

Prevalence of Kidney Stones Among Patients Presenting to Orotta Medical Surgical National Referral Hospital

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Abstract

Background

Nephrolithiasis is a condition of having stones in the kidneys, which progressively lead to loss of renal function if untreated properly.¹ The prevalence and incidence of kidney stones is increasing across the world.²

Methods

A retrospectively collected data of kidney stone disease was reviewed on patients who visited the outpatient department of Orotta Medical Surgical National Referral Hospital from January 2012 to December 2012.

Results

Out of 30,335 patients 173 were confirmed to have stones making them 0.5%. Generally results show male predominance with male to female ratio of 2.46:1. Results also show prevalence decreases as age increases with the highest among the age group 15-25 making a prevalence rate of 27.7% with observed significance of 0.002. Out of those patients who visited the outpatient department patients from Zoba Maekel were the highest in number (59.9%) followed by Debub (19.1%) while the southern Red Sea Zone had the lowest prevalence (2.3%). Majority of the stones were found on the kidney comprising about 80.3%, followed by ureter 16.8% of patients and 2.9% stones were located on the bladder. When data was reviewed for associated co morbidity only one patient had associated Diabetes mellitus and Hypertension, three had ectopic kidney(1.7%), one had renal cyst (0.6%) and 12 (6.9%) patients were complicated with hydronephrosis. (P=0.548)

Conclusions

The prevalence of kidney stone in Orotta Medical Surgical National Referral hospital from January to December 2012 is 0.5%, with higher predominance in men than in women with a ratio of 2.46:1.

1. Literature Review

Nephrolithiasis is a condition of having stones in the kidneys, which progressively lead to loss of renal function if untreated properly.¹ The prevalence and incidence of kidney stones is increasing across the world.² The prevalence report over single time period for United States revealed a steady rise between 1964 –1972 and then stabilization since the early 80's. Germany, Spain and Italy also reported increase in prevalence in over single period report. Scotland however reported a decrease in prevalence from 1977 to

1987. Overall the prevalence of kidney stones in the 1980's on average was 3.25% and 1990's 5.64% with the highest prevalence reported on adult Uranium workers in Tennessee, USA (18.5%) and adults in North East Thailand (16.9).² The exact prevalence of the disease in Africa is not known, as it was found in the studies done in South Africa there are stone prone and stone free areas. Sudan and Ethiopia are some of the stone prone areas. Those countries have high prevalence of calcium oxalate stones about 70%.³ Though kidney stone disease is common in this country, there is no any documented study done about the prevalence of kidney stone disease in Eritrea.⁴

Men are more affected than women, Studies done in Japan and Iran showed that the ratio of kidney stone of men to women was 2.5:1 and 1.15:1 respectively. In Korea, prevalence rates decreased as men aged, but increased in women and peaked at age 60 to 69 years. Similar patterns were shown in Germany in the age group 14-24, in Milan 21-30, 60- to 79-year-olds in Korea, in the United States in the age group 20-29 and in Greece similar occurrence was reported in three different age groups (age < 20, age 30 to 39 years, and age 50 to 59 years).² Studies done in Africa showed that Sudan and Ethiopia were prone to stone formation with higher prevalence in men than women.³

The prevalence of kidney stone generally increases as age increases. Studies done in Germany showed an increase in the prevalence as age increases, this trend was observed both in 1979 and 2001 reports. US kidney stone prevalence also increased with age. In 1978 prevalence in US men and women demonstrated a rise and fall pattern as the population ages, with peak prevalence occurring between age 60 and 69 years in men, and between age 50 and 59 in women. Studies done from 1976 to 1980 in the United States showed the prevalence to decrease in women over 59 and in Men over 69 but by the year 1991 the prevalence rate rose significantly as the age group increased. Milan, Italy, kidney stone an increasing prevalence was observed with increasing age among those living in Milan, but a prevalence decreased after age > 60 years. In 1998 Korean studies demonstrated a rise and fall pattern with Korean men prevalence increasing with age whereas in Korean women it showed an increase and decrease pattern peaking between 60 and 69 years.²

In the United States, data relating Race and prevalence of kidney stone revealed kidney stone to be commonest among whites followed by Hispanics, blacks and Asians. However the prevalence has doubled for African Americans in the age group 60 to 74 comparing studies done in 1976 through 1980 and 1988 through 1994. For each race men have higher prevalence as compared to women in the same race.² A study done in Benin, Nigeria showed the prevalence of kidney stone to be 6.3 per 100,000 of population. The ratio of male: female was 4: 1 with peak age being between the third and 6th decade of life.¹³

Different factors have been associated with the increase in the prevalence of kidney stones. Environment, genetic, dietary changes and obesity have been known to contribute to these changes. Historical evidence shows that the first report of increase in kidney stone formation occurred during the 16th century when the demand for European stone cutters (Stein-Schneiders) increased, at which time the

food production improved and corn became popular staple food. The consumption of foods rich in starch like corn contributed to obesity, risk factor to kidney stone formation.²

Different dietary factors have been known to promote kidney stone formation. The intake of refined starchy foods and obesity has been linked to kidney stone formation. With the increase in the incidence of obesity studies also show that it correlates with the rise in the incidence and prevalence of kidney stone formation. Studies show that with the increase in the BodyMassIndex the prevalence of kidney stones and chronic kidney disease increased, however the prevalence ceased to increase after the BMI increased above 30. Obesity is associated with excess nutritional intake of lithogenic substances such as refined sugars, low fluid intake, calcium, oxalate, high sodium intake and purine-rich foods. Obesity is also associated with an increase in incidence of urinary tract infection. Patients with central adiposity or high waist-to-hip ratios appear to have the highest risk¹¹. A study conducted in the United States shows consumption of antioxidants to decrease the formation of kidney stones. Antioxidants alpha-carotene, beta-carotene, and beta-cryptoxanthin were significantly lower in those with kidney stones (-9.36%, -10.79%, and -8.48%, respectively than those without kidney stones⁶. kidney stone formation has also been linked to high dietary Zinc intake. A study showed increase in the prevalence of kidney stones in patients with high dietary zinc intake (>15 mg/day)⁷. It has been proposed that dietary calcium, potassium, and total fluid reduce the risk of kidney stone formation, while supplemental calcium, sodium, animal protein, vitamin C intake of >90mg/day and sucrose may increase the risk¹¹. In younger female adults the intake dietary calcium was associated with decreased risk of developing kidney stone while supplemental calcium was not associated with any risk. However in older individuals the facts may change due to change in metabolism of calcium. In males < 60 years dietary calcium decreases the risk whereas in men >60 years dietary calcium does not seem to affect the risk. Intake of animal protein was associated with risk only in men with a body mass index < 25 kg/m².¹¹.

