PREVALENCE AND RISK FACTORS OF KIDNEY STONE

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INTRODUCTION

Kidney stones, one of the most painful of the urologic disorders, are not a product of modern life. Unfortunately, kidney stones are one of the most common disorders of the urinary tract. A large number of people are suffering from urinary stone problem all over the globe. Kidney stones, which are solid crystals that form from dissolved minerals in urine, can be caused by both environmental and metabolic problems. Calcium oxalate and/or phosphate stones account for almost 70% of all renal stones observed in economically developed countries.

Kidney stones are quite common and usually affect people who are between 30 and 60 years of age. They affect men more than women. It is estimated that renal colic (severe pain caused by a kidney stone) affects about 10-20% of men, and 3-5% of women. In India, 12% of the population is expected to have urinary stones, out of which 50% may end up with loss of kidneys or renal damage. Recurrent stone formation is a common problem with all types of stones and therefore an important part of the medical care of patients with stone disease.

In most countries with a relatively high incidence of renal calculi due to climate, diet habits, local geology with hydro mineralogy and sanitation by affecting geo mineralogy. Rising global temperatures could lead to an increase in kidney stones, according to research presented at the 103rd Annual Scientific Meeting of the American Urological Association (AUA). Dehydration has been linked to stone disease, particularly in warmer climates, and global warming will exacerbate this effect. The correlation between increased environmental temperature and increased number of stone events supports the conclusion that global warming has an impact on the development of stones. This has been recently addressed in a study by Brikowski and associates.

As a result, the prevalence of stone disease may increase, along with the costs of treating the condition. The researchers discovered that stone formers had a 60% greater risk of developing chronic kidney disease (CKD) and a 40% increased risk of developing end-stage renal disease (ESRD), the most severe form of CKD.

Diet may have a significant impact on the incidence of urinary stones. The incidence has been steadily increasing, paralleling the rise in other diseases associated with the so-called ‘Western diet.’ Being obese (higher BMI) and experiencing weight gain have been associated with stone risk among men and women. Diet and fluid intake may be important factors in the development of urinary stones. As per capita income increases, the average diet changes, with an increase in saturated and unsaturated fatty acid; an increase in animal protein and refined carbohydrates. Increased animal protein intake, lower potassium intake, lower fluid intake were recently identified to higher stone risk.

Higher consumption of fructose has been tied to kidney stone risk. A less energy dense diet may decrease the incidence of stones. This fact has been documented during war years when diets containing minimal fat and protein resulted in a decreased incidence of urinary stones. Those afflicted with recurrent urinary stone disease are encouraged to maintain a diet restricted in sodium and protein intake. Postmenopausal women with low estrogen levels have an increased risk for kidney stones. Women who have had their ovaries removed are also at increased risk.

AIM AND OBJECTIVES

The objective of this study was to evaluate the prevalence of kalladaippu (Renal calculi) among patients visiting in OPD-1, Dept.of Maruthuvam (Medicine), National Institute of Siddha and to assess the factors influencing the development of kidney stones and also to find out the independent relationship of the following risk factors especially Family history, in adequate fluid intake, Stress, Over weight and Obesity, Dietary habits and lifestyle modifications, association with other diseases (diabetes, hypertension). Materials and methods: The study was conducted among 666 kalladaippu (kidney stone) patients. Details of factors influencing the formation of kidney stone were obtained using a pretested questionnaire. Results and conclusion: The study revealed a high prevalence of kidney stone is due to low fluid intake 72.07%(p=0.000), dehydration 67.56% (p=0.012) and dietary habits of mixed diet 91.59%(p=0.000), high intake of coffee and tea 57.50%, sodium 64.26%, sugar 49.84%. Life style modifications of smoking 36.03%, alcohol consumption 41.59%, lack of physical activity 42.79%, obesity 54.80% also revealed a high prevalence of this disease.

KEYWORDS : Kalladaippu, Kidney stone, risk factors, Siddha.

PREVALENCE AND RISK FACTORS OF KIDNEY STONE

Nalini H.Sofia
Lecturer, Department of Maruthuvam (Medicine) National Institute of Siddha, Tambaram Sanatorium, Chennai, India.

