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Lunar cycle, seasonal variation, and prevalence of emergency urological presentations: correlation or coincidence?—A preliminary report

Tosin S. Akinpelu[a], Abdullah E. Laher[a], Andrew Chen[b], Ahmed Adam[c,*]

[a]Department of Emergency Medicine, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa; [b]School of Physics, Faculty of Science, University of the Witwatersrand, Johannesburg, South Africa; [c]Division of Urology, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa

Abstract

Objective: The objective of this study was to conduct a pilot study to determine the prevalence and patterns of emergency urological presentations and to evaluate their relationship with the lunar cycle and seasonal variation.

Methods: Medical records of subjects that presented with urological pathology to the Emergency Department during the 2017 calendar year were retrospectively reviewed. The data extracted included demographic details, date and day of presentation, presenting complaints, investigations, radiological findings, and final diagnosis. Associations between emergent presentations and the lunar phase and seasonal variation were determined.

Results: A total of 199 subjects were enrolled. The median participant age was 49 (interquartile range 31–64) years with the majority (n=136, 68.3%) being male. Cystitis (n=55, 27.6%), prostate cancer (n=30, 15.1%), benign prostatic hypertrophy (n=29, 14.6%), and urolithiasis (n=29, 14.6%) were the most common clinical diagnosis. There were 96 (48.2%) patients who presented during the waxing moon phase, whereas 85 (42.7%) presented during the waning moon phase, 11 (5.6%) presented on the day of full moon, and 7 (3.5%) patients presented on the day of the new moon. Most patients presented during the summer months (n=61, 30.7%). There was no significant association between the lunar cycle and emergent urological presentations ($p=0.99$).

Conclusion: In this pilot study, there was no significant association between the lunar cycle and emergent urological presentations. However, during the summer months more urology-related emergency presentations to the Emergency Department were observed.

Keywords: Coincidence; Emergency; Lunar cycle; Seasonal variation; Urological presentation

1. Introduction

"No physician should be entrusted with the treatment of disease who was ignorant of the science of astronomy" Hippocrates (c 460–377 BC).[1]

Urological conditions are common presentations to the emergency department (ED). Although, compared with other surgical fields, urological emergencies can still be described as infrequent.[2] These conditions may either be medical or surgical in nature and can affect all age groups. Commonly seen urological conditions include infection-related conditions, urolithiasis, testicular torsion, urinary retention, benign and malignant prostatic pathology, obstructive uropathy, and various trauma-related urological conditions.[3,4]

The role of the lunar and seasonal cycles and its resultant effect on human well-being has been well documented in the medical literature.[5] Over the years, there has been contradictory evidence to suggest a relationship between urological presentations and the lunar cycle.[6] However, there is evidence to support the pattern of urological presentation in relation to seasonal variation.[7,8] The aim of our study was to conduct an audit of urological presentation to a tertiary academic hospital ED and to explore their relationship with the lunar cycle and seasonal variation within a South African setting.

2. Materials and methods

This pilot study was a retrospective audit of medical records of patients that presented to the adult ED of the Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) with urological pathology from January 01 to December 31, 2017. CMJAH is a tertiary care public hospital as well as a citadel of learning for healthcare graduates and postgraduates. It services a major portion of the Johannesburg inner-city region and its environs.

The study principal investigator undertook informal training on the methodology and principles of data abstraction from medical records before the initiation of data collection. Once clearance was obtained from the Human Research Ethics Committee of the University of the Witwatersrand (certificate

* *Corresponding Author: Ahmed Adam, Division of Urology, Faculty of Health Sciences, University of the Witwatersrand, 7 York Road, Parktown, ZA–2193 Johannesburg, South Africa. E-mail address: aadam81@gmail.com (A. Adam).*