Different metabolic syndromes have shown to have impact on the formation of kidney stones. Diabetes is associated with an increase in the incidence of renal stones disease. The shared links between the metabolic disorder and kidney stone is insulin resistance. Furthermore, insulin resistance is thought to alter renal acid-base metabolism, resulting in a lower urine pH and increased risk of uric acid stone disease^{2,5}. A study showed that in patients with kidney stone disease the presence of hypophosphatemia, hypokalemia, hyperuricemia and hypercalcemia was 11%, 12.6%, 20%, and 5% respectively⁸. The presence of Hypertension has shown to have impact on the prevalence of kidney disease.⁹.

Calcium oxalate stone formation was significantly associated with several coronary heart disease risk factors, including smoking habit, hypertension, hypercholesterolemia, and obesity¹¹. In primary gout 39% of patients had urinary stones of which about 30% were silent and diagnosed only by ultrasonography¹¹. other medical conditions associated with renal stone include hyperparathyroidism, hyperthyroidism, sarcoidosis, malabsorption (inflammatory bowel disease, ileal resection or bypass) and cystic fibrosis¹² patients with injuries to the spinal cord are at high risk to develop kidney stone. Some of

the reasons include catheterization leading to urinary tract infection along with urinary stasis and immobilization. Renal abnormalities which lead to urinary stasis such as polycystic kidney disease and other anatomical abnormalities increase the risk of kidney stone. Medullary sponge kidney, distal renal tubular acidosis and recurrent history of urinary tract infection also increase the risk of stone disease.¹²

Different environmental factors have been linked to the increase in the prevalence of kidney stones. Warm climates and sunlight exposure have been linked to kidney stone disease. The possible theories include exposure to warm climate leads to dehydration, making the urine more acidic, a risk factor to stone formation.¹⁰ Sunlight stimulates the increased production of 25-hydroxycholecalciferol in the skin, which, after conversion to 1,25 dihydroxy-vitamin D by the kidneys, enhances intestinal absorption of calcium.

Elevated levels of circulating 1, 25 dihydroxyvitamin D have been found in patients with hypercalciuria and excess urine calcium is linked to stone formation, this occurrence was more common in men probably due to more sunlight exposure.¹⁰

Almost 85% of stones contain calcium with oxalate and phosphate either alone or combined. Calcium oxalate stones are made of monohydrate (COM) and dihydrate (COD) crystals. COM, the thermodynamically most stable form, is observed more frequently in clinical stones than COD, at a ratio of >2:1. The pathogenesis of calcium oxalate stone formation is a multi-step process and includes nucleation, crystal growth, crystal aggregation and crystal retention. Enucleation is the formation of solid crystals in urine; supersaturation plays a big role in this process. Naturally urine has inhibitors of crystallization, holding large amount of solute in the urine, however if solute reaches to a point where it cannot be held in urine then the process of enucleation starts. New crystals may form on pre-existing crystals called secondary enucleation. Epitaxy is a process whereby material of one crystal type is precipitated upon the surface of another whose lattice dimensions are almost identical, this process is important for the formation of calcium oxalate stones. The next important step is the crystal growth which starts approximately with enucleation. This process is determined by the molecular size and shape of the molecule, the physical properties of the

material, SS levels and pH. Crystal aggregation is the third process whereby crystals in solution stick together and form a larger particle. This process is determined by balance of forces, Tamm-Horsfall glycoprotein and other molecule may act as glue and increase viscous binding. Aggregate may further be stabilized by solid bridges formed by crystalline material connecting two particles. Normally tubular cells and crystal repulse each other hence inhibiting aggregation. In pathological conditions however, injury from free radicals results in sloughing of membranes from tubular membranes providing a conducive environment for enucleation and aggregation. Crystal retention is the next important process for kidney stone formation. A defective non-adherent property of the renal tubular epithelial cells promotes this process.¹⁴

Clinical pictures for patients with kidney stone may vary from acute pain to being asymptomatic. A study showed that in developing countries the prevalence of stones was underestimated after discovering kidney stones were diagnosed by renal sonography in 3% of non-symptomatic subjects.¹¹

Manifestations include flank pain, urinary retention, renal colic, pyuria.¹³ Patients may present with moderate to severe colic, caused by the stone entering the ureter.

Stones in the proximal ureter cause pain in the flank or anterior upper abdomen. When the stone reaches the distal third of the ureter, pain is noted in the ipsilateral testicle or labia. A stone at the junction of the ureter and the bladder often causes dysuria, urgency, and frequency and may be mistaken for a lower urinary tract infection, hematuria is also common.¹⁵ Occasionally patients may present with ureteral obstruction which later results in hydronephrosis of the proximal kidney. Patients may also present with recurrent urinary tract infection. Colicky pain may radiate to the groin and as the stone descends down the ureter the pain may localize. The renal capsule and intestines share visceral innervations hence patient may also present with nausea and vomiting. Due to the severity of the pain it may mimic acute abdomen or pelvic condition but peritoneal involvement is absent.¹⁶

Helical CT without contrast is the preferred imaging study in patients with suspected nephrolithiasis. It has the advantage that it requires no radiocontrast material; it has the ability to show the distal ureters; it can detect radiolucent stones like uric acid stones, radio-opaque stones, and stones as small as 1 to 2 mm; and it can detect complications such as hydronephrosis and intra-abdominal and renal disorders other than stones that could be causing the patient's symptoms. A study showed that CT scan done in 100 patients the sensitivity was 98% and specificity was 100%. Ultrasonography though convenient in that it does not expose to radiation has its own limitation. It is less sensitive in that it can detect stone in only kidney and proximal ureter. A retrospective study showed that ultrasonography when compared with helical CT scan had a sensitivity of 24% and a specificity of 90%. Ultrasonography may also miss stones smaller than 3 mm in diameter. Kidney-Ureter-Bladder x-ray has low sensitivity, misses out on radiolucent and small stones. Intravenous Urography although previously widely used has few advantages not to mention the risk of hypersensitivity to iodine dye in patients.¹⁵