Manickavasakam. K
Ex- Director, National Institute of Siddha, Tambaram Sanatorium, Chennai, India.

Thomas M.Walter
Lecturer, Department of Gunapadam (Pharmacology), Govt. Siddha Medical College, Palayamkottai, India.

ABSTRACT

Background: Kidney stone affect 10-12% of the population in industrialized countries. The average life time risk of stone formation has been reported in the range of 5-10%. Recent stone formation is a common part of the medical care of patients with stone diseases. The etiology of this disorder is multifactorial and is strongly related to dietary, lifestyle habits or practices. Increased rates of hypertension, diabetes and obesity which are linked to nephrolithiasis, also contribute to an increase in stone formation. Hence, this study was undertaken to find out the prevalence among kidney stone patients. Aim and objectives: To assess the prevalence of kidney stone among patients visiting in OPD-1, Dept.of Maruthuvam (Medicine), National Institute of Siddha and also to find out the risk factors influencing the development of kidney stones especially Family history, inadequate fluid intake, Stress, Over weight and Obesity, Dietary habits and lifestyle modifications, association with other diseases (diabetes, hypertension). Materials and methods: The study was conducted among 666 kalladaippu (kidney stone) patients. Details of factors influencing the formation of kidney stone were obtained using a pretested questionnaire. Results and conclusion: The study revealed a high prevalence of kidney stone is due to low fluid intake 72.07%(p=0.000), dehydration 67.56% (p=0.012) and dietary habits of mixed diet 91.59%(p=0.000), high intake of coffee and tea 57.50%, sodium 64.26%, sugar 49.84%. Life style modifications of smoking 36.03%, alcohol consumption 41.59%, lack of physical activity 42.79%, obesity 54.80% also revealed a high prevalence of this disease.
stone formation, family history, and water intake, over weight and obesity, dietary habits, lifestyle modifications association with other diseases (Hypertension, Diabetes and UTI).

RESULTS

The study was conducted among 666 kalladaippu patients. Out of them, 430 were males (64.56%) and 236 were females (35.44%). In our study the male female ratio was 1.82:1. Scales et. al observed a dramatic increase from 1997 to 2002 of the adjusted rate of discharges for stone disease in females in a representative sample of United States population with a change in the prevalence by gender of treated stone disease from a 1.7:1 to 1.3:1 male-to-female ratio. 384 patients (57.50%) were between the age of 21 and 40. Prevalent between age is showed in Fig.1. It has been found that renal calculi is more prevalent between the age of 20 and 40. In our study all the renal calculi patients were literate and majority of the patients (55.70%) were belonged to upper socioeconomic status as per the modified Kuppuswamy B scale. The Sociodemographic parameters of the study patients are illustrated in Table.1. The number of patients visited for the treatment of kidney stone during each seasons were showed in Fig.2. 37.68% of patients visited in OPD for treatment during summer season (April to June). The annual maximum average temperature in Chennai, Tamilnadu, India is 33.1°C (91.6 degrees Fahrenheit). The highest temperature is often registered in May which is the hottest month in the state. The skilled occupation (39.03%) had the highest relationship with renal calculi. In recent years the epidemiology of urinary stone disease was still changing as social conditions gradually improved particularly in the urban areas of the more affluent developing countries.

Out of 666 patients, we found that 288 (43.24%) patients had already stones in their life time. 154 (23.12%) patients had family history of kidney stone. 480 (72.07%) patients did not drink required water (2-3 litters/day) daily. 450 (67.56%) patients sweat a lot every day. 165 (24.77%) patients were used NSAID frequently for pain. 365 (54.80%) patients were observed BMI between <25 and ≥39.99, of which 131 (35.89%) patients were observed as childhood obesity.