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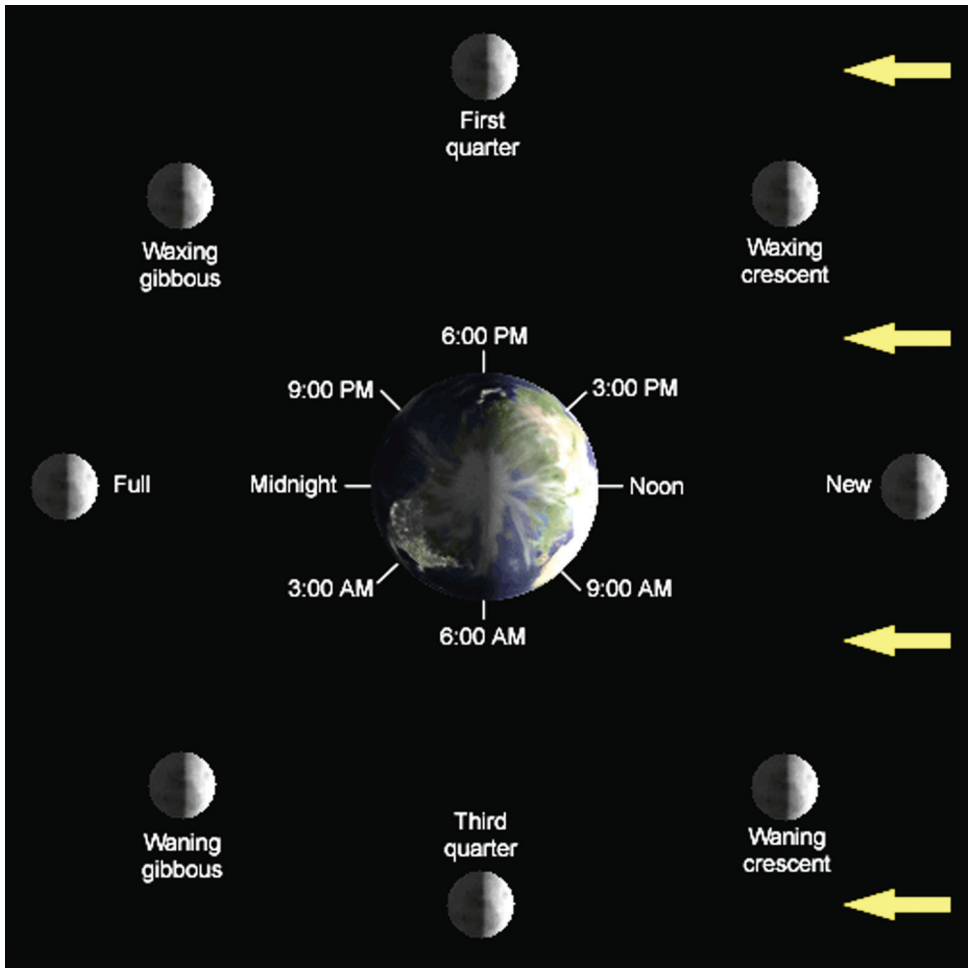

Figure 1. Phases of the moon (reproduced with GNU Free Documentation Licence https://commons.wikimedia.org/wiki/File:Lunar-Phase-Diagram.png).

no. M180215), data relevant to this study was abstracted by the principal investigator from medical records of subjects fulfilling inclusion criteria. The process of data collection was periodically monitored by the study supervisors. Collected data included demographic details (age, sex, nationality, race), date of presentation, time seen by ED doctor, main complaint, history of presenting complaints, past medical history, past urological history, urine dipsticks analysis, point-of-care ultrasound findings, formal radiologic investigations performed and final diagnosis, various laboratory investigations including venous blood gas, full blood count, international randomized ratio, urea and creatinine, C-reactive protein (CRP), blood culture and urine microscopy, culture and sensitivity,

Conflicting data entries or uncertainties were resolved by careful review of patients' medical records and discussion with senior doctors from the urology department. Urological conditions were defined as any presentation with genitourinary pathology. Primary trauma-related urological conditions were excluded. The phase of the moon was determined by inputting the date and time of presentation into the following website: https://www.moonpage.com/. For the purposes of this study, the phases of the moon were categorized as full moon (presentation during the day that the moon achieves full illumination), new moon (presentation during the day that the moon first appears), waxing phase (presentation from the day after the day of the first appearance of the new moon until the day before the full moon), and waning phase (presentation from the day after the day of the full moon until the day before the birth of the new moon). Figure 1 illustrates the phases of the moon.