Several modalities of treatment are available for kidney stones. Urgent intervention is one option, indications include patient with obstruction, infected upper urinary tract, impending renal deterioration, persistent pain or vomiting, anuria, or high-grade obstruction of a solitary or transplanted kidney. Infection secondary to obstruction is manifested by fever, urinalysis revealing pyuria, bacteriuria, and leukocytosis, and the presence of urosepsis, in such cases intravenous antibiotics might be needed, intravenous ampicillin and aminoglycoside provide broad antibiotic coverage, although oral fluoroquinolones may be a reasonable alternative; the type of antibiotic may be adjusted once the culture results are known. During acute pain traditionally Narcotics were used, however Nonsteroidal anti-inflammatory drugs have been labeled as adequate analgesics. Non-steroidal anti-inflammatory drugs when acting on afferent arteriole provide adequate pain relief by reducing ureteral spasms and reducing diuresis. Other remedies for acute pain relief include acupuncture and resistive heating blanket set to 42°C. Because the pain is due to renal

capsular distention, intractable pain is controlled by decompressing the obstruction. In rare instances, patients may have persistent vomiting; they patients also require decompression and intravenous hydration.¹⁶

Smaller stones tend to pass spontaneously. For a stone to pass spontaneously the size has to be 5mm or less. It has also been noted that as the stone size increases the likelihood of the stone to pass decreases. Two thirds of ureteral stones pass within four weeks. Here also as the stone size increases the mean time for passage decreases. It has been proposed that a ureteral stone which has not passed within one or two months of period is unlikely to pass at any given time. A stone which has stayed in the ureter longer than 4 weeks is associated with further complications such as renal deterioration, sepsis, and ureteral stricture. Therefore for the above mentioned facts it seems only reasonable to appoint patient for 4 weeks of observation.¹⁶

Uric acid stones are the only stones that can be managed medically. At a urinary pH less than 5.5, uric acid is insoluble; solubility increases at a pH greater than 6.5. Alkalinizing the urine with potassium citrate (or sodium citrate or sodium bicarbonate) dissolves pure uric acid stones. A usual therapy practice is 20 mmol of potassium citrate orally two to three times daily, and later reassessment is needed to verify adequate urinary alkalinization (to pH 6.5 to 7). The time to dissolution varies with the size of the stone and the extent of urinary alkalinization. A 2-cm uric acid stone in urine with a constant pH of 7 takes approximately nine days to dissolve. Investigation can be repeated at one month to determine whether dissolution has occurred. Unless a stone is pure uric acid, oral dissolution therapy is not possible. If oral dissolution therapy fails, treatment should proceed as for a radiopaque stone.¹⁶

When managing renal stones the options of treatment depends on whether the stone is small or big. For stones less than 2cm the preferred option of treatment is Lithotripsy. It is most effective for stones in the renal pelvis with 76% of patients becoming stone-free and least effective for stones in the lower pole (59% stone-free). For this reason, for stones in the lower pole, only those smaller than 1 cm in diameter are treated with lithotripsy. The disadvantages of lithotripsy include perforation, bleeding, inflammation and disturbances in cardiac electrical signal transmission, leading to cardiac arrhythmias during treatment. It is contraindicated in pregnancy and coagulopathic states and is less effective in morbidly obese patients is contraindicated in pregnancy and coagulopathic states and is less effective in morbidly obese patients, lithotripsy is more likely to fail if the skin to- stone distance is more than 10 mm.¹⁷

For larger stones the preferred option of treatment is percutaneous nephrolithotomy. It involves inserting a needle through the skin into the collecting system and then dilating the tract. Instruments are then inserted through this tract to break up and remove stones. is indicated in patients who have renal or ureteral stones larger than 2 cm or lower-pole stones larger than 1 cm. Percutaneous nephrolithotomy is invasive and carries several risks as any major surgical procedure, some of the complications include sepsis, perirenal hematoma or bleeding, and injury to nearby organs, including pleurae, lungs, bowel, or spleen.¹⁷

On treating ureteral stone, for the sake of selection of surgical options the ureter is anatomically divided into proximal and distal portions taking the iliac vessels as land marks for division. Shock wave lithotripsy is the preferred method for proximal stones; it is useful for stones less than 1 cm. Different type of the machines has different intensities and produce fragments of different sizes and retreatment rates. Stones composed of calcium oxalate dihydrate or struvite fragment more effectively than stones made of calcium oxalate monohydrate, Calcium phosphate, or cystine. Proximal ureteral stones that are larger than 1 cm are treated more effectively by ureteroscopy than shock-wave lithotripsy. In a retrospective analysis of ureteral stones treated by ureteroscopy or shock-wave lithotripsy, the stone-free rates for stones of 1 cm or greater were 93 percent and 50 percent, respectively. For stones less than 1 cm, the stone free rates between the two groups did not differ significantly (100 percent and 80 percent, respectively).¹⁶

For distal ureteral calculi, the preferred treatment is controversial. In a prospective study patients with distal ureteral stones (mean size, 7 mm), shock-wave lithotripsy and ureteroscopy had similar results in stone-free rates. The percentage of patients who were in favor of repeating the procedure was slightly greater for shock-wave lithotripsy (100 %) than ureteroscopy (87 %).

Although there are no evidences to support the theory applying shock wave treatment to the distal third of the ureter to women with child bearing age might affect the ureters. Ureteroscopy may be used in women of childbearing age if not pregnant. Regardless of the mode of treatment used, the composition of all stones should be determined. Ureteroscopy with use of special laser is effective for stones of all compositions and sizes. This technique involves passing the ureteroscope retrogradely through the urethra, bladder, and ureter to the stone under video guidance. The laser is delivered through a small-diameter fiber passed through the ureteroscope. The fiber tip touches the stone, the laser is discharged, and the stone absorbs the laser's energy, producing photo thermal lithotripsy. In a series of 504 patients treated with the use of this approach, stones were eliminated in 98 percent of those with distal ureteral calculi, 100 percent of those with middle ureteral calculi, and 97 percent of those with proximal ureteral calculi. Ureteroscopy is less expensive than shock-wave lithotripsy, but it is more time consuming and technically more demanding.¹⁶

To prevent recurrence of kidney stones several measures could be taken. To prevent calcium oxalate stones one must treat the underlying causes of calcium in the urine. Calcium oxalate overgrowth on plaque is directly linked to calcium oxalate supersaturation, which is strongly linked to high urinary calcium excretion. Hypercalciuria can be caused by primary hyperparathyroidism, sarcoidosis, vitamin D excess, corticosteroid treatment, renal tubular acidosis, hyperthyroidism, and malignant neoplasms, it can also be idiopathic. In the latter hypercalciuria can be prevented by restricting sodium intake and giving thiazides. Thiazide diuretics lower urinary calcium excretion and promote mineral retention. Restriction dietary calcium however is not recommended as it may promote unbound oxalate in the urine, a precursor to calcium oxalate stone.

