	.44	.84	.74	-.18	.16	.38	-.51	.75	.88	1										
Ba	-.21	-.23	-.60	.35	-.54	-.38	.33	.65	-.19	.08	.67	24	.52	-.16	1									
Cr	-.08	26	-.53	-.28	-.56	-.17	.60	-.32	21	-.40	-.08	.06	-.27	28	-.20	1								
As	-.16	-.11	-.50	.46	-.41	-.22	.35	.85	-.23	-.16	.46	.06	.81	.78	.84	-.21	1							
Whe	-.30	.14	-.32	-.54	-.35	-.23	.87	-.18	25	-.25	-.14	.53	.86	.89	-.24	.57	-.08	1						
Wed	-.33	.03	-.15	-.50	-.20	-.29	.53	-.15	.15	-.33	-.23	-.13	.67	.67	-.13	.31	-.32	27	1					
UA	-.17	-.25	-.23	-.55	-.51	-.45	.06	.03	-.47	-.25	-.26	-.10	-.02	-.40	.85	-.40	.92	-.25	-.35	1				
Lau	.95	.91	21	-.19	.46	.52	-.21	.33	.14	.43	-.54	.78	-.33	-.33	-.33	.90	-.37	-.78	-1	.72	1			
Vat	29	28	-.35	-.52	-.34	-.28	.45	-.28	-.19	-.25	.41	-.14	-.35	-.44	-.02	.66	-.19	-.29	.32	-.27	.74	1		
APA	.52	.78	.84	.62	.56	.68	.13	22	.09	.40	-.01	.43	.77	.89	.08	-.40	-.16	-.25	-.25	-.25	-.27	-.25	1	
STR	.86	.76	.77	.74	.58	.82	-.58	21	-.27	26	-.24	-.27	.43	.45	-.62	-.62	-.61	-.38	-.35	-.38	-.38	-.32	26	1

Whe: Whewellite; Wed: Weddellite; UA: Uric Acid; Vat: Vaterite; APA: Apatite; STR: Struvite; Lau: Lautite

The reason behind the presence of P in some kinds of urinary stones is high concentration of P in water and food besides the excessiveness of drinking milk and eating cheese, eggs, and some kinds of vegetables which increase phosphorous.

Sr (r=0.84) and Zn (r=0.92) have relationships with concentrations of Na especially in oxalate stones with whewellite mineral (Sr: r=0.89, Zn: r=0.86) and oxalate whewellite/apatite stones (Sr: r=0.89). In a group of oxalate stones, Sr and Zn have strong correlation with K (Sr: r=0.84, Zn: r=0.93). This happens because of the relation between Ca and K in this group (r=0.93). This result is consistent with the correlated results of Wandt and Underhill (1988).

Potassium (K) correlation is negative with all minerals except with lautite (r=0.52), apatite (r=0.68), and struvite (r=0.82). This element appears because of drinking water and eating foods rich with K (Al-Maliki, 1998).

Elements like arsenic (As) with Sr (r=0.78) and Zn (r=0.81), and K with Na (r=0.93) can be substituted with Ca in apatite minerals especially in its crystal surface (Simpson, 1968; Wandt and Underhill, 1988). There are some processes of small amount of substitutions through the combination of crystal especially in oxalate stones.

Fe which is concentrated in urine usually comes from cells in the human urine channel (Lentner, 1981), which increases its percentage in the urinary system and allows it to enter oxalate (r=0.53) and calcium phosphate stones (r=0.43) (Wandt and Underhill, 1988). Fe ions increase in the kidney stones if there is an enrichment of citric acid (Meyer and Thomas, 1982). However, Al percent increases in apatite stones if citric acid increases, which does not affect the presence of Al in calcium oxalate (Meyer and Thomas, 1982). In this study, Al has a correlation with P (r=0.78) and with apatite (r=0.84). This result is consistent with those of Wandt and Underhill (1988), which was (r=0.82).

Some concentrations of S in some urinary stones, which were analyzed, indicate its concentration in cystine stones. It is also found in low concentrations in oxalate stones (Lautite) (r=0.46), oxalate with apatite stones, and apatite stones (r=0.62). Another reason for S concentration in oxalate stones is the alteration between inorganic sulfur (S with Ca) in the crystal structure during the growth of stones crystal (Schwille *et al.*, 1985; Wandt and Underhill, 1988). There are no obvious correlation coefficients between S in the urinary stones and the reason behind diseases (Wandt and Underhill, 1988).

Molybdenum (Mo) plays a secondary role in the statistical results of this study. It has low concentrations decreasing its effect. Mo has a correlation with Fe (r=0.77) as a result of the harmony of the geochemical relation in the ionic exchange.