Inter-rater reliability was assessed by an independent individual experienced in the methods of data abstraction but blinded to the study aims and objectives. This was done by reabstracting data from a sample of 25 randomly selected medical records and comparing these to the data that were abstracted by the primary investigator. The inter-rater reliability using Cohen's Kappa measure of agreement was 0.98. The independent reviewer only disagreed in 1 case that involved a primary diagnosis and secondary presentation to the ED. This matter was resolved by concluding that the primary diagnosis should remain the final diagnosis.

Data was analyzed using IBM SPSS software, version 25.0 (IBM Corp, Armonk, NY). For continuous variables (age, CRP, urea, and creatinine), the Shapiro-Wilk and Kolmogorov-Smirnov test was used to assess normal (Gaussian) distribution and equal variance of the data. Because all continuous variables were not normally distributed ($p < 0.05$),[9] median and interquartile range (IQR) was reported for these variables. Categorical variables were summarized using frequencies and percentages. Missing data was treated as missing and discarded. Patient diagnosis was plotted against the day of the month, lunar cycle,

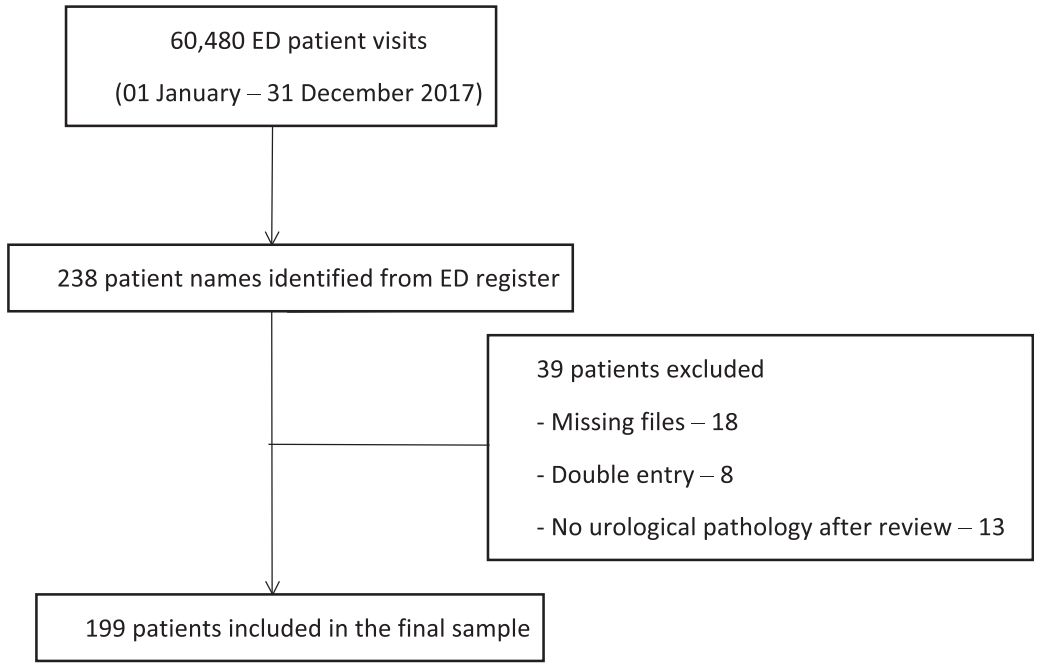

Figure 2. Exclusion and final sample for analysis.

and season. Patient confidentiality was always strictly adhered to. Reporting of study findings was in conformance with STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines.[10]

3. Results

A total of 60,480 patients were seen at the ED between January 01 and December 31, 2017. Of these, 199 (0.3%) were diagnosed with urological pathology and included in the final sample. Details of how the final study sample was achieved are outlined in Figure 2. Of the 199 subjects that were included, 136 (68.3%) were male. The median age of the patients was 49 (IQR 31–64) years.