Distal renal tubular acidosis is defined by systemic metabolic acidosis, alkaline urine, hypokalemia, hypercalciuria, hypocitraturia, and nephrolithiasis. The chronic metabolic acidosis results in loss of bone calcium, contributes to hypercalciuria, and is responsible for the hypocitraturia. Stone formation is the result of excessive urinary calcium excretion and persistently alkaline urine. Treatment with sodium bicarbonate or potassium citrate corrects the metabolic acidosis, reduces the loss of calcium from bone, corrects hypokalemia, and increases urinary citrate.

Elevated urinary uric acid excretion (> 800 mg/day in men, > 750 mg/day in women) is associated with formation of calcium stones. Treatment includes lowering uric acid stones with Allopurinol. Hyperoxaluria may be the result of high dietary intake, increased gut absorption, malabsorption of fat or simply genetic. Correction of hyperoxaluria includes dietary correction and appropriate management of underlying conditions which lead to fat malabsorption. Struvite stones are the result of chronic upper urinary infection with urease-producing bacteria like *proteus spp* Treatment includes eradicating bacteria and removing the stones which harbor the bacteria.

Cystine stone disease is seen in people who have inherited an autosomally recessive gastrointestinal and renal tubular transport disorder of four amino acids, i.e., cystine, ornithine, arginine, and lysine. Of these four amino acids cystine is the most insoluble and precipitates in urine. To prevent cystine stone disease treatment should include hydration adequately to achieve daily urine volumes of 3 to 3.5 L, alkalinization of the urine to a pH higher than 6.5 with potassium alkali or sodium bicarbonate reduction of protein and sodium intake to decrease cystine excretion. If these measures fail, D-penicillamine, tiopronin, or captopril can be given to convert the cystine to a more soluble disulfide cystine drug complex.¹⁵

2. Objectives And Methodology

2.1 objectives

Studies show that the prevalence and incidence of kidney stone disease is increasing across the globe. Change in life style, diet, obesity, environment and climate as explained by global warming, genetic modifications are thought to contribute to these changes. The rising incidences of metabolic syndromes such as Diabetes mellitus are also directly linked to this rising prevalence.^{2, 8, 9}. Eritrea, as part of the globe undergoing rapid change, is no exception. No previous data was available concerning the prevalence of kidney stones locally. This study was therefore conducted the following objectives in mind

- To determine the prevalence of kidney stone disease in patients visiting Orotta Medical Surgical National Referral Hospital on outpatient basis in the year 2012
- To compare the prevalence between male and female patients
- To determine the different patterns between different age groups; age groups included were 15- 90 years
- To correlate the association between different co morbidities and kidney stone disease

- To determine the association with environmental factors i.e. warm climate

2.2 Methodology

2.2.1 Study design

The research conducted was a retrospective and quantitative study. The data was based on hospital documents which included patients who visited there with different complaint and using diagnostic means were confirmed to have kidney stone disease. The time range for data collection was from January 2012 to December 2012.

2.2.2 Study area

The study was conducted at a tertiary referral hospital, the Orotta Medical Surgical National Referral Hospital (OMSNRH) in Asmara, Eritrea from January 2013 to April 2013.

2.2.3 Study population

The study population were patients who visited the Orotta Outpatient department for different symptoms such as flank pain, dysuria or hematuria and using Ultrasonography, KUB x-ray or any other means were confirmed to have kidney stone disease. Patients included in this study were patients who visited the hospital from January 2, 2012 to December 31, 2012.

2.2.4 Data collection and Processing

After permission was acquired from authorities of OMSNRH for approval and ethical consideration, the log book for Health Management Information System (HMIS) for clinic/outpatient department recording form from January 2012 to December 2012 was collected from the archive room of OMSNRH. This form was a form which recorded all the diseases which were diagnosed during that year with their respective card numbers and other information such as age, sex, and whether it is the first or repeated visit. It is normally used for documentation and for data processing for Health Management Information System and assigns different diagnosis code for different diseases and syndromes. In OMSNRM, the coding system is according to the International Classification of Diseases Tabulation List for Morbidity (ICDDIAG). Patients with kidney stone disease usually present with flank pain, acute colicky pain, hematuria, and dysuria and may present with symptoms of urinary tract infection. In this research patients which were included include those whose diagnosis was confirmed using diagnostic images like ultrasonography and KUB x-ray and therefore the code 215 was used. After selection of the population sample, card numbers with these codes were written in new form including age and sex. All card numbers which were selected were entered in data form using Microsoft excel separately for each month. The card numbers were arranged sequentially and repeated numbers were removed. Following the arrangement of card numbers for each month, the cards were retrieved from the archive card room of OMSNRH. The information that were recorded from each card include age, sex, address, location of stone, investigations used and any other co morbidities or complications.

The data retrieved from the cards were entered to Microsoft excel and they were processed using the new edition of Statistical Package for Social Science version 18 (i.e. PASW statistics version 18) to analyse the data.

Ethical consideration

The research proposal was approved by Orotta school of Medicine and Dentistry. Furthermore, ethical approval for the study was obtained from the Ministry of Health Research Ethics and protocol review committee.

3. Result

3.1 Over all Prevalence

During the year 2012 out of 30,335 patients who visited the outpatient department of Orotta medical surgical national referral hospital, 173 patients were confirmed to have kidney stone diseases making it a prevalence of 0.5%. Generally the study showed male preponderance in every month, out of 173 patients who were confirmed to have kidney stone disease 125 were male and 48 females making the male prevalence ratio of 72.2% and female prevalence ratio of 27.8%. **Table-1** shows the monthly prevalence of male and female patients.