188 (28.22%) patients were observed problem in voiding. We found that 304 (45.64%) patients had stressful life. We observed that among 666 patients, 184 (27.62%) patients had the habit of late night eating. We observed that only 39 (5.85%) patients were pure vegetarians, 17 (2.55%) were non vegetarians and 610 (91.59%) patients were consuming meat. Out of 666 patients, we found that 383 (57.30%) patients consume coffee and tea more than 8 ounce a day and 118 (17.71%) patients consume soft drinks. 428 (64.26%) patients taking higher soya and tea which increase the risk for kidney stones. Vegetarians have a less risk comparing to non vegetarians. A diet high in sodium, fats, meat and sugar, low in fibre, vegetables and fruits, alcohol and smoking is associated with increased risk of kidney stone. Diet plays an important role in the development of kidney stone. Use of soft water does not decrease the incidence of urinary stone disease. High urinary calcium oxalate saturation occurs in summer when the humidity is high and temperature is warm. Immigrants from less industrialised nations gradually increase their stone disease. The relative incidence of stone disease is higher in developing countries than in industrialised nations. Urine oxalate excretion has been correlated with increased exposure to sunlight. Global warming may increase the incidence of urinary stone disease. Urinary stone disease is more common in men (12%) than in women (6%) and is more prevalent between the ages of 20 to 40 in both sexes. Initial presentation predominates in the 3rd and 4th decades. Some of the studies reported that in developing countries the male-to-female ratio range from 1.15:1 in Iran and 1.6:1 in Thailand to 2.5:1 in Iraq and 5:1 in Saudi Arabia.

Kidney stones develop more frequently in individuals with a family history of kidney stones than in those without a family history. In our study the family history is significant association (p<0.009) between kidney stone. Studies had proved that a family history of stones has been reported in 16% to 37% of patients who have formed a kidney stone, compared with 4% to 22% in healthy control subjects. A family history of kidney stones substantially increases the risk of stone formation. The relative risk increased in patients with family history for calculous, with the tendency to eat protein-rich food and with overweight and body mass index (BMI)>32 kg/m². A patient with stones is twice as likely as a stone-free cohort to have at least one first degree relative with renal stones (30% vs 50%). Those with a family history of stones have an increased incidence of multiple and early recurrences.

Our study has significant association between recurrent stone formations. The recurrence of kidney stone will form within 5 to 7 years is approximately 50%. Low urine volume is the most common abnor- mality and the single most important factor to correct so as to avoid recurrences. Diets low in salt (<50 mmol/day) and animal proteins (<52 gm/day) are helpful in decreasing the frequency of recurrent calcium oxalate stones.

Geographic factors contribute to the development of stones. Areas of high humidity and elevated temperatures appear to be contributing factors, and the incidence of symptomatic ureteral stones is greatest during hot summer months. Individuals living in hot climates are prone to dehydration, which results in an increased incidence of urinary stones, especially uric acid calculi. Although heat may cause a higher fluid intake, sweat loss results in lowered voided volumes.

In our study we found a significant relationship between dehydration and kidney stone. Robertson stated that the increased incidence of renal stone disease in the tropics where the risk of stone formation is compounded by low urine volume. As living standard increase, particularly in the urban areas of the more affluent developing countries, so the incidence of upper urinary tract stones is increasing being characterised by calcium oxalate stones often mixed with calcium phosphate and uric acid. Hot climates usually expose people to more ultraviolet light, increasing vitamin D3 production. Increased calcium and oxalate excretion has been correlated with increased exposure time to sunlight. Global warming may increase the incidence of urinary stone disease. High urinary calcium oxalate saturation occurs in men during summer season and in women during early winter.

Renal stones are more common in affluent, industrialized countries. Immigrants from less industrialized nations gradually increase their stone incidence and eventually match that of the indigenous population. Use of soft water does not decrease the incidence of urinary stones. Occupation can have an impact on the incidence of urinary stones. Physician and white collar workers have an increased incidence of stones compared with manual labourers. This finding may be related to differences in diet but also may be related to physical activity. Physical activity may aggravate urine and dislodge crystal aggre- gates.