More than half of the patients who presented to the ED with a urologic pathology had a known previous urological history (n = 77, 38.7%), with benign prostatic hyperplasia (BPH) (n = 33, 16.6%) and prostate cancer (n = 16, 8.0%) being the most common. Urea, creatinine, full blood count, and CRP were the most common laboratory investigations that were performed in 146 (73.4%) patients each, followed by urine dipstick analysis (n = 107, 53.8%). These findings are summarized in Table 1.

Table 2 summarizes the presenting complaints and final diagnosis of study subjects whereas the median age, sex, urea, creatinine, CRP, and lunar phase of presentation for each diagnostic category are presented in Table 3. The most common presenting complaints amongst all patients were abdominal pain (n = 96, 23.3%), urinary retention (n = 60, 15.8%), dysuria (n = 48, 12.7%), and flank pain (n = 32, 8.4%). Cystitis was the most common diagnosis that was reported in 27.6% (n = 55) of the patients. Unlike most of the other urological presentations, subjects with cystitis were predominantly female (n = 45, 81.8%). Other common presentations included prostate cancer (n = 30, 15.1%), BPH (n = 29, 14.6%), urolithiasis (n = 29, 14.6%), and urethral stricture (n = 15, 7.5%). Of those with BPH, 19 (65.6%) patients presented with features of urinary retention. Ultrasonography was performed in 31 (15.6%) subjects, of which only 7 (3.5%) were done in the ED. Only 2 patients underwent X-ray (1.0%) imaging whereas 34 patients (17.1%) had a CT scan done.

A total of 178 patients required procedural intervention. A review of the selected files revealed that intervention was required in 70 cases by urologist and 108 by emergency care attendants. The other 20 cases were reviewed, discharged, or referred accordingly.

The most common days of presentation per month was on day 6 (n = 12, 6.03%) and day 17 (n = 11, 5.53%), whereas the least common day of presentation was on day 27 (n = 1, 0.5%) (Fig. 3). The majority of patients presented in the first quarter of each year

Table 1

Previous diagnosis of urological pathology and laboratory investigations performed in study subjects.

Known urological history	n (%)
BPH	33 (16.6)
Prostate cancer	16 (8.0)
Traumatic urethral injury	6 (3.0)
Urolithiasis	4 (2.0)
Others*	18 (9.1)
Laboratory investigations performed	
Urea	146 (73.4)
Creatinine	146 (73.4)
Full blood count	146 (73.4)
CRP	146 (73.4)
Urine dipstick analysis	107 (53.8)
International normalized ratio	53 (26.6)
Blood culture	47 (23.6)
Blood gas	46 (23.1)
Prostate specific antigen	32 (16.1)
Partial thromboplastin time	23 (11.6)
Urine microscopy, culture and sensitivity	7 (3.5)

CRP = C-reactive protein.
* Others: fistula (n = 3, 3.3%), sexually transmitted infections (n = 3, 3.3%), urosepsis (n = 3, 3.3%), urethral stricture (n = 2, 2.2%), bladder atrophy (n = 1, 1.1%), bladder diverticulum (n = 1, 1.1%), bladder involution (n = 1, 1.1%), bladder tumor (n = 1, 1.1%), hydrocele (n = 1, 1.1%), metastatic cancer (n = 1, 1.1%), and testicular torsion (n = 1, 1.1%).

Table 2

Summary of presenting complaints and final diagnosis of study subjects.