Table-1: The prevalence of Urolithiasis among male and female patients by month

3.2 Age and Gender of Study population

The prevalence of kidney stone disease generally showed a decreasing pattern as age increased. The sample populations' age ranged from 15 to 82 with mean of 36.88 (SD \pm 16.037). The prevalence rate was highest among 15-25 age groups and declined as the age increased until the age 76-85 where there was a slight increase. The observed level of significance was 0.002 ($P < 0.05$). For male patients prevalence by percentage showed highest to be in the age group 76-85 where all the patients were male (**Table-1**). In females however the prevalence by percentage showed a steady pattern among the age groups 15 to 45 and then showed a slight decreasing pattern until the age group 66-75 where male and female prevalence were equal (P value was 0.212; $P > 0.005$). (Figure 1 & 2)

Table 2
Prevalence of Urolithiasis in male and female patients among different age groups

Age group	SEX		Total	P value
	F	M		
15-25	15	33	48	0.212
26-35	15	29	44	
36-45	12	23	35	
46-55	5	16	21	
56-65	1	14	15	
66-75	2	2	4	
76-85	0	6	6	
Total	50	123	173	

3.3 Location of Stone in Study population

Nephrolithiasis includes stones found in all part of the urinary system starting out from kidney, ureter, bladder and urethra. In this study out of the 173 patients majority were found on the kidney comprising about 80.3% (139), followed by ureter 29 (16.8%) of patients and 5 patients' (2.9%) stones were located on the bladder. **(Figure-3)**

3.4 Distribution of study population by Address

Eritrea as a sub-Saharan country has a relatively warmer climate and except for Zoba Maekel and Zoba Debub most of its lands are warm and dry. Results from this study however showed that patients from Zoba Maekel were the highest in number (59.9%) followed by Debub (19.1%) while the southern Red Sea Zone had the lowest prevalence (2.3%). **(Figure-4)**

3.5 Comorbidities and Complications

Several comorbid conditions were associated with the formation of kidney stone disease. Diabetes is associated with an increase in the incidence of renal stones disease⁵. The presence of Hypertension has shown to have impact on the prevalence of kidney disease.⁹. In patients with kidney stone disease the presence of hypophosphatemia, hypokalemia, hyperuricemia and hypercalcemia was 11%, 12.6%, 20%, and 5% respectively.⁸. In this study only one patient was diagnosed to have both Diabetes mellitus and hypertension making it 0.6%. Two patients had dyslipidemia (1.2%). Other anatomical anomalies associated with kidney stone disease the researchers found were Ectopic kidney in 3 (1.7%) of patients

and renal cyst in one patient (0.6%). Out of the 173 patients 12 (6.9%) were complicated by Hydronephrosis with a significance level of 0.548. (Table-3)

Comorbid diseases	Frequency	Percent	Cumulative Percent	P value
Bronchitis	1	.6	.6	
Dyslipidemia	2	1.2	1.7	
Ectopic kidney	3	1.7	3.5	
HYDRONEPHROSIS	12	6.9	10.4	0.548
Hypertension and Diabetes mellitus	1	.6	11.0	
None	151	87.3	98.3	
PUD	1	.6	98.8	
Renal cyst	1	.6	99.4	
Seizure disorder	1	.6	100.0	
Total	173	100.0		

Table-3: Co morbidities and complications

3.6 Means of Diagnosis

Helical CT without contrast is the preferred imaging study in patients with suspected nephrolithiasis. Ultrasonography though convenient in that it does not expose to radiation has its own limitation. It is less sensitive in that it can detect stone in only kidney and proximal ureter. Ultrasonography may also miss stones smaller than 3 mm in diameter. Kidney- Ureter- Bladder x-ray has low sensitivity, misses out on radiolucent and small stones. Intravenous Urography although previously widely used has few advantages.¹⁵. The available options for diagnostic investigations in Eritrea include Ultrasonography, KUB x-ray and Intravenous Urography (pyelography). From population study 167 were investigated with ultrasonography, 31 patients were investigated with IVP with or without Ultrasonography and 25 patients did KUB x-ray in addition to ultrasonography or alone. (Table-4)

Diagnostic image	frequency	percentage
Ultrasonography	167	96.5
Intravenous Urography	31	17.9
KUB x-ray	25	14.5
Cystoscopy	1	0.6
CT-scan	1	0.6
Table-4: Diagnostic images used for diagnosis		

4. Discussion

Research done on the prevalence of Kidney stone disease during the year 2012 at the Orotta Medical Surgical National referral Hospital showed that 173 patients out of 30,335 had confirmed kidney stone disease making the prevalence rate 0.5%. The estimated prevalence of kidney stones in the 1980's on average was 3.25% and 1990's 5.64%.² and when the finding was compared with the above stated data, it can be concluded that the prevalence is lower than that of other countries. The researchers however doubt if this is the true representation of the prevalence as other regional referral hospitals data was not included and due to geographical and other barriers rural communities may not have the same access as urban communities. In addition since no previous Eritrean literature reported on the prevalence of kidney stones it would be impossible to comment if the prevalence has increased or otherwise.

Studies done in Japan and Iran showed that the ratio of kidney stone of men to women was 2.5:1 and 1.15:1 respectively.² Studies done in Korea showed prevalence rates decreased as men aged, but increased in women and peaked at age 60 to 69 years. In Germany in the age group 14-24, in Milan 21-30, 60- to 79-year-olds in Korea, in the United States in the age group 20-29 the prevalence of kidney stone was the highest. In Greece similar occurrence was reported in three different age groups (age < 20, age 30 to 39 years, and age 50 to 59 years).² Studies done in Africa showed that Sudan and Ethiopia were prone to stone formation with higher prevalence in men than women.³ In this study the prevalence of kidney stone was higher in men than in women with a ratio of 2.46:1. This ratio however changed with different age groups, the male to female ratio was 2.2:1 in the age group 15-25 and the ratio was similar until the age group 46-55 and 56-65 where the ratio peaked to 3.2:1 and 14:1 respectively and ratio tended to equalize (1:1) in the age group 66-75 but beyond that no female patient was found. Our findings were similar to the data we reviewed.

Studies done in Germany showed an increase in the prevalence as age increases, this trend was observed both in 1979 and 2001 reports. US kidney stone prevalence by also increased with age. In 1978 prevalence in US men and women demonstrated a rise and fall pattern as the population ages, with peak prevalence occurring between age 60 and 69 years in men, and between age 50 and 59 in women. Studies done from 1976 to 1980 in the United States showed the prevalence to decrease in women over 59 and in Men over 69 but by the year 1991 the prevalence rate rose significantly as the age group

increased. Milan, Italy, kidney stone an increasing prevalence was observed with increasing age among those living in Milan, but a prevalence decreased after age > 60 years. In 1998 Korean studies demonstrated a rise and fall pattern with Korean men prevalence increasing with age, whereas in Korean women it showed an increase and decrease pattern peaking between 60 and 69 years.² The data collected show that kidney stones were higher in the age group 15-25 and declined as the age increased until the age 76-85 where there was a slight increase. This data was not very consistent with most of the literature reviews and whether the relatively short Eritrean life expectancy or the increased awareness among the younger generation towards seeking medical attention is responsible for this change remains yet to be seen. Victoriano Romero et.al however commented differences could be in sampling methods or subjects with stones dying at a younger age. The relatively shorter life expectancy of patients with kidney stone disease has been related to a number of medical co morbidities including obesity, diabetes mellitus, hypertension, chronic kidney disease, and cardiovascular problems.