Other trace elements such as; Ni, Mn, Ba, Cr, Co, As have negative or positive correlations with all elements and minerals. Generally, correlation coefficients become between elements that make mineral stones when the element enters the chemical formation of that element, or when it has geochemical relations with the radius and/or are charges of major elements.

Many theories have been proposed to link and explain the relation between concentration of some trace elements and their role in forming the urinary stones in humans. However, no direct relation has been found linking the concentration of trace elements in urinary stones and the reasons behind it. It can be said, based on the results of this study, that the concentration of many trace elements in different stones is due to environmental and nutrition reasons. These contributed to increased calcium concentrations inside the human body reaching the urinary system, preparing the biological and physical conditions for gathering many nuclei forming the stones.

4. Analysis and Discussion of the Results

Four hundred and sixty questionnaires have been distributed between 1 /5/2001 and 13/12/2005 on urinary stones patients in selected hospitals in Jordan. Two hundred and eighty two questionnaires have been retrieved representing 61.3 % of the total. This is a high percent and validates the study. These 282 stones have been relieved for those who filled the questionnaires.

Table 3 clarifies the diagnosis of the disease. The urinary stones are 4 kinds: gallbladder, kidney, ureter, and bladder. The distribution is similar to the study of Dajani *et al.*, (1988) with all kinds except for the stones in the gallbladder. The percentages also matched those of

Mhailan (1992) in the types of stones in the bladder and kidney. They were fewer than those in the ureter.

Table 3: Type and percentage of urinary stones in patients and numbers (282 patients).

Gallbladder Stones		Kidney Stones		Ureter Stones		Bladder stones	
No.	%	No.	%	No.	%	No.	%
184	65.25	71	25.2	23	8.15	4	1.4
Total						282	

Al-Maliki (1998) had the same percentages in the kidney and ureter. The percentages of the study were consistent with Malki (2000) and Zargooshi (2001). There have been no gallbladder stones in the previous studies, whereas they represent the highest percentage in this study. The kidney stones include the stones that are formed because of increased amount of salt in blood because of filtration through its passage inside the urinary units in the kidney, or that some disorder affected the urinary system. Stones in ureter move from the kidney and settle in the ureter as a result of some stoppage in the urinary passage. The stones in the bladder are formed by a gland of tumor (Al-Attar, 1970). An important factor creating urinary stones is the amount of salts in urine. The formation of nuclei in the urinary system and the process of the salt crystallization help in creating urinary stones in the body (Hashem, 1990).

Table 4: Sex of patients (282 patients)

Sex	No.	%
Male	144	51.06
Female	138	48.94
Total	282	100

In this study, there have been 144 male patients and 138 female patients. Table 4 shows that males are more exposed to urinary calculus. The results of this study are consistent with the results in Dajani *et al.,* (1988), Slimon (1994), Al-Maliki (1998), Stein *et al.,* (1998), Yagisawa *et al.,* (1999), Malki (2000), Goel and Hemal (2001), Naya *et al.,* (2002), and Al-Fawaz (2006), with minor differences in percentages. We noticed that females are more exposed to urinary calculi after adolescence. The reasons behind the presence of stones in females more than in males include hormones of pregnancy. This decreases chenodeoxy cholic-A which decreases the cholesterol forming the stones leading to crystallization of stones in gallbladder (Belal, 1994).

Table 5 shows the distribution of patients of urinary stones in terms of age. The patients range between 5-90 years. The average age of people suffering from urinary diseases is between 45-50 years. The total number of people with this disease is 125 (44.3%). This percentage is consistent with Mhailan (1992), Al-Maliki (1998), Yagisawa *et al.,* (1999), Goel and Hemal (2001), McConnell *et al.,* (2002), Naya *et al.,* (2002), Angwafo *et al.,* (2004), and Al-Fawaz (2006). Second, comes the age group of 31-45 years with 39.4%, then 16-30 (8.5%) followed by 71-90 with 4.6%. Finally the age group of 15> with 93.2%. Urinary calculi are also present in children, which supports Al-Maliki (1998) about the Iraqi patients and Al-Fawaz (2006) regarding Jordanian patients. The reasons for its presence in children is the excessive eating of eggs, drinking milk, bad health conditions, malnutrition, and the nature of social life of children.

Table 5: Distribution of urinary stones in patients depends on age and sex (282 patients)

Age (year)	Male	%	Female	%	Total	%
5-15	6	4.17	3	2.17	9	3.2
16-30	12	8.33	12	8.7	24	8.5
31-45	55	38.2	56	40.58	111	39.4
46-60	63	43.75	62	44.93	125	44.3
61-75	8	5.55	5	3.62	13	4.6
Total	144	100	138	100	282	100

Married couples (246 patients with an average 87.2%) are more exposed to this disease, which is dominated by people who are more than 45 years old. The number of the unmarried couples is 36 (12.8%) (Table 6).