Diagnosis	Number of patients presenting with the diagnosis, *n*	Symptoms, n (%)													
		Abdominal pain	Vomiting	Dysuria	Hematuria	Flank pain	Blocked catheter	Urinary retention	Scrotal pain	Scrotal swelling	Fever	Anuria	Nausea	Priapism	Urgency
Cystitis	55	47 (85.5)	8 (14.5)	37 (67.2)	7 (12.7)	3 (5.4)	1 (1.8)	6 (10.9)	0	0	8 (14.5)	1 (1.8)	0	0 (0)	2 (3.6)
Prostate cancer	30	5 (16.6)	0	0 (0)	12 (40)	1 (3.3)	13 (43.3)	15 (50)	0	0	0	1 (3.3)	0	0 (0)	1 (3.3)
BPH	29	7 (24.1)	0	2 (6.8)	3 (10.3)	0	7 (24.1)	19 (65.5)	0	0	0	1 (3.4)	0	0 (0)	1 (3.4)
Urolithiasis	29	19 (65.5)	7 (24.1)	0	5 (17.2)	27 (93.1)	0	0	0	0	0	0	3 (10.3)	0 (0)	0 (0)
Urethral stricture	15	3 (20)	0	2 (13.3)	1 (6.6)	0	5 (33.3)	13 (86.7)	1 (6.6)	1 (6.6)	0	2 (13.3)	0	0 (0)	0 (0)
Epididymo-orchitis	6	1 (16.7)	0	0	0	0	0	0	5 (83.3)	6 (100)	0	0	1 (16.7)	0 (0)	0 (0)
Testicular torsion	6	3 (50)	1 (16.7)	0	0	0	0	0	5 (83.3)	6 (100)	0	0	0	0 (0)	0 (0)
Pyelonephritis	4	3 (75)	0	4 (100)	0	0	0	0	1 (25)	1 (25)	2 (50)	0	0	0 (0)	0 (0)
Priapism	3	2 (66.6)	0	0	0	0	0	0	0	0	0	0	0	3 (100)	0 (0)
Prostatitis	3	3 (100)	0	3 (100)	1 (33.3)	0	0	0	0	0	1 (33.3)	0	0	0 (0)	0 (0)
Paraphimosis	3	0	0	0	0	0	0	2 (66.6)	0	2 (66.6)	0	0	0	0 (0)	0 (0)
Neurogenic bladder (unknown cause)	2	0	0	0	0	0	1 (50)	1 (50)	0	0	0	0	0	0 (0)	0 (0)
Cervix cancer with urinary retention	2	0	0	0	0	0	0	2 (100)	0	0	0	0	0	0 (0)	0 (0)
Cervix cancer with urethral obstruction	1	1 (100)	0	0	0	0	0	0	0	0	0	0	0	0 (0)	0 (0)
Colon cancer with urethral obstruction	1	0	1 (100)	0	0	0	0	0	0	0	0	1 (100)	0	0 (0)	0 (0)
Anal cancer with urinary retention	1	0	0	0	0	0	1 (100)	0	0	0	0	0	0	0 (0)	0 (0)
Cauda Equina Syndrome	1	0	0	0	0	0	0	1 (100)	0	0	0	0	0	0 (0)	0 (0)
Anaplastic seminoma	1	0	0	0	0	0	0	1 (100)	0	0	0	0	0	0 (0)	0 (0)
Complicated pyelonephritis	1	1 (100)	0	0	0	0	1 (100)	0	0	0	0	0	0	0 (0)	0 (0)
Postorchidectomy sepsis	1	0	0	0	0	0	0	0	1 (100)	1 (100)	0	0	0	0 (0)	0 (0)
Fournier gangrene	1	1 (100)	0	0	0	0	0	0	0 (0)	1 (100)	1 (100)	0	0	0 (0)	0 (0)
Hydrocele	1	0	0	0	0	0	0	0	0 (0)	1 (100)	0	0	1 (100)	0 (0)	0 (0)
Scrotal abscess	1	0	0	0	0	0	0	0	1 (100)	1 (100)	0	0	0	0 (0)	0 (0)
Scrotal cellulitis	1	0	0	0	0	0	0	0	1 (100)	1 (100)	0	0	0	0 (0)	0 (0)
Squamous cell bladder carcinoma	1	0	0	0	0	1 (100)	1 (100)	0	0	0	0	1 (100)	0	0 (0)	0 (0)

Table 3

Median age, sex, urea, creatinine, CRP, and lunar phase of presentation for each diagnostic category.