Different environmental factors have been linked to the increase in the prevalence of kidney stones. Warm climates and sun light exposure have been linked to kidney stone disease. The possible theories include exposure to warm climate leads to dehydration, making the urine more acidic, a risk factor to stone formation.¹⁰ Eritrea as a sub-Saharan country has a relatively warmer climate and except for Zoba Maekel and parts of Zoba Debub most of its lands have warm climate and are dry. Results from this study however showed that patients from Zoba Maekel were the highest in number (59.9%) followed by Debub (19.1%), whereas both Northern Red Sea and Anseba Zone both consisted about 7.5%, Gash Barka 4% while the southern Red Sea Zone had the lowest prevalence (2.3%). The above stated findings were inconsistent with the literature reviews. However there are several factors that need to be taken into consideration. One is the population difference in each zone, Zoba Maekel notably has the largest population followed by Zoba Debub and it's not surprising to find that most of the patients who were confirmed to have nephrolithiasis were from the Maekel region. In addition Orotta Medical Surgical National Referral Hospital is situated in Asmara, Zoba Maekel and due to its proximity more Zoba Maekel residents are bound to visit more.

In this study out of the 173 patients majority were found on the kidney comprising about 80.3% (139), followed by ureter 29 (16.8%) of patients and 5 patients' (2.9%) stones were located on the bladder. Different studies show different predominance of location of stones. In Japan magnesium ammonium phosphate stones was common accounting for majority of stag horn stones located in the upper tract which later showed dramatic decrease during the last decade. In Nigeria however Upper urinary tract stones are relatively uncommon

Probably due to chronic dehydration exacerbated by religious fasting.¹¹

Ahmed MH et al explained that the probable association of Diabetes mellitus and Kidney stone formation was insulin resistance, formation of acidic urine and formation of kidney stones⁵. Jeong IG et al reported that in participants with hypertension, the OR for the presence of kidney stones was 1.47 compared with

that for participants without hypertension.⁹ In this study only one patient was reported to have both Diabetes mellitus and Hypertension making a 0.6%.

Renal abnormalities which lead to urinary stasis such as polycystic kidney disease and other anatomical abnormalities increase the risk of kidney stone.¹² In this study 3 patients were also diagnosed to have ectopic kidney (1.7%) and another one was shown to have Renal cyst. Keller JJ et.al. reported that patients with CKD were more likely than comparison subjects to have been previously diagnosed with kidney calculus odds ratio [OR] 2.10, ureter calculus OR 1.68, bladder calculus OR 1.49, and unspecified calculus OR 1.89¹⁸. In this research 12 (6.9%) patients were complicated with Hydronephrosis; however it's not known whether those patients developed chronic kidney disease.

A study showed that CT scan done in 100 patients the sensitivity was 98% and specificity was 100%. Ultrasonography though convenient in that it does not expose to radiation has its own limitation. It is less sensitive in that it can detect stone in only kidney and proximal ureter. A retrospective study showed that ultrasonography when compared with helical CT scan had a sensitivity of 24% and a specificity of 90%¹⁵. In this study majority of the patients were diagnosed using ultrasonography From population study 167 were investigated with ultrasonography, 31 patients were investigated with IVP with or without Ultrasonography, 25 patients did KUB x-ray in addition to ultrasonography or alone and only one patient was diagnosed with the use of CT scan. With the sensitivity of about 24% the use of ultrasonography as the sole means of diagnosis, the researchers speculate quite a lot of patients might have been missed and this above stated number might be under presented.

4.1 Conclusion

Out of 30,335 patients who visited the outpatient department of Orotta Medical Surgical National Referral hospital from January to December 2012, 173 patients were diagnosed to have nephrolithiasis making it a prevalence of 0.5%.

Generally the prevalence of kidney stone was higher in men than in women with a ratio of 2.46:1. The male to female ratio fluctuated with different age groups but it generally it showed male predominance.

The collected data shows kidney stones were higher in the age group 15-25 and declined as the age increased.

Majority of the stones were found on the kidney comprising about 80.3%, followed by ureter 16.8% of patients and 2.9% stones were located on the bladder.

Results from this study however showed that patients from Zoba Maekel were the highest in number (59.9%) followed by Debub (19.1%).

Out of the 173 population study only one patient had associated Hypertension and Diabetes mellitus. Three had ectopic kidney and one had renal cyst. Twelve patients were complicated by Hydronephrosis

however it's not known whether those patients developed chronic kidney disease.

4.2 Recommendation

Kidney stone disease is a disease that is globally on the rise due to its association with environmental factors such as global warming, dietary changes and obesity. The researchers recommend for further nationwide studies to be done on the prevalence and incidence of kidney stones. Further yearly reports might be needed to assess if kidney stone disease is on the rise.

Data reviewed in this study show 6.9% of patients were complicated with hydronephrosis. In order to prevent the progress to chronic kidney disease, we recommend early detection, follow up and appropriate treatment of ureteral stones.

Using ultrasonography to detect kidney stones needs adequate skills and we therefore recommend adequate training to be given to ultrasound operators on the use of ultrasound and interpretation of results.

We also recommend respected authorities to work to increase the awareness of kidney stones and their means of prevention.

4.3 Limitation of the Study

- The study was a retrospective study which was prone to bias, less informative and cannot directly compute incidence rate of the disease.
- It was difficult to assess the association between Prevalence of Urolithiasis and its comorbidity.
- The main diagnostic imaging used was ultrasound, which has low sensitivity in detecting stones.
- There was limited recorded information regarding the presence of complication.

Declarations

The authors report no conflicts of interest in this work.

Abbreviations

BMI	Body Mass Index
COM	Calcium oxalate Monohydrate crystals
COD	Calcium oxalate Dihydrate crystals
CT	Computed tomography
OMSNRH	Orotta medical surgical national referral hospital

ICDDIAG International classification of disease tabulation list for morbidity

CKD Chronic kidney disease

OR Odds Ratio

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Table 1

Table 1 is available in the Supplementary Files section.