In this study we could establish a significant relationship between high intake of animal protein, sodium, sugar, coffee and tea. But we have not found a significant relationship between soft drinks and kid- ney stone. Diet plays an important role in the development of kidney stones, especially in patients who are predisposed to this condition. A diet high in sodium, fats, meat and sugar, low in fibre, vegetable protein and unrefined carbohydrates are increase the risk of kidney stones. Oxalate is found in green beans, tomatoes, nuts, chocolates and tea which increase the risk for kidney stones. Vegetarians have a decreased risk of developing stones. Studies have shown that even among meat eaters those who ate higher amounts of fresh fruits and vegetables had a lower incidence of stones. Studies have shown that even among meat eaters those who ate higher amounts of fresh fruits and vegetables had a lower incidence of stones.
Changes in diet, life-style and obesity increase the incidence of nephrolithiasis. Nowfar et al. reported that a significant positive correlation exists between obesity and nephrolithiasis for both genders; however, obese females were more likely to develop stones than obese males. Patients with central adiposity or high waist-to-hip ratios appear to have the highest risk. Curhan et al. found that the prevalence and incidence of calcium oxalate stone disease was directly associated with body mass index (BMI). Without lifestyle changes and appropriate medical intervention, stone rates can be as high as 50% within 5 years.

Regular moderate exercise reduces the risks associated with stones, such as hypertension and diabetes. Type 2 diabetes mellitus is characterized by insulin resistance, a metabolic derangement that may increase the risk of kidney stone formation. Eric N Taylor et al., in their study reported that a history of diabetes mellitus was independently associated with a history of nephrolithiasis. People with Type 2 diabetes mellitus have highly acidic urine that can lead to kidney stones, particularly uric acid stones.

A high frequency of kidney stone formation among hypertensive patients has been reported, and among those with high body mass index as well. Hypertension is one of the major causes of development of renal failure. ESWL is associated with greater prevalence of hypertension. Cappuccio et al. reported that hypertensive men had a greater risk of developing kidney stones than normotensive ones.

Gout, a painful inflammatory arthritis induced by the deposition of monosodium urate monohydrate crystals in tissues has been linked with kidney stone disease in several studies. Yu and Gutman reported a 15% to 22% prevalence of kidney stone disease among individuals with gout, greater than the 12% lifetime risk reported in the general population. Holly J Kramer et al. in their study reported that there was no significant association between history of kidney stone disease and risk of incident gout in the multivariate-adjusted model (RR 0.72; 95% CI 0.32 to 1.60).

Walter D.C. in his study reported that stressful lifestyles have been shown to increase lithogenic urinary constituents (calcium, oxalate and uric acid); with peak concentrations occurring within 24 hours after an individual is subjected to stress [51]. Reza Najem G et al. stated that increased production of PTH under stressful events could cause an increase in serum calcium concentrations, which results in hypercalciuria. One study reported that, major stressful life experience increased the risk of stone formation. This increased risk may be due to a hormone called vasopressin which is released in response to stress. Vasopressin also decreases the urine volume, which makes the chemicals in more concentrated and prone to form crystals and stones.

Increased sodium intake will increase sodium and calcium excretion, increase monosodium urate saturation (that can act as a nidus for stone growth), increase the relative saturation of calcium phosphate, and decrease urinary citrate excretion. All of these factors encourage stone growth. According to the World Health Organization, the daily consumption of salt should not exceed 5 grams or one teaspoon. The average Indian salt consumption is 9 to 10 grams per day. This must be reduced to <2300mg sodium/day. Reduction in dietary sodium helps to reduce recurrent calcium nephrolithiasis.

Fluids intake and urinary output may have an effect of urinary stone disease. The average daily urinary output in stone formers is 1.6 L/d. A low fluid intake, with a subsequent low volume of urine production, produces high concentrations of stone forming solutes in the urine. High fluid intake may be beneficial not only to prevent CaOx overgrowth, but also to reduce plaque formation itself. One of the goals of kidney stone treatment is to keep your urine as dilute as possible. This helps to keep the substances that could potentially form a kidney stone, such as calcium and oxalate moving quickly through the urinary tract. Caffeine contains beverages like coffee, tea and cola to one or two cups a day, science caffeine acts as a diuretic, causing your body to lose fluids too quickly and the urine to become too concentrated. Furthermore, both coffee and tea contain high levels of oxalate, a common component of kidney stones.