Diagnosis	Age, median (IQR)	Males	Urea, median (IQR)	Creatinine, median (IQR)	CRP, median (IQR)	Full moon	New moon	Waning moon	Waxing moon
Cystitis	35 (25–55)	10 (18.2)	5.9 (3.5–9.4)	95.5 (74.5–122)	19 (10–107.5)	2 (3.6)	2 (3.6)	22 (40)	29 (52.7)
Prostate cancer	71 (65–80)	30 (100)	6.2 (5–13.6)	100 (73–165.5)	10 (10–35.3)	2 (6.6)	2 (6.6)	13 (43.3)	13 (43.3)
BPH	60 (53–69)	29 (100)	5.9 (3.6–10.1)	98 (70–206)	76 (10–144)	2 (6.9)	1 (3.4)	14 (48.3)	12 (41.4)
Urolithiasis	49 (35–54)	23 (79.3)	8.7 (4.7–10)	110 (85–150)	22 (10–52.7)	1 (3.4)	2 (6.9)	12 (41.4)	14 (48.3)
Urethral stricture	35 (30–44)	13 (86.6)	5.2 (4.4–6.7)	82 (67.5–112.5)	25 (10.7–113.2)	3 (20.0)	0 (0)	7 (46.7)	5 (33.3)
Epididymo-orchitis	28.5 (26–38)	6 (100)	4.1 (3.6–7.9)	74 (68–220)	73 (73–73)	0 (0)	0 (0)	4 (66.7)	2 (33.3)
Testicular torsion	22 (19–23)	6 (100)	4.1 (3.5–6.9)	111 (99–163)	21 (10–171)	0 (0)	0 (0)	1 (16.7)	5 (83.3)
Pyelonephritis	51.5 (40.5–66)	3 (75)	7.5 (6.7–10)	185 (79–248)	102 (102–102)	0 (0)	0 (0)	2 (50)	2 (50.0)
Priapism	32 (31–36)	3 (100)	4.8 (4.8–4.8)	95 (95–95)	10 (10–10)	0 (0)	0 (0)	2 (66.7)	1 (33.3)
Prostatitis	70 (47–90)	3 (100)	12.6 (8.9–40)	201 (95–1,319)	179 (179–179)	0 (0)	0 (0)	2 (66.7)	1 (33.3)
Paraphimosis	25 (15–34)	3 (100)	5.1 (4.9–5.2)	46.5 (38–55)	25 (25–25)	0 (0)	0 (0)	1 (33.3)	2 (66.7)
Neurogenic bladder (unknown etiology)	31 (20–42)	1 (50)	4.1 (2.6–5.5)	74 (67–81)	10 (10–10)	0 (0)	0 (0)	1 (50)	1 (50)
Cervix cancer with urinary retention	52 (52–52)	0 (0)	7.7 (3.7–11.7)	81 (55–107)	126 (126–126)	0 (0)	0 (0)	0 (0)	2 (100)
Cervix cancer with urethral obstruction	34 (34–34)	1 (100)	15.6 (15.6–15.6)	234 (234–234)	89 (89–89)	0 (0)	0 (0)	0 (0)	1 (100)
Colon cancer with urethral obstruction	76 (76–76)	0 (0)	3.9 (3.9–3.9)	79 (79–79)	23 (23–23)	0 (0)	0 (0)	0 (0)	1 (100)
Anal cancer with urinary retention	33 (33–33)	1 (100)	8.9 (8.9–8.9)	156 (156–156)	10 (10–10)	0 (0)	0 (0)	1 (100)	0 (0)
Cauda Equina Syndrome	52 (52–52)	1 (100)	4.2 (4.2–4.2)	6.6 (6.6–6.6)	24 (24–24)	0 (0)	0 (0)	0 (0)	1 (100)
Anaplastic seminoma	42 (42–42)	1 (100)	4.5 (4.5–4.5)	94 (94–94)	19 (19–19)	0 (0)	0 (0)	0 (0)	1 (100)
Complicated pyelonephritis	26 (26–26)	0 (0)	40 (40–40)	2,095 (2,095–2,095)	33 (33–33)	0 (0)	0 (0)	1 (100)	0 (0)
Postorchidectomy sepsis	45 (45–45)	1 (100)	4.1 (4.1–4.1)	69 (69–69)	126 (126–126)	0 (0)	0 (0)	1 (100)	0 (0)
Fournier gangrene	42 (42–42)	1 (100)	25 (25–25)	240 (240–240)	286 (286–286)	0 (0)	0 (0)	0 (0)	1 (100)
Hydrocele	74 (74–74)	1 (100)	5.4 (5.4–5.4)	96 (96–96)	17 (17–17)	1 (100)	0 (0)	0 (0)	0 (0)
Scrotal abscess	23 (23–23)	1 (100)	4.6 (4.6–4.6)	63 (63–63)	93 (93–93)	0 (0)	0 (0)	0 (0)	1 (100)
Scrotal cellulitis	57 (57–57)	1 (100)	5.2 (5.2–5.2)	56 (56–56)	184 (184–184)	0 (0)	0 (0)	1 (100)	0 (0)
Squamous cell bladder carcinoma	53 (53–53)	0 (0)	4.5 (4.5–4.5)	94 (94–94)	19 (19–19)	0 (0)	0 (0)	0 (0)	1 (100)