Figures

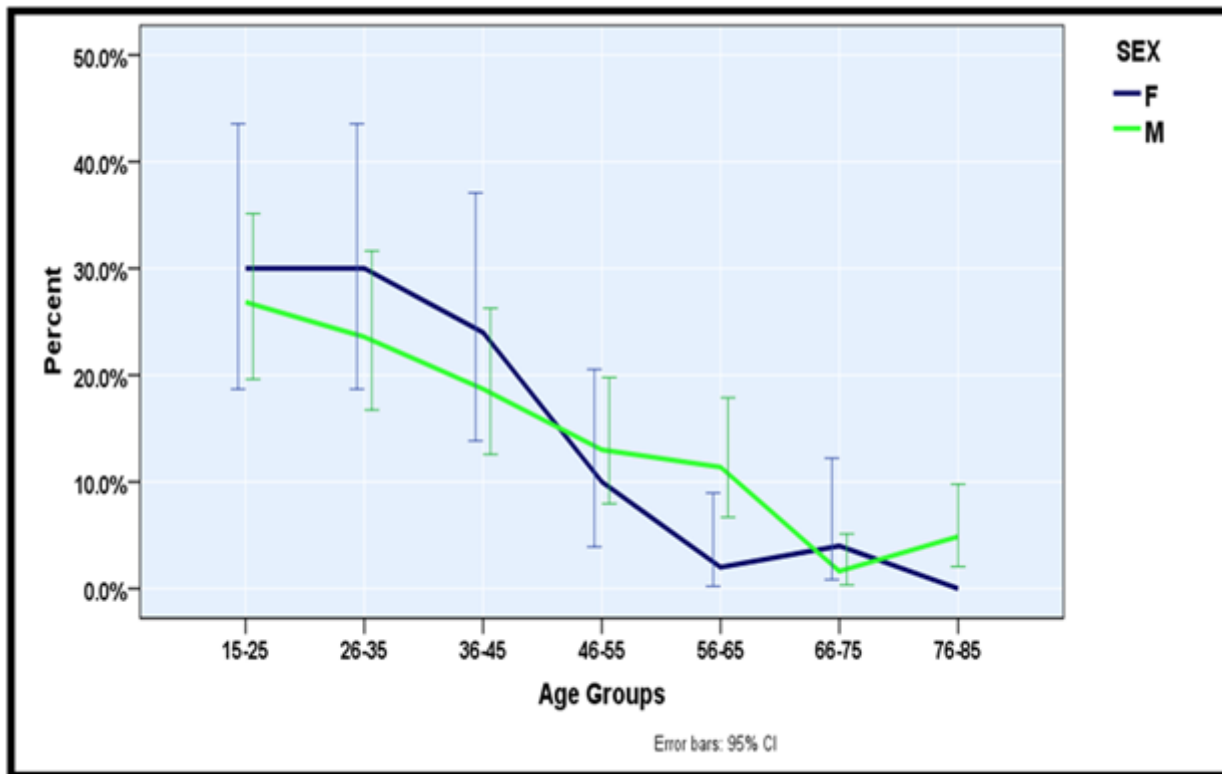


Figure 1

Distribution of Study Population by Age group and sex

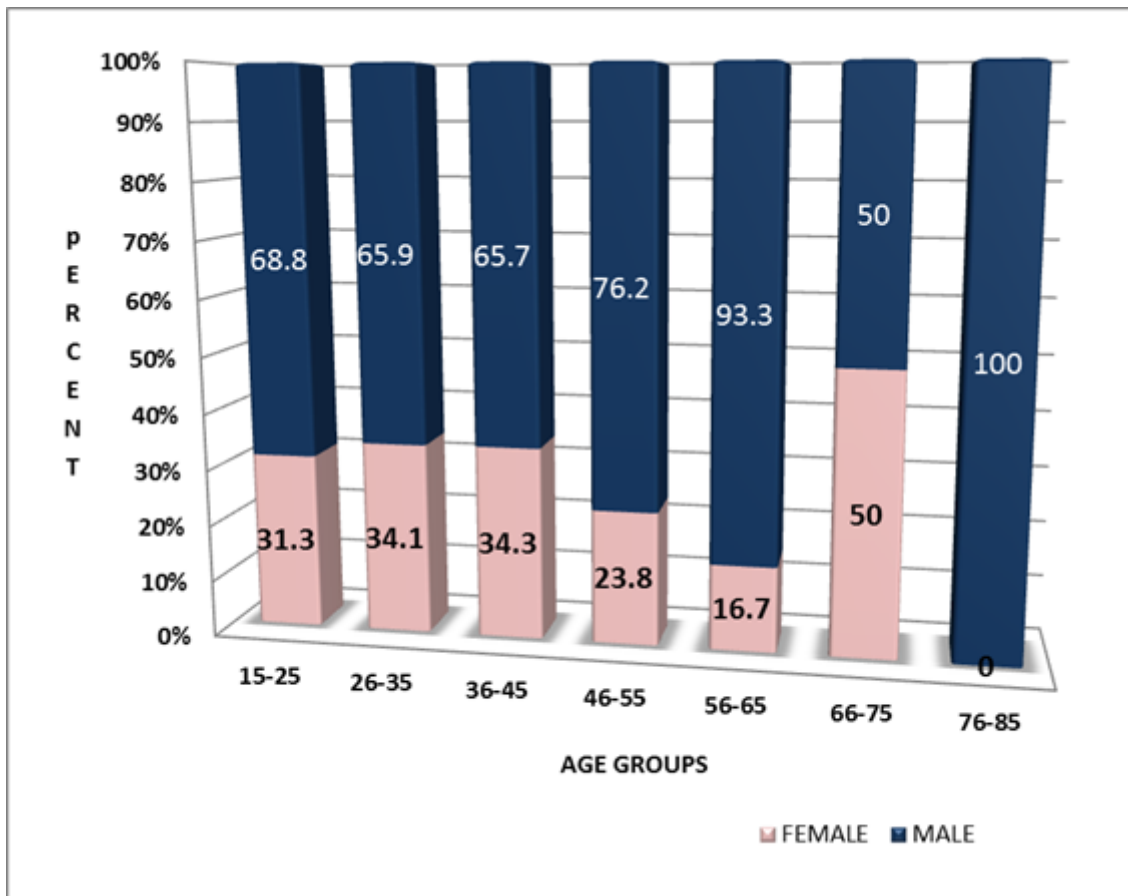


Figure 2

Prevalence of urolithiasis among male and female patients of different age groups