Table 6: Distribution of urinary stones in patients depending on social status (282 patients)

Marital status	Male	%	Female	%	Total	%
Single	20	13.9	16	11.6	36	12.8
Married	124	86.1	122	88.4	246	87.2
Total	144	100	138	100	282	100

Table 7 shows the distribution of the percentage of the diseases in weight as follows the most exposed to the disease are between 61-80 kg (43.3%) then weights between 81-100 kg, 41-66 kg, and 51-40 kg (28.4, 24.1, 4.3)% respectively. Fat as a result of diets leads to the fact that the gallbladder can not drain its extract and thus creating stones (Al-Attar, 1970). Obesity helps in creating stones. Other studies showed that the possibility of this disease increases with people who quickly lose weight (Al-Attar, 1970; Bakkar, 1995).

Table 7: Weight of patients and frequency (282 patients)

Weight (Kg)	Frequency	%
40-20	12	4.3
60-41	68	24.1
80-61	122	43.25
100-81	80	28.35
Total	282	100

Table 8 shows the time span of suffering form the urinary calculi distributed in three periods as follows 2001-2005 (56.8%), 1996-2000, 1990-1995 (34.8%), and (8.5%) respectively. In 2001-2005 the proportion was high because the polluted water in Jordan led to shortage of clean water. This led to the increase in the concentration of solid hard nucleus crating stones.

The repetition of this disease has been determined if the patient has made previous removing operations. Many patients have not recorded removing operations (77%)

(Table 9). Bakkar (1995) indicated the possibility of iterative disease over the years (67%).

Table 8: Urinary stones distribution depending on year periods

Periods	No.	%
1990-1995	24	8.5
1996-2000	98	34.75
2001-2005	160	56.75
Total	282	100

To determine if patients have other diseases linked with the occurrence of calculi 80.2% of patients hadn't had any others disease, but (19.9%) have been linked with diseases like diabetes or hypertension (Table 10). Many drugs which are taken by patients result in forming stones. Women who take Estrogens, for example, are exposed to the calculi by 2 to 3.7 times as much the women who do not. Furthermore, women who take contraceptives show more risk (Mendo, 2000).

Table 9: Surgery frequency (282 patients)

Surgery	No.	%
No	217	77
Yes	65	23
Total	282	100

We have also determined the relationship between the urinary calculi and heredity through determining if patients have a relative or family member suffering from the disease. 65.6% of patients do not have relatives suffering from this problem (Table 11). This is what Slimon (1994), Bakkar (1995), Abu Ali (1998), Malki (2000) have assumed with 18% of the patients. Table 12 shows that 66.3% of the sick relatives do not have kinship with the patients. The disordered genes can cause calculi disease (Bakkar, 1995) because it results in diseases like kidneys' acidity which causes urinary stones with 73% (Slimon, 1994). The disease of belay cystine is an inherited disease that increases cystine for more than 600g in the urine each day (Takla, 1985). Also, the inherited readiness of the urinary stones has a probable influence which differs from generation to generations (Bakkar, 1995).

Table 10: Urinary stones with other diseases (282 patients)

Another disease	No.	%
No	226	80.15
Yes	56	19.85
Total	282	100

The study has determined the proportion of people suffering from the disease by relating the disease to the educational level of the patient: 12.8% with elementary school, more 9.9% with high school, 26.6% with Al-Tawjihi (secondary certificate), 14.9% with diploma, 21.3% with bachelors' degree, 8.2% with masters, and finally 6.4% with Ph.D. degree (Table 13). Therefore, we notice that the educational level has no obvious association with the urinary calculus in people.

There is a connection between people's salary and the presence of the disease. People with the salary between 0-100 JD are more exposed to the disease (46.8%), followed by people who get 101-200 JD (33%), followed by those of 201-300 JD (12.4%), and people who get more than 300 JD (7.8%) (Table 14). The urinary calculi are in reverse with the social status. People with low social status have malnutrition leading to the disease (Takla, 1985).

Table 11: Urinary stone disease in another people from family (282 patients)

Disease in another family people	No.	%
No	97	34.4
Yes	185	65.4
Total	282	100

Table 12: Family member suffering from the disease (282 patients)

Family degree	No.	%
Husband	*20*	7.1
Mother	*25*	8.87
Sons	*28*	9.93
Brothers	*22*	7.8
Nothing	*187*	66.3
Total	*282*	100

Table 13: Relation between educational level and urinary stones (282 patients)

Educational Level	No.	%
Elementary	*36*	*12.77*
High school	*28*	*9.93*
Al-Tawjihi	*75*	*26.59*
Diploma	*42*	*14.88*
Bachelor	*60*	*21.27*
Master	*23*	*8.18*
Ph.D.	*18*	6.38
Total	*282*	100