(n=68, 34.2%), followed by the second quarter (n=54, 27.14%), third quarter (n=45, 22.61%), and the fourth quarter (n=32, 16.1%). Most patients presented during summer (n=61, 30.7%) followed by autumn (n=52, 26.1%), winter (n=49, 24.6%), and spring (n=37, 18.6%). Notably, 75.8% (n=22) of subjects with urolithiasis presented during the spring and summer months.

Ninety-six (48.2%) patients presented during the waxing phase of the moon, whereas 85 (42.7%) presented during the waning phase of the moon, 11 (5.6%) presented on full moon days, and 7 (3.5%) patients presented on new moon days (Table 3). Measure of association between the final diagnosis and phase of the moon using the Fischer exact test showed no significant association ($p=0.99$).

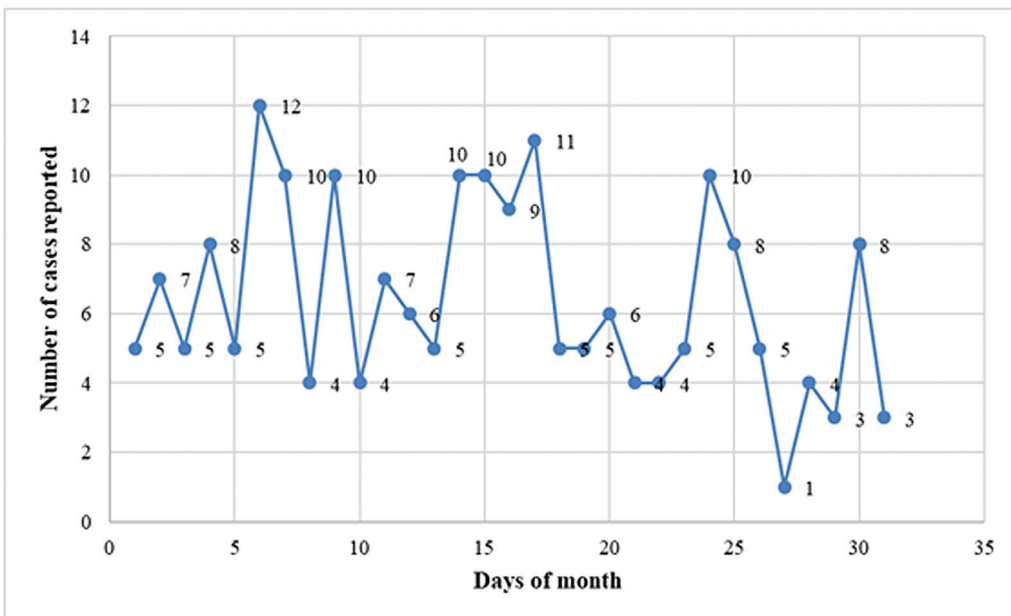

Figure 3. Days of urological presentation.

4. Discussion

More than two-thirds (68.3%) of study subjects were male. This can be attributed to the fact that male defining diagnosis such as prostate cancer and BPH accounted for approximately a third of presentations. In contrast to our findings, Cimen[11] reported urinary tract infections and renal colic as the most common emergency presentation with a female preponderance in their study.

Although the renal and electrolyte profile was measured in 73.4% of subjects in this study, it is concerning that the urine dipstick was only documented in 53.8% of subjects even though cystitis and urolithiasis, which could have been suggested earlier with urine dipstick analysis, were amongst the commonest presentations. Because determination of urine dipstick is quick, easy, and inexpensive, it should be routinely measured in all patients presenting with urological symptoms.