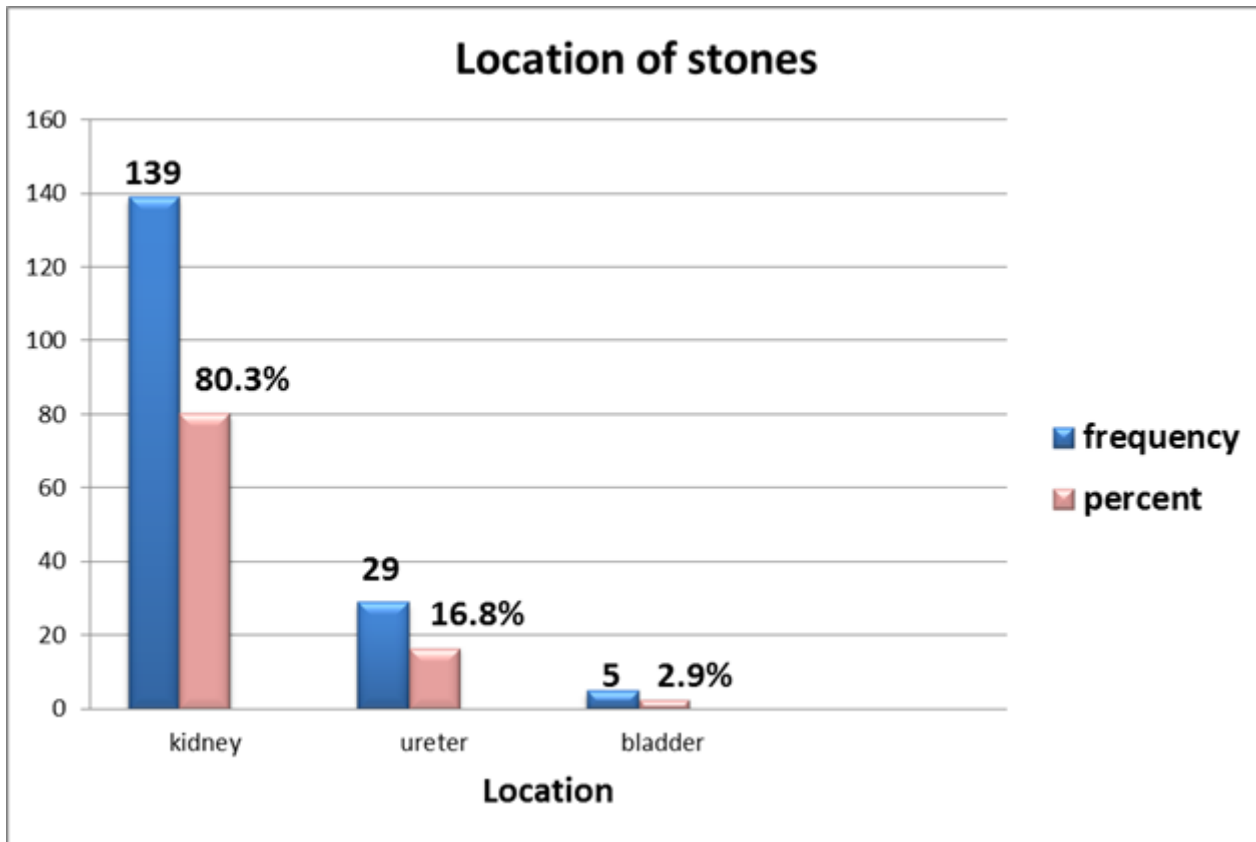


Figure 3

Stone location of Study population

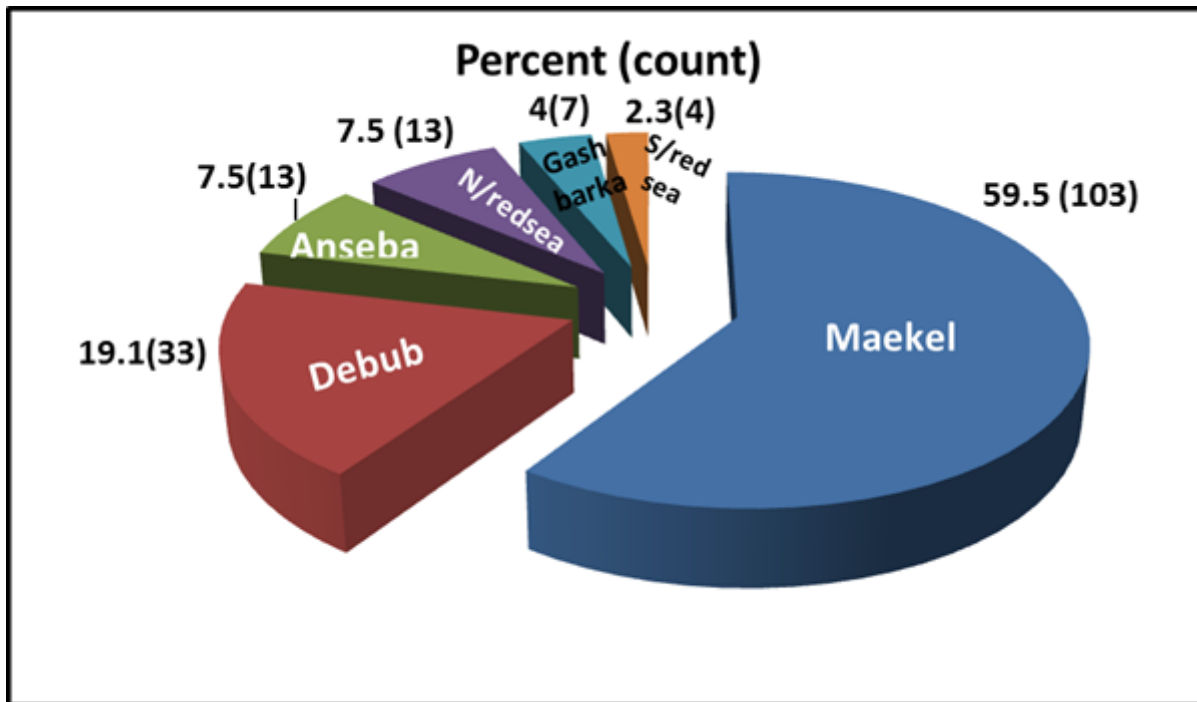


Figure 4

Distribution of study population by address

Supplementary Files

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- [floatimage2.png](#)