Table 14: Relation between deposit incoming and urinary stones (282 patients)

Deposit (JD)	No.	%
0-100	*132*	*46.8*
101-200	*93*	33
2001-300	*35*	12.4
>300	*22*	*7.8*
Total	*282*	100

Table 15: Water resources

Water resources	Frequency	%
Authority	242	85.8
Commercial treatment	10	3.55
Minerals water	20	7.1
Another	10	3.55
Total	282	100

The results of the statistical analysis of water data taken from patients are as follows: The main water sources come from the competent Authorities (85,8%), followed by commercially treated water (7.1%). The third kind is the least in use which is treated water and other resources like water from rain (3.6%) (Table 15). Most houses don't have filters (87.6%) (Table 16).

Table 16: Equipment of water filtration

Filter	No.	%
No	247	87.6
Yes	35	12.4
Total	282	100

Table 17: Daily amount of drinking water

Amount (litter)	Frequency	%
0.5	21	7.45
1	64	22.7
1.5	114	40.42
2	53	18.8
>2	30	10.63
Total	282	100

The amount of water the patients take daily is a liter and a half (40.4%). 22.6% of the patients consume one litter daily. However, 18.8% consume 2 liters daily, 10.63% consume more than 2 litters daily, and 7.5% consume half liter daily (Table 17). Two hundred and one houses consume less than $50m^3$ in one quarter (71.3%) followed by 61 households that consume 51-100 m^3 (21.6%). The least number is 20 households consuming 101-150 m^3 (7.1%) (Table 18).

Table 18: Water amount consumed during period/m^3

Water consumed (m^3)	frequency	%
0-50	201	71.28
51-100	61	21.62
101-150	20	7.1
Total	282	100

Table 19: Weakly consumption of meat

Type	No.	%	No. f meals	No.	%
Cow meat	35	12.4	0-2	182	64.54
Cheep meat	63	22.3	3-4	78	27.66
Chicken	184	65.3	5-6	22	7.8
Total	282	100		282	100

There are two factors related to drinking water and making urinary calculi: one is the amount of water, and another is the salt and metal found in water. More water intake decreases the proportion of creating urinary calculi. The amount of solid and dissolved materials in water has a relation with creating stones. The proportion of dissolved Ca in water increases the possibility of the disease. Furthermore, the presence or the absence of certain elements in water affects creating the stones. Zn for example, prevents the crystallization of Ca and low Zn in urine increases the possibility of this disease (Malki, 2000). By analyzing water, we found a high proportion of dissolved Ca in water because the water reserve is made of carbonate.

Regarding food, the researcher has noticed that most of the people suffering from this disease eat chicken by 65.3%, sheep meat by 22.3%, and beef with 12.4% (Table 19).

Table 20: Weakly consumption of yogurt, cheese, and milk

Type	No.	%	No. f meals	No.	%
Milk	32	11.35	0-2	46	16.3
Cheese	44	15.6	3-4	61	21.63
Labaneh	108	38.3	5-6	77	27.3
Yoghurt	98	34.75	7	98	34.77
Total	282	100		282	100

The weekly consumption of meat is low. 64.5% of the patients consume 0-2 meals a week, 27.7% consume 3-4 meals a week and 7.8% consume 5-7 meals a week (Table19). Yoghurt consumption was 38.3% and 34.8% cheese 15.6%, and milk 11.4% (Table 20). The above-mentioned averages indicate that 34.8% eat 7 meals a week, 27.3% eat 5-6 meat a week, 21.6% eat 3-4 meals a week and 16.3% eat 0-2 meals a week (Table 20). Regarding the consumption of eggs, it is found that most people suffering from the disease consume 21-30 eggs a week (35.1%), 11-20 eggs a week (33.3%), less than 10 eggs a week 23.1% and 31-40 eggs a week (8.5%) (Table 21).

Table 21: Weakly consumption of eggs

Amount	No.	%
0-10	65	23.07
11-20	94	33.33
21-30	99	35.1
31-40	24	8.5
Total	282	100

Regarding vegetables with green leaves, Jew mallow was the most consumed one (55.3%), cabbage (19.5%), lettuce (13.5%) and spinach (11.7%) (Table 22). It was previously mentioned that eating eggs, red meat, green leaves, and drinking hard water containing Ca help increase Ca in the urinary stones in the body. The researcher also mentioned that some kinds of vegetables, eggs, cheese and milk increase phosphorous and its concentration in the stones. Phosphorous concentration in water may also increase the risk.

Table 22: Weakly consumption of green vegetables

Type	No.	%
Spinach	33	11.7
Jew mellow	156	55.3
Lettuce	38	13.5
Cabbage	55	19.5
Total	282	100

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