It is noteworthy that urolithiasis was the third most common presentation (14.5%) in this study. Comparatively, Eaton et al.[12] reported a prevalence of 10% in a USA-based nationwide ED study that enrolled 1.2 million subjects between 2006 and 2009. Similar to our findings, the presentation of urolithiasis has consistently been associated with an increase in ambient temperature.[7,8,13] This has been attributed to dehydration-related higher urinary concentrations of calcium and other minerals that promote the formation of renal stones.[14]

BPH was also diagnosed in 14.5% of study subjects. Comparatively, in a prospective study conducted in a West African population by Chokkalingam et al,[15] the incidence of BPH was reported as 19.9%. A likely reason for the relatively lower incidence in this study is that we did not include patients who were directly referred to the Urology Department without passing through the ED. Compared with 71.6% of the 2618 participants with BPH who presented with urinary retention in a French study based, 65.5% of subjects with BPH in this study presented with urinary retention.[16] In keeping with other studies,[2,17] BPH was also the commonest cause of urinary retention in this study (65.6%). Cathcart et al[18] reported a 20% recurrence rate within 6 months after an episode of urinary retention in patients with urinary retention due to BPH and 4% recurrence in those with urinary retention due to other causes.

Lunar phases have been reported to be associated with basic human systems.[19–21] Of the 365 calendar days in 2017, there were a total of 24 (6.6%) new and full moon days. Though not statistically significant, proportionally more study subjects (9.1%) presented over the 24 new and full moon days. Previous studies have reported contradictory relationships between the full moon and the presentation of urolithiasis.[6,22] Molaee et al[6] reported a significant difference between the day of presentation of renal colic and the lunar cycle. However, a recent study showed no significant relationship between the lunar cycle or super moon and renal colic due to ureteral calculus.[23] Our study findings support the results presented by Arampatzis et al[22] and Yang et al[23] who both reported no significant association between the diagnoses of urological conditions and the lunar cycle. Qazi et al[24] reported that emergency urological admissions were increased on full moon days and were lower on new moon days. Similar to our findings, the differences were also not statistically significant. They postulated that the new moon due to its "calming" effect may result in fewer urologic presentations.

Per definition the "'blood' moon occurs when the earth's moon is in a total lunar eclipse and 'super' moon occurs when a full moon coincides with the moon's perigee, or the point in its elliptical orbit at which it is closest to the earth."[25] There was no "blood" moon in 2017, whereas a "super" moon occurred on December 3, 2017 in South Africa. However, there were no urological presentations on that day. Two lunar eclipses took place on February 11 and August 7, 2017, respectively. No urological cases presented at our ED on February 11, 2017, whereas 4 cases (2.0%) presented on August 7, 2017.

5. Conclusion

This was a single-center preliminary study with a relatively small sample size that was performed over a single calendar year within a busy South African center. Furthermore, due to the retrospective study design, there is a possibility of selection bias. Other limitations that are applicable to all "review of medical record" type studies include spurious findings, missing data, and conflicting data. Despite the above limitations, this study has increased our understanding on the topic in an African context. It is hoped that this study will inspire similar larger scale studies across varying clinical settings globally.

Results of this preliminary study indicate that the relationship between seasonal changes, the lunar cycle, and pattern of emergent urologic presentations is presently more of a coincidence than a correlation. However, there is an increased presentation of urolithiasis during summer that is associated with a relative increase in temperature. Further studies utilizing a multicenter prospective design are needed to explore this time-enduring, fascinating relationship between the lunar cycle, seasonal variation, and emergent urological presentations.

Acknowledgments

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Statement of ethics

The study was approved by the Human Research Ethics Committee of the University of the Witwatersrand (Certificate no. M180215), and permission was granted to conduct the study by the Charlotte Maxeke Johannesburg Academic Hospital (CMJAH), South Africa.

Conflict of interest statement

The authors declare that they have no conflict of interest.

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None.

Author contributions

All the authors contributed to the conceptualization of the study and the writing of the manuscript.

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