A diet high in animal protein-from meat, chicken and fish may cause the body to release too much calcium, uric acid and citrate in the urine. Red meat, tinned fish, meat extracts and muscles are rich in purine, which in turn increases the uric acid concentration. Protein intake should be limited to 1g/kg/day. Recurrent kidney stones may form in patients who are sensitive to the chemical by products of animal protein and who consume large amount of meat. An increased protein load can also increase calcium, oxalate, and uric acid excretion and decrease urinary citrate excretion.

The ingestion of sucrose and other simple sugars causes an exaggerated increase in the urinary calcium oxalate content in approximately 70% of recurrent kidney stone formers. Much of the sugars consumed today are “hidden” in processed foods that are not usually seen as sweets. Adults who consume less sugar have lower body weight and, second, that increasing the amount of sugars in the diet is associated with a weight increase. In addition, research shows that children with the highest intakes of sugar-sweetened drinks are more likely to be overweight or obese than children with a low intake of sugar-sweetened drinks. Sugar stimulates the pancreas to release insulin, which in turn causes extra calcium to be excreted in the urine. Excess weight and insulin insensitivity lead to hypercalciuria and are high-risk factors for stone formation. Urinary pH falls with increasing body weight, probably because of insulin resistance causes uric acid stones. Patients with rapid weight loss have an increased incidence of uric acid lithiasis.

Mohammad Reza Tamadon et al., in their study the proportion of smokers among patients with nephrolithiasis was significantly higher than in the control subjects. Cigarette smoking was 2.06 times more common in stone formers than in the control group. Hence, smoking may be an independent risk factor for nephrolithiasis. One of the possible factors which may explain the effect of smoking on stone formation is a high body calcium and lead level in smokers. Cigarette smoking may induce urolithiasis by decreasing urinary flow and increasing serum calcium in healthy subjects. Also, Scott et al. in their study proposed that increased serum calcium levels associated with cigarette smoking may be a risk factor for urinary tract stone formation.

Hyperoxaluria may develop in patients with bowel disorders, particularly inflammatory bowel disease, small-bowel resection, and bowel bypass. Renal calculus develop in 5-10% of patients with these conditions. Estrogen actually lowers the risk of hyperoxaluria. Estrogen increases citrate excretion and may be a factor that decreases the incidence of stone formation in women, especially during pregnancy. Postmenopausal women with low estrogen levels have an increased risk for kidney stones. Women who have had their ovaries removed are also at increased risk.

CONCLUSION

In this study, we could establish a significant relationship between family history, diet and life-style modifications, low fluid intake, obesity are the major factors play a role in development of renal calculi. We also found a significant relationship between patients associated with diabetes mellitus, hypertension and renal calculi. Life style changes helps to reduce recurrent stone disease. Renal calculi can be prevented by the most important thing is to drink plenty of water daily the goal should be to urinate from two to four litters per day make sure you avoided getting dehydrated, there are no specific dietary recommendation until a stone from your system has been analysed. After analysis diet can be evaluated and changes recommended.

LIST OF ABBREVIATIONS

AUA = American Urological Association
BMI = Body mass index
CaOx = Calcium oxalate
CKD = Chronic kidney disease
ESRD = end-stage renal disease
ESWL = Extracorporeal shock wave lithotripsy
IBD = Irritable bowel disease
MAP = Magnesium ammonium phosphate
NIS = National Institute of Siddha
NSAID = Non steroidal anti inflammatory drugs
OPD = Out Patient Department
PTH = Parathyroid hormone
UTI = Urinary tract infection
WHO = World Health Organization

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CONFLICT OF INTEREST

Figure 1. Prevalent between the ages

Figure 2. Relationship towards Season

Table 1: Sociodemographic parameters of the study patients

<table>
<thead>
<tr>
<th>Sociodemographic determinants</th>
<th>Number (n=666)</th>
<th>Percentage (%)</th>
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</thead>
<tbody>
<tr>
<td>Age (in years)</td>
<td></td>
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</tr>
<tr>
<td>11-20</td>
<td>9</td>
<td>1.35</td>
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<td>21-30</td>
<td>167</td>
<td>25.07</td>
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<tr>
<td>31-40</td>
<td>217</td>
<td>32.58</td>
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<tr>
<td>41-50</td>
<td>166</td>
<td>24.92</td>
</tr>
<tr>
<td>51-60</td>
<td>67</td>
<td>10.06</td>
</tr>
<tr>
<td>61-70</td>
<td>35</td>
<td>5.25</td>
</tr>
<tr>
<td>71-80</td>
<td>5</td>
<td>0.75</td>
</tr>
<tr>
<td>Gender</td>
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<td></td>
</tr>
<tr>
<td>Male</td>
<td>430</td>
<td>64.56</td>
</tr>
<tr>
<td>Female</td>
<td>236</td>
<td>35.44</td>
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<tr>
<td>Socioeconomic status</td>
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<td></td>
</tr>
<tr>
<td>Upper</td>
<td>371</td>
<td>55.70</td>
</tr>
<tr>
<td>Upper middle</td>
<td>83</td>
<td>12.46</td>
</tr>
<tr>
<td>Lower middle</td>
<td>122</td>
<td>18.31</td>
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<tr>
<td>Upper lower</td>
<td>90</td>
<td>13.51</td>
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<tr>
<td>Lower</td>
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<td>0.00</td>
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Table 2: Association of Risk factors with Renal calculi patients

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<th>Sl.no</th>
<th>Risk factors</th>
<th>Number (n=666)</th>
<th>Percentage (%)</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Already stones in their life time</td>
<td>288</td>
<td>43.24</td>
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<td>2.</td>
<td>Family history of kidney stone</td>
<td>154</td>
<td>23.12</td>
</tr>
<tr>
<td>3.</td>
<td>Did not drink required water</td>
<td>480</td>
<td>72.07</td>
</tr>
<tr>
<td>4.</td>
<td>daily</td>
<td>450</td>
<td>67.56</td>
</tr>
<tr>
<td>5.</td>
<td>Sweat a lot every day</td>
<td>165</td>
<td>24.77</td>
</tr>
<tr>
<td>6.</td>
<td>BMI between &lt;25 and &gt;39.99</td>
<td>363</td>
<td>54.90</td>
</tr>
<tr>
<td>7.</td>
<td>Childhood obesity</td>
<td>131</td>
<td>19.89</td>
</tr>
<tr>
<td>8.</td>
<td>Problem in voiding</td>
<td>188</td>
<td>28.22</td>
</tr>
<tr>
<td>9.</td>
<td>Stressful life</td>
<td>304</td>
<td>45.64</td>
</tr>
<tr>
<td>10.</td>
<td>Habit of late night eating</td>
<td>184</td>
<td>27.62</td>
</tr>
<tr>
<td>11.</td>
<td>Pure vegetarians</td>
<td>39</td>
<td>5.85</td>
</tr>
<tr>
<td>12.</td>
<td>Non vegetarians</td>
<td>17</td>
<td>2.55</td>
</tr>
<tr>
<td>13.</td>
<td>Mixed diet</td>
<td>610</td>
<td>91.59</td>
</tr>
<tr>
<td>14.</td>
<td>Consume coffee and tea more than 8 ounce a day</td>
<td>383</td>
<td>57.50</td>
</tr>
<tr>
<td>15.</td>
<td>Consume soft drinks</td>
<td>428</td>
<td>64.26</td>
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<td>16.</td>
<td>Higher sodium intake</td>
<td>220</td>
<td>34.08</td>
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<td>17.</td>
<td>Frequently consume processed foods</td>
<td>332</td>
<td>49.84</td>
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<td>18.</td>
<td>Taking high sugar</td>
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<td>19.</td>
<td>Soya</td>
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<tr>
<td>20.</td>
<td>Habits of smoking</td>
<td>277</td>
<td>41.59</td>
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<tr>
<td>21.</td>
<td>Alcohol consumption</td>
<td>285</td>
<td>42.79</td>
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<tr>
<td>22.</td>
<td>Lacks of physical activity</td>
<td>227</td>
<td>34.08</td>
</tr>
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<td>23.</td>
<td>Associated with hypertension</td>
<td>178</td>
<td>26.72</td>
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<tr>
<td>24.</td>
<td>Associated with Diabetes</td>
<td>106</td>
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<td>25.</td>
<td>Associated with UTI</td>
<td>3</td>
<td>0.45</td>
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